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Final Report

OFF-GRID SOLAR MARKET ASSESSMENT MADAGASCAR

The World Bank

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1 INTRODUCTION AND SCOPE

1.1 Background

Access to electricity in Madagascar is among the lowest in Africa. In 2014, the Ministry of Water, Energy and Hydrocarbons (MEEH) estimated the average rate of access to electricity services was only 15% at the national level, while 55% of urban residents and only 5% in rural areas had access to electricity[1]. This is due in part to the country's high poverty levels, low population density outside urban areas and the weak financial situation of the national utility. Of the households in the bottom income quintile —most of whom live in rural areas— only about one percent has access to electricity.

Electrification efforts in this context are particularly challenging. Grid extension is not economically viable due to the need for high capital expenditures coupled with the fact that lower-income households will consume only small amounts of power. This makes it impossible to amortize the cost of equipment within a reasonable timeframe. This situation, aggravated by the political crises of 2002 and 2009 and the general deterioration of the utility's financial situation, explains why little progress has been made on the electrification rate over the last 20 years.

Through its New Energy Policy (NPE) elaborated in 2015, the Government of Madagascar has set an ambitious goal of increasing the electricity access rate to 70% by 2030, with 85% of the energy mix to be supplied by renewable energy. The NPE specifically recognizes the role that off-grid solar solutions (both lanterns and home systems) can play in increasing access to affordable electricity services.

As a continuation of the NPE, the SNE[2] (Stratégie Nationale d'Electrification) is currently under development. In order to reach the 70% access rate, the SNE is proposing the following targets for delivering service to new customers:

1. 70% of will be served by extension of the grid;
2. 20% will be served through the development of mini-grids (with an energy mix of 50% from hydropower, 25% from diesel, 20% solar and 5% biogas from rice bales);
3. 10% will be served via individual solutions (5% decentralized solar systems or solar kits, and 5% solar lamps).

Consistent with the SNE guidelines, close to 460 mini-grid projects are planned for development during the period 2018-2022, with the goal of bringing electricity to 1000 new localities. While still under discussion, the energy mix powering these new customers is now suggested to consist of 50% hydro, 25% diesel, 20% solar and 5% biomass. Ongoing studies should inform the final decisions about resource mix, including this market research effort as well as the PAGOSE research conducted by Tractebel for the Ministry of Energy, and a geospatial analysis of least-cost national electrification options by KTH for the World Bank.

To enact established policies, the Government of Madagascar, with technical assistance and financial support from the World Bank, has initiated a project (establishment of an ear-marked fund and technical assistance) to increase access to electricity services while strengthening institutional capacity of energy stakeholders in country. Though the project is still in development, the fund it is expected to include the a USD 30-50 million off-grid component to (i) accelerate growth and development of the off-grid PV market, and (ii) improve energy access planning and implementation capacity through technical assistance to the Ministry of Water, Energy and Hydrocarbons (MEEH) as well as to JIRAMA and ADER.

Enclude has been commissioned by the World Bank (WB) to undertake this study of the status and potential size of the stand-alone solar market in Madagascar, focusing on the demand and needs from households, Institutions and SME. The study will also assess the barriers to further market penetration of standalone solar and identify key intervention areas to overcome them.

[1] *From the ToR and validated in this study under section 3.1*

[2] *Projet PAGOSE - élaboration d'une stratégie d'accès à l'électrification à Madagascar – Tractebel, Décembre 2017.*

The findings of the study should provide valuable information for the establishment of the World Bank's LEAD fund, of which 50M USD is preliminarily allocated to accelerating the market for standalone solar solutions. The assumption is that stand-alone systems might be more viable in Madagascar than mini-grids, especially for the household segment.

1.2 Objectives of the Study

The objective of this study is to determine the **potential of standalone solar systems** to expand electricity access for a variety of end-user groups in Madagascar.

Specifically, this research will yield a holistic **market assessment** that identifies and analyses areas and market segments that can be served by off-grid solar solutions. The assessment will identify **barriers and risks** across the entire energy access value chain, and review the regulatory structure and enabling environment as it pertains to off-grid solar. The ultimate purpose of the study is to provide a basis for the design of practical intervention models for the prospected off-grid solar program by the World Bank to enable access to electricity services to households, public institutions, and SMEs. The intervention ideas should support the development of the off-grid market through the mobilization of key market enablers, including commercial banks; non-banking financial service providers such as microfinance institutions, PAYGO service providers and mobile money providers; and private off-grid companies, such as off-grid solar technology distributors.

1.3 Methodology Overview

The researched described in this report assessed the solar off grid market with regards to the demand, technical feasibility, and investment analysis and pipeline development.

The methodology employed consisted 4 phases:

- **Phase 1** – **Stocktaking**: review of existing literature and knowledge-bases;
- **Phase 2 - Primary research:** survey preparation and interviews/field visits;
- **Phase 3 - Draft reporting**: data analysis, intervention design and mid-term workshop;
- **Phase 4 - Final reporting**: proposal for intervention design and final workshop.

1.4 Stocktaking

The desk research for this study produced an overview of the available information and information gaps in respect to the renewable energy sector and solar market in Madagascar. Specifically, we looked at the demand for renewable energy, available technologies, supply of equipment and financing solutions. During the stocktaking, the team focused on further identification of the key stakeholders active in the Malagasy energy sector, including NGOs, donors, companies, government institutions, and their specific activities. The reports that were analysed are listed in annex 1.

1.5 Primary Data Collection

The following research techniques were part of the primary data collection for this study:

- Household demand assessment with assistance of an in-country survey company;
- Small business (SME) demand assessment through selective interviews with SMEs in Antananarivo and Mahajanga in Madagascar;
- Institutional demand assessment via a series of interviews with relevant ministries;
- Supply analysis including mapping of key distributors and suppliers; and
- Overall landscape analysis through desk review and interviews with different stakeholders in Madagascar.

In the examination of each market segment, data collection methods included quantitative, qualitative or a combination of the two. The use of varied data collection techniques enabled validation of past research

findings as well as newly collected data. In addition, findings of this study were compared with data from other ongoing studies that are directly linked to the LEAD project, such as the KTH geospatial analysis. The demand and supply analyses were conducted simultaneously, while the intervention analysis was based on data from the demand and supply analyses.

Enclude's team of five experts spent a week in country, and a local expert continued primary data collection after the field visit. In addition, a local finance and banking expert continued to conduct interviews in the financial sector, specifically with banks and non-banking financial institutions who were not interviewed during the in-country visit.

The objective of the field work in Madagascar was to collect sufficient quantitative and qualitative data on the ground to develop perspectives on the characteristics and size of the stand-alone solar market and test initial intervention ideas and financial instruments for LEAD.

Demand Assessment

Our analysis mapped the demand and electricity needs of **households, SMEs and institutions**. We assumed that the success of interventions and business models for expanding access to renewable energy through off-grid solar solutions will be driven in part by the level of consumer awareness of solar lighting options, their ability and willingness to pay for them, and the costs associated with the distribution and sales of these systems. Therefore, the study also analysed the viability of potential financing options for solar product consumers through Banks, MFIs and/or PAYG, and the interest among consumers in using these financial products.

Households: To assess the demand for standalone solar systems for households, a nationwide mobile-to-mobile survey was conducted by HNI/Viamo Mobile in December 2017. To engage with the predominantly rural and peri-urban households and guarantee the highest response rates and data quality levels in a short timeframe, **Independence Voice Response (IVR)** technology was used. Survey respondents received a voice call, listen to an explanatory welcome message in their language followed by audio questions which they answered by pressing the corresponding buttons on the telephone ("If you have interest in a solar panel, press 1").

The mobile phone numbers for the IVR-powered mobile-to-mobile survey was drawn from HNI's database of about 100,000 registered users from all across Madagascar that can be disaggregated by their gender, age and location. VOTO (Viamo/HNI) Madagascar worked with Enclude as well as one of the WB representatives to optimize the questionnaire for mobile communication before field-testing the questionnaire among 500 households, recording the sound files in different dialects, and launching the automated IVR survey. The final survey for the households demand assessment is provided in annex 2.

The final sample included **3054 households** in all regions and districts in the country. The selection of regions and the sample size per region was finalized during the field trip in Madagascar in collaboration with the WBG and Voto (Viamo) Mobile. The table below provides an overview of the sample size by province and type of community (village, small town, peri-urban, city). Only respondents in the age groups of 25-34 and 35-44 were included in the sample because these groups are most often financially responsible and knowledgeable about households needs.

Due to the fact that the survey targeted mobile phone owners[3], there is a small bias in the data in that purchasing power and therefore energy needs may be higher among our sample than among those who do not own a mobile phone. This potential for bias is referenced, where relevant, throughout the report. Also, in estimating market size and the size of different market segments for off-grid solar, we used various other data-points than these survey outcomes, only.

[3] *Percentage of population owning a mobile phone estimated at 30 %. A door-to-door survey of a similar sample size wasn't feasible within the scope/budget of this assignment. The World Bank is planning to conduct a 3000+ door to door household survey on energy access late 2018*

Table 1: Overview of the Demand Assessment Sample

Province	Village	Small Town	Peri-urban	City	Don't Know	Total
Antsiranana	88	31	32	2	9	162
Fianarantsoa	380	67	112	22	17	598
Mahajanga	446	91	112	19	25	693
Toamasina	180	48	78	60	20	386
Antananarivo	255	45	103	56	15	474
Toliara	466	125	84	15	51	741
Total	**1815**	**407**	**521**	**174**	**137**	**3054**

SMEs: For the SME demand analysis, 17 SMEs were interviewed about their energy needs, their appetite for standalone solar, and the financing needs. The questionnaire developed for this section is provided in Annex 3.

The questionnaire sought to determine the following:

- how many SMEs with low or no access to grid electricity use solar electricity products, by sector;
- SMEs current and future electricity requirements;
- Type of SME / type of services offered by the SME;
- SMEs willingness and ability to pay for standalone solutions;
- Current expenditures on electrification;
- Financing needs and acceptable interest rates for loans for solar solutions;
- SMEs' appetite for different business models, including cash sales, lease-to-own schemes, and DESCO models (where customers pay a regular fee to an operator for the provision and then maintenance and renewal of equipment).

Data was collected through semi-structured in-depth interviews with SMEs in each of the sectors targeted based on the desk study and discussions with donors, NGOs, and government institutions. Findings of the field mission and documentation on the key sectors and business activities in Madagascar led us to focus on SMEs in the following industries:

- Refrigeration and cold storage for fish, other crops, and small vendors;
- Water pumping, milling and rice husking;
- Cereal milling and fruit and vegetable processing; and
- Services for small businesses (print shops, cafés, repair shops, carpenters, and metal workshops).

Seventeen SMEs were interviewed in and around Antananarivo and in the region of Mahajanga. The following table provides an overview of the number and type of these enterprises.

Table 2: Overview of the SME Survey Sample

Province	Place	Activity
Antananarivo	Fenohasina	Weaving
Antananarivo	Antsahamaro	Carpentry
Antananarivo	Manerinerina	Restaurant
Mahajanga	Antsiafabositra	Welding and Carpentry
Mahajanga	Antsiafabositra	Agro processing: Rice mill
Mahajanga	Antsiafabositra	Commerce
Mahajanga	Antanimbary	Welding
Mahajanga	Berivotra 5/5	Carpentry
Mahajanga	Berivotra 5/5	Agro processing: Rice mill
Mahajanga	Berivotra 5/5	Commerce
Mahajanga	Berivotra 5/5	Welding
Mahajanga	Ambalajanakomby	Agro processing Rice mill
Mahajanga	Ambalajanakomby	Fishing
Mahajanga	Boanamary	Fishing
Mahajanga	Berivotra 5/5	Printshop
Antananarivo	Manerinerina	Tire repair business
Antananarivo	Manerinerina	Restaurant

The data from SME interviews is not meant to be representative for the entire country. However, it does provide anecdotal insights into how these types of small businesses prioritise their energy needs and how they perceive stand-alone solar as a potential solution to operate their business.

Institutions: The public institutions that need to be electrified in Madagascar include government offices, schools, health centres, and religious facilities. During the field visit, we focused on the health and education sectors because of the high potential social impact of electrifying schools and rural clinics. Both types of institutions can be considered "low hanging fruits" in terms of immediate impact, and ease of implementation and replication. With help from relevant ministries, a calculation was made of the current energy needs of various types of institutions, based on the size of the building, its equipment and the daily activities to be performed.

Supply Analysis

The solar supply and distribution analysis focused on interviewing suppliers, importers and installers of stand-alone solar solutions (and documenting the challenges that hinder the development of the off-grid solar market. In each of these interviews the following elements were assessed:

- **Company profile:** Operational history, size of enterprise;
- **Products and turnover:** Annual turnover in numbers of units sold, price of product and profit margin, number and types of sales, inventory turnover, procurement, financing;
- **Strategy to market:** Target market segment, key regions/districts, transportation/distribution, marketing/promotion strategy, perceived opportunities/constraints in the supply chain, existing and potential partnerships;
- **Availability of needed services:** installation, maintenance, operation and other servicing;
- **Future outlook:** Perceived market trends, market expectations, initiatives in pipeline
- **Key barriers/risks related to the ease of doing business;**
- **Examples distribution/business models** (as applied in other countries), end user financing, PAYG,
- **Financing needs for growth,** considering grants, local debt, equity, and Results Based Financing (RBF)

The final survey used for the supply assessment is provided in Annex 4.

Sixteen suppliers were interviewed. In-depth interviews were conducted with enterprises who are serving the household market with more innovative business models during the field mission. The full list of (quality) solar providers interviewed is shown in the table below. In order to get a better understanding of the type (including price and size of systems) of equipment being sold by lower quality suppliers, a dozen retailers in town were visited and analysed.

Table 3: Solar Home System Suppliers Madagascar

Solar Home System Suppliers
Baobab
WeConnex
Heri
SQVision
Energie technologie
Power Technology
Majinco SA
ENR Madagascar
Greencorp SARL
Nanoe
Jiro-Ve
Madagreen

Landscape Assessment: Financial Institutions, Mobile (Money) Operators, Digital Financial Services and Donors

For the landscape analysis, we interviewed key stakeholders like financial institutions, government agencies, RE/EE promotion programmes, international donor agencies and NGOs that influence the energy sector in Madagascar. These actors provided insights on the issues that hinder the development of private solar businesses, and shed light on how to enhance access to financing for low-income end-users with e.g. "*pay-as-you-go*" mobile payment models. For the landscape analysis the following institutions were interviewed:

Table 4: Financial Institutions Interviewed

Name of Financial Institution
CECAM
MicroCred
Access Bank
BFV-SG
BOA
OTIV
SOLIDIS
PAMF

2 LANDSCAPE ASSESSMENT

2.1 State of the Malagasy Economy

Since 1990, the Madagascar economy has gone through a period of transition into a more market-driven, private sector oriented country. Under guidance of the World Bank, the country went through a process of liberalisation and privatisation. Despite a dip in 2012, the economy has experienced limited growth with intermittent disruptions. These episodes are often marked by reductions in development aid as well as reductions in investment flows, which in turn have prevented the IMF from qualifying Madagascar as a healthy, stable economy.[4]

Madagascar is the only country in the world that, without experiencing civil wars or other violent conflicts, has seen its per capita income decline between the 1960's and 2010. According to the World Bank[5], the average Malagasy person is approximately 42% poorer than he or she would have been in 1960. Countries such as the Democratic Republic of Congo or the Central African Republic have experienced a similar decline in wealth, but in these countries the changes are directly related to violent internal conflicts. In Madagascar, other types of instability have probably caused this deterioration, such as the frequent political crises which have occurred since independence.

Although there has been some growth over the last decade, economic recovery has slowed in recent years. One example is the slowdown 2015 which was mostly related to falling revenues in the tourism and mining sectors. The value of the national currency also gradually weakened, despite of measures taken by the Central Bank, and harsh weather conditions in the first half of 2015 also weighed on the economy, leading to higher inflation and lower household purchasing power. Despite the government's ambition to achieve GDP growth of at least 4.5% for 2016, the forecast is about 2.7%, mostly due to poor performance in the agricultural sector.[6]

The above economic developments, especially the slow-down in growth of recent years is important context for an energy market analysis, specifically in analysing willingness and capacity to pay for stand-alone solar systems, and designing finance solutions necessary to accelerate the off grid solar market.

2.2 Energy Regulatory Environment

2.2.1 Background

The current legal and regulatory framework for Madagascar's renewable energy sector was developed in the last decade. The Electricity Law of 2000 and its regulations enabled the establishment of a fairly comprehensive institutional framework. Following the promulgation of the Electricity Law, private investment is legally possible in the energy sector in Madagascar. Independent Power Producer (IPP) tariffs are currently negotiated on a contract by contract basis and are supervised by the *"office de regulation de l'électricité"* (ORE). Laws defining and updating the roles and legal structure of ORE, ADER and the national electrification fund, FNED, are currently being finalised and enacted.

In 2015 the Government of Madagascar adopted a new and ambitious policy, Energy Policy or NPE that set the goal of increasing the energy access rate to 70% by 2030, with 85% of the energy mix supplied by renewable energy. The NPE recognizes the role that off-grid solar solutions can play in increasing access to affordable electricity services to the population. However, the targeted energy mix is still under discussion. As stated in the introduction chapter, the energy mix originally proposed in the Policy document was as follows:

- 70% via interconnected grid extension (with a production mix composed of 75% hydro-electricity, 15% thermal, 5% wind and 5% solar);
- 20% via mini grid mix: (50% hydro-electricity, 20% biogas from rice stalk, 25% diesel and 5% solar);

[4] *IMF, Financial System Stability Assessment (2016)*
[5] *World Bank, Madagascar Systematic Country Diagnostic (2015)*
[6] *Enclude, Financial Sector Report for AFD (not yet published), 2017*

- 5% from off grid solar systems; 5% from solar lamps.

The current assumption of the World Bank is that this division should be backed up by market data, as well as technology information and resource mappings. This market study should offer useful insights and data on needs, energy demand, barriers to scaling certain solutions, access to finance, and potentially viable business models for the stand-alone solar segment.

2.2.2 Key Players

Most of the players in Madagascar's energy sector are discussed in other reports; however, a quick overview of these actors and their link or role in upscaling access to solar is provided below.

Table 5: Overview of Stakeholders in the Solar Sector

ACTOR	ROLE / ACTIVITIES	LINK / ROLE FOR SOLAR MARKET ACCELERATION
JIRAMA	JIRAMA is the state-owned utility responsible for generation, transmission, and distribution of electricity. It does not have a legal monopoly, only long-term concessions in the areas in which it operates.	JIRAMA is likely to be the main off- taker for all grid-connected solar, whether in an IPP or net-metering configuration. This is also of importance to off-grid solar in areas where JIRAMA grid might be extended. JIRAMA's main asset is its large customer base. It is, however, in financial crisis and has been insolvent for several years.
Ministry of Energy and Hydrocarbons (MEH)	• Designs and implements government policy • Provides coordination of the energy sector • Provides oversight of JIRAMA's electricity sector activities.	The MEH drafts and implements national energy policy, and is therefore the key partner in defining any solar sector support program.
Rural Electrification Agency (ADER)	Rural electrification through grid-extension and/or off-grid and mini-grid systems.	As the government's main implementing agency for all rural electrification activities, ADER is a key implementing partner for all public Solar PV activities and programs. Further, ADER applies the government's concessions and authorisations regime for larger (subsidised) installations.
National Fund for Electrification and Development (FNED)	A recently reformed national fund to promote electricity access through grid extension and renewable energy. The fund is financed through a 1.25 % charge on all electricity sales by JIRAMA and other concession-holders. Other donors are invited to contribute.	The FNED is the government's main vehicle for financing electrification via a cross-subsidy from grid clients. For any solar subsidy mechanism that is to outlive the World Bank's project duration, the FNED should be considered as a potential partner.
The Energy Regulation Office (ORE)	Responsible for: • Monitoring and enforcement of quality norms, and • Development of laws and regulations. ORE is to be renamed to ARELEC. It is also to obtain a permanent "Collège de Commission" in place of the current part-time members of the "Conseil d'Administration".	ORE plays a key role in in quality assurance in energy services: • For Solar PV, **a new set of norms has been established**, based largely on IEC norms, but not yet published. It was to be presented to the government on November 22, 2017. • ORE is concerned about reaching the government's target of 70% electrification by 2030, given its limited financial and human resources

2.2.3 Key Issues Related to Scaling Stand-Alone Solar

The political crises of 2002 and 2009, the general deterioration of JIRAMA's financial situation, a weak economy, and an unsupportive regulatory environment have contributed to slow progress in improving the electrification rate over the last twenty years. In particular, the following issues are important for the deployment of stand-alone and other solar systems:

- A number of legal developments are underway in the sector, including a new electricity code, new law establishing the rural electricity fund (FNED) and a number of donor-driven policy review processes.

- Following the NEP, a 12% annual growth rate would be needed to reach the 70 % goal for electricity access. In 2017, 20,000 new connections were expected to be realized, although 75,000 would have been needed to stay on track towards the 2030 goal.

1. Quality assurance

There are no effective quality standards currently in place. A new law was expected to enter into effect in November 2017 defining standards applicable to all sales in Madagascar. Enforcement will likely be a major impediment, given a difficult state of finances of the ORE.

At present, the ORE's operational budget is drawn entirely from fees (1.2% of sales) levied on electricity operators. The most important of these is the state-owned JIRAMA, which is insolvent. As a result, ORE does not receive sufficient budget to function. Consequently, the number of staff at the ORE is currently at 20 and falling. In order to fulfil its mandate, the ORE would need sufficient expertise and staffing levels for the enforcement of norms and standards. Currently, ORE does not verify the quality of individual systems, public systems, or installers in any way. ORE would be supported with external expertise to help operationalise the quality regime being put in place: labelling, import controls, collaboration with customs, policing, etc.

Key issues that would need to be addressed are:

- Low levels of collaboration between ORE and customs;
- Lack of regulations and guidelines for (i) product specifications, (ii) protocol, procedure and certification for the installation of systems, (iii) operation and maintenance requirements (O&M), (iv) systematic collection and recycling of waste and used solar products;
- Shortage of technicians in Madagascar to safeguard the quality, operation and maintenance of solar home systems

The **World Bank** is already actively working with the Bureau of Standard**s** on internalizing Lighting Global standards as well as implementing the possibility to link tax advantages to quality products only.

The following points can be considered to strengthen the capacity of ORE and improve coordination of ORE with customs:

- Support with enforcement of import tax exemptions for accredited products. This is easy / easier to implement for pico-solar products, which is currently mostly in demand
- For larger solar home systems, loose components need to be assessed, which is more complex to implement. A program could be implemented for training and certification of the technicians to create a "critical mass" of specialists that can safeguard the quality and proper operation of systems; this same group of specialists could as well act as market enablers , by explaining the opportunities of solar (home) systems to the wider public
- Support customs with adding product standards and labels to prevent low quality products to enter the market, and how to enforce the new quality norms that were supposed to be implemented in November 2017.
- It could be useful to avoid potential future problems, before the solar takes up, to implement guidelines for systematic collection and recycling of waste and used products, especially for batteries.

2. Lack of effective cross-subsidy

The Government of Madagascar recognises the need to provide subsidies for rural electrification and consequently the need to establish a permanent cross-subsidy mechanism to use electricity sales revenues collected from wealthier/urban customers to lower the price of electricity to poor/rural customers. To this end, the government created the National Electrification Fund (FNE) financed through a 1.25% levy on electricity sales. Until now, this fund was little more than a budget line administered by ADER and generally used to subsidise electrification projects. In 2017, the fund was established as an independent legal entity under the name "FNED". In this new form, the fund aimed to increase its revenues from levies by attracting funds from international donors.

FNED faces several challenges:

1. A project based on subsidy mechanisms can be slow and cumbersome. A leaner and more "automated" subsidy mechanism is needed to achieve the high disbursal rates required for the aggressive roll-out of rural electrification.
2. Since the vast majority of electricity sales originate from JIRAMA, the levy is rarely transferred to the fund in full because of the difficult financial situation of the utility. An ongoing reform process at JIRAMA and supported by the World Bank may rectify this situation in the coming years. These reforms are critical to ensuring sufficient government funding for rural electrification in the future.
3. Whilst FNED seeks funding from outside donors, most of the targeted partners raise serious concerns about the set-up of the fund. In particular, the World Bank has objected to the Government's relatively low prioritisation of renewable energies and the central role played by ADER. It therefore seems unlikely that the Bank will contribute to the fund. Other donors active in the sector such as GIZ, UNIDO, and EU have only limited funds available for infrastructure, many of which are already committed. It is unclear whether KfW could contribute to the fund at a future date.

3. Inadequate national data collection and objective-setting

There is a lack of reliable data to support the planning processes of ADER, JIRAMA, ORE, and other policies/programs to enact the National Energy Policy and enforce reform of JIRAMA. This is a recognised problem for all agencies involved and their development partners. Currently, several studies are underway in search of solutions to this situation. Most notably, a national energy observatory is being established within the MEH to collect, manage and distribute data.

It is expected that the data from ongoing studies by development partners (World Bank, GIZ, EU, UNIDO and others) will enable improvements to the NPE as well as the electrification planning of ADER, JIRAMA and ORE. The challenge will be to embed a monitoring and corrective feedback mechanism in these processes. Only in this way will national planning be able to react to changes in technology costs and socio-economic realities, thus paving the way for a "least-cost" approach to electrification.

2.3 Donor & NGO Programmes

2.3.1 Key Programs and Donors

Within the renewable energy sector, various donor and NGO programmes are active in Madagascar, of which quite a few are devoted to off-grid electrification. Most of these players are involved with larger rural electrification projects, or else they specifically focus on mini-grids. Hardly any programmes were identified that focus on the Bottom of the Pyramid, or on implementing innovative business models to accelerate the market for Solar Home Systems. The only exceptions are KfW, which recently provided a credit line and technical assistance for solar loan product development at Access Bank, and the EU, which financially supports the solar home systems suppliers HERi and Jiro-Ve through grants

The following table provides an overview of the key programs and projects of other donors active in the off-grid solar sector. This overview is intended to give guidance on which partners the World Bank could consider, where overlaps can be avoided and where synergies can be exploited. In addition, the table points to where lessons might be learned from other programmes.

Table 6: Key Programs and Projects Relevant to WB Activities

	General description of activities	Activities relevant to the proposed off-grid solar program	Relevant future plans	Possible overlaps/ synergies with WB activities
KFW	- KfW is financing and supervising the construction of several MW of hydropower plants and mini-grids in the SAVA region.	The activities of KfW may improve the procedures for awarding concessions.	KfW seems interested in expanding its activities in the country. An expansion of the available investment budget	- Potential contributing partner to funds for solar development - Participation would need to be discussed on a case-by-case basis. - Lessons to be learned from the recently started

	General description of activities	Activities relevant to the proposed off-grid solar program	Relevant future plans	Possible overlaps/ synergies with WB activities
	- KfW recently launched a credit line and TA with Access Bank for solar loan product development.		is likely in the medium-term, according to the KfW desk officer.	project with Access Bank (for example on partnership development. See section 4)
GIZ	GIZ aims to promote a favourable political and economic ecosystem for energy sector development in Madagascar through: - Policy and regulatory reform - Private and public sector capacity building - Financial sector training - Support in developing on- grid concession schemes - Support in developing mini-grid concession schemes - Development of the concessions framework - Support of specific hydropower projects in the SAVA region	GIZ supports the development of a number of PV mini-grids in close collaboration with ADER through technical assistance, logistical and financial support GIZ is delivering trainings within financial institutions to encourage loans to the energy sector, notably solar home systems.	GIZ will continue to build the capacity of ADER, ORE and the MEH by providing integrated training and expertise. This may help improve the viability of these organisations as implementing partners.	GIZ could be an attractive partner for the extensive institutional capacity building required to ensure sustainable impact of solar energy programs.
UNIDO	UNIDO supports ADER with the implementation of its hydropower projects in the SAVA region through financial and technical support. UNIDO mobilises grants from the Global Environment Fund (GEF) and provides technical support (training, policy studies, and advisory services to the government).	UNIDO provides regular and ongoing advisory services to ADER, including in regard to the solar sector.	N/A	- Reinforcing the capacity of state actors - Supporting policy reform
AFD / Solidis / Sunref	The Agence Française de Développement (AFD) supports two financial instruments in Madagascar: Solidis, a guarantee fund, and SUNREF Indian Ocean, a green credit line also focusing on Madagascar. Solidis Garantie was introduced in 2008, working jointly with the MCB and the SBM banks, to support lending to SMEs.	Solidis, whilst not energy-specific, has expressed a strong interest in supporting energy-sector projects and companies. SUNREF explicitly targets mid-sized to larger renewable energy projects (ranges between EUR 500K – 3M	Both Solidis and SUNREF continue to expand their funding lines through financing from AFD and multiple other donors.	- SUNREF and Solidis are primarily attractive for larger projects (hundreds of thousands of dollars and higher). - Either could be used for large solar projects, or bundling of many solar home systems under one loan. - World Bank could be complementary in focusing their credit line on the household and (smaller business /MSME segments

	General description of activities	Activities relevant to the proposed off-grid solar program	Relevant future plans	Possible overlaps/ synergies with WB activities
	In January 2018 AFD launched a call for a feasibility study for a dedicated SUNREF credit line in Madagascar.			
EU	The EU is engaged in the following energy sector activities in Madagascar: - Flexible / interim financing support to energy projects and suppliers via the Electrification Financing Initiative (ElectriFI) - Subsidies to hydro mini-grids via the Energy Facility - program - Financing solar (service) providers: HERi's energy kiosks via the Energy Facility, and to Jiro-Ve; - The support of a grid interconnection project under the 11th Fonds Européen de Développement (FED)	The EU's support to supplier's HERi's *"energy kiosks"* represents an interesting scaling-up of one of the appropriate approaches to electrifying the poorest in Madagascar (discussed in section 4) The EU's mini-grid projects have provided interesting insights into the limitations of mini-grids as an economically viable solution to electrification, whilst nonetheless improving national capacities for their implementation.	In 2018, the European External Investment Plan (EIP) will be introduced as a new mechanism in development aid that will promote foreign direct investment (FDI) and credit-based financial instruments in addition to grants.	The ElectriFI fund represents an interesting partner for larger (>3m EUR) energy ventures. HERi represents a viable partner for the rolling out of low-end lamp-rental services for the poorest of the poor. The EU's experience with HERi should be drawn on in establishing activities in the "energy kiosk" business model.
GRET	GRET is an international NGO active in Madagascar in the agricultural and energy sectors.	GRET's *"Café Lumière"* project is implementing solar PV-based multifunctional platforms in Vakinankaratra region to enable a range of productive uses in agro-processing, metal-working, wood-working and other services. The project enjoys a grant from AFD and technical support from ESF. Six sites have been identified to host the pilot phase. Each platform will have a capacity of 6 to 7 kWp.	When the Café Lumière project moves into an implementation phase, it could provide useful experiences on promoting the use of solar energy for production of goods and services.	Supporting a scale-up of the multifunctional platform approach.
Fondem	FONDEM is an international energy NGO that has realised a number of PV mini-grids in Madagascar, most notably those completed recently under the BOREALE programme, co-financed by the EU.	FONDEM has some of the most extensive PV mini-grid experience in Madagascar, having realised four 7.5kW mini-grids, two 10kW mini-grids and one 15kw mini-grid.	A number of future opportunities are open to FONDEM in the mini-grids sector, notably ADER's planned continuation of solar concession schemes and future EU energy	Experiences from FONDEM can illustrate the limitations of mini-grid projects in Madagascar. Further, FONDEM is a potential partner in the realisation of mini-grid projects.

