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# 1. Executive Summary

This report summarizes the main results and activities of the RePower project in Ambararatabe, Madagascar, including a feasibility study done during the site visit, the household survey conducted by Green Africa Youth Organization (GAYO) and University of Nairobi (UoN), as well as the feedback from various stakeholders involved since the start of the project. It also provides an overview of the key stakeholders, how they were engaged, and the methods used to ensure the community's active participation.

The project focuses on meeting the needs, values, and economic conditions of the local community. To achieve this, Africa GreenTec Madagascar (AGT-M) has worked closely with the Ministry of Energy (MEH), the Agency for Rural Development (ADER), local leaders, small businesses (SMEs), and community representatives. multi-stakeholder-cooperation is essential for the project's long-term success, making sure it provides clean and reliable energy for a as large as possible part of the population and local businesses while addressing the interests of all parties involved.

This report highlights the project's progress, the involvement of key stakeholders, and the community engagement strategies used, giving a clear overview of the steps taken to align the project with local needs and policies.

# Abbreviations

| | |
|---|---|
| AC | Alternating current |
| ADER | Agency for Rural Development |
| AGT | Africa GreenTec (partner in RePower) |
| AGT S | Africa GreenTec Madagascar (partner in RePower) |
| AU | Aarhus University |
| BCHP | Biomass based combined heat and power unit |
| BESS | Battery energy storage system |
| D | Deliverable |
| DC | Direct current |
| DTI | Danish Technological Institute (partner in RePower) |
| EC | European Commission |
| EIA | Environmental Impact Assessment |
| EMS | Energy management system |
| GAYO | Green Africa Youth Organization |
| GIZ | German Development Agency |
| UoN | University of Nairobi |
| WP | Work Package |
| WT | Work Task |

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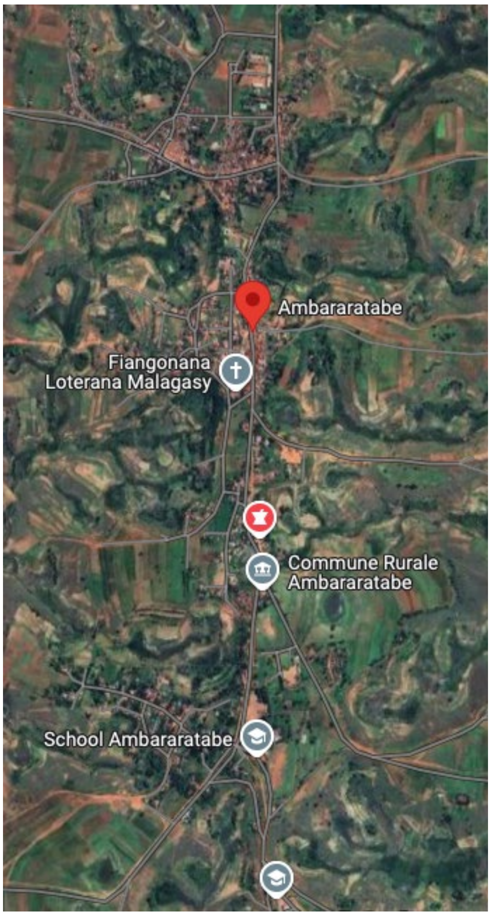
# 1. Introduction

The RePower project in Ambararatabe, Madagascar, focuses on setting up a community-based microgrid to provide renewable energy. This system includes one portable Solartainer unit, pull-out PV system container, a Battery Energy Storage System (BESS), and a Biomass Combined Heat and Power (BCHP) unit. The project's success relies on working closely with local stakeholders. The installation, operation, and maintenance of the microgrid will be done in cooperation with the local community and Ambararatabe’s administration. The project will also follow the national guidelines from the Agence de Développement de l'Électrification Rurale (ADER) and the Ministry of Energy, Water, and Hygiene (MEH).

Located about 184 km west from the capital Antananarivo, Ambararatabe’s remote location led to and will lead to the fact that it is not connected to the national grid. A stand-alone Mini-Grid solution is therefore the go-to-option. RePower brings the inclusive and holistic approach of Africa GreenTec to a whole new level, including a R&D scope, stronger community engagement and new technologies such as the mentioned BHCP, generating electricity from agricultural waste.