	General description of activities	Activities relevant to the proposed off-grid solar program	Relevant future plans	Possible overlaps/ synergies with WB activities
			funding (such as ElectriFI). It's not clear to what extent Fondem wants to be involved and will benefit from these programs.	

2.3.2 Key lessons & recommendations from current donor activities relevant for LEAD

As illustrated in the table above, the off-grid PV sector has a number of activities that are already far advanced. Many of these are under the umbrella of the quickly evolving policy and institutional framework being created by ADER, ORE, the MEH and FNED. Through its long-term energy program, the World Bank has been a central player in advising the government in this reform process.

In order to ensure the sustainability of the World Bank interventions and coordination with on-going projects, the following actions are proposed:

- Support the continuing efforts of donors to build the capacities of ADER, ORE and the FNED. Although these institutions have developed their legal structure and in-house procedures significantly with the support of GIZ, UNIDO and others, resources allocated to date are not sufficient to guarantee a strong and lasting impact. The greater financial resources of the Bank could be deployed, for example, to:
  - ✓ Help ADER develop PV home system projects to complement its mini-grids projects
  - ✓ Support ORE with technical assistance / human resources for the enforcement of quality standards
  - ✓ Support the finalisation of FNED's legal status and the provision of seed funding.
- Coordination: although the various donors are currently undertaking different activities, especially in terms of target market, region and size of solutions, a body or actor that coordinates all donor and NGO work could be beneficial to avoid overlap in the future. The World Bank could encourage the Government of Madagascar to set up such a body. Otherwise, it is advised to coordinate with GIZ and EU in promoting the solar PV market in Madagascar, in respect to both off grid and larger PV projects.
- Draw on the expertise of FONDEM, GRET, ADER and GIZ in mini-grid activities. Despite these projects having revealed the high-cost of mini-grid-produced electricity and its limited suitability in Madagascar compared to other solutions (such as SHS), mini-grids are still likely to be deployed under certain conditions.
- Avoid overlap: At present, various credit lines are underway, including AFD / SUNREF Madagascar, KFW's technical assistance and dedicated credit line for Access Bank, as well as Electrifi from the EU. Collaboration with these credit lines is advised to leverage their contribution to mobilizing capital in the sector. Consider contributing to their energy-specific funds or setting up complementary programs/funds.

3 DEMAND ASSESSMENT

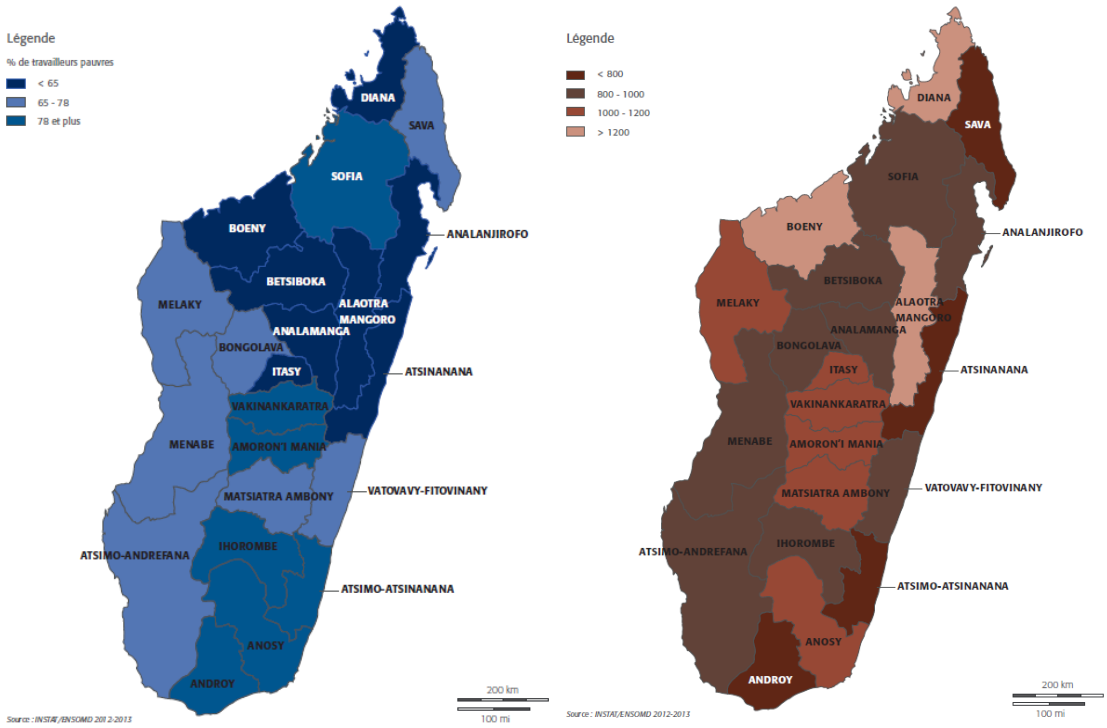
3.4. Household Financial Situations

The data presented in this chapter are based partly on secondary sources or interviews with key players in the energy sector, but is mainly drawn from a survey of 3000 households across Madagascar that was completed as part of this market assessment (see section 1.5 for details primary data collection methods).

3.4.1. Low Household Incomes and Purchasing Power

Madagascar is characterized as a very-low-income country with households having low purchasing power compared to their East African neighbours. On average, Malagasy have an income of 99,600 MGA (Malagasy MGA) a month (30 USD), while 48% have an income of less than 40,000 MGA a month (12 USD), which is just above the cash sale price of a quality solar lantern[7]**.** Over 90 percent live under the general poverty line, earning between USD1.90 and USD3.10 per day[8]. The lowest income regions are in the country's South East, in Sofia and in the centre (under Itasy), while incomes are on average 43% higher (as much as 78,479 MGA per month) in the Central and Northern areas. These differences are important in designing interventions and selecting the right product-market combinations.

Figure 1: Proportion of the employed population with less than USD 1.25 PPP per day (left); Average annual farm income by region (in millions MGA) (right) (source: Instat 2012)

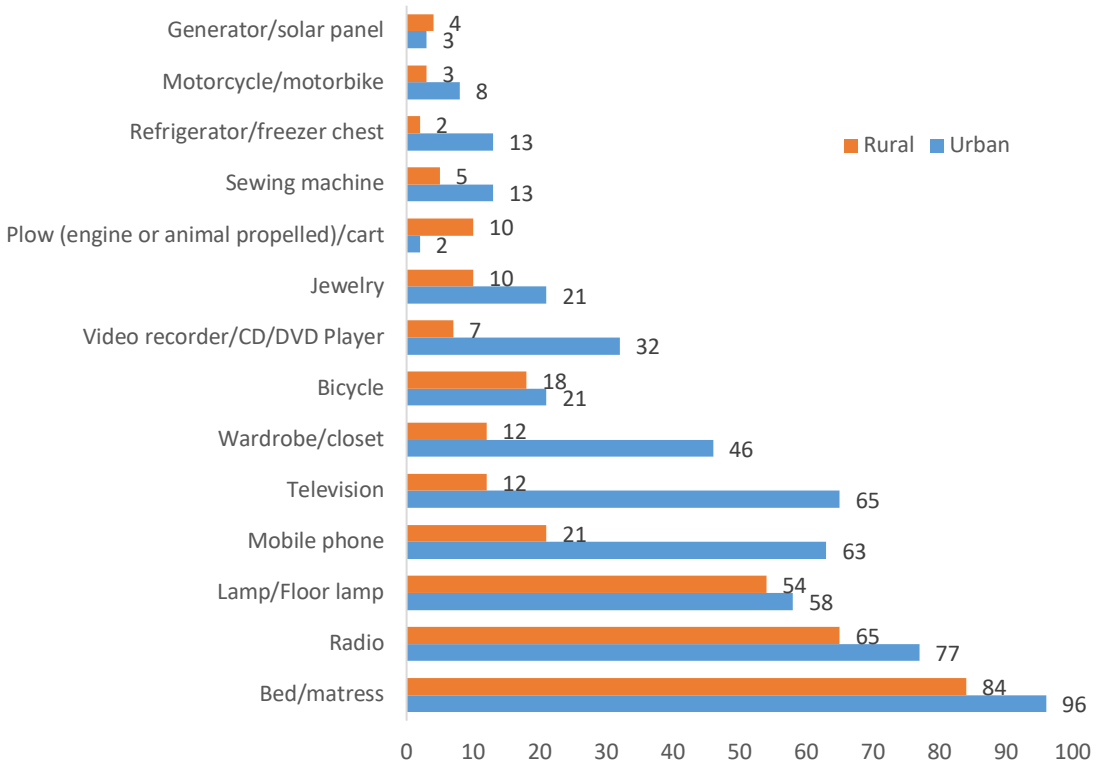


More than half (58%) of the Malagasy households surveyed rely on agriculture as their main income source. This is even higher in the villages (70%). Another 10% work at a private company or as domestic help, and 8% are self-employed. As a consequence of the high involvement in agriculture, 39% of the households report that their incomes fluctuate frequently, and while another 33% say they fluctuate "sometimes". According to the 2016 Finscope survey, about 10% get their income from other household members via remittances or other governmental assistance programmes. Thus, the **informal economy provides the main income source for the 36% of adults**[9].

[7] *30,000 MGA, Sunking Pico 50*
[8] *Instat data from 2012, Household survey Enclude/Viamo 2017*
[9] *Finscope (2016)*

About 71% of households in Madagacar are involved in farming, of which 18% produce solely for household consumption and 9% are fully commercial, while 73% both consume and sell their produce. On average, across rural and urban areas in Madagascar the majority of households own a bed or mattress (87%), a radio (68%) and a lamp (56%). In rural areas the percentage of households owning a mobile phone, TV, and video recorder/CD/DVD Player is significantly lower than is the case in urban areas (see Figure 5 below).

Figure 2: Household ownership of assets (%) (Source: Finscope, 2016)



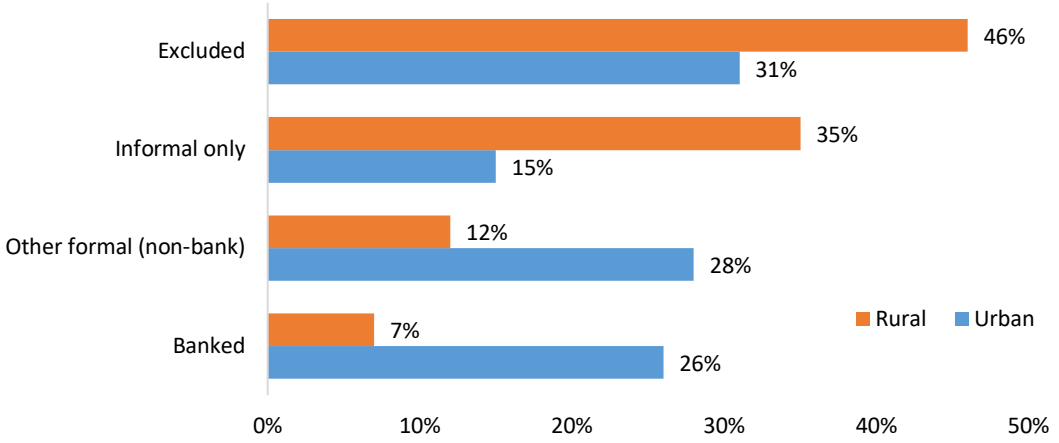
3.4.2. Financial Inclusion

Only 29% of Malagasy adults are served by the formal financial sector, meaning by banks or by other formal non-bank products and services. Only 12% of the adults in Madagascar are officially banked (see Figure 6 below). About 26% of adults have or make use of other formal non-bank products/services, of which 21% is being served by MFIs. Another 25% make use of informal types of financing. Particularly in rural areas, the 'financially included' use informal channels to meet their financial needs, such as friends, family and non-regulated financial institutions. This means that on average **over 64% of the Malagasy adults are financially excluded, even from informal types of financing (81% in rural areas and 46% in urban areas)**[10].

In particular, the areas of Sofia (North West) and Androy (South) show high rates of financial exclusion, which correspond with the low levels of income in each of these areas. This high degree of financial exclusion is partly due to adults not having an ID card (30%), which are required to access bank or MFIs services, and the large distances that Malagasy in rural areas would need to travel to a bank, MFI branch or mobile money agent.

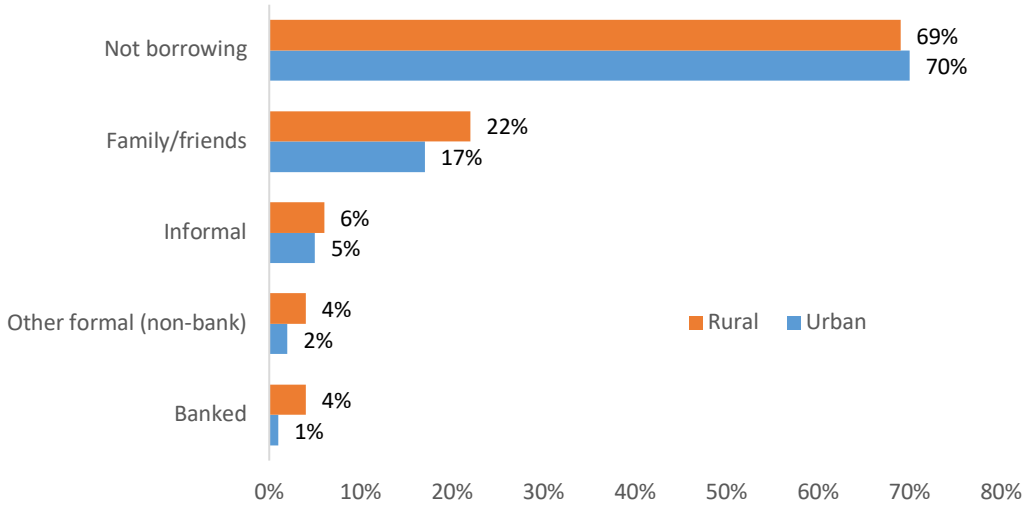
[10] *Finscope (2016)*

Figure 3: Financial inclusions of Malagasy adults (Source: Finscope, 2016)



In terms of borrowing money, the majority of both rural and urban adults (69% and 70%) have never borrowed any money, even from informal sources (see figure below). Especially the areas of Androy and Sava, and 90% and 88% respectively have never borrowed money. Although the highest rates of financial access (both banked and other formal) are seen in the areas of Analamanga (42%), Analanjirofo (41%), Vakinankaratra (36%), Atsimo Andrefana (32%), and Boeny (32%) , the percentage of households also borrowing money from these financial institutions is only 4% - 10%.

Figure 4: Borrowing money (Source: Finscope, 2016).



Based on these numbers, the apetitite for borrowing money from a formal financial institution to purchase a solar product would be low for both rural and urban households. However, the survey showed that over **70% of households would be more interested in buying a solar product with a repayment plan**, while 8% would prefer to rent a solar product.

3.5. Madagascar's Low Electrification Rate

In Madagascar, the access to electricity is very limited, especially in rural areas. The estimated current access rate via the grid is 15%, with an estimated 55% of the population[11] in urban and peri-urban and only 5% in rural areas having access to electricity. [12] Based on these percentages, the size of the population without access to the grid is estimated to be about **4.7 million households.**

[11] *Population in 2017 estimated at 25mln with 4.5 persons per household*

[12] *Percentages based on a comparison of numerous data points, including https://www.africa-eu-renewables.org/market-information/madagascar/energy-sector/, Finscope, Instat, etc. A recent study of the Word Bank on Malaria mentions an electrification rate of 23%. This is likely to be related to the fact that the question raised was too general ("do you have access to electricity". This can comprise of shared (jirma) connections, but also other sources of energy access.*

Over 78% of Malagasy households rely on alternative energy sources, including generators, solar systems, and other basic lighting devices (kerosene lamps, candles, and torches).[13] On average, 4% use generators (about 5% in rural areas and 3% in urban), 15% have solar systems (3% in rural areas and 37% in urban), and about 53% use kerosene lamps, candles and torches (about 80% in the rural areas). On average, 6-7% use wood for cooking and lighting or no energy source at all (see table below). The districts of Analamanga (centre), Boeny (northwest) and Diana (north) have the highest electrification rates at 60%, 30%, and 29%, respectively. While the districts in the south show the lowest; Atsimo-Atsinanana 2%, Androy 2%, and Vatovavy Fitovinany 3%.

Table 7: Breakdown energy used by households in Madagascar

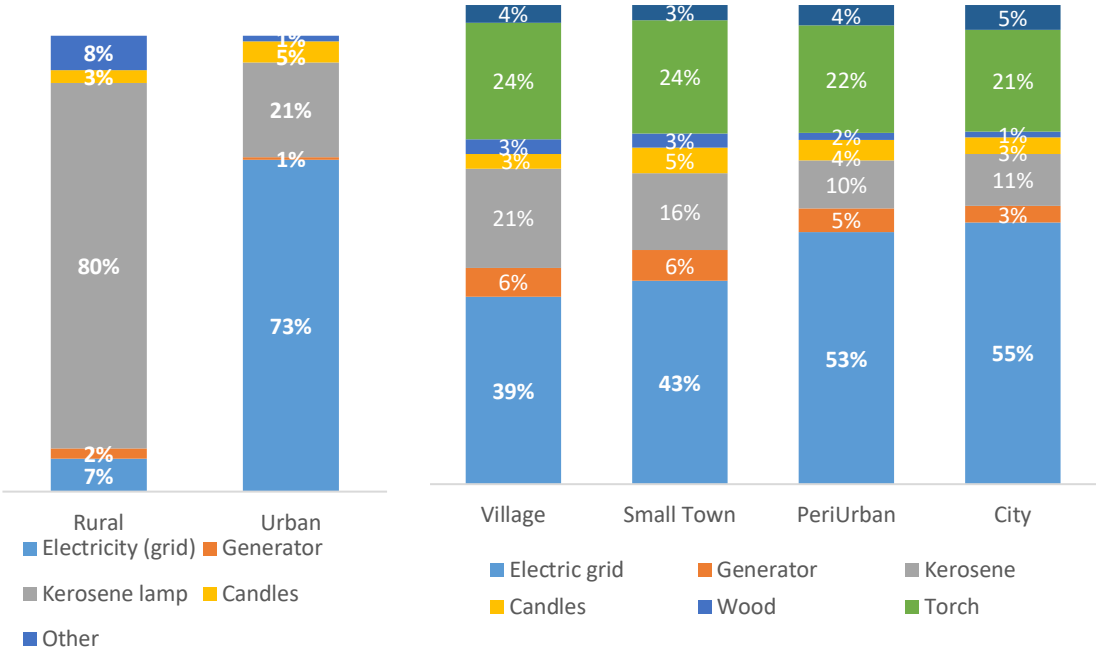
Energy sources used	Average	# hhs	Rural	Urban
Electrification rate (grid)	15%	833,000	5%	55%
Generator	4%	222,000	5%	3%
Solar	15%	833,000	3%	37%
Kerosene lamps, candles	53%	2,944,000	83%	26%
None (wood)	6.5%	361,000	7%	6%

Despite high resource potential and opportunities, Madagascar's power sector faces significant challenges including the need for improved distribution and transmission capacity. The annual consumption of electricity per capita is among the lowest in Africa, and is estimated at 48.53 kWh, less than one-third of the average for Sub-Saharan African countries (excluding South Africa)[14].

3.5.1. Energy for Lighting

The main energy source used for lighting in rural areas is fuel for the kerosene lamp (80%)[15], compared to 21% in urban areas. Only 3% uses candles for lighting in both urban and rural areas). In urban areas, grid electricity is the main source of energy for lighting the home. In Aanalamanga, grid connection is high (60%), followed by Boeny (30%) and Diana (28.8%). Kerosene usage is high in Atsimo Atsinanana (95.7%), Amoron'i mania (88.3%) and Sava (86.2%). These are also the regions with low purchasing power.

Figure 5: ***Main Source of Energy from Home Lighting***



Source: Instat 2012, left, Enclude survey 2017, right

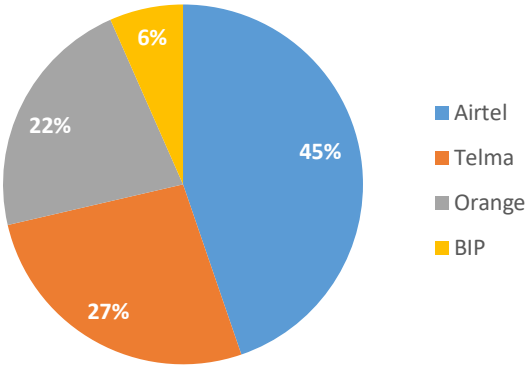
[13] *Rough estimation based comparison of numerous data points, including from Instat (2012), Finscope (2016), Enclude/Viamo survey (2017), and solar supplier data (2017)*
[14] *https://energypedia.info/wiki/Madagascar_Energy_Situation*
[15] *Instat 2012*

There is significant variation in hours of electrical lighting used per day, ranging from the 17% who use for only 1 hour a day to the almost 20% who use it more than 4 hours a day. Clearly in the villages the average use of electricity per day in hours is much lower than in the cities, where over 30% uses it more than 4 hours a day compared to 16% in the villages.

3.5.2. Energy for Communications

The main use of energy for communications is for mobile phones, of which there are over 6.6 million unique subscribers in Madagascar[16]. On average 30% of the population owns a mobile phone: 21% in rural areas and 68% in urban areas[17]. If **people sharing phones** and/or having access to a phone in the household or compound, or from family and friends, are included then **about 75% of the population has access to a mobile phone**. Among SIM/mobile phone owners the majority subscribes with **Airtel,** followed by Telma and Orange. Airtel also has the largest outreach into rural areas in Madagascar.

Figure 6: Market share Telco's

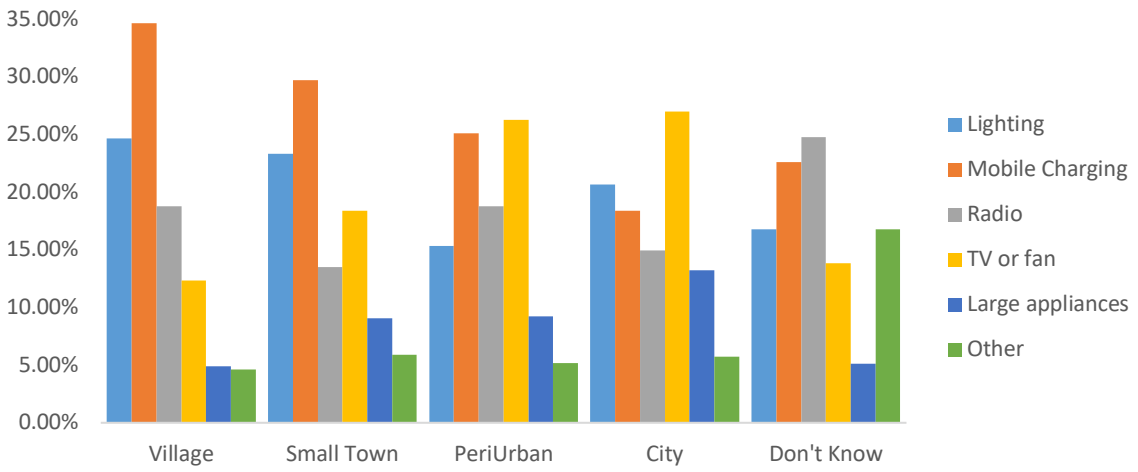


Source: GSMA, 2018

The 21% of households in rural areas and 68% in urban areas that own a mobile phone charge their phones at home. Over 40% of households use their energy source for both lighting and phone charging overall, while 48% in rural areas use energy for both purposes. About 25% of the households also use energy to power radios, while 22% use it to watch TV.

If households had a better source of energy, they would generally use it for mobile phone charging (31%), followed by lighting (22%), and radio (18%). Especially in the rural areas mobile phone charging and lighting are important, while in the cities using a TV or fan would be the number one choice (see figure below).

Figure 7: Uses of Additional Electricity



Source: Enclude survey 2017

[16] *Data from GSMA, Viamo, CGAP.*
[17] *Still awaiting data from Telco's*

3.5.3. *Current Solar Use*

General awareness of solar products among households in Madagascar is not as low as one would expect, given the low rates of solar ownership, particularly in rural areas. For the conducted survey only 11% said they did not know what solar power is. Solar awareness is lower in the areas of Atsinanana (23%), Androy (18%) and Analanjirofo (16%). However, **information on the quality of products seems to be lacking**, beyond basic information on what solar does and how it works. Households judge the quality of solar products mainly based on the reputation of the company (40%), recommendations (15%), and the behaviour of the company or sales representative (14%). The most appealing aspect of solar for the surveyed households is the lower energy costs associated with the product (39%), followed by the convenience (18%) and reliability (17%) of the product. The increased safety and better lighting are regarded as the least appealing features of solar products.

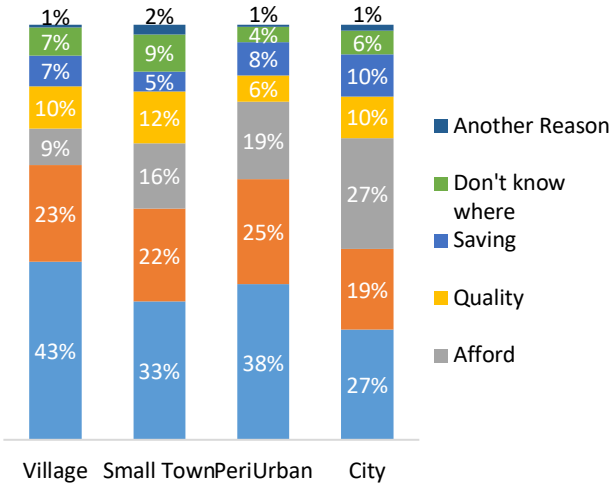
According to Finscope (2016 data), about 3% of the households in rural areas owns a solar panel compared to 37% in urban areas. The data from the household survey conducted for this market assessment suggests that 53% of all households own a solar product, with an even higher rate in the villages (61%). The majority of the owners have small systems, either a single light system (31%) or a single light with phone charger (37%). The latter number is skewed by the fact that only households with mobile phone access were targeted by this survey.

Of the households currently not owning a solar product, over 71% would want one—although more so in urban areas (83%) than in villages (70%). Residents of Analamango and Vakinankaratra in particular show high interest in solar products, while interest in Androy and Vatovavy Fitovinany is lower.

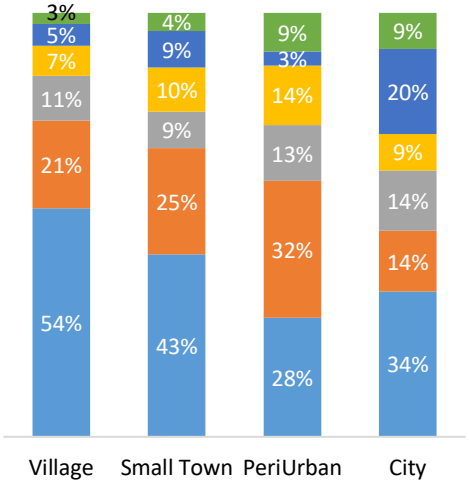
Moreover, the majority of current solar owners (73%) would want another solar product, but the **main reason for not having purchased one is that they don't know enough about the technology** (39%). This is particularly the case for households in the villages. The second most common reason is being afraid to pay too much for energy (23%). Both reasons contradict the earlier findings of high levels of awareness on solar, which clearly does require some detailed attention.

For those households not interested in buying solar, the main reasons were 'not knowing enough about the technology' (47%) and "*afraid to pay too much"* (23%)--once again illustrating a lack of awareness of solar, particularly in the rural areas (villages and small towns).

Figure 8: Reason for not having bought a solar product yet (although being interested)



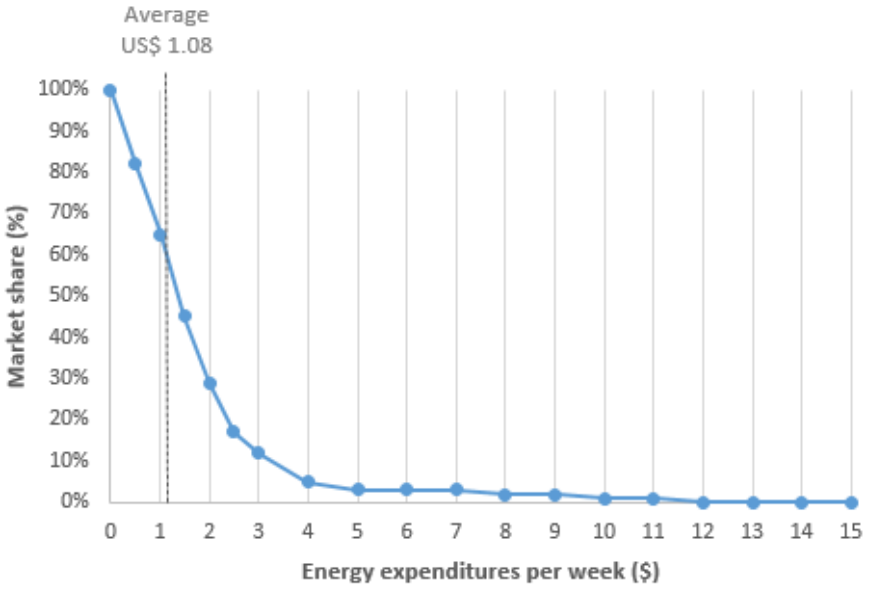
Reason for not being interested in solar at al



3.5.4. *Current Energy Expenditures*

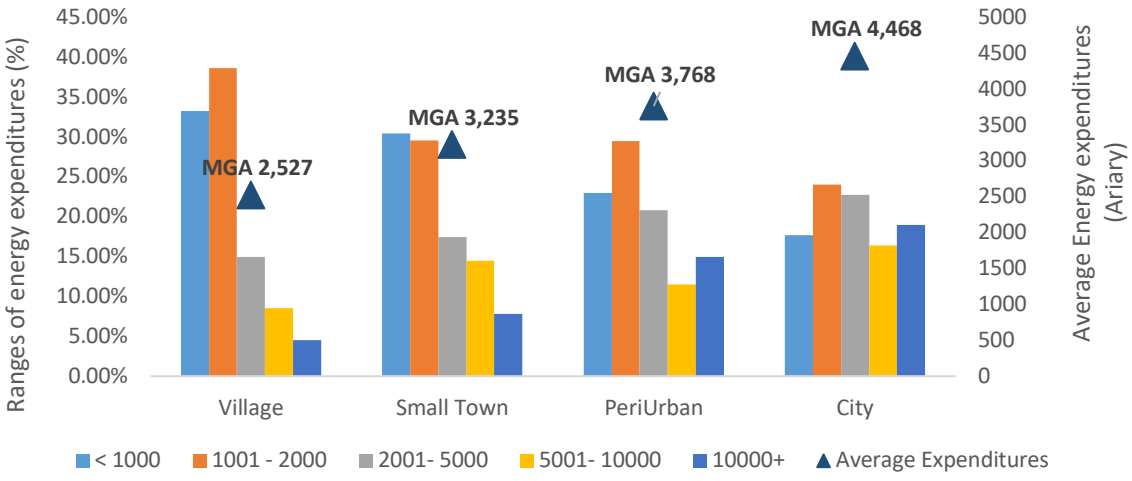
Average monthly spending on energy in Madagascar is about 15,249 MGA (USD 4.70), or 1.08 USD on a weekly basis (see figure below). In rural areas, where 65% of the population lives, monthly spending is lower at 11,000 MGA a month (USD 3.40). Thus the market share of households being able to spend (based on current expenditures) between 1 and 2 US dollars a days is only between 30-65%.

Figure 9: Distribution of Energy Spending (USD)



Average monthly spending on all types of energy in Madagascar is 8000 MGA+ or lower for the majority of the population (56%). Average overall spending on fuel for kerosene lamps, for instance, is around 500 MGA per week and spending on candles is 1000 MGA per week[18]. This amounts to 6650–8200 MGA per month (USD 2.07 – USD 2.55). On average, about 35% *"sometimes"* and 31% *"frequently"* cannot afford to buy the energy source they currently use. By comparison, average rural spending on energy in Uganda lies between USD 2.7 and USD 5.5.

Figure 10: Average Energy Expenditures per Week



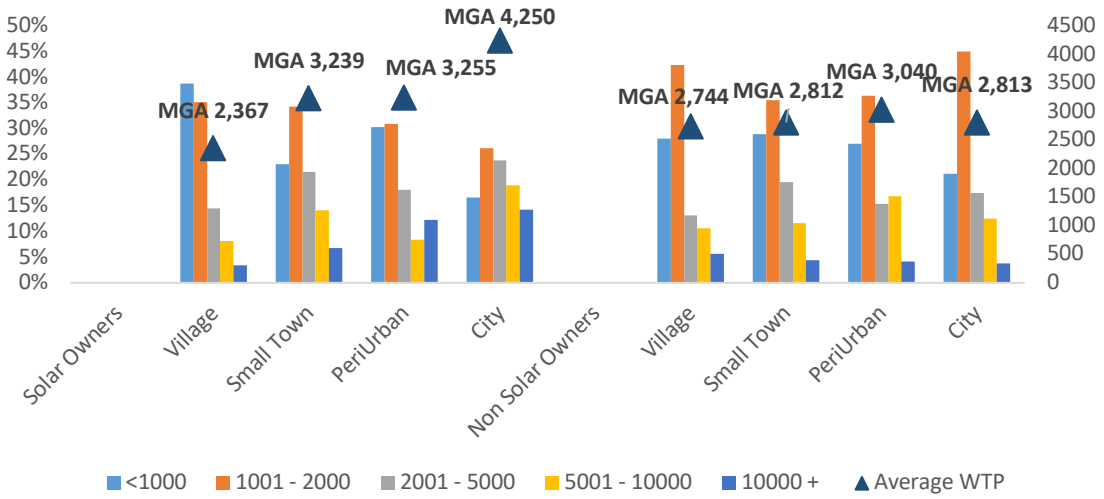
3.5.5. Willingness & Ability to Pay for Solar Energy

On average, households are willing to spend about what they already pay for energy on solar (see Figures 11 and 12), or about 2992 MGA (0.92 USD) for a solar product. This can be considered very low, especially in rural areas) where households are willing to pay only 2508 MGA, compared to 3307 MGA in the cities. The differences between current solar owners and the amount they are willing to pay compared to non-

[18] *Data from Interviews with Jirove*

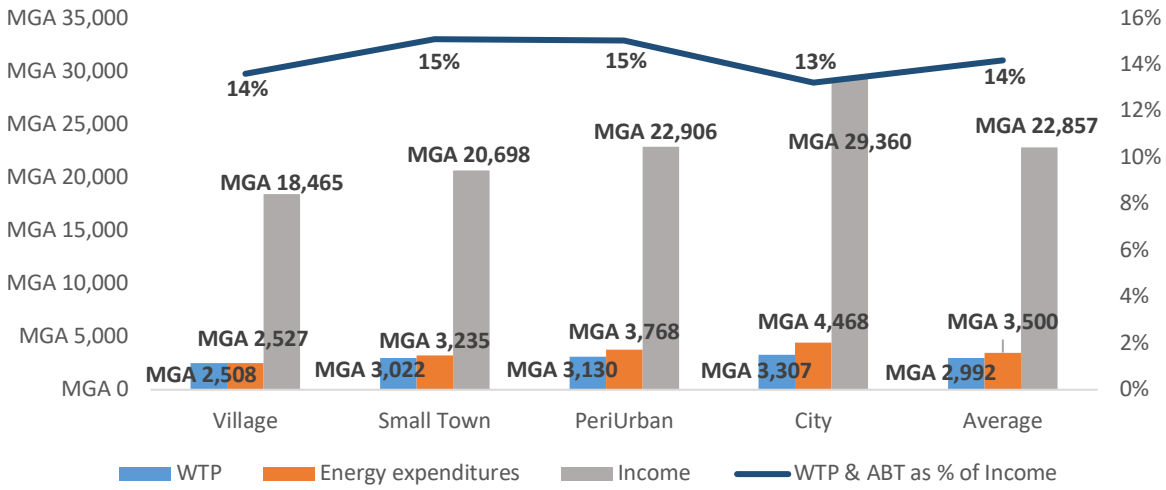
solar owners are rather striking; on average solar owners are willing to pay 15% more than non-solar owners (although in absolute terms that is only 0.13 USD per week more).

Figure 11: Willingness to pay for solar products, segmented per area (rural, urban, peri-urban) & owning a solar product



When comparing average willingness to pay and ability to pay across the different areas (rural, urban, peri-urban), based on current energy expenditures and average income regardless of whether people own a solar product already, it becomes clear that current expenditures and willingness to pay are very low, and a very small percentage of the total income (see figure below). Households are seemingly not willing to pay a substantial amount of their income for lighting in general, let alone on a solar product, unless they are convinced of the cost and quality.

Figure 12: Willingness vs. Ability to Pay and Average Income (all on a weekly basis)



3.5.6. Market Segments and Estimated Market Size

The data above clearly illustrates the differences between rural and urban areas and among different target groups, including banked vs unbanked and those owning mobile phone vs not owning a mobile phone. This next step is a specific market segmentation that details the specific approach and product type necessary to sufficiently fulfil the needs of households.

When segmenting the market along the lines of affordability (income and current energy expenditures) and willingness to pay for a new or improved energy product, it becomes apparent that the **large majority can only afford lanterns or Pico PV system.** Table 8 differentiates type of products available in the market and

the average prices of these systems along the Multi-Tier Framework[19]. Note that the prices provided in Table 8 are illustrative, especially the cash prices of the systems above tier 1, as most of these systems are only sold on credit, either PAYG or MFI loan.

Table 8: Overview tiers and available products in Madagascar

Tier	Product types	Serves	Capacity in Wp	Cash Price of Example Product in Madagascar
0.5- 1	Lanterns Pico Solar PV	Lighting Lighting & phone charging	~0.5 – 3 3-11	SunKing Pico 30,000- 35,000 (~10 USD). SunKing Pro 155,000 (48 USD)
1 – 1.5	Plug and Play (Solar Home Kits), including PAYG solar kits	Multiple light(s) + some energy efficient appliances (incl. phone charging, small radio)	> 11 - 30	Sunking Home 40 395,000 (~123 USD)
>2	Component based system (solar home System) incl. PAYG home systems	General lighting + multiple energy efficient appliances (incl. phone charging, small radio, TV)	30 – 50 50-200	Solar Home System of 50W: > 1,500,000 (~463 USD)
3	Large Solar Home Systems, nano- and pico-grids	All the above + multiple appliances Small productive usage	>200Wp	Mostly fee for service (daily, weekly or monthly payments)

The table and figure below (table 9 and figure 13) illustrate that **none of the segments** show an ability (based on income and current energy expenditures) and willingness to pay for the **smallest solar product in cash**. The highest average amount households are willing to pay is 22,900 MGA (7 USD), for the highest income segment. This means that selling products on a cash basis in rural and peri-urban areas in Madagascar will be extremely challenging. This assumption is validated by suppliers currently offering solar products on a rental and pay-go basis (Boabab+, HERi, Jiro-Ve).

Furthermore, based on the needs of each segment (mainly task or general lighting and phone charging), products in tier 1 and in some cases tier 2 appear to have the largest market potential. **About 54% of the population ought to be able to afford tier 1 or 2 products.** For the largest segment, however, ability and willingness to pay is so low that the better market opportunities most likely lie with segments 2 and 3, which show sufficient ability and willingness to pay in line with their specific energy needs. Realistically, the potential market for new solar lighting sales would be around **20% of all households (1.1mln)** in Madagascar.

Table 9: Segmentation

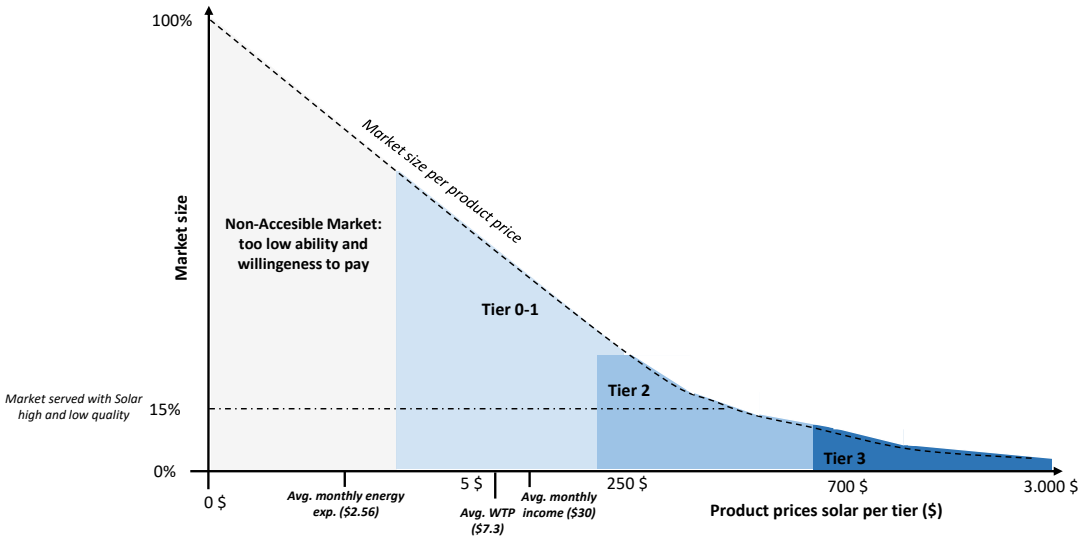
Seg-ment	Income MGA (month)	Av. energy exp. (month) MGA	WTP (month) (MGA)	Needs & Likely use of product	Products of interest / ability to pay	Type /technology	Payback period (avg. of exp. & WTP)	Market size* (hhs)
1	< 43,500 (<USD 3)	5,343	5,028	Task Lighting, mobile charging, radio	Tier 0/1 (± 30,000 MGA)	Solar lantern (e.g. Sunking Pico)	± 6 months	29% (1.6 mln)
2	10,000 – 20,000 (USD 3 - 6)	8,981	8,980	Task Lighting, mobile charging, radio	Tier 0/1 (30,000 – 100,000)	Solar lantern/Pico PV (e.g. Sunking Pro)	± 3 - 11 months	14% (777k)
3	20,000 – 40,000 (USD 6 - 13)	13,461	16,109	General Lighting, mobile charging, radio	Tier 1 (30,000 – 150,000)	Solar lantern/Pico PV (e.g. Sunbell,	± 2 - 10 months	5% (277k)

[19] This study refers to "product tiers" according to the product tier framework established by ESMAP to analyse the size of the market and market potential for different type of solar products. The World Bank Group (Lighting Global) and GOGLA apply the same framework in their reporting, table illustrates the tiers most applicable to this market study, slightly modified to enable more differentiation within tiers 0-2, which is expected to cover the largest market potential in Madagascar.

Seg-ment	Income MGA (month)	Av. energy exp. (month) MGA	WTP (month) (MGA)	Needs & Likely use of product	Products of interest / ability to pay	Type /technology	Payback period (avg. of exp. & WTP)	Market size* (hhs)
						Sunking Pro)		
4	40,000 – 70,000 (USD 13 - 22)	14,973	17,063	General Lighting Mobile charging, TV or fan	Tier 1 (Maybe 2) (30,000 – 200,000)	Pico PV/Kit (e.g. Home 60)	± 2 - 12 months	3% (166k)
5	> 70,000 (USD 22)	19,291	22,916 (USD 7.01)	General Lighting, mobile charging, TV or fan	Tier 1/2 (100,000 – 300,000)	Pico PV/Kit/SHS (e.g. Home 60, SHS)	± 4 - 12 months	3% (166k)

**Based on affordability (income/energy expenditures) and willingness to pay.*

Figure 13: market per product type



The estimated number of households that currently own a solar system (tiers 0-3) is about 830,000[20]. Based on data from currently active solar PV suppliers in Madagascar[21] -who focus on the rural "BoP" customer- their total sales and/or outreach include about 230,000 systems over the last 3-4 years. This includes both high quality units approved by Lighting Global, and lower quality products sold by retailers based in Antananarivo. Market penetration of these solar PV systems is more advanced in the urban areas (e.g. Antananarivo, Diana, Boeny) or the more easily reachable peri-urban and rural areas (e.g. Antsirabee, Antsiranana). The table and graphs below illustrate sales estimates as well as the potential market share by product type.

Table 10: Estimate of sales and/or customers reached quality suppliers, cumulative[22]

Supplier	Sales Type	Region	Tier	Sales / clients served
Majinco	Cash	Tana	0-1	6,000
HERi	Rental	Center and South East	0-1	33,000
Baobab+	PAYG & Cash	Analamanga, Alotra Mangoro, Atsimo-Atsinanana, Bongolava, Itasy, Boeny, Vatovavy-Fitovinany, Atsinanana	1	19,000
Jiro-Ve	Rental	Tana & AntSirabe	0-1	7,000
Nanoë	Fee-for-Service	Diana	2	350

[20] Rough estimate based on comparison of numerous data points, including from Instat (2012), Finscope (2016), Enclude/Viamo survey (2017), and solar supplier data (2017).
[21] The 10 suppliers we interviewed for this report.
[22] Most of these suppliers have not been actively selling longer than 5 years, so most sales occurred over the last 3-5 years

Sqvision	Cash	Diana, Atsinanana	1 & 2	6,000
		Total		**71,350**

The total sales by low quality suppliers shown in Table 11 might actually be understated, considering the large difference between the above mentioned 830,000 households owning a solar system, and the total estimated sales by both the quality as well as low quality suppliers of 230,000. According to IFC/GOGLA[23], "non-affiliates" (suppliers not selling Lighting Global accredited products, who are more competitive on price) account for an estimated 71% of pico sales globally today. If this ratio holds true for Madagascar as well, the actual sales of low quality equipment would then total about 580,000, getting closer to the estimated 830,000 solar home systems currently in use.

The higher number of solar owners of 830,000 is furthermore likely to include systems purchased longer than 3 years ago, even though most - pico-solar needs to be replaced after 3-5 years. If we assume that 830,000 households own a solar system, some of these systems will need replacement soon, adding to the potential market.

Table 11: Estimate of (lower-quality) equipment sales by retailer, cumulative[24]

Tier	Sales per week	Yearly sales per retailer	3 years' sales assuming 20 retailers
1	50	2,600	156,000
2	6	312	18,720
3	2	104	6,240
		Total	**180,960**

Although, the potential market size of segments 2 and 3 is large enough, the reality is less encouraging. In actuality, availability of the smaller products is limited and a lack of favourable repayment options compounds the problem. The supply-side section (Chapter 5) reveals that most suppliers are active in the same urban and some peri-urban areas, while there is limited activity in the more rural areas. This means that current offerings will not be able to reach the poorest in segments 1 and 2.

3.6. SMEs: Energy for Productive Use

The data presented in this chapter is mainly based on interviews conducted with 17 SMEs active in the fields of agricultural processing, repair shops, carpentry, fishing, restaurants and silk making. Data in this section is supplemented by secondary sources such as reports, internet research and interviews with energy sector experts.

3.6.1. Context: Madagascar's SMEs

Entrepreneurial activity in Madagascar is lower and more informal compared with other Sub-Saharan countries. For example, only 630 new businesses are registered each year, compared to almost 18,000 in Kenya[25]. Most micro and small firms are not registered with statistical and tax authorities or with the social security agency, mainly because the registration process involves multiple steps with various institutions.

The SME sector in Madagascar is dominated by the timber, agricultural processing, construction, tourism and agriculture subsectors. The majority of businesses are in agriculture, which accounts for 30% of GDP and employs about 75% of the work force. Most agricultural in Madagascar is small-scale subsistence farming. The following production records are provided by the Food and Agricultural Organization (FAO).

Table 12: Production of agricultural produce, animal husbandry and fisheries in Madagascar (in tons)

Main agricultural products	Year	Production in Tonnes
Rice	2015	3,722,304
Cassava	2015	2,676,951
Sweet potatoes	2015	1,140,758
Maize	2015	329,366

[23] *Dalberg and Lighting Global. Off-Grid Solar Market Trends Report 2018*
[24] *We interviewed 5 of these retailers, and assumed at least 20 are steadily active in Antananarivo.*
[25] *Impact Amplifier, Madagascar Entrepreneurial Ecosystem (2015)*

Main agricultural products	Year	Production in Tonnes
Cattles	2015	10,280
Pig	2015	1,625
Chicken	2015	37,123
Goats	2015	1,556
Fisheries Captures	2016	113,494

The country's non-agricultural private sector is dominated by self-employment and family businesses; about 42% of the employed work in their own business while 18% help in their family's businesses. The artisanal mining sector is the third largest non-agricultural employer in the informal sector, after commerce and manufacturing. While almost entirely informal, artisanal mining is far from being marginal in the economy. The country is well-known worldwide for its precious and semiprecious stones such as sapphire, ruby, aquamarine, tourmaline, topaz, amethyst and emerald. Their exploitation provides full-time or seasonal livelihood for to up to 500,000 artisanal miners country-wide[26].

Artisanal fisheries are an important source of income for the poor, and are in urgent need of reorientation towards a sustainable path. The artisanal branch represents the vast majority of the fisheries sector, with an estimated 102,000 fishermen catching 135,000 tons on average annually, and relying heavily on marine resources for subsistence and income. The catch is sold almost exclusively to local markets as products have difficulty getting certified for export[27].

3.6.2. Lack of Safe Access to Electricity as the Main Barrier for SME Development

Reliable and affordable access to electricity is crucial for unlocking the potential of the SME sector. The World Bank's 2013 Madagascar Enterprises Survey report points out that electricity is perceived as the second most important barrier to doing business after political instability, especially for small and medium sized firms. The lack of reliable electricity supply is perceived as one of the most important factors affecting competitiveness. Most SMEs we interviewed expressed their willingness to pay more for electricity if the reliability and quality of service were improved. SMEs experience 6.7 power outages per month with an average duration of 1.5 hours (about 2.5 hours per week). The impact on business profitability is significant: the average firm loses the equivalent of 7 percent of its sales because of power outages[28].

Furthermore, the report[29] mentions that high connection fees make grid electricity unobtainable for many small businesses in Madagascar, and assumed that "w*hile JIRAMA offers highly-subsidized lifeline tariffs for monthly consumption up to 25 kWh, upfront connection fees (USD 165 in average) remain a major barrier to grid access for most households and small businesses"*. SMEs that can afford grid electricity have to wait up to 18 months to get connected - a situation that is unfavourable for the development of productive uses.

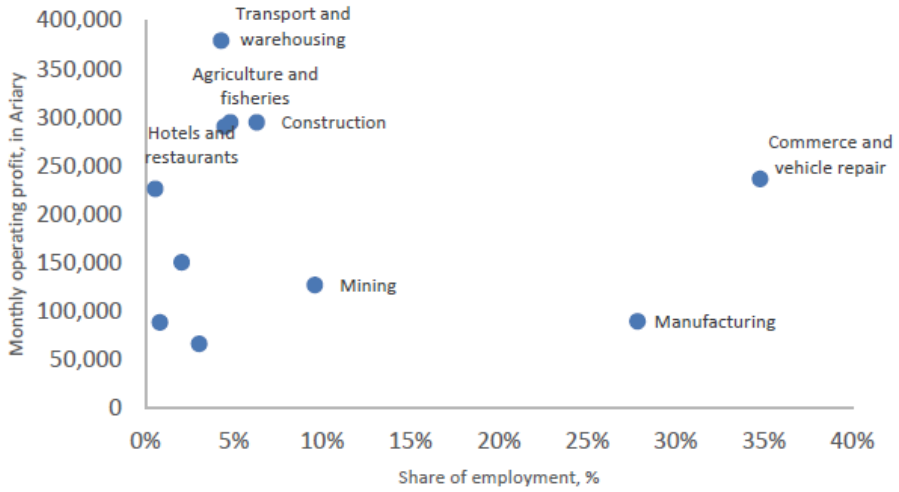
These challenges are validated by the interviews conducted for this assessment with 17 companies in different sectors in and around Antananarivo and Mahajanga. All companies in the sample mentioned the lack of reliable electricity has such a detrimental effect on their business that they would be prepared to pay a 20% increase in the kWh price for a more reliable supply. Ten of the companies used a generator to power their specific business activities, while very few have grid-power (2 businesses) or solar products (3 businesses). The average consumption of electricity is about 1000 Kwh per month, with rice mills, carpenters and car repair garages requiring the most energy. A more reliable source of energy would help enterprises improve product quality, reduce losses and diversify (e.g. into refrigerated products).

3.6.3. Income and Expenditures

Sectors with a high share of employment in general have low levels of operating profits, but there are niche businesses with higher levels of operating profit (see figure below). For instance, the average net monthly operating profit of informal enterprises in the manufacturing sector is about 100,000 MGA. Certain niche informal activities, such as transport and warehousing, construction, hotels and restaurants have average operating profits above 300,000 MGA per month

[26] *Madagascar: Systemic Country Diagnostic, World Bank 2015*
[27] *ibid*
[28] *World Bank Enterprise survey (2013).*
[29] *Project Information Document/ Integrated Safeguards Data Sheet (PID/ISDS), 2017*

Figure 14: Average Profit by Share of Employment (Informal Sector)



The interviews with the SMEs revealed that energy costs can reach up to 70% of total operating costs (including connection fees and maintenance). In particular, businesses using generators (and thus petrol/diesel) have the highest energy costs, with over 80% of their total operating costs going to energy. Actual operating costs range between 90,000 MGA per month (28 USD) for a small shop or garage, and about 2 million MGA per month (602 USD) for a rice mill or carpenter.

3.6.4. Willingness to Pay

The interviewed enterprises all expressed strong interest in investing in alternative energy sources: the average investment priority score given to energy was 8.3 (10 being highest). The SMEs interviewed are willing to invest on average 10 million MGA (3,000 USD), with some SMEs stating as much as 30 million MGA (9,000 USD) if the option of paying for the solution in instalments is offered. The majority (9 businesses) are open to taking a loan in order to finance the investments, while 7 of these 9 businesses have never actually dealt with a financial institution before. Some enterprises explicitly do not want a loan because they do not trust financial institutions, mainly due to bad experiences in the past.

3.6.5. Potential for Productive Uses of Power

Based on this research, off-grid solar appears to have a key role to play in the provision of electricity for productive uses amongst Malagasy SMEs, by providing affordable and reliable electricity. Based on the survey of SMEs and interviews with other stakeholders, the need for off-grid solar for productive use encompasses mainly the following economic activities:

- Refrigeration and cold storage (fishing, meat, fruits and vegetables, and ice);
- Water pumping and irrigation;
- Small-scale food processing: drying, oil press, juice making, etc.;
- Small-scale sawmills and carpentry;
- Metal workshops, wielders, repair shops, etc.;
- Milling, husking, and pulping of rice, grain and other agricultural produce;
- Commercial services such as print shops, internet cafés, hair dressing, cloth making, etc.

The market for off grid solar for productive use will be mainly determined by its affordability and accessibility for local entrepreneurs. The concept of solar powered **multifunctional platforms (MFP)** to provide sustainable energy for small business is widely spread across West Africa and could hold potential for Madagascar as well. The MFP is a simple, inexpensive energy source at the village level that is built around a diesel or solar-diesel-hybrid electrical generator and which has the capacity to power various tools, such as a cereal mill, husker, alternator, battery charger, pump, welding and carpentry equipment, etc. Several thousands of MFPs have gone into operation in West Africa in the last 20 years, creating local jobs and adding value to local production.

GRET, for instance, is implementing a project based on the construction of solar PV based multifunctional platforms to enable a range of productive uses: husking, drying, cold storage, print shops, small metal and wood work, and small shops in the region of Vakinankaratra, mainly in Antsirabe. This *"Café Lumière"* project

is based on the principle of co-financing. AFD provides seed capital in the form of a grant, a volunteer from Electriciens sans Frontières is in charge of the technical implementation, and GRET manages the project and develops the capacity of the local enterprises that manage the platforms. The project was initiated in 2015 and 6 sites have been studied to host the pilot phase. Each platform will have a capacity of 6 to 7 kWC, which can serve roughly 1,000 inhabitants. The cost of the platform is EUR 52,000 per unit. The local enterprise must invest in its own production equipment and machinery which will run off of the power source[30].

Weconnex is another organization that delivers energy for productive use, mostly for fishermen in the Southwest. Originally, Weconnex focused on drinking water, working together with World Wildlife Fund (WWF). This proved not to be a viable option, however, as insufficient numbers were willing to pay drinking water alone. Weconnex discovered more demand and greater willingness to pay for supply of productive energy through solar energy hubs, mostly for cold storage solutions for the fishing sector. Weconnex supports with operation and maintenance of these systems, and customers pay for services through a cooperative model.

A large part of the market for productive use solar is likely to be in systems purchased by medium and large commercial businesses to supply their own needs. This is visible in the numerous hotels and commercial-industrial operations that use solar systems[31]. This market is much more easily accessible than that of small-scale artisans and agro-processors. Furthermore, such businesses have their own funds which can be leveraged through **informational campaigns** and **targeted financial support**. Such financial support could encompass the facilitation/subsidy of commercial credit, technical training, and/or subsidised technical assistance for the sizing and costing of solar systems.

In addition, the recent experience with mini-grids in Madagascar could be built on to further support the productive use of solar electricity for SMEs in rural and peri urban areas. Since 2004, Madagascar has been granting mini-grid concessions to private operators to electrify rural villages. Tractebel[32] reports that 30 organizations now operate mini-grids providing electricity to around 200 villages, serving approximately 7,000 consumers in total. They generate power using diesel, biomass, or small hydro generators with capacities ranging from 40kW to slightly more than 200kW.

With the decreasing costs of solar PV hardware, battery storage and metering technology, there are opportunities to hybridize and densify existing systems and build new solar-powered mini-grids that could promote both rural economic development and electricity access. However, even with decreasing technology costs and upfront capital expenditures, the business case for mini-grids remains unstable in Madagascar. As illustrated in the demand chapter, the capacity to pay (specifically on the part of households) is limited, but both residential and business markets would need to contribute in order for the business model to be viable. Furthermore, operation & maintenance remains a key issue, especially considering rugged physical terrain in most rural areas of the country.

3.7. Power Needs of Public Institutions

The reliable delivery of power (and the services which depend on it) is a defining feature of a country's level of development and state capacity. We therefore analysed the need among public institutions for energy services in rural and peri urban areas of Madagascar, in order to improve the quality of services to local populations. The public services we considered included health centres, schools, administrative buildings, customs offices, police stations, army settlements and options for public street lighting. The quality of these services varies substantially between rural and urban areas in Madagascar, and their quality is strongly affected by the availability of power.

The grid electricity access rate is currently estimated at 15% [33] of the total population, or 55%[34] in urban and peri-urban areas and only 5% in rural areas. Therefore, the large majority of rural schools, health centres

[30] *Enclude is still verifying preliminary results of this pilot.*
[31] *GIZ 2016: "Madagascar: Opportunities for Solar Business Subsector Analysis."*
[32] *Tractebel (December 2017) Projet Pagose – élaboration d'une stratégie d'accès à l'électrification à Madagascar.*
[33] *Percentages based on a comparison of numerous data points, including https://www.africa-eu-renewables.org/market-information/madagascar/energy-sector/*
[34] *Population in 2017 estimated at 25mln with 4.5 persons per household*

and other public offices in Madagascar are not electrified, which severely impacts the delivery of education, healthcare and other government services to rural and peri-urban inhabitants.

Overall, there is good potential for delivering electricity to the public institutions we examined via stand-alone solar systems. Our findings on the current state of electrification and the potential investment costs of electrifying public institutions[35] are discussed below, together with a set of recommendations.

3.7.1. Administrative Buildings

Administrative buildings include offices and facilities with a wide variety of public functions, such as the office of the mayor, the local council, police stations, customs station, military bases. One might also consider public markets, and other social and religious centers as part of this landscape.

Number of Buildings and Current Electrification Rate

Madagascar is divided into 22 administrative regions and 111 districts. Each district is divided into communes and each commune into a number of *"fokontany"* [36] (an administrative term for small community). The *"décret"* 2015-59, 210 establishes the number of communes as 1693 units [37]. The number of fokontany is 17,544 according to the census of 2008[38]. More recent data about the number of the fokontany is not available, but it can be assumed that the figures have not much changed since 2008, as the likelihood of creating or withdrawing villages is low.

Table 13: Overview of Administrative Divisions in Madagascar

ENTITY	AMOUNT
Administrative regions	22
Districts	111
Communes	1,693
Fokontany	17,544

It is assumed that there will not be a customs, police or military presence in each fokontany. These facilities depend on the ministries related to national security and their numbers and size could not be retrieved for this study (unknown).

It is estimated that there should be about 17,544 public offices (one for each fokontany) hosting a local council or other government services for the surrounding population. Approximately, 95% of these administrative offices and buildings are not electrified, which would amount to 16,667 public offices.

Estimates of Basic Electricity Needs

One of the major challenges for developing a program to electrify remote administrative offices in Madagascar is the large diversity in terms of shape, design, dimensions and building material. While public schools and health centers are clearly identifiable with their relatively standard features, administrative buildings vary in their architectural design, size and building technology. Some administrative buildings can even be temporary structures made of non-durable materials (such as grass or palm leaves) and therefore, unfit for electrification. Each site may require a specific study.

Although it has not been possible to pinpoint the exact location and numbers of administrative buildings across the country within the scope of this study, we have assumed that government offices are typically configured as follows, on average:

(i) three rooms totalling 100m^2;
(ii) two rooms totalling 80 m^2; or
(iii) one single room of 25 m^2).

All three options are assumed to have basic lighting, one printer and one computer. The set up for each scenario is given in Table 14.

[35] *It is recommended that these estimates will be combined by WB with outcomes of the least-cost electrification study of KTH*
[36] *http://www.madacamp.com/Regions,_Districts_and_Communes_of_Madagascar*
[37] *www.mefb.gov.mg, Ministère des Finances et du Budget, 1er avril 2015.*
[38] *3e recensement général de la population et de l'habitation Madagascar fin octobre 2008)*

Table 14: Scenarios for Electrifying Public Offices

SCENARIO	NEEDS
1. Three rooms, 100m^2	• 5 lights of 15W • 1 printer • 1 computer
2. Two rooms, 50m^2	• 4 lights of 15W • 1 printer • 1 computer
3. One room, 25m^2	• 3 lights of 15W • 1 printer • 1 computer

If 95% of the 17,544 offices are not electrified, the estimated costs to electricity the remaining 16,667 units are estimated as follows, depending on size and design:

Table 15: Cost scenarios for electrifying public offices through stand-alone solar

	ENERGY WH	PV WP	COST MGA	COST USD	# SITES	TOTAL COST USD
Scenario 1	1,980	2,000	23,948,000	7,663	16,667	127,719,221
Scenario 2	1,755	1,800	21,913,000	7,012	16,667	116,869,004
Scenario 3	425	500	11,622,000	3,719	16,667	7,083,475

A combination of the 3 scenarios would seem more likely than any single configuration. The assumptions related to power estimates and related costs are provided in Annex 5.

Recommendations

Beyond the challenges related to the diverse design of public administrative buildings, it is worth noting that most local councils or fokontany are not expected to have sufficient resources to maintain and repair electrification systems. Any plan to electrify government offices will also need to provide for an operating and maintenance budget over the entire life cycle of the systems. It is therefore advisable to link the electrification of these offices within the ADER electrification scheme, which can provide for maintenance and repair needs.

3.7.2. Street Lighting

Current Electrification Rate

Street lighting is essential for raising standards of living in that it enables evening activities, improves security, and delivery of health and education services. Street lights are needed for security purposes on every street corner in the country, especially in rural areas of Madagascar where armed robberies and cattle theft are common. Moreover, street lighting is needed to extend the hours during which income generating activities are possible.

However, street lighting in Madagascar is rather occasional and available only in the few villages that are already electrified by ADER or JIRAMA (approximately 5%). The investment costs for supplying solar-powered street lights to currently underserved villages are estimated below (table 16). In these calculations it is assumed that approximately 10 units would be necessary for a fokontany.

Estimates of Basic Needs and Costs

Solar street lighting is technically easy to implement, but requires budget for regular maintenance, repair and replacement of parts, such as batteries and lamps. Local governments are theoretically responsible for such costs, but unfortunately face insufficient budgets. The small funds allocated by the central government are not adequate, and local councils aren't able to collect the needed revenues from taxes and levies because of the underdevelopment of the local economy. Moreover, the local councils face other, more urgent demands on their limited budgets.

The table below outlines the technical specifications that would meet the needs for solar street lighting in rural Madagascar, if LEAD were to support such a program. The equipment described in the table is currently available in the local market.

Table 16: Technical Specifications for Solar Street Lighting

DESIGNATION	QUANTITY	TECHNICAL SPECIFICATIONS
Solar panels (20 -25 yrs)	1	150Wp, 12V Monocrystalline, high efficiency Aluminium fence and glass protection
Batteries GEL (5 years)	1	150Ah/12V, Batteries GEL
Intelligent control system (8-10 years)	1	15A/12-24V, IP68. Automatic management of light and time Protection against overload / discharge Function dimming 0-100% Automatic start with light detection, extinguishes after 11 or 12 pm.
Lamps: LED high voltage (80,000 à 100,000Hrs)	1	40W LED White in colour, 6000lm, 28 Lux, IP66 High power, high luminosity, angle 120°
Lamps structure (> 20 years)	1	Aluminium, IP66 Glass, high density
Battery case	1	Metal, high security, anti-vandalism features
Pole (> 20 years)	1	Metal Q235, 7 m Resistant to wind up to 150Km/H
Cables	50m	Solar cable UV-proof 6mm²
Foundation	**1**	type "J" or "L"

Estimated Costs

The costs of providing street lights to the 16,667 fokontany that are not electrified is estimated between USD 373,340,800 and USD 1,866,704,000, depending on how many lights are placed in each area (see table below).

Table 17: Cost of Providing Street Lighting to 16,667 Fokontany

STREET LIGHTING	ITEMS	QTY	UP MGA	TOTAL MGA	USD PER SITE	FOKONTANY	TOTAL USD
Scenario 1	Solar street light 40W	10	7,000,000	70,000,000	22,400	16,667	373,340,800
Scenario 2	Solar street light 40W	15	7,000,000	105,000,000	33,600	16,667	560,011,200
Scenario 3	Solar street light 4W	50	7,000,000	350,000,000	112,000	16,667	1,866,704,000

Recommendations

In Madagascar, solar street lights in rural and small remote communities will be easier to install than to maintain over the longer term as municipalities and fokontany do not have the financial resources to pay for maintenance and repairs. The likelihood that installed systems will cease functioning only a few months or years after installation is high because of the lack of financial means. Therefore, the high investment costs, ranging between USD 22,400 and USD 112,000 per site, cannot be justified without ensuring that lighting will be maintained. Overall, providing street lighting to the 16,667 fokontany that are not electrified could cost up to USD 2 billion.

We recommend including street lighting within the ADER electrification scheme, which can help guarantee that the systems will be properly cared for and maintained. Therefore, LEAD funding for public street lights is not recommended.

3.7.3. Schools

Estimation of Numbers and Electrification Rate

The electrification of schools is crucial in terms of the many benefits it would provide to students. The uses of electric power in schools would include:

- Lighting (indoor, outdoor and emergency);
- Communications (radio, telephone, email, fax);
- Computers for instruction and administration;
- Audiovisual equipment (VCRs, televisions, radios, film and slide projectors);
- Water heating and pumping; and
- Refrigeration and power for food preparation in school cafeterias.

Madagascar has some experience with solar electrification of rural schools. UNESCO, with financial support from the OPEC Fund for International Development (OFID) and the Panasonic Company, has implemented a pilot program for solar electrification of rural schools[39]. The program needs to be scaled up to reach more schools, since according to the Ministry of Education, only 379 (1.6%) of the 23,090 primary schools and 212 (9.8%) of the 2,173 colleges nationwide were electrified in 2016, mainly in urban areas. This leaves more than **20,000** primary schools and roughly 2,000 colleges yet to be electrified. For a large proportion of these schools, a stand-alone system would be more economically viable than investment in grid extension.

In terms of policy, the Ministry of Education has set a school electrification target of 100% by 2025. As part of this, the government provided 700 solar systems to a select group of schools in 2016, and the Ministry of Education is currently seeking financing for this program.

Estimates of Basic Needs and Costs

Discussions with the Ministry of Education provided the following estimates of the basic needs of a standard 4-classroom rural school:

- Eight Lights
- One TV/laptop/battery charging station

The power consumption per day in such a school is therefore estimated at 810Wh or 0.81kWh, meaning a generation capacity of about 800Wp or 0.8kWp.

Table 18: Estimation of Daily Power Consumption per School

Designation	Equiv Unit Power W	Total Units	Total Power W	Equiv Use Hour H	Equiv Unit Cons° Wh	Total Cons° WH	Equiv Ks Simultaneity Coeff	Real Cons° Wh	kWH	Rate
Light	15	8	120	3.00	45	360	1.00	360	0.4	44%
Electronic Appliance	75	2	150	3.00	225	450	1.00	450	0.5	56%
Household Appliance										
Total	**27**	**10**	**270**	**3**	**81**	**810**	**1.00**	**810**	**0.8**	**100%**

Appliance	Unit	Unit Power W	Total Unit	Total Power W	Use Hour H	Unit Cons° WH	Total Cons° WH	Ks Simultaneity Coeff	Real Cons° WH	kWH
Lighting	4	15	8	120	3	45	360	1.00	360	0.4
TV/Laptop/Tel charger	1	75	2	150	3	225	450	1.00	450	0.5

The estimated cost of the equipment needed for a typical school, expressed in local market prices as of February 2018, is illustrated in the table below, which shows the cost per school as well as the total amount for electrifying 20,000 schools, assuming a standard capacity of 800Wp. The total cost to electrify **20,000** schools is estimated at USD 71,635,200

[39] *http://www.unesco.org/new/en/media-services/single-view/news/solar_electrification_program_of_rural_schools_in_madagascar/*

Table 19: Specifications for School Equipment

DESIGNATION	U	Qty	PU MGA	TOTAL TTC MGA	TOTAL TTC USD per school	Number of schools	Total USD
SOLAR EQUIPMENT							
Solar panels Monocrystalline 24V 80Wp	U	10	216,000	2,160,000	691.2	20,000	13,824,000
Régulateur Steca 45A	U	1	1,353,000	1,353,000	432.96	20,000	8,659,200
Batteries 12V 102AH	U	8	408,000	3,264,000	1,044.48	20,000	20,889,600
Convertisseur 1000W	U	1	1,016,000	1,016,000	325.12	20,000	6,502,400
ACCESSOIRIES & PROTECTION						20,000	-
Solar cable UV-proof 6mm²	M	50	12,000	600,000	192	20,000	3,840,000
DC Box	U	1	800,000	800,000	256	20,000	5,120,000
Support, fixtures, connectors, cables, batteries, Batt Fuse, other	Fft	1	2,000,000	2,000,000	640	20,000	12,800,000
TOTAL				**11,193,000**	3,581.76	20,000	71,635,200

Recommendations

Rural and peri-urban schools operate normally without electricity in Madagascar, as the services are delivered only during the day, when no lighting is required. Using computers and providing internet (both require electricity) for educational purposes would however be an advantage. The challenge with electrifying schools in Madagascar (similar to government offices as well as public lighting) is to ensure that the costs for maintenance, repair and replacement parts are sufficiently budgeted and funded. When it comes to schools, expert experience throughout Africa shows that financing maintenance with voluntary contributions from parents does not always work. Therefore, it is recommended that LEAD will not (in the initial stages) fund the electrification of schools unless (or before) reliable sources of maintenance budgets are identified.

3.7.4. Health Centres

Numbers and Current Electrification Rates

Almost 30 percent of all deaths in Madagascar are attributable to preventable infectious and parasitic diseases, with the burden of disease falling disproportionately on the poor[40]. The World Bank reports that the national infant mortality rate has remained relatively steady since 2008 (from 48 per 1,000 live births in 2008 to 42 per 1,000 live births in 2012). At the same time, maternal mortality rates have increased from 469 per 100,000 live births in 2004 (DHS), to 478 per 100,000 live births in 2012 (MDG Survey, 2012-2013). In addition, the poorest regions have the highest rates of neglected tropical diseases in the country.

In Madagascar, rural and peri-urban areas are served by the Centres de Santé de Base (CSB), which provide basic health services to the surrounding population. CSBs are headed by a medical doctor and categorized into two classes. A CSB has about seven to nine rooms, while the average number of rooms for a CSB II is three to five, depending on the size of the village. In addition, each CSB generally has a government-owned pharmacy.

A study by the French Development Agency[41] mentions about 3,240 rural health clinics (CSB[42] I and II) throughout the country, of which 2,506 are public. In line with the rural electrification rate, less than 5% of all clinics are electrified, making services such as child delivery quite risky in the evening. This means that Madagascar has **2,380 CSB that are not electrified.**

[40] *http://documents.worldbank.org/curated/en/779411487574935022/pdf/ITM00184-P160848-02-20-2017-1487574932600.pdf*
[41] *AFD study 2012 (http://www.matin.mg/?p=574)*
[42] *Centre de Sante de Base; type I and II*

Table 20: Breakdown of Inhabitants per CSB by Region (2009)

Region	<1 CSB for 5,000	1 CSB for 5,000 to 7,000	>1 up to 7,000
Androy	*		
Anosy	*		
Boeny			
Alaotra Mangoro		*	
Menabe		*	
Amoron'i Mania		*	
Vatovavy Fitovinany		*	
Ihorombe		*	
Atsimo Atsinanana		*	
Atsimo Andrefana		*	
Diana		*	
Sofia		*	
Sava			*
Analanjirofo			*
Atsinanana			*
Melaky			*
Betsiboka			*
Bongolava			*
Analamanga			*
Itasy			*
Vakinankaratra			*
Haute Matsiatra			*

Source: http://www.matin.mg/?p=574

Estimates of basic needs and costs

The size and equipment of in each CSB is standardized: a type I CSB has dimensions of 100m^2 while a type II has 60m^2. The electricity supply must cover the needs for basic lighting, key medical appliances and some office equipment. The estimated equipment requirements to meet the needs of the CSB II with seven rooms are as follows[43]:

- Lights (seven inside + one outside + three lamps for the office of the head doctor)
- four fans
- one desktop computer
- one printer
- one delivery lamp
- two freezers
- one sterilization autoclave oven
- one 100L solar water heater
- one laptop computer
- one TV

Based on the list of equipment and appliances provided by the Ministry of Health and their estimated power needs, the total energy demanded per day at a CSB II is about 7-9kWh, requiring an installed capacity between 2 and 4 kWp.

[43] *The list of equipment requiring power is provided by the Ministry of Health and was assessed by the team during the in-country visit; detailed calculations appear in Annex 5.*

Table 21: Cost estimates per CSB and for all 2,380 not electrified clinics

DESIGNATION	U	QTY	PU MGA	TOTAL in MGA	TOTAL USD	NUMBER OF CSB	TOTAL USD
SOLAR EQUIPMENT							
Solar panel Monocrystalline 36V 300Wp	U	12	810,000	9,720,000	3,110	2,380	7,402,752
Charge controller 70-90A	U	1	2,500,000	2,500,000	800	2,380	1,904,000
Batteries 12V 200AH	U	16	800,000	12,800,000	4,096	2,380	9,748,480
Inverter 4,000W	U	1	3,048,000	3,048,000	975	2,380	2,321,357
ACCESSORIES & PROTECTION							
Solar cables s UV-proof 6mm²	m	50	12,000	600,000	192	2,380	456,960
DC Box	U	1	800,000	800,000	256	2,380	609,280
Support, fixation, connectors, cable batteries, batt. fuse,	fft	1	2,000,000	2,000,000	640	2,380	1,523,200
Solar water heater 100L	U	1	2,000,000	2,000,000	640	2,380	1,523,200
TOTAL				33,468,000	10,710		25,489,229

In Tables 22 and 23 below, the cost of electrifying **500 and 1,000 health institutions** are estimated**.** We believe a demonstration base of 500 to 1,000 health clinics will provide impetus or incentives for the full-scale electrification of all health systems in Madagascar, as unserved populations will likely demand the same quality of health services nationwide.

The costs of an intervention to electrify 500 CSB II would then be approximately USD 7,400,000, and that of 1,000 clinics will be roughly USD 12,700,000.

Table 22: Estimated budget for 500 health services

PROJECT PHASE	COST PER CSB (USD)	TOTAL PROJECT COSTS (USD)
Development phase – Feasibility study – cost of tendering		550,000
Implementation phase	10,700	5,350,000
Operation and Maintenance phase over 15 years		1,500,000
Total:		7,400,000

Table 23: Estimated budget for 1,000 health services

PROJECT PHASE	COST PER CSB (USD)	TOTAL PROJECT COSTS (USD)
Development phase – Feasibility study – cost of tendering		700,000
Implementation phase	9,000	9,000,000
Operation and Maintenance phase over 15 years		3,000,000
Total:		12,700,000

Economies of scale will reduce the cost per unit at 1,000 CSBs, but with a slight increase in the cost related to the development phase (feasibility study and management costs). The operation and maintenance cost per unit is assumed to be the same for both scenarios.

3.7.5. Summary of Recommendations

Challenges for Electrification of Institutional Infrastructure

A number of challenges for electrifying public services and buildings must be addressed:

- Appropriate and substantial capacity building is needed where local personnel are to take ownership and responsibility for the maintenance of the electricity system over the long term.

- Attracting private sector investment can prove to be problematic; one solution is to take a more collaborative approach to financing with multiple investors through Public Private Partnerships.
- Financing plans need to account for system sustainability and maintenance. One way of funding maintenance is to sell the extra power generated to other users, such as local small businesses. Reliability of devices and technical issues can also present a challenge. Regulatory frameworks and quality standards at a national level can help guard against this.
- Theft is an ever-present risk for institutional electrification projects. Addressing the power needs of the surrounding community and perhaps neighbouring villages may reduce the tendency for theft.
- To maximize the benefits of electrification for health clinics or education infrastructure, household access to energy should also be enabled. This can raise awareness among parents about the value of education, reduce household costs, free up money for educational purposes, enable girls to have more time for study and school, and reduce absenteeism.
- Care needs to be taken that personnel of the health clinics or the school teachers are not overburdened with responsibilities for energy system maintenance.

A summary is provided below of the total investment costs for stand-alone solar systems for each category of public services we've discussed.

Table 24: Overview total costs all institution segments

Segment	Assumptions and quantity to be electrified	Investment costs (USD)
Public Offices	- 16,667 sites - Scenario 2 system of 7,012 USD each	116,869,004
Street lights	- 16,667 sites - Scenario 2: 15 Streetlights per site - USD2,240 each	560,011,200
Schools	- 20,000 primary schools - USD3,581 per system	71,635,200
Health institutions	- 2,380 clinics - USD10,710 per system - (Recommendation: 500-1000)	25,489,229 (Recommendation intervention of 500 - 1000, total costs: 7,400,000 – 12,7400,000)

Recommended intervention: focus on the health sector

- Although facilities such as military bases, police stations and customs offices need to be electrified, direct budget support to the Government may be a more appropriate instrument to address these needs. Military and police institutions will likely not be able to meet the requirements of the LEAD program in terms of reporting and accountability. By nature, police and armed forces can be difficult to deal with in terms of openness, transparency, accountability and reporting related to the use of international development funds.
- Administrative buildings hosting basic services such as birth registration, tax collections, and local government play a crucial role for local populations. However, those buildings are not standard in terms of shape and size, and will require an individual approach in each fokontany, which will be costly. In addition, it will be challenging for the local council to procure the required funds for operation and maintenance of the systems. These electrification needs might be better covered within the ADER electrification scheme, which provides resources for maintenance and repair. Therefore, the study does not recommend including the administrative buildings in the LEAD funding scheme because of the difficulties related to maintenance, repair and replacement.

Providing electricity to health clinics can be perceived as more urgent than electrifying rural schools. While very few rural schools in Madagascar are currently equipped with appliances requiring power, such as computers and TVs, clinics have an urgent need for refrigeration, sterilisation, warm water and lighting.

The additional reasons for prioritising health clinics over rural schools relate to financial feasibility and magnitude of impact on the local population

- Powering rural clinics is more beneficial in the short term as it immediately improves the level of care available and has the potential to save many lives by enabling the storage of medicines, evening procedures, etc. On the other hand, rural schools operate only during the day and have less need for lighting.

- The Centres de Santé de Base (I and II) have clearly allocated budgets and revenue streams that can be used for the maintenance and amortization of standalone energy systems. Other public facilities such as government offices, schools, and similar institutions rely on less reliable government funding for O&M, and will be especially challenged when it comes to replacement of power infrastructure. Given the assumption that there will no additional budget for O&M made available by the government, experience teaches that parents cannot be expected or obliged to participate in the cost of maintaining school equipment. On the other hand, health clinics sell medicines, and can collect a small fee for each consultation to minimize dependency on government budgets.
- Rural clinics (CSB I or II) are not only standardized in terms of size and design, but also in terms of a standard set of equipment requiring power. The needs of schools, on the other hand, can vary significantly according to the number of students they serve.
- The Ministry of Health seems better positioned to enforce a systematic collection of fees on the sale of medicines or services. Such fees can be used for the O&M of the solar installation and for replacement of the equipment as needed. The Ministry of Education does not have such fee collection mechanisms in place and can only ask for voluntary contributions from parents.

4 Financial Landscape

4.1 Financial Sector and Key Players

The formal financial sector consists of commercial banks and the microfinance institutions,[44] although there is some overlap in target markets and services offered by each type of institution. Some of the banks actually offer microfinance services (for instance, Access Bank). An overview of the key actors in the financial sector is illustrated in the table below.

Table 25: Financial Sector Overview

Key Players	Number
Commercial banks	11
Microfinance institutions	24
Institutional investors	10

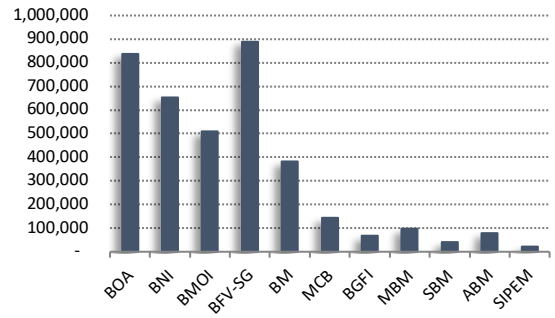
Banks

Of the 11 commercial banks in Madagascar, most are subsidiaries of foreign banks, mainly based in Mauritius, France and the African continent. In December 2014, the total consolidated bank balance was **USD 2.4 billion**, with total deposits of USD 1.9 billion and USD 1.2 billion loans.

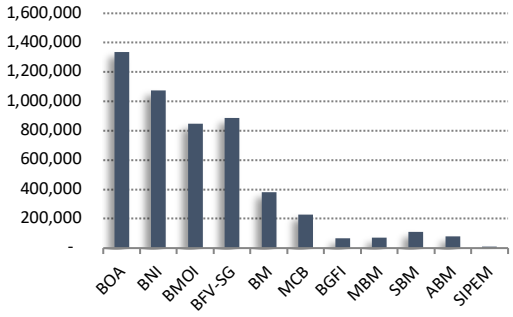
The four banks with the largest market share, both in terms of outstanding credit and deposits, are the Bank of Africa (BOA), the Indian Ocean Malgache Bank (BMOI), the NB Madagascar and the BFV-SG (BFV-Société Générale).

Figure 15: Market share by bank

Outstanding credit (in millions of MGA)



Deposits (in millions of MGA)



The banking sector is structurally liquid; liquid assets represent 41.2% of the total consolidated balance sheet of the sector. Significantly, though, the average rate of non-performing loans or portfolio at risk (PAR) is 13.1%, which is well above the average in the region. By comparison, the average PAR in Zambia is 6.9%, while in Kenya it is 5.9%, in Mozambique it is 4.3%, in Tanzania it is 6.2%, and in Botswana average PAR is 4.1%.[45]

Non-Bank Financial Institutions

Madagascar's microfinance sector was established in 1990 and while microfinance activities are mainly executed by MFIs, some banks also participate in this market, such as Access Bank, as well as some mobile money providers. According to the IMF, the MFI sector in Madagascar is "liquid, adequately capitalized and provisioned", although there are some poorer performing institutions. The figure below illustrates the soundness indicators of the MFI sector in Madagascar[46]:

[44] *Institutions such as pension and insurance funds not included in this study*

[45] *Figures derived from Enclude's Study on the Financial Market in Madagascar for AFD (not yet published).*

[46] *IMF (2016) Financial Systems Stability Assessment Madagascar (numbers shown are for 2015).*

Figure 16: Madagascar: MFI Financial Soundness Indicators[47]

	2010	2011	2012	2013	2014	2015
Asset Quality						
NPLs/total loans	7.7	3.8	3.9	4.4	5.9	7.1
Loan loss reserve/NPLs	81.6	74.5	78.5	74.6	80.7	85.3
Annualized loan growth	10.0	45.1	29.2	20.8	8.6	-6.3
Profitability						
Net interest margin	17.3	15.9	17.5	18.4	17.3	17.1
Efficiency (cost/income)	83.7	83.8	88.1	88.4	86.6	82.5
Return on assets	2.8	1.8	2.0	2.0	1.8	1.7
Return on capital	11.6	7.8	8.6	9.0	8.4	8.4
Liquidity and Funding						
Loan to deposit ratio	128.3	131.4	133.7	125.6	115.0	92.5
Liquid assets/total assets	26.1	21.5	20.8	19.7	23.1	27.3
Liquid assets/short term liabilities	77.8	64.0	65.3	56.3	67.4	63.0
Capital Adequacy						
Capital to risk-weighted assets	15.5	14.6	39.5	36.3	34.2	31.6
Memoranum items:						
Number of MFIs	26	28	31	31	29	25
Total assets (MGA billions)	184	252	315	363	417	401

Sources: Malagasy authorities and Fund staff estimates.

Madagascar's microfinance sector has been steadily growing for the last ten years. In December 2014, the total (consolidated) balance sheet of the sector was USD163.3 million, with a deposit total of USD 85.1 million and USD 97.1 million in loans. In addition, according to Statistics of the National Treasury / National Coordination of Inclusive Finance (CNFI), the number of clients has surpassed 984,000 in 2012 to more than 1.3 million at the end of 2015, which is a 42% increase in three years[48]. The World Bank LEAD document[49] reports an overall steady growth of 11% of the total customer base of MFIs. In 2016, the total amount of customers was estimated at 1.5 million, with deposit levels of USD 150 million. Madagascar has **24 microfinance institutions** providing services within the regulatory[50] tiers shown in Table 8 below.

Table 26: Overview MFIs relevant per Energy Tier

Number of institutions	Tiers	Services
12	1	Mostly short-term loans
10	2	Short and medium-term loans, deposit-taking (only of their members)
2	3	Short-, medium- and long-term loans, deposit-taking (members + wider public)

Five institutions (OTIV Tana, CECAM, TIAVO, OTIV coastal areas, OTIV Alaotra) serve 3/4 of the total MFI client base. OTIV Tana, OTIV coastal areas zone, TIAVO[51], PAMF, and CECAM, on the other hand, have mobilized about 75% of all savings and manage 75 % of all outstanding credit.

Despite the strong growth of microfinance activities over the last years, two institutions have faced [52] serious difficulties and are under surveillance of the Banking and Financial Supervision Commission (CSBF). These two institutions are similar in structure and might have suffered from the most recent Malagasy crisis, but were certainly both related to mismanagement, fraud or a liquidity crisis.

[47] *IMF (2016) Financial Systems Stability Assessment Madagascar*
[48] *Banque Centrale de Madagascar. http://www.banque-centrale.mg/*
[49] *WB (2017) Project Concept Note Madagascar - Least-Cost Electricity Access Development Project - LEAD (P163870)*
[50] *MicroFinance Act (2005)*
[51] *Due to financial management issues, TIAVO was /is temporary under surveillance by the Banking and Financial Supervision Commission*
[52] Tiavo and Boeny (latter to be confirmed)

These struggling MFIs have had a negative impact on the sector as a whole, since other MFIs kept deposits at these institutions and the public image of MFIs has suffered in a context of formal financial inclusion rates that are already very low. According to the IMF[53], MFIs in Madagascar "are given too much leeway in classification and provisioning". The institute advocates for prescribing minimum liquidity levels, combined with higher capital requirements, especially for the larger institutions. Although larger MFIs (level 2 and 3) perform better, small-scale MFIs (mostly level 1) remain fragile, institutionally as well as financially.

A few other risks related to the banking and microfinance sectors identified by the IMF are:

- Supervision (by the Commission for the Supervision of Banks and Finance (CSBF) is overly focused on compliance, and **not able "to proactively detect and address emerging risks";**
- There is **no finalized regulatory framework for payments**, which can lead to risks in the near future. The good news, however, is that there is progress in facilitating payment infrastructure and credit reporting, and a law on electronic money is on its way[54]. A law adopted February 2nd, 2017 but not yet enforced widely seeks to regulate e-money and the activities of digital transactions companies. In addition, the Banking and Financial Supervision Commission (CSBF) has issued a policy related to Article 79 of the law, which defines guidelines and procedures on how e-money linked accounts must be opened, managed and closed with financial institutions.
- Regulation and enforcement of property rights is unclear, which can delay financial inclusion. Both bank-lending as well as leasing need proper regulations in respect to transfer of property rights and titles, which will especially be useful in facilitating the financing of SMEs and in designing **financial instruments for solar solutions for SMEs.**

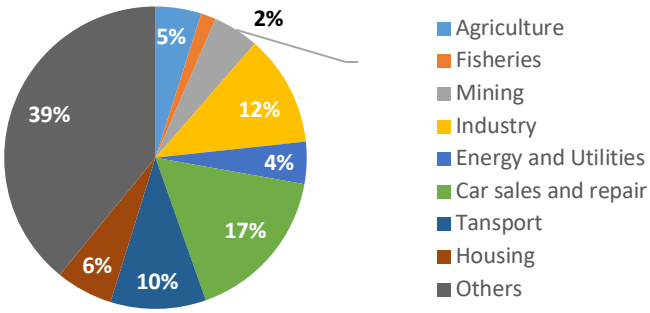
Because of the risks outlined above, our preliminary recommendation is for LEAD to **focus mostly on Tier 2 and 3 MFIs** as potential intermediaries, although it would not be appropriate to completely exclude a group of MFIs at this stage.

4.2 Financial Sector as a Channel for Accelerating Access to Energy

Two of the proposed financial instruments under the LEAD program to accelerate access to solar power and equipment are **credit lines** and/or **risk sharing mechanisms** for financial intermediaries. The financial institutions could use the World Bank funding to on-lend (potentially on preferential terms) to households and SMEs, as loans earmarked specifically for stand-alone solar systems.

Risk sharing facilities are supposed to stimulate financial activity in the off-grid energy market, to shift the currently low risk appetite of financial institutions for investing in the energy sector, which is partly a result of insufficient knowledge and understanding of this market. According to another financial sector analysis done by Enclude, lending activities by the banking sector are divided as illustrated in below figure, showing **little activity in the energy sector** so far. A caveat to this graph, however, is that most of the banks in Madagascar who are currently active in the energy sector **do not distinguish or earmark** these loans, making it difficult to quantify the exact size of the total energy loan portfolio, or to assess the performance of these loans.

Figure 17: Lending per sector in Madagascar[55]



[53] *IMF (2016) Financial Systems Stability Assessment Madagascar*
[54] *No new developments (April 2018)*
[55] Enclude report on agricultural finance for LAFco (2016)

4.2.1 Financial Sector Activity in Renewable Energy

The table below provides a summary of discussions with a group of microfinance institutions and banks in Madagascar. It illustrates the current role and activities that each financial intermediary plays in the off-grid energy market.

Table 27: Overview of Financial Institutions in Madagascar

Institution	Branch Network	Active borrowers (number)	Active in RE financing	Interest in RE financing	Agency Banking	Mobile Banking
Banks						
Access Bank (banking license, but offering MFI services)	26 Branches Peri-Urban and Rural	33.800	Yes, limited uptake	Yes	Yes, just started	Starting
MicroCred (banking license, but offering MFI services)	34 branches Urban/Peri-Urban. Rural through Baobab+	33.000	Yes, 200-300 / month	Yes, but only through Baobab+	Yes	Yes, starting in 2017. Standalone solution, not with an MNO
Bank of Africa	88 branches Rural / Urban / Peri Urban	600.000	No	Yes	Yes	Yes (Partnership with Airtel Money)
BFV-SG	Urban / Peri Urban 53 branches (18 in Tana)	180.000	No	Some	No, not yet	Yes (partnership with MVola)
MFIs						
CECAM Tier 3	Country wide urban, peri-urban, 80 %rural) 20 regions	77.000 (total members: 215.000)	Yes, >10,000	Yes	Yes, started with support of PAMIGA (NGO)	Piloting for both credit and payments, partnership with MVola
PAMF (Aga Khan) Tier 3	Mainly rural, 23 branches	15.000	No	- Yes, but gradually - Is currently assessing potential a partnership with Orange	Not yet	-In process of MIS transition, cannot undertake mobile banking until it is complete
OTIVTANA Tier 2	10 regions in Madagascar 120 distribution points (43 branches)	32.000	No	Yes, small solar kits for home lighting	Starting	No, not interested (fear it will uplift lending-rates)

Access Bank, Microcred and CECAM have established specialized renewable energy loan products, and all three of them also specifically focus on providing loans for solar home systems for the household level consumer. Most of these energy lending activities have enjoyed moderate uptake and have shown early signs of success.

Access Bank received EUR 8M of funding from KFW, which includes a credit line as well technical assistance to develop renewable energy loan products, establish partnerships with renewable energy suppliers, train staff, and support consumer education. Access Bank is the only player with a staff **person dedicated to the renewable energy segment**. This has proven to be a critical factor in successfully implementing renewable energy credit products, especially in terms of motivating staff to sell a relatively new and unfamiliar product,

and to work in an effective manner with the partner suppliers[56]. The current uptake of solar loans is slow, and one reason for this may be that that the pilot area chosen for the project may not be the most viable (though it is close to the head office).

Microcred uses their *"Baobab+"* channel that focuses on the rural customer segment to develop and implement solar energy loans. Interestingly, the Microcred head-office mentioned during interviews that the institution does not see renewable energy as a key priority, but rather as a *"nice to have"*, as it motivates the staff. The programme developed a top-up loan with a maximum value of 50% of the customer's original loan. In terms of outreach, the Baobab+ programme seems to have reached, together with CECAM, the highest numbers in terms of solar loan uptake. For Microcred, this amounts to the sale of approximately 200-300 RE / solar loans a month, which is comparable to the better performing MFIs that provide solar loans in the Sub-Saharan Africa region, such as FINCA in Uganda, WPS in Kenya, A3C in Cameroon, and Renaca in Benin. Each of the former reports a solar /RE loan uptake of a couple of hundred per month, mostly in the pico-solar segment.[57]

The Baobab+ programme led to the establishment of a new, separate distribution entity, operating as a private-sector supplier in the form of a social enterprise. These activities are therefore described under the supply section of this study.

CECAM has established a successful partnership with a local Malagasy supplier which started in 2012. The institution offers a separate RE/solar loan. The main solution financed through these loans is lanterns, with an average price of EUR 18 and uptake of 10,000 since the pilot phase. CECAM is in the process of expanding the range of products offered, and will soon introduce a pico-solar kit at a price of 30,000 AR which will provide features beyond lighting. Another indicator of CECAM's interest in the renewables sector is the fact that it is also associated with the HENRY FRAISE Group of companies. In this partnership, CECAM is in charge of providing electricity metering and the billing/collection services for a 100 kWc mini grid system that was recently installed in Madagascar. This project will be scaled throughout the country to 100 other locations to reach 27,600 households, or 150,000 customers.

OtivTana has had mixed experiences in the renewable energy sector:

- OtivTana provided an inventory loan to a local solar home system supplier, with the goal of expanding sales in the region of Marovoay. OtivTana was not especially satisfied with this partnership, as the supplier offered low-quality equipment and demand in this region was limited as well. End customers were disappointed, and OtivTana did not supply loans to suppliers after that.
- OtivTana granted a loan to an NGO that specializes in the production of solar cookers and improved cookstoves[58], which was a more successful relationship in terms of loan-repayment.

Although OtivTana has had mixed experiences in the renewables sector, it is interested in initiatives that would create demand for RE, including solar energy solutions for its customers, and would welcome some sort of guarantee to stimulate lending in the sector. Key points mentioned were the importance of vetting for quality, which was deemed "more important than price". This illustrates the MFI will probably be able to communicate the quality / price trade-off to its customers. One of the options OtivTana would prefer for its customer base is 'micro-leasing', or fee-for-services, to ensure follow up and maintenance happen when a system fails.

PAMF has no solid experience in RE financing. As the institution is currently upgrading its management information system, new product development is not a priority at the moment. That being said, PAMF does potentially envision demand for RE financing among their 100,000 customers who are mainly in rural areas. PAMF would be eager to assess integrations and business models whereby it could participate in delivery of PAYG solutions. The new MIS will be live in 2018, and it could be interesting to see whether there is an opportunity to integrate PAYG within this upgrade. In any case, PAMF will need assistance in developing financial products for solar home systems. PAMF furthermore illustrated interest in establishing a

[56] *Lessons learned from other Enclude projects such as the programme EIB/Pamiga : Access to RE through Microfinance, implemented by Enclude in 7 SSA countries (2015-2018)*
[57] *Experience from other Enclude projects, including EIB: access to RE through Microfinance (EIB/Pamiga)*
[58] Likely to be Adesolaire, as this is the only NGO our study came across active in ICS

partnership with Orange. In this model, PAMF would be the credit provider for loans for (a share of the) end-customers to access the equipment that Orange will distribute; thereby limiting credit risks for Orange. Such a relationship would be interesting for both partners, as PAMF would benefit from the outreach capacity Orange has, thereby expanding its client network.

Other financial institutions have shown interest in the energy sector, but do not have a specific, tailored renewable energy or solar loan. Examples of these institutions are BFV-SG, BNI, Bank of Africa and BMOI.

Some of these institutions have some experience with **renewable energy project finance**, but with mixed results. A positive example is MCB; the head office bank in Mauritius received funding through AFD's SUNREF program and used it to finance 2-3 renewable energy projects in the range of EUR 2-3M in Madagascar (neither were solar, however). Other banks that have experience with renewable energy project finance are the Bank of Africa (BOA) and BFV-SG. Both have financed hydropower projects but report difficulties with estimating project profitability even though they worked with mature, and well-established operators. This same challenge is often reported by banks attempting to finance mini-grids in country.

4.2.2 Risk Sharing Facilities and Credit Lines

Most of the financial institutions we interviewed seem to welcome risk sharing facilities, but are not uniform in their opinion with regards to establishing dedicated credit lines for renewable energy within the proposed World Bank fund. It would be useful, as a second round of assessment, to organize a workshop with a **group of pre-identified banks and MFIs to further discuss the preferred financial instruments**, as well as to detail out specific terms. It is advised to focus on the institutions described in the section above, which have already gained some experience in the sector, or are eager to enter the market.

More concrete examples that could be useful in structuring these instruments are provided in the final section. All the institutions mentioned their need for guidance and technical assistance in financial product development, sector-training of staff, and establishing partnerships with quality providers. Lessons learned from other guarantee funds are limited, since only Solidis has experience in the wider renewable energy sector, but no experience in the solar home systems market.

4.2.3 Channels for Outreach and Accelerating Access to Solar

Although both the MFI and the banking sectors are growing, there remain some fragile institutions--mostly tier 1 MFIs--that might not be the most suitable partners to work with under the LEAD programme.

The World Bank LEAD programme document recognizes the lack of knowledge of the energy sector as well as the risk adverse attitude of the financial sector towards investing in the energy space. These barriers are addressable by proper guidance and technical assistance. For example, GIZ regularly undertakes training workshops in renewable energy finance, and is actively linking energy suppliers with financial institutions, enabling them to establish partnerships and develop energy lending products. Another example is the above-mentioned EUR 8M KfW project with Access Bank.

Another perhaps larger question is **whether the formal financial sector is the most appropriate, or only, intermediary** that can accelerate access to energy in off-grid areas. This question is directly related to both the **low financial inclusion rate**, as well as the **limited current rural outreach** of the financial sector. As mentioned in the demand chapter, Madagascar is marked by a very low formal financial inclusion rate; most of the population does not have access to formal financial services, or is simply not used to making use of them. The majority of those that do have access to formal financial services are salaried employees, civil servants, or medium to large business owners who live in the urban or peri-urban areas, where most of the banks and MFIs are located. The majority of the population arranges its finances in an informal manner, such as by borrowing within the family.

Specifically in the rural areas, the outreach and density of branches and agents providing financial services is amongst the lowest in the region. According to the World Bank, Madagascar has 2.07 ATMs[59] for every

[59] *World Bank, Indicateurs du développement dans le monde, 2015*

100,000 adults, and 1.8 Point of Sale (POS) terminals. To compare, Tanzania, Zimbabwe and Mozambique have higher POS penetration rates, respectively 6, 5.8 and 7.8 per 100,000 adults.

Due to poor infrastructure, the cost of doing business in the rural areas, which includes access to electricity and transport, is simply too high for financial institutions, making it even more difficult to develop financial products that meet the needs of the rural population. Digital financial services as well as mobile channels, including agency banking could therefore be helpful to limit costs and facilitate access for the rural customer segment. Agency banking is in its infancy, and is currently offered by a only few banks such as Access Bank, and is under development by CECAM and Microcred

In establishing partnerships for LEAD, It may be best to **focus on those institutions that are considering or already implementing digital channels as well as agency banking.** These institutions show a more promising potential to reach the last mile.

4.2.4 Mobile Banking

Many Malagasy banks and MFIs are collaborating with MNOs as intermediaries in banking operations to reduce their transaction costs (see Figure 6 above). In most cases, this takes the form of a mobile wallet offering, whereby the customer makes a transfer of money from his electronic wallet to his account within the bank. Banks offer other payment via the mobile channel, including money transfers.

In addition to mobile money, technology is increasingly being used by banks as a service tool, for instance in the application of tablets, telephones or electronic payment terminals (EPTs) by staff within routine business processes. Decentralized service points (or agents) are being established to provide simple financial services outside their branches. The technology used is still subject to many challenges including weak communication infrastructure including absent or unreliable GSM signal or Internet service and poor understanding on the part of customer levels. However, mobile technology certainly does represent a promising development for the financial sector, in terms of its potential to reach new client segments and serve as a channel for driving solar uptake.

4.2.5 PAYG opportunities

As mentioned in the demand chapter, on average 30% of the population owns a mobile phone and about 75% of the population has access to a mobile phone (through sharing). Among SIM/mobile phone owners the majority is subscribed with Airtel, followed by Telma and Orange. Airtel also has the largest outreach into rural areas in Madagascar. Although phone access shows potential for information sharing/awareness raising activities, mobile phone ownership as well as mobile money usage indicates the real potential target group for PAYG solar and mobile banking.

Mobile money has been developing rapidly in Madagascar, with four providers currently active in this market: Orange, MVola (Telma), Airtel, and BIP (a newcomer). MVola has 50% of the mobile money market share. The remaining market is divided amongst Orange Money and Airtel Money. As compared to the East African region, the actual usage numbers remain low: only 25% of the workforce in Madagascar has access to mobile money transfer services[60], while almost half (44%) of unique subscribers (who are the mobile phone owners) has internet on their phones. At the beginning of 2018, MVola was the first telco provider to provide nano-credit, and reports a *"good uptake"* though they did not disclose the actual numbers.

Mobile Network Operators and PAYG

Mobile Money Operators have well established **last-mile agent networks**. Two Mobile Network Operators that are Mobile Money Operators (**Orange** and **Telma/MVola**) expressed interest in becoming a player in the solar market value chain. Both players have built up solid operations in country, and Orange specifically has international experience in the sector. Therefore, both could accelerate solar uptake in three ways:

1) As a payment facilitator for existing solar home systems suppliers;
2) As a distribution channel through established Mobile Money agents; or
3) Both of the above

[60] *CGAP/Microfinance gateway: https://www.microfinancegateway.org/fr/pays/madagascar*

Orange is preparing to take up the combined role as mentioned under point 3. Considering the intensity of their current market preparation activities, their outreach with approximately 4,000 agents, Orange can be considered as a serious candidate to roll out this business model in Madagascar.

MVola has expressed initial interest in entering the PAYG market and leveraging their network of 10,000 points of sale (agents) for distribution, but is keen to monitor the progress of their recently launched partnership with Baobab+ first, where MVola acts mostly as payment facilitator. [61]

The suggestion is to develop a more detailed analysis of mobile connectivity and mobile money data, including regional density of mobile money and telco agents as well as subscription and customer activity data[62]. This will point to the most appropriate ways of using these players as channels to improve solar market acceleration in country.

Solar suppliers and PAYG

A few initial partnerships have been established between mobile money operators and solar suppliers. One example is the recently signed agreement between **Baobab+ with MVola** and **Orange**. In these partnerships models, the Mobile Money Operator acts mostly as a payment facilitator and not necessarily as a distribution channel (i.e. by using Mobile money agents). In this case, the Mobile Money Operator helps the supplier integrate the technology within their business model. This means the supplier needs to take on an entirely new role.

LEAD could play a key role by offering easier access to local funding for companies that have already incorporated PAYG to scale up their PAYG business, or enterprises that are inclined to, to fund the costs of integration. The latter would however need technical assistance to support their transition from being a technology supplier to a PAYG provider. Lessons learned from East Africa, where the PAYG model is well established, illustrate that companies that did not start off as PAYG providers need to **grow in to their new role as credit-provider.** These companies must learn how to deliver and manage credit, and how to maintain a stable portfolio quality--all of which involve new and unfamiliar activities. An initial analysis of RE suppliers in Madagascar reveals variability in needs and appetite for financing through the potential fund, which is further described in the following chapter on the supply side of the market.

Another strategy would be to look into **international PAYG providers** that might be interested in entering the Malagasy market. Although the model has shown impressive outreach in East Africa, copying such a model in an entirely new setting might not immediately lead to success. Mobile Money awareness is still relatively low in Madagascar; most of the PAYG models (with the exception of the scratch card system) require mobile money access, and as mentioned in the demand chapter, awareness and understanding of this channel is still limited, though rising.

Improving Mobile Money awareness (and uptake) together with MNOs and PAYG providers, and developing commercial pressure to attract international companies to enter the Madagascar market could be activities to explore under LEAD. An intermediate / alternative solution is to work with PAYG models that do not need connectivity, such as the scratch-card model, whereby codes for unlocking the equipment are provided on a cash-sale basis in small retail shops. The downside of this model is that it is manual and cumbersome, and monitoring payments is much less efficient than working with digital channels.

[61] Airtel discussions to be completed by the World Bank

[62] Data did not come available, WB in the process of collecting this data with the MNOs

5 SUPPLY ASSESSMENT

5.1 Solar Suppliers

5.1.1 Key Suppliers and Models

Similar to the demand side of the market, the supply side of the market is **nascent** and under development; this is especially true of enterprises distributing high quality, **affordable, household level solutions**. The business models of SHS suppliers in Madagascar can categorized as follows:

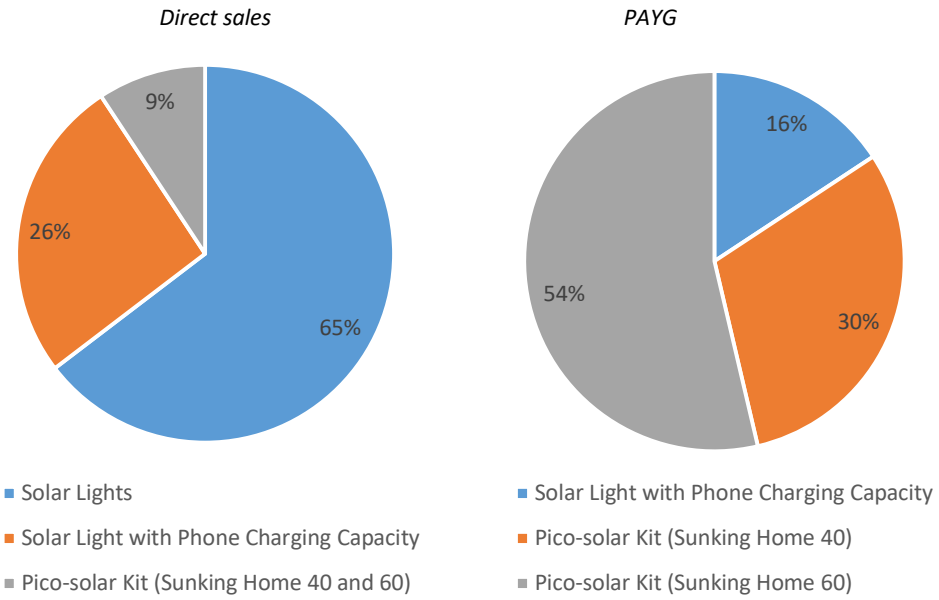
1. **Companies that design, install and maintain larger Solar PV installations**. These firms serve mostly institutional clients, high-income households or commercial clients (e.g. hotels, agricultural processors). These players also have the professional capacity to respond to calls for proposals to design, build and operate mini-grids for ADER or international organizations. Whilst some of these enterprises would like to target middle- or lower-income households at some point, current market conditions do not make this market attractive to them. The key barrier to is the low purchasing power of rural customers, as well as the costs of retail distribution. During interviews, these companies called for public support and donor interventions to open up the middle- and lower-income market segment.

2. **Social enterprises focusing on the Base of the Pyramid.** There are a limited number of social enterprises that distribute *Lighting Africa* accredited pico-solar products in rural areas, with some sort of consumer credit. These enterprises are managed by international staff and most of them initiated their businesses with external funding (mostly grants). None of these companies have reached the break-even point yet.

3. **Retailers selling low- to average-quality equipment**, **offering some warranty and consumer credit on a case-by-case basis**. The most favourable terms of sale are generally only available to friends and family of distributors. The number of these retailers is hard to estimate but is certainly high and overlapping significantly with electronics and appliances retailers. In Antananarivo, the team visited over 10 of these shops, including Madawatt, Sanifer, Confortech, Solair, and Baoialai. Most of these players are currently not providing quality equipment, and have created distrust among clients. Despite their limitations, these players could still serve as interesting partners for LEAD to expand sales of solar systems and lamp sale beyond the limited networks of known social enterprises. The power of these players lies in the fact that they are deeply embedded in the Malagasy business environment, with extensive networks of local suppliers, agents, technicians and installers. With some assistance, including introduction to higher quality Solar Home Systems as well as new business models integrating consumer credit, these enterprises could be the building blocks for a stronger local solar market driven by Malagasy players. Examples of enterprises that could fall under this category are Majinco and Metaplasco.

The companies providing pico-solar kits (such as the SunKing Home) to lower-income households currently distribute only 200-300 products per month, but aim to reach sales of 500-1,000 products per month in 2018. Almost half of these products are sold on credit through an MFI PAYG set-up or a rental model, and companies noted that existing sales numbers could not have been reached without offering some kind of consumer credit solution. Products sold on a cash basis, for instance by Baobab+, are mostly basic lanterns. As an illustration, the following 2017 sales were reported (anonymously) by one solar supplier in Madagascar (see Figure 17).

Figure 18: One Solar Supplier's Sales to Rural Households[63], 2017



Two businesses (Heri and Jiro-Ve) rent the smallest solar lanterns (such as SunKing Solo), for approximately 100–300 MGA per day (this is **not** a rent-to-own model). These two companies reach thousands of customers on a daily basis. Heri, the company that has set up 100 active kiosks where lamps are charged and rented out by local entrepreneurs, rents 33,414 lamps on a daily basis, or 330 per kiosk. Though not in production anymore, the lantern that used to have the highest uptake is the SunKing Solo, especially when it was offered for 4800 AR/month. After a price increase to 6000/month, customers switched to the SunKing Pico, a smaller and less bright product, which is rented out for 4000/month.

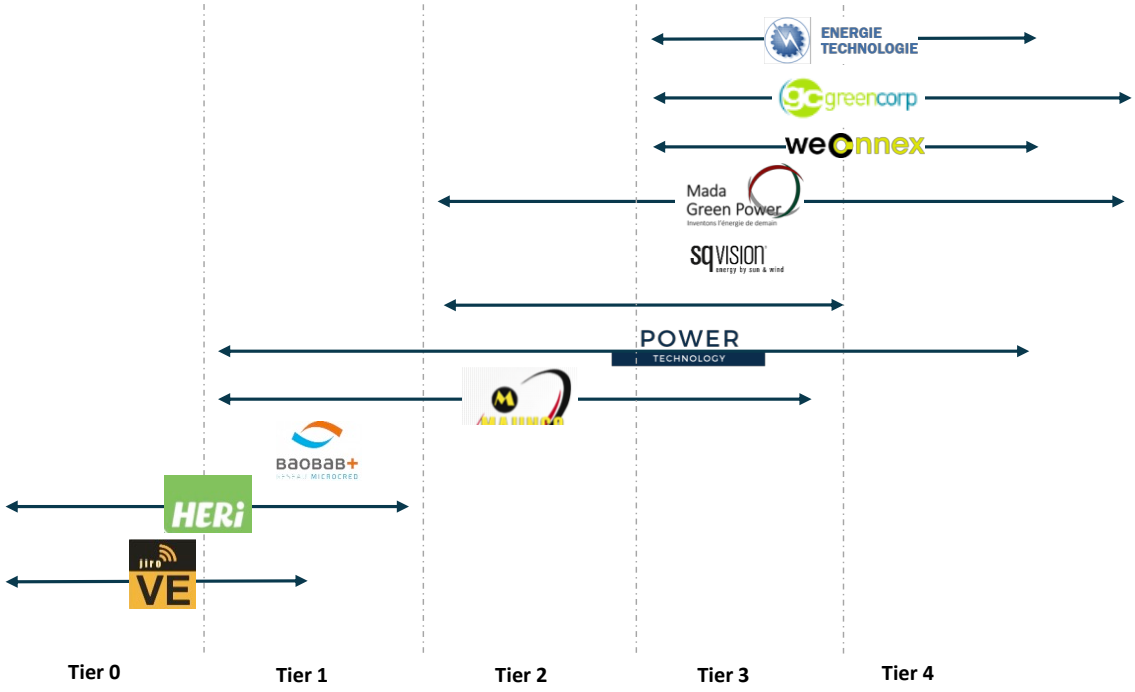
Regional differences in business models are striking, as illustrated by the differences in outreach and types of products provided by enterprises such as Heri and Nanoë. Both companies serve rural households: Nanoë is located in the richer North of the country, where households have benefited from higher vanilla prices, whereas Heri focuses on the centre and eastern portions of the country. Nanoë installs nano-grids of 100 up to 500Wp, providing energy services to approximately five households at the cost of 500– 2000 MGA per customer per day, depending on energy consumption. In contrast, Heri rents out 1-2Wp pico-solar lanterns, where customers pay 150–300 MGA on a daily basis. Hence, the maximum amount that the average Heri customer is willing to pay is equivalent to the starting amount of the Nanoë customer in the North.

Considering the results of the demand and supply assessments together, we can estimate that approximately 56% of Malagasy off-grid households would be willing and able to obtain a solar product, with the largest demand being for Tier 0-1.5 products. However, even for the smallest and most modestly priced products, a financing solution is needed given the target market's low capacity and willingness to pay. There is currently a very small number of suppliers with limited outreach and distribution capacity—to date only about 100,000 customers have been served – that can meet this specific demand and who supply the package of small product plus financing solution. **In short, the sales activity currently underway and the product plus financing packages currently available are not sufficient to reach the poorest.** Interventions upscaling of activities in poorer, more remote areas and targeting BoP customers are needed to build the market and attract new entrants.

Figure 18 and Table 28 provide a full overview of the companies that were interviewed for this study along with their key characteristics.

[63] Anonymous, collected by Enclude during this study

Figure 19: SHS Suppliers by Customer Segment



Tier	Product types	Serves
0.5- 1	Lanterns Pico Solar PV	Lighting Lighting & phone charging
1 – 1.5	Plug and Play (Solar Home Kits), including PAYG solar kits	Multiple light(s) + some energy efficient appliances (incl. phone charging, small radio)
>2	Component-based system (solar home System) incl. PAYG home systems	General lighting + multiple energy efficient appliances (incl. phone charging, small radio, TV)
3	Large Solar Home Systems, nano- and pico-grids	All the above + multiple appliances Small productive usage

Table 28: Distributors Interviewed in the Supply Assessment

Company	BoP focus?	Revenue or growth status	Sales/Outreach	Product category (ESMAP)	Providing credit/PAYG solution
Majinco	Partly, provides SunKing lanterns & large SHS	Profitable business (mother company in furniture)	Mainly in the Tana region; 3,000 sales/year	Tier 1 - 3	In discussion with Access Bank on a solar loan product for customers
ENR	No (SHS for residential areas & SMEs)	7 to 10 installations per year	Main customers in the residential segment are expats & embassies (e.g. US)	Tier 2-3 (SHS)	No
HERi	Yes (Kiosks, run by local entrepreneurs, rent out Sunking Pico, Solo, Pro-AN lamps)	Not yet breaking even	100 kiosks serving 330 people per kiosk for a total of 33000customers; serves Central and South-East regions of Madagascar	Tier 0-1	• Yes, renting through 100 kiosks in country • Plans to start selling with PAYG in 2018

Company	BoP focus?	Revenue or growth status	Sales/Outreach	Product category (ESMAP)	Providing credit/PAYG solution
Baobab+	Yes, 2 business lines: 1. MFI clients: Top-up loan through MicroCred 2. New clients: PAYG through social enterprise Baobab+	Nearly breaking even	300 per month (starting in August 2016); cumulative sales of 19,000; active in 5 regions – Analamanga, Alotra Mangoro, Atsimo-Atsinanana, Bongolava, Itasy, Boeny, Vatovavy-Fitovinany, Atsinanana	Tier 1	Yes, PAYG, first to set up partnerships with MVola & Orange
Jiro-ve	Yes, rent out lamps through franchisee model	Not yet breaking even	7000 lamps rented daily through 31 franchisees in Tana & AntSirabe	Tier 0-1	Yes, credit, not PAYG
Nanoë	• Yes, but do focus on "richer" BoP • Establish nano-grids for a few households, operated by local entrepreneurs	Start-up, not break-even	Mostly North of Madagascar: Diana and Sava 350 hh reached	Tier 1-3	Customer pay through PAYG for their consumed energy services per day
GreenCorps/ EoSol	Partly (only through Minigrids)	Not breaking even	4 mini-grids totalling 1.5 MW: 2 in the South and 2 in the North of the country	Tier 3-5	No
Energie Technologie	Partly (only through 2-3 minigrids with GIZ, partly successful)	Profitable business	Mini-grid location: in Tulear	Tier 3-4	Case by case basis
Power Technology	No	Profitable business. No growth.	• One Outlet in Antananarivo. • Sales agents in approx. 20 locations around the country.	Tier 2-3 (SHS)	No
SQVision	No (SHS for hotels, residential areas)	Making revenue	Off-grid areas: Tana, Diego Suarez, Nosy Be – Androkaroka, Toliara 6000 hh reached	Tier 2-3 (SHS)	• Setting up partnership with Access Bank • No PAYG yet but open to start with Victron products.
MadaGreen	No (SHS for SMEs /Institutions and larger)	Making revenue	Households, small enterprises, hotels in Southwest	Tier 2 - 5	No (starting with leasing offer for hotels)
WeConnex (Nexus centres)	Partly (with nexus hubs)	Not yet break even	5 nexus hubs in Southwest	Tier 3 - 4	No

Based on what was shared with us during conversations with a few of the quality suppliers – to the extent that sales numbers were shared, or known - we estimate sales of approximately 71,000 products (cash and credit) by these quality vendors over the last three years. Total sales of low-quality suppliers were estimated at 180,000. The plans for the future are more aggressive. For instance, Baobab+ hopes to reach 10,000 customers in 2018 while Orange, which is considering entry to the PAYG market, hopes to sell an additional 10,000 systems in its first year of operation (2018).

5.1.2 Opportunities and Barriers

Barriers mentioned by most of the vendors are similar to challenges faced by entrepreneurs in other, underdeveloped solar markets in Sub-Saharan Africa, such as **low customer purchasing power and limited access to finance**. Details on financing needs for growth are described in more detail in the next section. Needless to say, all enterprises mentioned that modified business models incorporating consumer finance are necessary to reach the Bottom of the Pyramid.

In Madagascar, solar distributors face the following challenges:

1. **The costs of rural distribution**. Due to Madagascar's poor infrastructure and large distances between population centres, it is extremely costly to focus on multiple regions, and to continue expansion in more rural areas. Some enterprises deliberately choose to stay within one or two regions, such as Nanoë in the North, as it means staff can more easily be trained and managed, and that distribution of products and after-sales support can be arranged from a few local centres or stock points. Companies that do expand into new areas specifically mention they often use grant financing to do so. Below graph illustrates (roughly) the current activity per region:

Figure 20: Geographic sales activity of suppliers

Though all have strong interest in developing larger distribution networks, this is an extremely costly undertaking. For example, Baobab+ now works with an agent network that is not solely commission based. The company tried working with independent distribution agents in the beginning, but faced issues with franchises not being able to balance sales targets with credit standards, thus threatening portfolio quality. Furthermore, the agents' levels of commitment were low, and therefore staff turn-over was high, making recruitment and training even more expensive.

According to a study by Energy Enterprise Partnership (EEP),[64] agent retention and motivation is a common challenge for solar enterprises using this delivery model. Agents cannot neglect or forego other income generating activities, as commissions on pico-solar products are low, given the small price tag of the products. Furthermore, the intense marketing activities required to sell these products are not always adequately compensated by the commissions generated. However, working with agents is the most logical delivery model for companies selling tier 0-1 products, like the companies in Madagascar. Baobab+ decided to switch to a partially-salaried model, where the agents earn a base-salary to cover for low-sales months. As result, Baobab+ has achieved better results as well as a salesforce that is more closely integrated and identified with the company. This model is, however, more costly and adds to the cash-flow pressure built into the PAYG model, where vendors must pre-finance the equipment they are selling on instalment.

The EEP study estimates supply chain costs of solar enterprises 30-50% of selling prices, especially for enterprises selling tier 1-2 products, compounding the cash flow and financing challenges implicit in this business model. The World Bank could consider introducing an incentive-based financing scheme (Results-Based Financing – RBF) to motivate enterprises to reach places where they are currently not active, or to reach more rural areas in regions where they have established a network. Some of the companies we interviewed understood the concept of Results-Based Financing (RBF), or were interested in such a facility. However, even the companies that were already working with this type of financing did not fully understand that RBF was not to be used for lowering prices. If such a model is properly introduced, it could be effective in reducing the particularly high costs of rural retail networks in Madagascar.

2. **Insufficiently enabling environment:**
   a. **Complex customs procedures and unclear application of VAT rules:** Although new VAT regulations are in development (see also chapter 2), all of the firms interviewed reported issues with import procedures. Some companies mentioned that they acted "by the book", but still received fines for committing fraud. Others reported extreme delays (up to 2.5 months) with clearance of goods, when "informal payments" were not made. One of the key issues seems to be that the customs officers face challenges with identifying or labelling Lighting Global-accredited complete or pre-assembled solar-kits as fully tax-exempt. (Apparently the difficulty stems from the fact that the box contains loose components as well). For loose SHS components that require assembly in country, the clearance process might be even more complex.
   b. **Low levels of quality assurance:** Currently the VAT rules do not differentiate between levels of quality in applying exemptions. This contributes to the large supply of low-quality solar products and equipment, damaging the product image for solar home systems in the Malagasy market. The LEAD program could introduce a list of pre-approved solar kits to public organizations involved in promoting solar, including ORE. Customs officers could be trained to apply this list in assessing VAT liability. For further details, see the policy and landscape chapter section as well as the final chapter. Also, the World Bank is already working with the bureau of standards on quality assurance matters.

3. **HR and Staffing**: Finding good team members in the Tana region seems to be relatively easy. However, recruiting highly-educated people for managerial roles in the rural areas (for instance, as regional sales or logistics managers) is not an easy task, making it even less attractive for companies to move into new areas.
4. **Consumer awareness:** The surveyed firms reported that most customers know what solar energy is, but their ability to judge quality and understanding of the importance of after sales service is still very

[64] *Energy and Environment Partnership South and East Africa (2018). Solar PV business models in East Africa: lessons learned from EEP supported projects*

limited. This is illustrated in the household survey as well, and makes it difficult to market medium-to-high-quality products, especially when these have similar outward appearances to their cheaper, low-quality counterparts. Most of the vendors recognized the need for public awareness campaigns, and accepted the fact these could be shared, industry-wide campaigns, demonstrating different products and brands. Awareness campaigns could be focused around **explaining quality and aftersales service**, enabling customers to identify quality brands & products, and explaining difference in price points. Using "champion" customers to send these messages, including local authorities that come from the same locality, can be helpful in creating trust. Driving sales by referral has also proven effective and low cost, and this approach can be replicated from programs in other Sub Saharan countries

5.2 Financing Needs for Growth

Access to finance remains one of the key barriers to scale. The majority of the enterprises serving the BoP are relatively **small and early stage**, with few enterprises having more than 3-5 years of operations. Their financing needs are quite diverse, as is their experience with local financing.

The below figures summarize some of the answers provided by companies about their **financing needs and challenges**. Note that not all companies were willing to answer the finance-related questions, and multiple answers could be given.

Figure 21: Financing Needs (multiple answers possible per company)

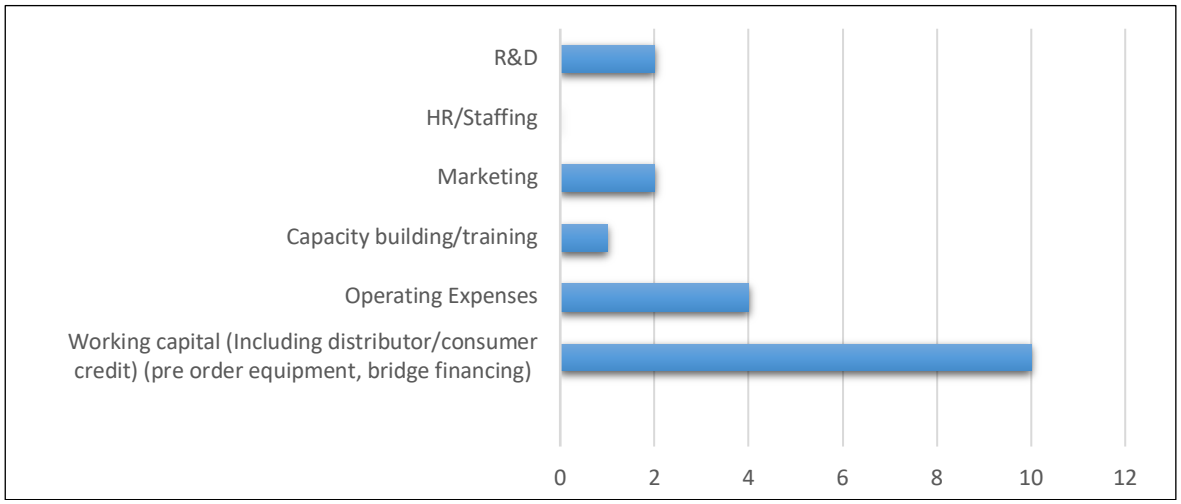


Figure 22: Key barriers for accessing finance (local and external)

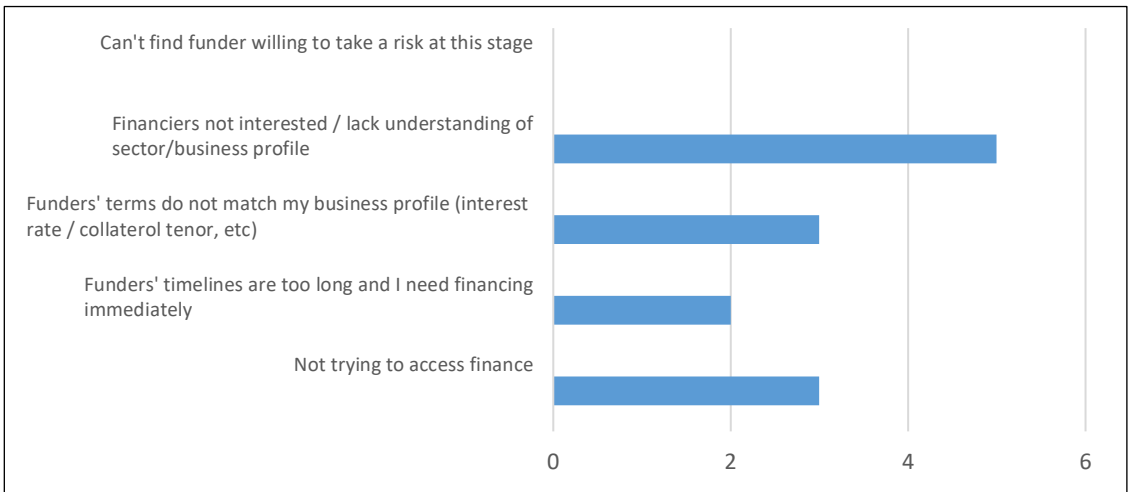


Table 29: Type of financing needs

Type of financing needed	Nr of companies

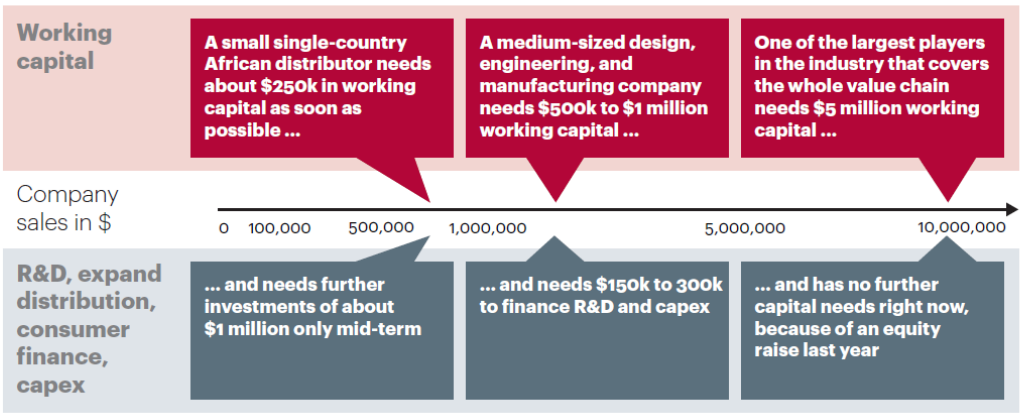
Debt	2
Grant	2
Equity	1
Combination (equity/debt, grant/debt, equity/grant or mezzanine)	6

Key insights emerging from discussions with solar enterprises about their financing needs include the following:

The greatest financing need among solar companies appears to be for working capital loans to finance operating expenses and finance support for expansion. Baobab+ specifically mentioned the issue of pre-financing equipment, especially when paying for shipment of products that will be only be repaid by the end customer (in case of providing end-user financing, leading to a double burden). We assume this will become a larger challenge as companies scale. Shipping can take up two months and delivery can be delayed beyond that at customs. Manufacturers, on the other hand, do not offer flexible payment terms to accommodate these circumstances. Large upfront payments (sometimes up to 100 %) are often required. This may present an opportunity for LEAD to support development of trade finance products to help manage these cash flow pressures and permit more rapid growth among distributors. Currently, some enterprises in Madagascar share shipping costs and combine multiple orders in one container.

The medium-term capital demands (over the next 5 years) range between USD **200,000 – and 1.5 M** per company, which is understandable, given the type, growth rate and sales levels of these enterprises. The graph below was made for a study on investment and financing of the off-grid lighting sector by AT Kearney in collaboration with GOGLA. It illustrates different types of solar enterprises that operate in the off-grid industry and what they need in terms of financing, which is helpful to understanding the absorption capacity of these companies.

Figure 23: Typical capital requirements suppliers in the off-grid industry[65]



- Enterprises mostly prefer a **combination** of financing solutions, to serve different types of needs. There is demand for equity and/or **very low-cost** debt; interest rates between 5% and 8% were cited as acceptable, although companies understand this might be hard to realize.
- Grants are mostly preferred for new product development, and for establishing new agent networks. The social enterprises with international management boards have managed to access grant funding from the EU, Veolia, EDF, Orange, and the DOEN Foundation. Others are experimenting with crowd funding (i.e. KIVA, Baobab+) and one enterprise is starting to raise equity from an impact investor (Nanoë). Jiro-Ve has been remarkably successful in raising over 3 million EURO in grants over the last few years.
- Very few firms reported any attempt in getting loans from banks or other local sources of debt. The challenges they report are typical for SMEs, namely that collateral requirements, loan tenors and

[65] AT Kearny (2014): Investment and finance study for off grid lighting

interest rates do not match their needs or capabilities. The perception is that local banks do not understand the sector well. In other cases, enterprises simply know their company is not at a sufficiently mature stage to consider local debt as a realistic option. The only experience that survey with respondents had with local banks was in the area of consumer financing, for their personal finances.

The companies that provide consumer financing via PAYG, fee-for-service or rental, including Nanaoë, Heri, and Jiro-Ve, did not directly share issues they face with purchasing equipment in international currency, while collecting payment in local currency. This is especially risky for borrowers when receivables are outstanding for a longer period. The fact the companies did not mention currency risks might be related to the fact they haven't been in operation long, as PAYG is in its infancy in Madagascar, with only one company having fully implemented the model and two that are starting to do so. They did acknowledge the advantage of local debt in terms of limiting currency risk, but considering previously mentioned reasons, they did not try to access local debt yet.

In general, the social enterprises know their way around the international donor and grant landscape, and are experimenting with other type of more formal financing, including equity. Considering their stage of development, local debt, under current market conditions and terms, is not a realistic option. Baobab+ is an exception, but reported that due to their relationship with MicroCred, they cannot seek local debt from other local banks.

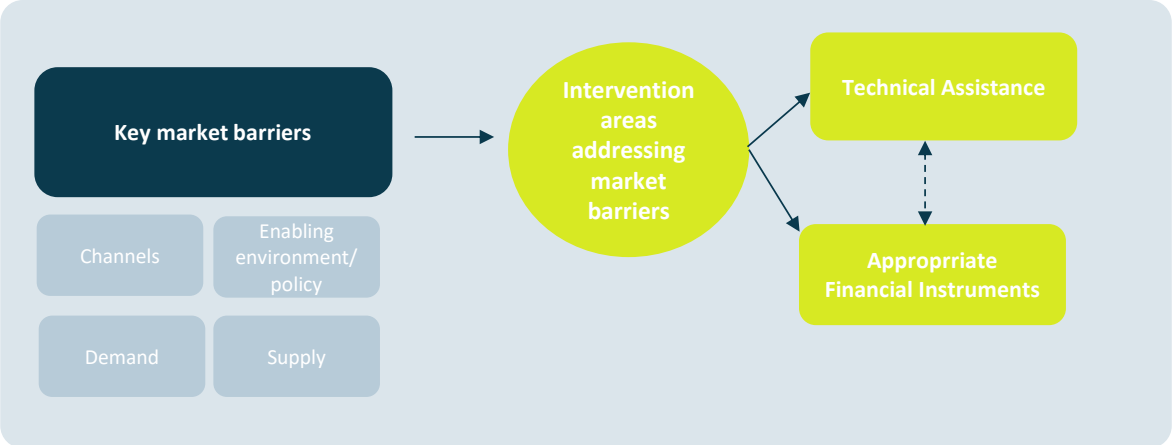
6 INTERVENTION DESIGN

6.1 Framework for Intervention Analysis

This market assessment aimed to quantify and define the characteristics of the off-grid solar market in Madagascar. An effective solar market ecosystem that can enable rapid growth to reach off-grid customers consists of a **mix of retailers, suppliers, financiers and customers**. In a system that is functioning well, demand, supply, channels and the enabling environment all work together, and no market barriers exist. However, such well-elaborated and smoothly operating ecosystems are rare at present, if they exist at all. The findings of this study illustrate that the standalone solar market in Madagascar is still **nascent**; in other words, a number of barriers need to be addressed to stimulate the development of this market.

This chapter summarizes **key market barriers for solar expansion along the solar market value chain**, illustrating potential intervention areas by market segment, including potential channels to reach different target groups. Figure 22 below illustrates the framework for analysis that we've applied to develop the recommendations that follow.

Figure 24: Framework for Identifying Intervention Areas



The below table summarizes the barriers, opportunities, intervention areas and potential financial instruments for addressing the various market barriers we identified through this study. Further details on three suggested interventions are presented thereafter.

Table 30: Overview of Challenges and Opportunities in Madagascar's Off-Grid Solar Market

Ecosystem Element	Market Challenges	Opportunities for Intervention	Financial Instrument / Technical Assistance
Regulatory landscape and enabling environment	Lack of quality standards[66]	- Support ORE with implementation / enforcement of new set of norms of Nov 2017 - Improve collaboration of ORE with customs and VAT - Build up and train a critical mass of "quality enablers", perhaps by offering installer training and certification	- TA and grant-funded support
	Scattered donor activities in the solar PV market	- Consider setting up a donor coordination body to avoid overlap in the future	

[66] *World Bank already actively working on this intervention with the bureau of standards*

Ecosystem Element	Market Challenges	Opportunities for Intervention	Financial Instrument / Technical Assistance
		- Ensure complementarity in particular with other credit lines	
	Lack of reliable and updated grid access data for energy planning	- Set up data (collection) process to allow date to feed back into energy planning processes within MEEH, ADER and ORE	
Demand: Households	- Very low willingness and ability to pay (based on current energy expenditures and income) - High awareness of solar in general, **but low ability to judge quality** - Informal economy provides the main income source for 36%. - 41% of the population is financially excluded, even from informal financing (25%)	- Provide awareness raising activities on product quality and selection. - High interest in SHSs for mobile phone charging (30% own mobile phones and 25% use mobile money) - Serve rural customers with access to basic financial services (29 % use MFIs or mobile money) though provision of energy loans - Offer support for rental schemes (e.g. Jiro-Ve or HERi) to remote rural customers without access to basic financial services (66%) and motivate suppliers to further expand to rural areas - Serve mobile phone owners (30%) with solar through PAYG solutions.	- Offer repayment/financing plan with Banks/MFIs (peri-urban mainly) - Set up rental-scheme/support companies with rent schemes (**peri-urban** & rural areas) - PAYG options (in peri-urban areas mainly) - Targeted and regional campaigns focusing on quality under LEAD technical assistance component - Subsidy and results-based financing schemes for most remote and excluded customers
Demand: SMEs	- Reliable and affordable access to electricity remains a big challenge; most rely on expensive generators - High level of informality among MSMEs - Limited experience with banking sector, some of it negative	- Reduce generator use and ensure provision of reliable, potentially hybrid solutions - Willingness to invest in renewable energy is rather high among SMEs - Medium to larger commercial businesses easier to target than informal small enterprises e.g., hotels and commercial-industrial operations - Integrate lessons learned from multifunctional platforms (example GRET, Weconnexx)	- Promote loans through MFIs/Banks for SMEs financially included, for individual systems - Facilitate and subsidize commercial credit for solar for businesses - Subsidised technical assistance for the sizing and costing of solar systems and technical training - Support expansion of multifunctional platforms for community-managed solutions - Concessional loans
Institutions	- Limited public funding for electrification - Limited capacity for O&M - Viable model possible for health clinics but (not for schools)	- Good potential to electrify clinics in terms of impact and ease of implementation - 5% of rural clinics are electrified, government aims to increase to 100% by 2020	- Grants and technical assistance for system installation, operation and maintenance - Fees collected from health clinic visitors to cover O&M
Supply	- Low purchasing power of customers - Consumer awareness: low capacity to identify quality	Addressed under demand / household intervention areas	

Ecosystem Element	Market Challenges	Opportunities for Intervention	Financial Instrument / Technical Assistance
	- Complex customs procedures and lack of transparency in VAT application	Addressed under quality assurance in table	
	- High costs of rural distribution & expansion - Too limited sales activity among the poorest households, which is a key segment - Limited access to appropriate financing - Limited experience with local formal financial sector	- Motivate companies to go beyond their current target areas - Support companies with market data ensuring they expand to those regions with customers that match with their product offering and pricing structure - Develop microfinance partnerships in urban and peri-urban areas - PAYG integration and partnerships with MNOs in more rural areas	- Appropriate mix of financing support (grants, low-cost debt and equity) - Incentive-based financing scheme motivating enterprises to reach more remote areas - Consider developing local retailers, to support a more local (and less costly) distribution network
	HR and Staffing	- Creation of a nationwide database of PV experts and technicians that allows for identification of agents, installers, technicians and managers across the country.	- Grants / TA
Channels			
Formal Financial Sector & Mobile channels	- Formal financial sector has limited understanding / experience in RE sector, even among the FIs already supplying solar loans - Limited to medium risk appetite to invest in solar market - Mobile money is in its infancy	- MFIs & Banks: Basic support & training in RE / solar finance - Do not consider formal FIs as only channel; work with FI – supplier partnerships where they make sense - Support MNOs to act as payment facilitator to integrate PAYG with existing suppliers or as distribution channel. - Consider implementing PAYG models that do not need connectivity for most remote customers (e.g. scratch-card model)	- Technical assistance in partnership development / and financial product development - Leverage financing (including CSR funding) already available for MNOs, work with at least 2 players (**Orange and Telma** most likely candidates) - Banks preferred guarantees over credit-lines: likely to be more appropriate at a later stage)

6.2 Estimated Funding Size & Needs

6.2.1 Market Size Summary

The demand and supply analyses have shown that although there is clear market potential for the scaling of solar products in Madagascar, the (easily) reachable and thus realistic size of the market is more restricted. Table 31 below summarizes the estimated demand for off-grid solar devices in Madagascar, based on interviews and secondary research.

Table 31: Overview of Market Size for Solar per Target Group

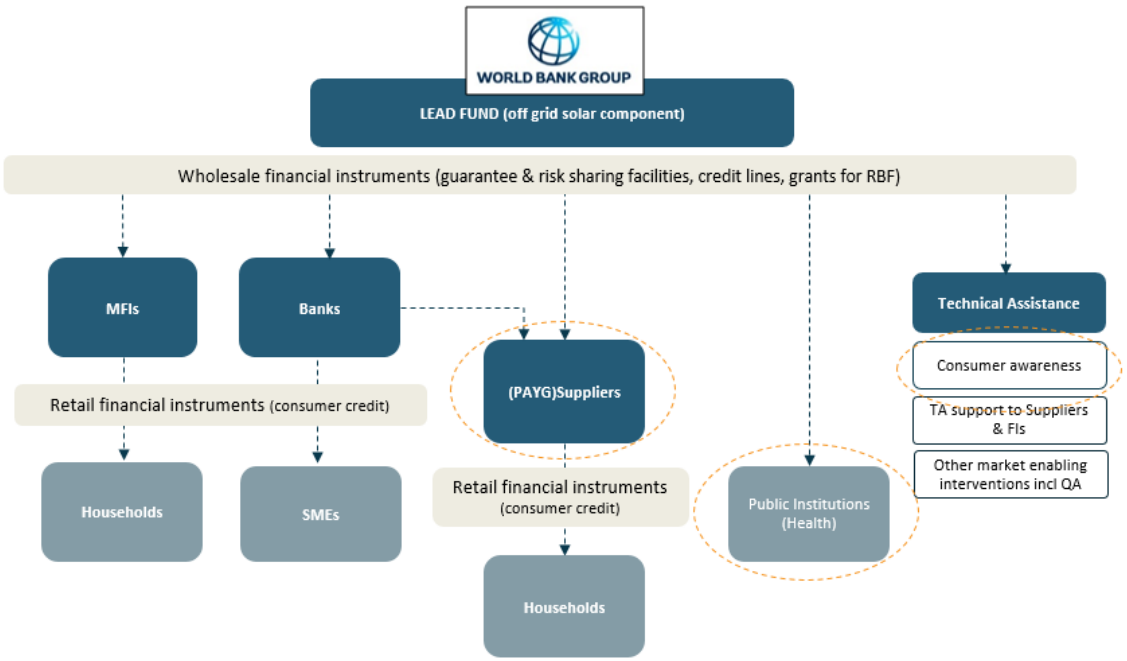
Target Group	Key market potential
Households	- 19% or 1.1 million households - Mostly products that are Tier 1-1.5 - If outreach improves, 54% (or 2.9 million households) off grid households could potentially afford a small solar home device.
SMEs	- Large numbers of informal small enterprises - Hard to estimate total amount of off-grid SMEs willing and able to afford standalone solar - Assuming two SMEs might need and be able to afford standalone solar for their operation per fokontany; - Total market size for off grid solar estimated at 33,000 SMEs
Institutions	- Focus on health institutions - Total un-electrified public clinics: 2,380 - Recommended focus on electrifying 1,000

6.2.2 Funding structure and Intervention areas

Based on the potential market size, the challenges and opportunities in Table 30, and the World Bank's sector prioritization, a general fund structure that focuses on the provision of credit lines to financial institutions would be most realistic. For the most part, banks and MFIs have the capacity to on-lend to different target groups, including institutions, households and SMEs.

In general, a **mix** of financial instruments in the right proportions is advised to address a variety of market barriers and accelerate different segments. In addition, as part of the fund's activities, there will need to be sufficient focus on technical assistance in areas such as consumer awareness, capacity building support to suppliers and FIs, and quality assurance. Figure 23 provides an outline of the potential fund structure. Elements of this fund structure and intervention target groups are further detailed in the sections below.

Figure 25: Overview of potential Fund Structure



The target groups circled in orange (health institutions, suppliers/PAYG providers and consumers) in the figure above have been described in more detail in the following sections[67]. These three intervention areas have been selected based on the diversity of their focus, and preferences expressed by the World Bank. A number of additional intervention areas for the fund, as well as key considerations for the fund's design, are briefly presented in section 6.5.

We have attempted to quantify the overall fund size required for three selected interventions[68], but detailed scenario planning and a full costing of all intervention areas suggested in the Table 30 are outside of the scope of this study. Table 32 summarizes the estimated funding needs and potential impact in terms of households that would be reached by these interventions. We have omitted funding estimates for establishing Fund governance arrangements

Table 32: Summary of Potential Funding Opportunities

Window	Type of capital	First year Funding (USD)	Funding (USD) (medium term)	Impact potential ((hh/SMEs)	Assumptions / Limitations
Solar enterprise support: Results Based Financing	Grant/ convertible grant	700,000	5,000,000 – 7,500,000	500,000 – 1,000,000[69] Households	- Target market of 500,000 – 1,000,000 households - 5-10 USD support per unit - +/- 5 % Management costs
Solar enterprise support: - Credit lines - Guarantee facilities (at a later stage) at banks	Low cost debt / concessional loans	500,0000-1,500,000	7,000,000		- Enterprise support estimated at 500,000- 1.5M per supplier / provider - Three banks assessed as potential intermediaries - 1.5M per credit line - Detailed assumptions on enterprise needs in 6.3.3.
End-user financing: - Credit lines at MFIs(Households and SMEs)	Debt	500,000	500,000 - 3,000,000	30,000 Households & SMEs	- 2-3 MFIs assessed as potential intermediaries - 500,000 per credit line for households and SMEs - 10% of client base to be reached
Electrifying institutions: 1,000 health Institutions	Grant		12,700,000	2,000,000 households	- 100 institutions in first year - 900 institutions in remaining years
Sub Total			**30,200,000**		
Technical Assistance - Market enabling interventions	Grant		3,000,000		- Appr. 10% of total financing support

[67] *Upon request (selection by) World Bank*
[68] *Modelling more funding windows than interventions that have discussed in detail would fall outside scope of this study*
[69] *Additional sales through funding, not total sales, supporting a handful of companies*

Window	Type of capital	First year Funding (USD)	Funding (USD) (medium term)	Impact potential ((hh/SMEs)	Assumptions / Limitations
including consumer awareness raising - Non-financial support for suppliers and FIs					
Total			**33,200,000**		

The estimates presented above assume that only the suppliers and financial Institutions currently active in the market are targeted and that 1-2 new players (including PAYG suppliers) could be attracted to enter the market. Furthermore, the estimates above relate only to additional households/SMEs reached through funding interventions, and do not include households that would have been reached under the business-as-usual scenario of slow but steady market expansion by the current suppliers.

6.3 Selected Intervention Areas

In the following sections, detailed concepts are presented for the following three interventions areas prioritised by the World Bank:

1. Consumer awareness
2. Financing rural health institutions
3. Appropriate financial support for suppliers including Results-Based Financing

For each recommended intervention, the required technical assistance and appropriate financing mechanisms[70] are presented.

6.3.1 Highlighted Intervention: Consumer Awareness

The study found that general awareness of the existence and the potential of solar is quite high, although the ability to judge quality and evaluate price-quality trade-offs is limited among household consumers. Consumer awareness campaigns should be focused on **explaining the elements of quality and aftersales service needs**, and explaining the reasons for different price points, thus enabling customers to select the best quality brands and products they can afford.

(Other) Problems to be tackled

- Consumers' short-term perspectives when purchasing solar products. Malagasy tend to make purchasing decisions based on the immediate savings they can achieve by acquiring cheaper and often lower quality products, as opposed to factoring in the potential for long term savings that different products can offer. As such, the high upfront cost of a quality pico-solar product compared to similar off-grid energy sources such as Chinese lights (which generally have a short life span) prevents consumers from switching to solar products.
- Pico-solar products' limited availability and accessibility constrains consumer purchases. Malagasy tend to purchase goods that they can access easily. The limited visibility of solar products in a market flooded with low-quality Chinese torchlights at every street corner makes it difficult for solar distributors to reach consumer groups and achieve sales. Most households do not know where to find or purchase a solar product, even in areas where local retailers are selling these products. Consumer awareness activities on what is a quality product are expected to **drive demand.**
- The accessibility of maintenance services for pico-solar and SHS products is equally challenging. Consumers are concerned about investing in a technology that requires specialist knowledge to install and repair while no one in their community may possess this knowledge.

[70] *After this mid-term report, in coordination and consultation with the World Bank, interventions will be prioritised and a selection of the prioritized interventions + costing can be worked out more in detail*

Recommendations for a marketing strategy

- Raising awareness on the right price to pay for certified quality products, and demonstrating their quality in trustworthy environments such as schools, universities, and office spaces would enable solar distributors to generate interest and confidence in their products. Door to door sales tactics and outlets managed by local sales agents are effective in building consumer trust in the product as they allow trained sales agents to address consumers' questions and get quick product uptake within a neighbourhood. Community events and product demonstrations would also help build consumers' confidence.
- Delivering visible messages on distributors' product quality and associated services (credit options, warranties, maintenance, after sales services, customer loyalty programs) would communicate distributor's unique value propositions in a market were the availability of these (high quality) services is still limited. It would also increase consumers' willingness to pay for solar products and to upgrade to more sophisticated solar products over time.

Target areas and market; key messages

The most remote rural areas should not be targeted by this strategy as it is assumed that any marketing campaign or local presence would not be cost-effective; rather, it is assumed that an established diffusion of solar products in more accessible rural areas will spur demand-driven distribution across the country. Universities in (peri-) urban areas should be involved in the strategy both as prospective consumers but also as sources of a workforce for sales, service and implementation.

The key message that should be portrayed through any marketing approach in Madagascar is quality. We suggest building a simple and immediate graphical brand to identify Lighting Global-certified products across the country. At the same time, quality products still have higher CAPEX than non-certified counterparts, and thus financing options, in collaboration with local financial institutions, should be set-up.

Channels and communication means

Different communication channels and means should be used in different regions:

- *In (peri-) urban areas* where the distribution channels are well in place through points of sale and agents, brand-agnostic campaigns focussed on quality should be promoted to make people aware of the benefits of higher quality products that can be found locally and benefit from Lighting Global-certified quality branding. Universities should be engaged to leverage students' openness to adopting new technologies, and also as a source of talent to be trained as sales and service agents. Financing should also be provided to retailers to strengthen their distribution channels.
- *In rural areas* close to towns where retailers and sales forces are not well established, **travelling road shows at local markets will help to build the market**. Financing should be provided to identify and train brand representatives in charge of stocking, promotion, sale and payment collection. Compared to (peri-) urban areas, where billboards and mass-media advertisements are effective, face-to-face promotion will need to be emphasized in rural areas. A few lessons learned on rural marketing are presented in the following two boxes.

Distribution: keep it simple & local

- **For last mile distribution, the most workable solution to promote life-enhancing durable goods is to cover small areas** by using local staff and representatives.
- **Piggybacking** on distributors already active in the region is a low-cost solution, for example by sharing delivery vehicles and logistic systems of existing retail channels (e.g. Unilever, Coke) can work well. Common last-mile distribution models are franchises, distributor-dealer networks or partnerships between institutions, enterprises, and organizations
- **Having access to pre-defined customer bases** and well-established community structures is very beneficial in terms of promotion and expanding distribution. The key reason for energy providers to establish partnerships with WPS is exactly this client-base argument. Unfortunately, the model still seems insufficient to effectively reach the last-mile customer, especially for after-sales activities.
- **Small entrepreneurs, as sales representatives or agents,** can take up incentive-based marketing activities in a workable, nearby radius. This keeps the travel aspect of promotion and marketing activities relatively inexpensive, enabling a relatively small commission to make it worthwhile for these agents.

When it comes to last-mile outreach and specifically marketing, these are crucial points:

- Early adopters of innovative products are **not necessarily the poorest of the poor**, but are needed to reach that group in the end. This point was also confirmed by a recent study from the Shell Foundation on accelerating access to energy. Rural customers prefer risk-free products, not necessarily cheap products.
- BoP Products like solar home systems are **a push-, not a pull product** which often means a long lead time for sales to materialize. Big market events are only worthwhile if there is a structure in place and resource availability for local follow up.
- Expressing the right value proposition is crucial: a marketing message focused on a long term pay-back period does not convince a customer with daily disposable income patterns.
- Word-of mouth is critical in low-income, rural societies. The involvement of local authorities and opinion leaders works: seeing is believing.
- Every after-sales or maintenance moment (even when fixing technical problems) is a potential sales moment. These moments often lead to repeat- or referral sales.
- It is necessary to overcome "lost in translation" issues – BoP customers' share some common characteristics, but the marketing message needs to be tailored to the regional and cultural context.
- Simple ideas such as **referral campaigns, loyalty programs** and sales incentive schemes targeting, for instance head-teachers or church leaders, have proven successful in bringing in new customers.

Implementation partners

Several stakeholders should be involved in an awareness campaign, starting with the **existing retailers of quality products**. A mix of grants and interest-free loans may need to be provided to support the different stakeholders in their initiatives:

- **University students and professors** should be involved through specific training and marketing programs, hence increasing the uptake of quality products among the younger generation and creating a prospective workforce of qualified sales agents and professionals in the sector.
- **Commercial banks and MFIs** should help promote products through the provision of micro-credit or loans for larger systems for households, SMEs and social institutions.
- **Local authorities**, major offices, village-chiefs, head teachers, church - leaders, and other trusted local influencers, especially in rural areas, are useful for delivering key messages, organizing events, and gathering large group of people.
- **Mass media** must be leveraged, including local radio and TV channels, **mobile providers** for SMS services, **professional marketers** for billboards and others.[71]

Target markets and strategies

(Peri-) urban areas, middle-to-high income, pico- and SHS products:

WHO	WHY	HOW
Middle-income urban and peri-urban professionals earning stable revenues, with irregular grid service or without any; University professors and students	Stable purchasing power at family level, Strong awareness about the availability of solar products; Understanding of differences in product quality; already use electricity, either off or on-grid.	Set-up a training course on the use and deployment of quality solar products at universities; Hire students to become local trusted sales agents to operate in (peri-) urban areas; Expand points of sale of retailers in trafficked areas of universities, large urban and peri-urban areas; Develop incentives and programs to motivate sales agents operating remotely; Develop marketing messages aligned with students' and middle income (male) head of households' priorities, including quality assurance.

ACTIVITY	AMOUNT
Design and promote training courses on the use and deployment of quality solar products at universities. Connect graduates with retailers.	75,000 USD
Provide financing to retailers to expand points of sale in trafficked areas of (peri-) urban areas and universities. Provide support in the identification of locations.	See 6.3.3.[72]
Provide TA to retailers to empower sales agents and motivate them to operate remotely.	See 6.3.3
Promote a brand-agnostic campaign to promote Lighting Global-certified products via radio, billboards, SMS for urban prospective users.	100,000 USD

[71] VIAMO, who executed the household survey for this study has a lot of experience with awareness campaigns

[72] Results-based financing integrated in RBF, see section 6.3.3

Rural areas close to towns, middle-to-low income, pico-products

WHO	WHY	HOW
Middle to low-income rural families close to towns without grid provision, with focus on women.	Higher purchasing power than households in remote rural areas as they tend to combine revenue earning activities as farmers and petty traders in neighbouring peri-urban areas; Exposure to solar products; Willingness to align with products used in urban areas.	Target areas that have not been tapped by competitors; promote sensitization and awareness campaigns through product demonstrations; deploy sales agents in local markets; train and hire local brand representatives; offer payment by instalment solution and credit options. **Referral** campaigns have proven to work well in rural areas, and are relatively low cost (end-customer can receive a discount on a new product when bringing a new customer, or a discount on their payment plan)

ACTIVITY	AMOUNT
Provide TA to retailers to identify new target areas	50,000 USD
Provide financing to retailers to promote product demonstrations in market areas	150,000 USD[73]
Provide TA to train local brand representatives	50,000 USD
Provide financing for instalment solutions and credit options	See 6.3.3.

SMEs, (peri-) urban and rural areas close to towns, SHSs products

WHO	WHY	HOW
Medium-to-large enterprises with access to financing options.	Higher purchasing power than micro enterprises; stable cash flow; access to financing from banks; existing and established energy users; possibility to diversify offer.	Support the availability of products matching the needs of SMEs; Promote a loan facility for the rental of SHSs; Promote a billboard and radio campaign in urban areas focussed on savings deriving from the deployment of solar products; Train bank officers to understand and promote sales of SHSs among their customers

ACTIVITY	AMOUNT
Promote a brand-agnostic campaign to promote Lighting Global-certified products via radio, billboards, SMSs for urban prospective users.	75,000 USD
Provide trainings to banks for better understanding of SHSs and how to promote them to final clients. Connect them with local retailers.	75,000 USD

Institutions, (peri-) urban and rural areas close to towns, SHSs products

WHO	WHY	HOW
Off-grid health clinics in (peri-) urban areas and rural areas close to town	Large market segment, in line with Government's goals to provide electricity to health clinics across the country; High social impact on beneficiaries; constant cash flow.	Promote a leasing format for health clinics, including the rental of appliances.

ACTIVITY	AMOUNT
Provide trainings to health clinics' officer for better understanding of SHSs and how to carry out basic O&M	100,000 USD

6.3.2 Highlighted intervention: Grants to electrify rural institutions, focusing on the health sector

This report recommends considering the health sector for the following reasons:

1. **Ease of implementation:** the size of the facilities and their equipment are standardised, making widespread electrification economically and technically feasible at minimal costs;
2. **Expected sustainability**: patients could contribute small fees via surcharges for operation, maintenance and replacement parts for the systems;

[73] Partially Interest-free loan, partially through a grant

3. **Direct (health) impact**: for instance by creating warm-water facilities, which is crucial for safe maternal care. Additional beneficial side effects include demonstrating solar as a good solution amongst villagers and SMEs and potential job creation in installation and O&M.

To have a substantial impact on the sector, we suggest supporting the electrification of at least 500 to 1,000 clinics. These numbers will create the expectation that the Government will take necessary steps to provide safe power to all health facilities in Madagascar. The **estimated** size of a grant-funded intervention for electrifying 500 and 1,000 health facilities is presented in Table 33 below. Annex 5 provides detailed calculations for the costs presented below.

Table 33: Estimated Funding Needs to Electrify 500 and 1000 facilities[74]

Activity	Cost per institution (USD)	Total project costs (Grant + TA + O&M) (USD)
Development phase – Feasibility study – cost of tendering		550, 000
Implementation phase	10,000	5,000, 000
Operation and Maintenance phase over 15 years		1,500, 000
Total (USD):		7,050, 000

Activity	Cost per institution (USD)	Total project costs (Grant + TA + O&M) (USD)
Development phase – Feasibility study – cost of tendering		700,000
Implementation phase	9,000	9,000,000
Operation and Maintenance phase over 15 years		3,000,000
Total (USD):		12,700,000

The unit cost for 1,000 clinics is lower than that of 500 due to economies of scale, which will reduce the cost per unit with a slight increase in the cost related to the development phase, which includes a feasibility study and management costs). The operation and maintenance (O&M) cost per unit is assumed to be the same for both scenarios. Therefore, scenario 2, providing power to 1,000 clinics, is recommended by this study, at a cost USD 12.7 million.

Site selection

We suggest that site selection be done in coordination with ADER and the Ministry of Health, which can advise in terms of number of patients served per clinic, location and remoteness of the grid. Data from KTH's geospatial analysis (once finalized) and Tractebel could potentially be used for further site selection as well.

Project developers

Project developers to work with should be selected through an open tender procedure. In order to ensure maintenance is provided for, it would be a good idea to work with domestic project developers. As discussed in the supplier section, all quality-oriented companies currently able to deliver Tier 3 and higher solutions could be considered, including Madagreen, ENR, Greencorps, Powertech, Weconnex

Possible combination of interventions

An option to ensure effective use of funds is to combine elements of the consumer awareness intervention with the electrification of public health institutions. As these institutions are in rural areas, the project developers selected for these installations could be asked to combine this with promoting and explaining the use of (quality) solar systems for household usage. Often, public solar installations draw attention from neighbouring residents; also, clinic visitors could be key potential customers for (small) solar devices. It might be expected that project developers selected for the public installations are not the same players as the companies providing household systems, especially the systems most frequently in demand (small units, tier 0-1.5). In that case, the solar suppliers that do focus on this share of the market could potentially join developers in the areas were installations take place, to ensure a marketing opportunity is not lost. As these project developers will be travelling to these areas in any case, travel costs could potentially be shared.

6.3.3 Highlighted Intervention: mix of financing solutions supporting suppliers

[74] Refer to Annex 5 for detailed calculations, based in coordination with the Ministries during in-country visit

The study found the need for a mix of financial solutions to support suppliers in Madagascar, including grants, low-cost debt, and equity. Instruments commonly used to support the small-scale solar sector include working capital credit lines, low-interest project finance facilities, guarantee funds, technical assistance facilities and business incubators/accelerators facilitating access to equity investors of various types. A mix of solutions is common and appropriate for small and growing enterprises in underdeveloped markets, including for solar home system suppliers in Madagascar. A **mix of instruments** allows for flexibility, answering to a diversified set of financing needs at different growth stages of these relatively young, cash-constraint suppliers.

The table below illustrates typical financing needs at various stages of enterprise growth. Most of the companies in Madagascar, which are currently serving the BoP solar market, or who could be triggered to enter and/or scale up this market, are in between *validate* and *prepare* phase.

Figure 26: Financing Solutions per Growth Stage Enterprises [75]

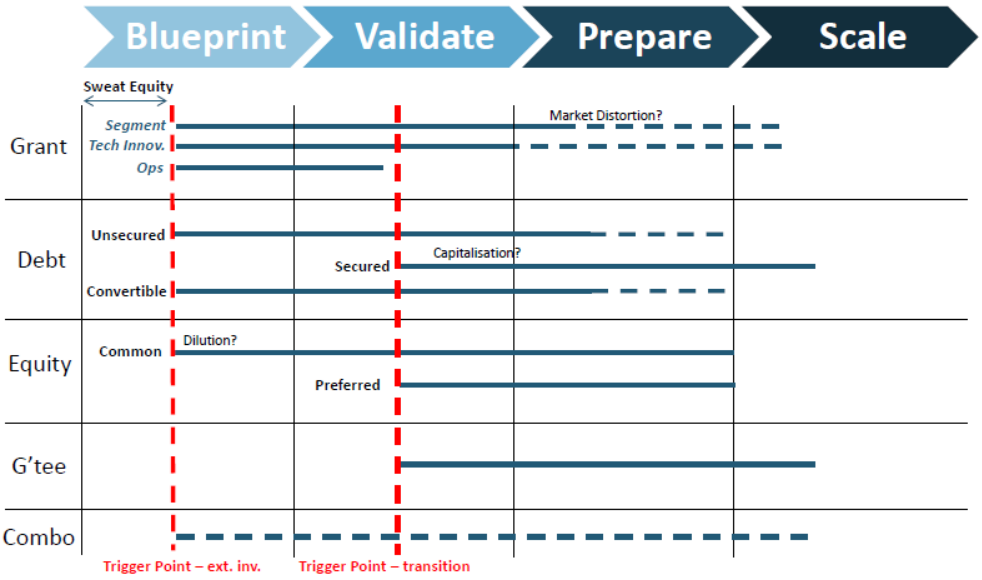
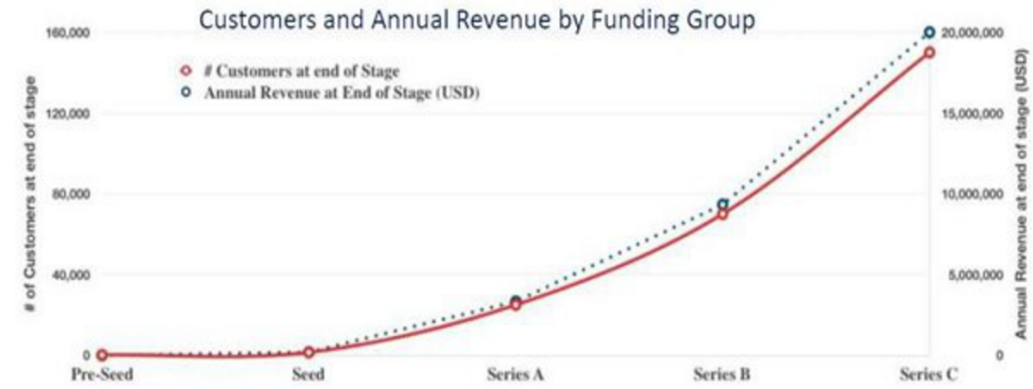


Figure 27: Financing stages enterprises[76]



	Pre-Seed	Seed	Series A	Series B	Series C
# customers at end of Stage	200	1,500	25,000	70,000	150,000
Debt (USD)		300,000*	1,000,000	3,750,000	9,500,000
Equity (USD)	50,000*		5,000,000	7,500,000	11,000,000
Grants (USD)	150,000	200,000	1,000,000	1,000,000	
Capital Sources	Founders, friends and family	Angels, foundations, family offices	Early stage impact funds, foundations	DFIs, specialized funds	Commercial sources, de-risking instruments

* Founders (Friends/Family) Equity

* Convertible Debt

[75] Source: Enclude (2017) for World Bank, Accelerator Research

76 Bloomberg (2016) Off-Grid Solar Market Trends Report 2016

Capital needs expressed

The types of funding that are demonstrated in the above graphs for these growth stages mostly match with the challenges and needs expressed by the solar suppliers interviewed for this study that included the following:

- (Extremely) high costs of distribution and outreach expansion; in combination with challenges to pre-finance equipment, or to provide a consumer financing solution;
- Limited (or negative) experience with obtaining local financing;
- Limited experience in the use of customer finance solutions to promote sales; and
- Most frequent combinations of funding requested were either (concessional) debt/equity or grants/equity.

The biggest challenge that needs addressing is distribution / expansion to rural and new areas and covering operating expenses. Working capital to facilitate pre-ordering equipment, as well as to support provision of consumer finance was mentioned less frequently, but is likely related to the relatively short period these companies have been active in providing credit to customers (rental and/or PAYG). Both needs can be addressed in various ways that are worked out below.

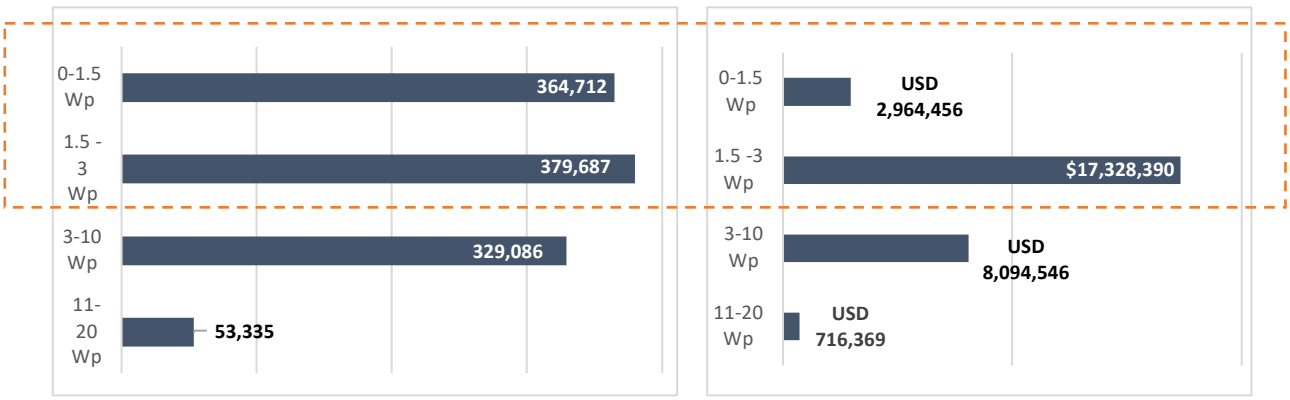
As earlier suggested, appropriate funding mechanism for the suppliers would be a mix of solutions. Straight equity participation is not likely to be a preferred role / option for the future fund. Some sort of quasi-equity (convertible grants, mezzanine or sub-ordinated debt) could be considered, although these types of investments still require an intense level of due diligence as well as support to the intermediary (likely a financial institution).

Credit lines providing low-cost debt, possibly with preferential terms (e.g. longer tenors) and limited collateral requirements in combination with Results Based Financing are likely to be an appropriate initial mix of instruments for the fund. The delivery of this capital is assumed to be directly through the fund. Results Based Financing is described in detail below.

Suggested enterprises to support

Supporting the companies that are currently providing consumer finance (via fee-for-service/ rental, PAYG) would serve the objective of the fund, as these companies can serve the highest share of the Malagasy market that can be reached with off-grid solar. Another aim could be attracting new players to the currently small group of solar suppliers that will probably not be able to serve the entire household and SME market (including repeat customers, assuming products will need to be replaced in 3-4 years). An important note is that the types of products that the Malagasy customers most frequently demand are the smallest Tier 0.5-1.5 products. This might limit the scope and revenue potential for new market entrants. The 2017 GOGLA trends sales report illustrates that while sales volumes of these entry-type products in the region are the highest, the actual sales revenue of larger sized products (1.5W-3W) is much higher (see Figure 28 below)

Figure 28: Sales and income values per product Tier in East Africa (volumes left, revenue right)[77]



[77] *Graph based on figures in Dalberg/GOGLA Semi-Annual Sales and Impact Data (2017)*

This market dynamic might have an effect new market entry of the main SHS suppliers, including PAYG players in the region (i.e. M-KOPA, Mobisol, BBOXX, Azuri, and OGE). It might therefore not be the easiest task to attract newcomers to a market where the smallest pico-products might be the only sales opportunity, or at least, the largest in numbers.

In addition to attracting players not yet active in country, motivating **other sector enterprises** already in country to enter the energy access market is a key option. For example, Orange is actively pursuing this and Telma has clearly expressed interest. Others, including hardware retailers may also consider entry in the household solar market. Clearly, there is an advantage supporting entities already active in Madagascar, since they are already familiar with the market, and have some sales or distribution infrastructure in place. Most solar enterprises need approximately **1-3** years to get established in a new market.

Results-Based Financing (RBF)

Results-based financing and subsidy schemes could stimulate companies that are selling high in demand products (smaller units) to expand to locations that are perceived as difficult.

A share of this small-unit market is currently being served by rental schemes (examples are Jiro-Ve and HERi). Customers demanding these types of products are located in peri-urban, rural and very remote areas. The majority of the solar technology suppliers are active in and around the capital (Tana) where their main offices (and warehouses) are located. The very small numbers that are active in other areas of the country work either through kiosks / franchisees (Heri, Jiro-Ve), or physical offices (SqVision, MadaGreen, WeConnex). There is limited activity in the rural areas or with the rural population in Madagascar. Even Jiro-Ve is just starting activities in the rural areas (now mostly in towns like Antsirabe). Companies like MadaGreen, WeConnex and Sqvision are located in off-grid areas but serve mainly higher segments (residential and hotels).

Also, there is a considerable portion of the consumer market that cannot currently be served through MFis / FIs or mobile channels, as a large portion of the population is unbanked. Twenty-five percent has no mobile phone access, and possibly thirty percent does not have an ID card (which is needed to get a mobile subscription).

The following considerations should be taken into account when implanting subsidy schemes to stimulate (rural) expansion:

- Companies will need reasons and possibly and possibly financial support to move into more rural / peri-urban areas, but interventions must take care not to distort the market or disadvantaging (other) existing players
- Retailers, agents, franchises in rural areas will need to be engaged in the supply chain
- Focus only on getting high-quality products into rural areas.

Results Based Financing: How it Works

The concept of Results Based Financing (RBF) means that small incentives are paid to solar suppliers after realization of agreed upon sales targets (possibly in defined areas), which is checked through proof of sales documentations (customer receipts) and audits. The incentives will motivate firms to invest in their business and scale up towards new / underserved areas.

The fundamental idea of RBF approaches is that payments that would otherwise be made automatically are made contingent on delivery of (a) pre-agreed result(s), with achievement of the result(s) being subject to independent verification. There are at least three fundamental preconditions for introducing an RBF approach:

1. It needs to be possible to monitor and verify the results against which payments might be made and these results need to be closely linked to the overall outcomes desired
2. If payments are only made by a principal after delivery of the results, the agent will need to have access to sufficient financing to cover any upfront costs prior to delivery of results, which may be a more acute challenge for capital intensive and large projects and/or in countries where financial sectors are less mature.
3. Both principals and agents need to have sufficient institutional capacity to set up and respond to an RBF incentive, respectively, particularly for monitoring and quick disbursement of payments

Background on model types of Results Based Financing is provided in annex 6.

Lessons from Results Based Financing Programmes and Opportunities in Madagascar

Lessons learned from the Endev RBF programme implemented in 15 countries in Africa, are important to keep in mind when designing an RBF programme in Madagascar. Key lessons reported from the existing RBF programmes for pico-solar relevant for Madagascar are as follows:

- **A strong host for delivering the subsidy** is important, the implementing bank or other organization needs to recognize the added value of the RBF approach. In Madagascar, a few financial institutions could be candidates for this, especially those already engaged in the sector, including Access Bank, CECAM and Microcred. Working with Microcred might be complex, giving the institution's relationship with Baobab+). Access Bank is already implementing an RE credit line through KFW which might be an advantage (sector knowledge wise), but can also be a disadvantage (resource wise, and considering risks for overlap). In case finding an engaged partner bank is a challenge, the RBF programme in Benin was delivered by the programme itself, which could also be considered for Madagascar.
- **Existence of "foundational market presence",** including elements such as consumer awareness, standards and taxation. RBF rarely functions as a standalone development tool. In fact, pilot RBF projects have so far often underestimated how ready markets actually were, and how much technical assistance was in the end needed to implement the programmes. This is worthwhile to take into account when designing an RBF project in Madagascar, given the currently nascent status of the market. Benin is a good example where the RBF programme started in an immature market, but activities did lead to more (diverse) sales activity, which included supporting the establishment of new PAYG players. Other RBF programmes advocate for more classic approaches with pre-financing and TA in immature markets where not all these pre-conditions are in place.
- **Keep the schemes simple**, especially for the suppliers. We advise keeping the process as simple as possible using flexible contracts, and to remain lenient on targets especially in a premature market like Madagascar. Most RBF programmes pay out subsidies after sales results have been verified, and suppliers need to understand that. An exception is Rwanda, where RBF was used to develop the physical energy infrastructure (of a mini-grid); in this situation subsidy payments were already disbursed after the early design phase. However, for suppliers, the "post-payment" model can be challenging, as there can be a long (time) gap between investing in new inventory or setting up new sales entry points and actually being paid the subsidy. The World Bank could consider a gradual approach working from partially pre-financing towards a post-paid system. Furthermore, it is advised (also referred to below) to **combine RBF with other forms** of (working capital) support, so companies will have less cash-flow issues. In any case, a lean subsidy mechanism is needed, whereby suppliers do not need to wait for months to get reimbursed. The implementing organisation of the RBF scheme would need to be capacitated to implement such a streamlined process, with limited red-tape.
- **Assess the potential of a geographically targeted approach versus a country wide programme**. There are disadvantages and advantages to focusing on certain regions. Currently in Madagascar there is too little sales activity in terms of product categories as well as geographic outreach. It would however be a challenge to identify specific regions, as all rural areas in all regions can be considered as "difficult to reach" locations. For instance, even more affluent areas where willingness to pay is higher like coastal Sava or Diego Suarez, are only accessible from Tana by plane because of the distance and poor roads. In Tanzania, RBF was specifically designed for the Lake Zone, following market intelligence research, which evidenced high demand, but lack of supply of pico-solar products in this area. In this case, a national-level RBF was not considered as the starting point. At that time, companies mostly operating from Dar-es-Salaam and Arusha stayed in their relative comfort zones, -selling in and near the main cities-, which is similar to what is currently happening in Madagascar. The RBF incentivized those companies to scale to new geographic areas.
- An option for Madagascar could be to have different incentives for different regions, but that will certainly complicate the implementation of the programme. Another option could be to start in regions where sales activity is on the low-to-medium side such as the Northern provinces, in order to build enthusiasm for the programme amongst supplier. More complex regions could be targeted for further scaling at a later stage. A similar approach was taken in Tanzania: Over time, the programme has

specified geographically differentiated incentive levels. For example, when the RBF facility was expanded to the Central Zone (adding 3 regions in the center of the country, which are considered difficult markets), the companies who stepped up received higher incentive levels while incentives in the initial Lake Zone had already decreased. Higher incentives were maintained in the additional regions to encourage companies to continue to serve customers in those regions. Overall, a **declining incentive mechanism** is useful, as it will ensure market distortion is limited, and subsidies are really used as the y should be: to kick-start, open up or launch a new market.

An incentive-based financing scheme would certainly stimulate the Malagasy solar enterprises to reach currently under-served areas including more rural areas in regions where they have already established a network. Some of the companies interviewed understood the concept of Results-Based Financing, although the rules of the game were not well known. For instance, vendors did not know that the financing was not supposed to be used for lowering prices of solar products, but rather stimulate further outreach and marketing.

Amount of financing

We can only estimate the capital needed for growth in the solar sector in Madagascar, based on demand expressed by the companies' active in country and insights coming out of the demand study. It was already reported that the average solar distributor would need (and be able to absorb) USD 250,000 in working capital and up to USD 1.5M for other operating expenses. Suppliers in country expressed a similar need of USD 200,000 – 1.5M each, which would lead to a combined amount of **USD 1.0 million to 7.5 million** in the initial years of an established fund.

The estimates above would be used for the following purposes[78]:

- **Expansion support**: Establishing a new agent is estimated to cost 2,000 USD, as reported by enterprises such as Baobab+. This is validated for instance by the RBF programme in Tanzania, which reported establishment of 368 new agents after spending a total RBF amount of 776,000 USD (approximately 2,000 USD per agent). Setting up a new solar kiosk (HERi) is more expensive, and estimated between 5,000 and 10,000 USD. Costs of establishing 140 new agents and 10 new kiosks, realized by a handful of enterprises, would then amount to 330,000 USD.
- **Other cash flow support including for (pre) financing of stock purchases**: An average shipping container holding about 9,000 units of products[79] can amount up to 120,000 USD. In order to grow sales by 20,000 units annually, two containers would be needed. This amounts to a capital requirement of 240,000 USD. Assuming five companies would need similar amounts (albeit of different products), the total cost would amount to 1.2M USD per year, which could be financed via low-cost debt / concessional loans, with longer tenors.

Overall, this means that financing needs in the range of **USD 150,000 - 1.5 million per enterprise** are likely in the early years, considering the status of most enterprises. If **newcomers** to the market, such as PAYG players and Orange and/or Telma, they are likely to need similar support this could be added to the total amount.

Impact

Based on results from other RBF programmes in Sub Saharan Africa and enterprise funding experience, it is possible to develop some assumptions. For example:

- In Tanzania, the total RBF injection was 776,000 USD which led to 24,000 new unit sales. Assuming an average sale income of 50 USD on the Sunking Pro II, this meant 2,400,000 in newly generated sales. When the program started in Tanzania, the market conditions were different than where the current market of Madagascar stands, in fact even more nascent. Therefore, the same multiplier cannot be directly applied to the situation in Madagascar.
- If funding is used to finance inventory, and thus to order more product, the potential impact can be calculated by the amount of new generated sales through this inventory. There is, however, an upper

[78] All focus companies of this study in Madagascar have different business models, in order to be able to make assumptions, an enterprise like Baobab+ is taken as an example

[79] Mix of pico solar product (average 13 USD / whole sale price per unit , including transport

limit to this type of growth as most companies attempt to plan and execute a strategy of phased and manageable growth

Based on the parameters above, we can make a very basic estimate of growth potential. Assuming **five suppliers remain active** in the quality pico-solar sector in Madagascar, then availability of USD 1.45M in financing would enable import of ten additional containers, and establishment of 140 new agents and ten other sales points (including kiosks). The resulting additional sales are summarized in the table below.

Table 34: Initial Finance support estimates for Malagasy solar companies

New sales activity through RBF and other working capital support	Funding/ Costs	New Sales (units)	Sales revenue
10 extra containers [80]	1,200,000	90,000	
140 new agents, selling 20 products a week	280,000	145,600	
10 new kiosks, reaching 3300 each	50,000	33,000	
	1,450,000	**268,800**	**13.4 million**

These amounts would be additional sales, on top of *"business as usual",* which is currently about 23,000 sales units per year (71,000 / 3 years). Assuming that other interventions would attract at least two players, the total impact will be higher than the estimates in the table above.

Non- financial support for enterprises

Currently, there is very limited experience amongst suppliers with short-term overdraft facilities, working capital loans and trade finance. Current terms, -collateral- requirements and other conditions of local financial intermediaries do not match with the needs and / or maturity status of most companies in the market. All credit activity identified was of very short duration (<6 months) and generally linked to a specific EPC contract (e.g., by a donor) or products for immediate re-sale. Credit is not frequently used for company expansion, customer-finance, or medium- to long-term investment. Most solar supplier experience is in receiving grants. Therefore, pre-pipeline support is necessary to get most of the suppliers in Madagascar investment ready--for LEAD, but also for potential follow-up financing from external investors. Some sort of "**acceleration services**" could be beneficial, assisting solar companies on their pathway to growth, providing or linking to a diverse set of enterprise support services. Suppliers can furthermore be supported in a few areas to stimulate market expansion and outreach:

- Providing more market data, encouraging firms to expand into regions with customers that match with their product range and prices;
- Building up strong partnerships with MFIS especially in urban and peri-urban areas (see section 6.4.1);
- Facilitating linkages with more informal retail networks, including solar shops currently selling low-quality equipment. The fund could support information campaigns, as well as match-making with these more informal equipment suppliers. Lessons from other markets, including Kenya, show that these retailers' ability to reach the last mile types of is often under estimated;
- PAYG integration and partnerships with MNOs in more rural areas, addressed in section 4

6.4 Other Considerations for the Fund

The above detailed three intervention areas illustrate only a selection of the intervention options for the LEAD fund. A few additional notes can be made specifically on consumer financing (households & SMEs) through MFI on-lending activities. Also, we have provided our view on the possibility to introduce guarantee facilities at banks to stimulate onlending to solar enterprises in the market. The latter could be an instrument for a later stage, once the solar market is more developed.

6.4.1 Consumer Credit through MFIs

Credit through MFIs for consumer financing

LEAD anticipates to furthermore providing credit-lines to MFIs to support and motivate on-lending to end-customers (both households as SMEs). A number of MFIs (and banks) in Madagascar are already providing loans to end-customers for RE specific products. For Instance Access Bank, Microcred and CECAM have

[80] *One container with 9,000 products (mix of pico solar and small Shs)I ncluding transport costs appr 120,000 USD*

established earmarked renewable energy loan products, and all three of them specifically provide loans for solar home systems. Most of these energy lending activities have illustrated moderate uptake but have shown early signs of success.

A few other MFIs and banks, including PAMF, OTIVTANA and Bank of Africa, currently less active in the sector seem to be interested, and also seem to have the capacity to do so. This includes their innovative capacity to expand their outreach and improve their services, which includes implementation of mobile and agency banking. It is advised to organize a workshop with this pre-identified group of banks and MFIs to further discuss the preferred financial instruments to motivate them to enter the sector, as well as to detail out specific terms of any instruments that could motivate them to enter or upscale their activities.

Using MFIs as a channel to accelerate solar penetration is justified, but other channels also need to be considered given the low financial inclusion rate in country.

- The size of the potential market reachable through the formal financial sector is limited, as only 29% of the population is formally banked. One idea to strengthen engagement with formal financial institutions is to focus on convincing the 25% who use informal financing sources to start using formal channels, but this process take time and may be costly.
- Locations reachable through this channel: peri-urban areas, mainly due to long distances for customers to branches (and vice versa, challenges when defaulting). A few regions show higher numbers of financial inclusion than others. Particularly the areas of Sofia (North-West), Androy (South), show high numbers of exclusion, which corresponds with the low levels of income in each of these areas;
- As discussed; another channel for reaching the non-banked households is through PAYG providers, either through existing providers (like Boabab+, Nanoe), or new comers like Orange, MVola (Telma).

Effective partnership development

Active support in partnership development with the right suppliers (for instance, in terms of geography), support with loan product development, and staff training are needed for successful implementation of end-user financing for solar home systems. A key lesson on partnership development and implementing solar lending at (M)FIs is that these partnerships need to be implemented all through the organization. Loan officers need to be directly linked to suppliers and their agents on the ground, for trouble shooting, to create trust among customers, and to safeguard portfolio growth. If loan officers are in direct contact with (sales representatives) of the suppliers, the officers become more naturally motivated to promote solar loans among their customers. The below box shares lessons learned on partnership development:

Building effective partnerships - not always an easy task

Developing partnerships between technology providers and (M)FI's has not been an easy task. Key challenges / lessons learned from similar programmes (building partnerships between FIs and suppliers) are the following:

- Long periods taken to develop one partnership with an (M)FI
- Bureaucracies existing within MFI
- Conflict on interests and needs
- Lack of interest among MFI's
- Long distances covered to very rural places to meet MFI's
- Technical service providers failure to meet MFI clients demands due to their inadequate capacity
- Lack of renewable energy awareness among many MFI staff derailing the partnership development process
- MFI management board politics
- Unethical business practices among the technology providers and officials of MFI's
- Unrealistic demands by FI's such as huge staff commissions that lead to high biogas and solar prices

This can be tackled through coaching FI's in some key prerequisites for building effective partnerships. These include:

- Putting themselves in the shoes of a technology provider and asses the added value of a partnership for them
- Presenting a clear value proposition when approaching potential partners
- Ensure the partnerships is "sealed" throughout the organization, especially the loan-officer and the solar supplier / agent need to know and understand each other well
- Integrating the right incentives within the loan-officer system to motivate energy lending ideally not isolated bonuses but integrated in the existing bonus model

6.4.2 Guarantee facilities at banks

The LEAD fund is not anticipating to establish guarantee funds at banks, mostly related to the fact that some of these funds have not been proven to be effective, even in more developed energy markets in East Africa. Supporting companies in a nascent market as Madagascar are likely to be better served through the financial instrument described above (credit lines and results based financing)

We would however still advise to keep a guarantee instrument in mind for later stages for two reasons:

1. **Sustainability:** If local banks become more familiar and remain more actively involved in the energy access sector, there will be higher chance for continuous growth of the solar market growth (and hence access), after the fund period
2. **Appropriateness:** The interviewed banks specifically mentioned to be interested in guarantees rather than credit lines for on-lending: liquidity did not seem to be an issue. The more pressing need is to reduce the perceived risk in a relatively "new".

Ensuring that (future) credit provided by financial intermediaries can be used to facilitate growth in the industry, partial credit guarantees with a built in first loss coverage will be helpful to develop and implementing long-term projects and company strategies. A credit guarantee facility could cover part of the financial intermediaries' losses due to loan defaults and failure of the financed and supplied equipment. These facilities can stimulate offerings with longer tenors, as well as more flexible interest rates (see next section for further detail)

A few banks are already providing SME finance, have shared their interested in the sector, or already have some experience lending to the clean energy sector. Examples are BFV-SG, MCB, BNI, Bank of Africa and BMOI. These banks could be potential participates if such a facility is introduced in the future.

Recommendations & lessons learned for potentially **future** guarantee instruments, based on lessons learned from other clean energy funds, are the following:

- Guarantees have acute abilities to generate financial leverage and catalyse lending to borrowers and technologies with higher perceived risk return ratios.

- Guarantee coverage could be 50% of the outstanding individual loan principal. At time of this study, some Malagasy institutions requested a higher percentage. Losses experienced would then be equally split between the fund as a guarantor and the financial intermediary as a beneficiary of the guarantee. It is advised to agree on a maximum guarantee amount.
- A first loss guarantee is often also requested by intermediaries. First loss guarantees cover losses in a predefined loan portfolio of a financial intermediary in a pre-agreed manner. For example, the fund could cover up to 5 or 10 % of the Guarantee Facility Limit. The actual first loss coverage will depend on past performance of similar loan portfolios of the financial intermediary and risk profile of the target portfolio.
- Finally, a combination of both types of guarantees reduces the risk further at the financial intermediary and is likely to have a stronger stimulation effect in lending to the sector. In case default occurs, initially the first loss layer can be applied. When the first loss layer is exhausted, the partial guarantee facility can be used, up to the percentage as agreed (e.g. 50 %).

Design and delivery

As revealed through an IDB study on green guarantees undertaken by Enclude, it is important to find the appropriate organizational arrangement to ensure the lowest transaction costs. Typically, two different models are used for guarantees - full delegation to a public or private entity, or full ad hoc structure whereby the donor retains remit over the guarantee. The latter is typically administered through a trust fund structure with governing bodies to make investment decisions.

Considering LEAD's anticipated fund size of around USD 50M, and that there is not likely to be a local national development bank or local FI with the requisite ownership, interest or skills to manage such a facility, we suggest the full ad hoc structure.

Since an ad hoc structure would require experts be hired to market and execute the guarantee (in accordance with the investment guidelines and constitutional documents), it is a more costly option. Furthermore, with this independent structure it takes more time to gain the acceptance by the local financial sector.

In the Enclude study previously cited, we also noted that accompanying TA is crucial to address both the supply and/or the demand side of credit. In the short term, the local FIs will need the guarantee to bring down perceived risk and overcome their insistence on prohibitive collateral requirements, whilst the TA can be used to build in-house capacity and skills for loan appraisal and marketing so that over time, the perceived risks will decrease even further, in turn assuring the eventual phase out of the guarantee. TA is furthermore suggested to avoid unused facilities, which is unfortunately quite common for these type of support structures.

A key principle is that the financial instrument itself doesn't solve the challenge that the RE/EE sector is still new and unknown for most financial institutions, even though these institutions are capable of doing complex credit assessments and loan appraisal. Energy credit lines are often accompanied with direct technical assistance to financial institutions, to ensure pipeline building continues through various channels and networks, technical feasibility studies are being executed to support the loan assessments and effective partnerships are built.

The below box illustrates a few lessons learned from green credit lines and examples of similar guarantee facility reserve sizes and leverage effect:

Lessons learned from designing, managing and evaluating green credit line programmes suggest some ways of maximizing their impact

- **Take on a promoter role** by actively searching for investment opportunities and by helping companies and bank staff in overcoming technical, commercial and operational barriers to making projects investment ready. Under the Access to Finance for Small Electricity and Water Operators programme in Cambodia, the TA provider liaised with key stakeholders in the sector (the Cambodia Water Association and the Electricity Authority of Cambodia) to identify the main challenges of businesses, and worked together with a project partner to provide direct technical support to potential investees to overcome them.
- **Target activities that have a powerful transformative or demonstration effect.** An example of this the BIO2Watt biogas plant financed by the SUNREF programme in South Africa. This project facilitates the transmission of electricity via an existing grid which, in its current form, had never been done before in South Africa. This project opens the door for the development of more industrial scale biogas plants in South Africa. Furthermore, the plant has created over 50 direct and indirect permanent and about 100 temporary jobs in a rural area, where employment opportunities are generally scarce.
- **Utilise and frequently update a simple but well-designed positive list of eligible measures** to be financed under the programme since this enhances the confidence of both bank staff and clients into the programme. This is one of the key lessons learned in the EBRD funded ROSEFFF programme Enclude carried out in Romania.
- Mexico's Financiera Nacional del Desarrollo (FND) began offering a credit guarantee in 2011 to cover individual loans and loan portfolios for sustainable forestry. With a total reserve size of US$ 7.5m over three years of operation 14 guarantees were issued, leveraging US$ 1,899,570 or 1:10 ratio.
- Central American Bank of Economic Integration (CABEI) began offering a credit guarantee in 2008 for individual loans for small scale renewable energy through its Accelerating Renewable Energy Investments in Central America and Panama (ARECA) project. With a coverage ratio of between 35 and 75% depending on loan size, the facility held US$ 7m, and issued 3 guarantees leveraging US$ 13.6m or 1:5 leverage ratio.

Aggregation

LEAD could assign a dedicated financing intermediary to aggregate and rapidly appraise loans at lower transaction costs for standalone systems that meets pre-approved, standard project specifications and agreements. This intermediary could be public or private; however in the case of Madagascar an MFI or commercial bank would be ideal.

Annex 1: Reports and documents consulted

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Annex 2: Household Questionnaire

Block Label	Question	Skip Logic	Script – ENGLISH
Enclude			**EN**
intro	Intro	1-> Q1, 2-> ThankYou	Hello! We are conducting a short research survey to learn about your energy use and interest in solar products. This survey will take 10 minutes and will use the keypad on your phone. Your information will be kept private. Would you like to take part in this survey? For yes, press 1, For no, press 2
	Location	All -> Q1	What is the location of your home? For I live in the country side or in a very small village, press 1 For I live in a small town, press 2 For I live in the outskirts of a large town or city, press 3 For I live in a large town or city, press 4
Q1	Solar	All -> M1	Do you know what solar products are? For yes, press 1, For yes, and I own a solar product, press 2 For no, press 3
M1	Explanation	All -> Q2	Solar products convert energy from sunlight into electricity. That electricity can be used for lighting, charging your mobile phone, and even powering TVs and fans and other appliances.
Q2	Traditional	All -> Q4	What energy source do you MAINLY use to light your home? For the electric grid, press 1 For a generator, press 2 For a kerosene lamp, press 3 For candles, press 4 For wood, press 5 For a torch with batteries, press 6 For none of these, press 6
Q3	Solar	Entrance rule: Q1=2 All -> Q4	What type of solar product do you have? For single light, press 1, For single light and phone charging, press 2 For multiple lights, press 3, For multiple lights and TV, press 4 For another solar product, press 5 For none of these, press 6
Q4	Alternative	ALL -> Q5	What do you use electricity for other than lighting? For mobile phone charging, press 1 For listening to the radio, press 2 For watching TV, or powering other appliances, press 3, If you only use it for lighting, press 4
Q5	Artificial	ALL -> Q6	Yesterday, for how many hours did you use artificial light (not sunlight)? For Less than 1 hour, press 1 For 1 to 2 hours, press 2

Block Label	Question	Skip Logic	Script – ENGLISH
Enclude			**EN**
			For 2 to 4 hours, press 3 For More than 4 hours, press 4 If you don't know, press 5
Q6	Problems	ALL -> Q7	Are there times in the year when you are not able to afford this energy source? For frequently, press 1 For sometimes, press 2, For never, press 3, If you don't know, press 4
Q7	Spending	All --> Q8	How much do you spend on average on this main energy source, per week? For less than 1000 MGA, press 1, For 1,001-2,000 MGA, press 2, For 2,001-5,000 MGA, press 3, For 5,001-10,000 MGA, press 4, For more than 10,000 MGA, press 5, If you don't know, press 6
Q8	More	If not a solar user-> Q9. If solar user -> Q10	If you had a better electricity source at home, what would you use it for? For lighting, press 1 For mobile phone charging, press 2 For radio, press 3, For TV and/or fan, press 4 For powering larger appliances like a fridge, press 5, For something else, press 6
Q9	Product	Only if they don't already own a product. 1 -> Q12, 2 -> Q11	Now we will talk more about solar products. Solar products convert energy from sunlight into electricity. Would you want to own a Solar product? For yes, press 1, For no, press 2, If you don't know, press 3
Q10		Only if they already own a product. 1 -> Q12, 2 -> Q11	Now we will talk more about solar products. You said you already own a solar product. Would you want to own another solar product? For yes, press 1, For no, press 2, If you don't know, press 3
Q11	NotBought	All-> Q13	Why are you not interested in a solar product? If you did not know enough about the technology, press 1 If you are worried about quality of the products, press 2 If you are afraid that you will overpay, press 3 If you cannot afford it, press 4 If you do not know where to buy it, press 5 If you have another reason, press 6
Q12	NotBought	All-> Q13	Why haven't bought a(nother) solar product yet? If you did not know enough about the technology, press 1 If you are worried about quality of the products, press 2

Block Label	Question	Skip Logic	Script – ENGLISH
Enclude			**EN**
			If you are afraid that you will overpay, press 3 If you cannot afford it, press 4 If you are saving for a larger solar system, press 4 If you do not know where to buy it, press 5 If you have another reason, press 6
Q13	Loan	All-> Q14	Would you be more interested in buying a solar product if: You were able to buy the product on a repayment plan, press 1, You were able to rent the product, press 2, If you don't know, press 3
Q14	Pay	Only if at least one of Q9 and Q10 is Yes; All-> Q15	How much approximately would you be willing to pay for a solar product per week? For 1,000 or less, press 1, For 1,001-2,000, press 2 For 2,001-5,000, press 3, For 5,001-10,000, press 4 More than 10,000, press 5 If you don't know, press 6
Q15	Modern	All Q-> 16	"Which of the following benefits of solar lighting is most appealing to you? For Cost savings, press 1 For Convenience (not having to go to the market), press 2 For Safety (no risk of fire), press 3 For Better light indoors, press 4 For Reliable power for phone & powering other appliances, press 5 If you don't know, press 6
Q16	Quality	All Q-> 17	"What makes you think something is a quality product? For Reputation of the product's brand, press 1 For Behavior of the company selling it, press 2 For Warranty certificate or guarantee, press 3 For Recommendations from friends/family, press 4 For Government recommendation, press 5 If you don't know, press 6
Q17	Sector	All respondents; all -> Q18	"What is your household's main source of income? From agriculture/agriculture activities, press 1 From a salaried job with individual (house help, driver, guard, etc), press 2 From a salaried job with government, press 3 From a salaried job with a private company, press 4 From casual or day labor, press 5, From own business, press 6, For anything else or no source of income, press 7
Q18	Income	All -> Q19	"What is your estimated weekly income? For less than 10.000 MGA, press 1, For 10.001 - 20.000 MGA , press 2 For 20.001 - 40.000, press 3,

Block Label	Question	Skip Logic	Script – ENGLISH
Enclude			**EN**
			For 40.001 - 70.000, press 4 For more than 70.000, press 5 If you don't know, press 6
Q19	Fluctuate	Thank You	"How often does your income go up and down depending on the season? For frequently, press 1 For sometimes, press 2, For never, press 3, If you don't know, press 4
Thank You	Thank You		Thank you for your time. We will use this information to help offer better solar products that will you save money and improve your life. Goodbye!

Annex 3: SME questionnaire

Company name	Details
Interviewee	
Interviewed by	
Date of interview	
In business since	Year
Sector	
Type of firm	Short description of activities
Location of activities	City/province
Urban/Rural	
Number of employees (FTE)	
Electricity/Energy use	
For which activities do you use electricity?	-Office (lighting, computer, heating) -Production – exact machine/use -Do you use electricity for grinding, cold storage, chilling or water pumping? (tailored technical solar solutions are available)
Are you connected to the grid?	Yes/No
If yes, what type of connection do you have	a) domestic b) 415v c) 11kv d) 33kv e) 66kv f) 132kv g) domestic water heating
Do you use a diesel powered generator? If yes, what is the rated power (kVA)?	-Own generator -Shared generated - how old is the genset and what is its capacity?
Do you use renewable energy? If yes, what is the installed power (kW)?	E.g. solar, wind
Do you use other forms of energy?	E.g. thermal energy (wood/oil) which could be generated by electricity
On average, how many hours do you use energy per week?	For each type of energy used
How much electricity does your company use in total per month?	kWh/month (total and per energy source)
Electricity costs	
What percentage of your total monthly expenses are electricity costs?	
How much do you pay for electricity in total per month (including connection fees)?	MGA/month (total and for each energy source)
Electricity outages (if connected to the grid)	
How often is there an electricity outage during operational hours? Average duration of the outages?	
What happens when there is an outage during operational hours?	1. Workers do the same activity manually 2. Workers switch to another (manual) activity 3. Employees return after working hours to make up for lost time 4. Nothing, work is resumed after the outage 5. Other
Which solutions do you use when there is a power outage?	
Do you incur any additional costs due to power outages? If so, what type of costs? And how much?	-Increased fuel costs for generator -Loss of material / damaged goods -Damaged equipment -Extra labour costs -Other
Awareness and Interest in Solar	
Do you know what solar is? Where to buy it?	

Would you be interested in a solar product? Why/Why not)	
Willingness To Pay - Scenario: You can buy a renewable energy solution that ensures a reliable energy supply 24 hours a day.	
Would you pay a 20% increase in price per kWh of electricity?	
What is the highest price that you would pay per kWh (or per month) for a reliable energy supply?	
How would a fully reliable energy supply affect your business?	
Investment priority	
In your current investment plan, what priority would you give to an investment in energy	Rank 1-10 (1 lowest, 10 highest)
What would be the maximum investment you would consider (assuming a positive net present value of the investment)	Amount
Would you be willing to take a loan from a bank at market rates? (%)	a) yes, b) no, if no, why not

Annex 4: Supply Assessment - Draft Technology Provider Interview topics

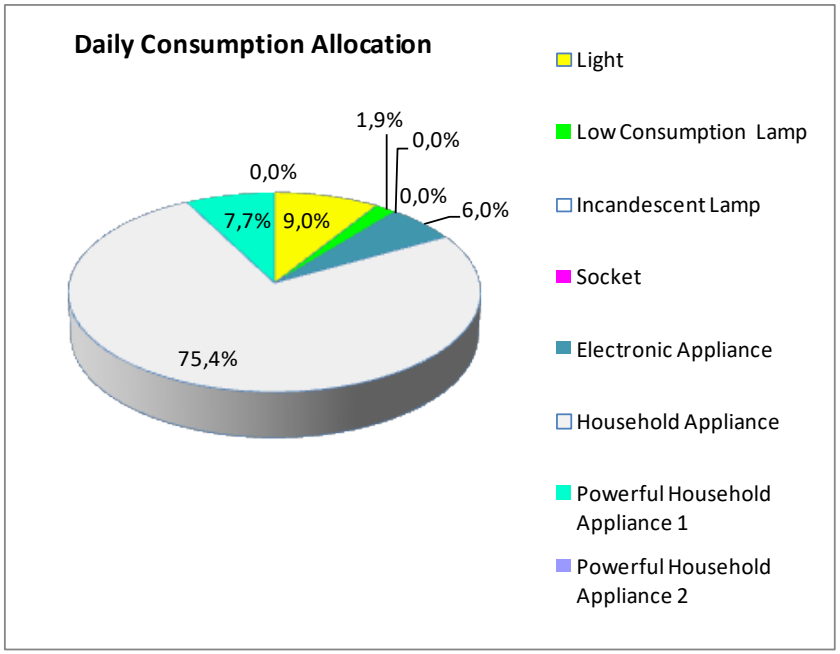
#	Company name	Details					
	Interviewee						
	Interviewed by						
	Date of interview						
	In business since	Year					
	Type of entity	Profit / NfP / Social Enterprise					
	Type of firm	Short description of activities					
	Location of activities	City/province					
	Urban/Rural						
	Number of employees (FTE) (fixed and contracted)	Fixed and Contracted vs rural outlets /F ranchises					
	Target market (hh, SMEs, institution)						
1	**Operations**						
1.1	What is your product portfolio / what type of services do you provide?						
	Please describe your business model						
1.2	Stage of the business	Seed stage – an idea/concept/business plan without tested product or service and revenue	Early stage – a validated product or service with initial revenue stream but negative cashflow	Growth stage – a solid business model generating positive earnings and poised for further growth	Mature/Expansion – an established business poised for further growth, by geography, segment, product, acquisition		
1.3.	What is your level of profitability/ retained earnings in USD ?	Less than $100,000	$100,000-$500,000	$500,000-$1M	$1M-$2M	$2M-$5M	Greater than $5M
2	**Market & end user financing**						
2.1	What is your view on the HH, SME and insitutional sector for solar specifically?						
2.3.	What are your key challenges to do business / grow your company ? / reach your target market ?						
2.4.	Who are your closest competitors?						
2.5	Do your customers typically require financing to buy your products?						
2.6	If so, who are the providers / what type of financing would you like to provide ?						
2.7	Have you heard of PAYG ?						
2.8	Have you consdered partnering with an (M)Fi?						
2.9	What is needed to accelerate the access to stand alone solar in Madagascar?						
3	**Financing**						
3.1	Have you ever received external funding / what type ? (and how much ?)	Own Equity	Third Party Equity	Debt	Grant / Award		
3.2	What type of financing would you need / and for what reason	Working capital (Including distributor/consumer credit)	Operating Expenses (incl. cap	Capacity building/training	Marketing	HR/Staffing	Research & Development
3.3	How much external financing are you seeking in the next 2 years ("short-term")? (US Dollars)	Own Equity	Third Party Equity	Debt	Grant / Award		
	How much external financing are you seeking in the medium to long term from 3-7 years (US Dollars)?	Own Equity	Third Party Equity	Debt	Grant / Award		
3.4.	Who are your most likely local financing providers? (e.g.. Banks, MFIs, NBFI) + what is your experience so far?						
3.5.	Do you have access to international financing providers?						
3.6.	What is your biggest barrier to accessing other types of financing?	Can't find funder interested in my sector/business profile	Can't find funder willing to take a risk at this stage	Funders' terms do not match my business profile	Funders' timelines are too long and I need financing immediately	I am not trying to access financing right now	

Annex 5: Detailed Calculations of Health Clinics' Power Needs

Estimation of daily needs per clinics

	Code	Designation		Equiv Unit Power W	Total Units	Total Power W		Equiv Use Hour H	Equiv Unit Cons° WH	Total Cons° WH	Equiv Ks Simultaneity Coeff	Real Cons° WH	kWH	Rate
	L	Light		20	8	160		4,75	95	760	0,93	704	0,7	9%
	LCL	Low Consumption Lamp		13	4	52		3,13	41	163	0,90	147	0,1	2%
	IL	Incandescent Lamp												
	S	Socket												
	EA	Electronic Appliance		56	4	225		2,10	118	473	1,00	473	0,5	6%
	HA	Household Appliance		103	6	620		9,52	983	5 900	1,00	5 900	5,9	75%
	PHA1	Powerful Household Appliance 1		800	1	800		0,75	600	600	1,00	600	0,6	8%
	PHA2	Powerful Household Appliance 2												
		Total		**81**	**23**	**1 857**		**4,251**	**343**	**7 895**	**0,99**	**7 823**	**7,8**	**100%**
												soit 8 kWH		

Building	Place units	Code	Appliance	Unit	Unit Power W	Total Unit	Total Power W	Observation	Use Hour H	Unit Cons° WH	Total Cons° WH	Ks Simultaneity Coeff	Real Cons° WH	kWH	
CSB II 7 Sallles															
CSB II 7 Sallles	7	L	Eclairage Reglette 0,60	1	20	7	140	Intérieur	4	80	560	0,90	504	0,5	
CSB II 7 Sallles	1	L	Eclairage	1	20	1	20	Extérieur	10	200	200	1,00	200	0,2	
CSB II 7 Sallles	4	HA	Ventilateur	1	55	4	220	4 unités	5	275	1 100	1,00	1 100	1,1	
CSB II 7 Sallles	1	EA	Desktop	1	80	1	80		2	160	160	1,00	160	0,2	
CSB II 7 Sallles	1	EA	Imprimante	1	30	1	30		0,25	8	8	1	8	0,0	
CSB II 7 Sallles	1	LCL	Lampe d'accouchement	1	13	1	13		0,5	7	7	1	7	0,0	
CSB II 7 Sallles	1	HA	Congélateur	2	200	2	400		12	2 400	4 800	1	4 800	4,8	
CSB II 7 Sallles	1	PHA1	Autoclave	1	800	1	800	Stérilisation	0,75	600	600	1	600	0,6	
Logement medecin															
Logement	3	LCL	Eclairage	1	13	3	39		4	52	156	0,90	140	0,1	
Logement	1	EA	Laptop	1	40	1	40		2	80	80	1,00	80	0,1	
Logement	1	EA	TV	1	75	1	75		3	225	225	1,00	225	0,2	


Daily Consumption Allocation
1,9%
0,0%
0,0%
0,0%
6,0%
7,7%
9,0%
75,4%
Light
Low Consumption Lamp
Incandescent Lamp
Socket
Electronic Appliance
Household Appliance
Powerful Household Appliance 1
Powerful Household Appliance 2

Annex 6: RBF Models

Model types

- **Advance Market Commitments (AMCs)** is a binding contract, offered by a donor or another financial entity that can be used to guarantee a viable market (and price) for service providers. Through such a commitment, the market for that product would become large and attractive enough for any service provider to be willing to invest. Advance Market Commitments could thus encourage private companies to invest in the development of new low-cost products and to make services available to an otherwise neglected market segment.
- **Cash on Delivery (COD) Aid** is an RBA approach that is donor-to-government funding. It refers to a specific form of RBA in which a donor commits to paying the recipient a fixed and agreed sum for each increment of progress against an agreed outcome, for example, US$ 100 for each additional child entering secondary school. The key features of COD are:
    1. the donor pays only for an outcome, not for inputs;
    2. the recipient has full responsibility for and discretion in using funds;
    3. the outcome measure is verified independently;
    4. the contract, outcomes and other information are disseminated publicly to ensure transparency; and
    5. the funding complements other foreign aid or domestic resources.
- **Outcome-Based Aid (OBA)** focuses on aid payments, conditional upon achievement of specific outcomes, from donors to governments of developing countries. Such agreements are rare so far. Unlike PFS arrangements, outcome-based aid is an agreement between donors and recipient governments, and it does not involve private investors or yield a return. In practice, outcomes have often been relatively straightforward and focused on big-picture results (e.g., immunization rates or reduction in deforestation). This focus on larger outcomes suggests this financing tool might be used to support a portfolio of complementary projects and activities rather than a specific program.
- **Output-Based Aid (OBA)** unlike the preceding approach, output-based aid focuses on what is directly delivered, linking aid payments with the delivery of basic service outputs, such as certain health services. Under an OBA scheme, service delivery is contracted out to a third party, i.e. a public or private or NGO, which receives a subsidy to supplement or replace the user fees. The service provider is responsible for "pre-financing" the project until output delivery. The subsidy is performance based, meaning that most of it is paid only after the services or outputs have been delivered and verified by an independent agent. OBA is explicitly targeted to benefit a poorer segment of the population. A subsidy that substantially lowers the price paid by the beneficiaries in targeted households or geographic areas makes it more likely that they can afford the services.
- **Social Impact Bonds (SIBs) and Development Impact Bonds (DIBs)** are the same concept applied in different contexts.
    - ✓ Social Impact Bonds (SIBs) improve the social outcomes of publicly funded services by making funding conditional on achieving results. Investors pay for the project at the start, and non-profit or private sector service delivery organisations deliver the outcomes. If successful, the investors get remunerated by the government based on the results achieved by the project.
    - ✓ Development Impact Bonds (DIBs) use the same concept, bringing together private investors, service delivery organisations and Governments with the additional participation of donors that can serve as guarantors for payments. Investors provide upfront funding for development programmes, and are later remunerated by donors (and/or host-country governments) if evidence shows that programmes achieve pre-agreed results. If the intervention fails, investors lose some or all of their investment.
- **Program-for-Results (PforR) or Performance linked Payments** was introduced by the World Bank in 2012 as a new lending instrument. As such it complements the World Bank's two existing lending instruments – investment lending (projects) and policy based lending (budget support). A PforR supports government programmes of expenditures and activities, and links the disbursement of funds directly to the delivery of pre-defined results. Once results have been achieved and measured using so called Disbursement Linked Indicators (DLIs), an agreed amount of programme spending is released.

The PforR instrument has a special focus on strengthening institutions and systems needed for the government programme to achieve the desired results. The PforR uses government systems and seeks to strengthen the systems rather than building parallel project implementing structures. The programmes can be co-financed by governments' own revenues and by other development partners.

- **Conditional Cash Transfers (CCTs)** use financial incentives in relation to individuals or households to encourage the use of certain services, like sending children to school. These results are made conditional by providing a financial subsidy or incentive to an individual or households, thus strengthening the demand side of services like energy services. CCT schemes often combine cash incentives with increased and improved supply of services to be able to respond to an increased demand by individuals or households.
- **Budget Support with performance tranches:** Budget support is an un-earmarked payment made to a government in return for commitment to good governance and satisfactory progress in poverty reduction. Budget support operations include a performance monitoring system that allows funds to be disbursed through base (or fixed) tranches and variable (or performance) tranches – linked to progress against specific indicators. The variable tranche can therefore be used to link financing to the fulfilment of actions or results obtained. The share of the variable tranche is balanced to provide incentives whilst avoiding excessive volatility.
- **Inducement Prizes**: are a results-based instrument in which the achievement of a predefined goal is rewarded with an incentive (usually, though not always, a lump-sum cash payment).
- **Auctions**: mainly examples for improved cook stoves programmes, not relevant for this study

Figure 29: Types of Result Based Financing mechanisms

	Example	Investor type	Type of results	Recipient	Timing
Development impact bond	India rural education development impact bond	Private, philanthropic, and multi- or bilateral organizations	Outcomes	Service provider	Up-front
Outcome-based aid/financing	Amazon Fund	Multi- or bilateral organizations	Outcomes	Service provider or government	Reimbursed
Output-based aid/financing	Global Partnership on Output-Based Aid	Multi- or bilateral organizations	Outputs	Service provider or government	Reimbursed
Performance-linked payments	World Bank Program for Results	Multi or bilateral organizations	Outcomes or outputs	Government	Reimbursed
Conditional cash transfers	Bolsa Familia	Multi or bilateral organizations	Outputs	Individuals	Reimbursed
Pay for success	Massachusetts Juvenile Justice project	Private and philanthropic	Outcomes	Service provider	Up-front