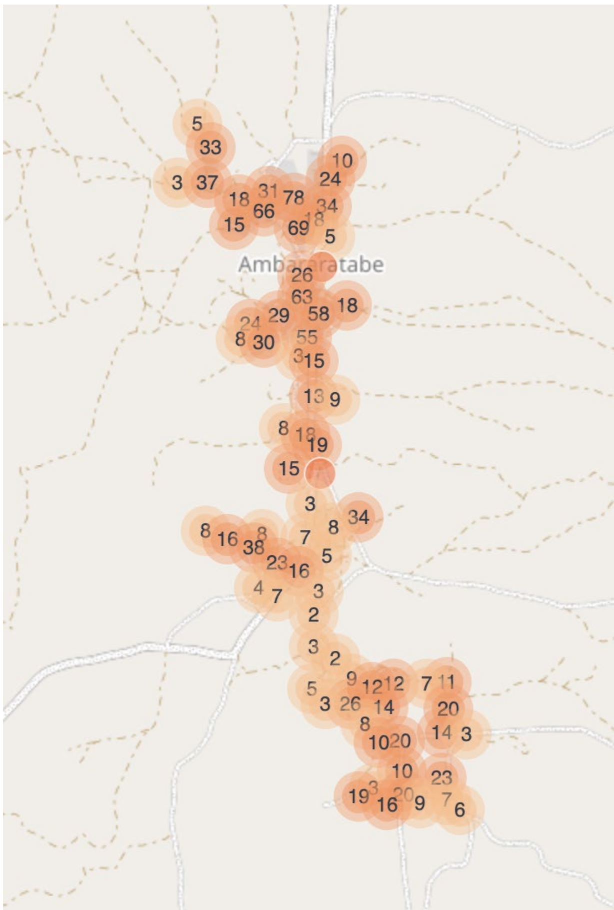



Figure 1: Ambararatabe satellite image. Map from Kobo.org showing surveyed households

Ambararatabe, like many areas in Madagascar, faces major energy challenges. Most people rely on firewood and charcoal for cooking which led to a widespread deforestation and thereby caused degradation of soil – in an area where 9 out of 10 people are working in agriculture. Furthermore, are candles, kerosine lamps and small solar lamps the go-to solution lighting. Besides the very high cost compared to LED lights in a mini-grid, health effects are a big issue. Besides some few diesel-driven machines, no productive use of energy (PUE) is possible in the rural areas of Madagascar.

The RePower project seeks to solve these issues by setting up a community-based microgrid powered by renewable energy such as solar and biomass-based energy through a so called BHCP. A key goal of the project is to involve the community. The feasibility study with their thorough household surveys is the first and most important milestone. This importance is reflected in the numbers below, mainly the 1.347 households being interviewed

*Table about the Ambararatabe village*

| | |
|---|---|
| Region | Bongolava |
| District | Tsiroanomandidy |
| Rural commune | Ambararatabe |
| Village | Ambararatabe et Ambatomitsangana |
| Chief town | Ambararatabe |
| Number of households surveyed | 1.347 |
| Number of households | 329 (source: RGPS 2012 INS) |
| Geographical coordinates | Google Maps Link |
| Population | 4.950 (source: mayor's office) |
| Number of questions asked | 38 |
| Number of consultants on the ground, performing the study | 14 |
| Days of study | 6 |

This report provides a detailed analysis of the stakeholders and explains the community engagement strategies used in the project. It identifies the main stakeholders, their roles, and how they impact the project's success. It also highlights the methods used to build trust and collaboration with the community. The engagement process is designed not only to bring a technical solution but also to address the social, cultural, and economic needs of Ambararatabe, ensuring the project has lasting benefits for the people in the region.

## 1.1. Purpose and objectives of the deliverable

The purpose of the deliverable is to identify relevant stakeholders, both at the local level and in the village, ensuring their active participation, exactly understanding their needs and their vision of a durable socio-economic development and addressing their concerns throughout the project. This report also outlines community engagement approaches, the feedback from the communities that were interviewed, in order to prioritize them and to ensure inclusivity, local ownership, and economic sustainability.

The purpose of the engagement of this is also to ensure:

- That various stakeholders have been informed about the project, the project activities, and the construction of the project, especially considering that the project also includes the Biomass Based Combined Heat and Power unit (BCHP) which is a complete innovation to the Malagasy market
- To get the feedback from all major stakeholders
- To learn and draw knowledge from the communities that could guide the project
- To comply with the local regulations and law in implementing the project

In addition, the report serves as a blueprint to enable engineering team at Africa GreenTec Madagascar (AGT-M) to perform their in-depth technical planning which is then the basis for the financial modelling of the project which has the tariffication of the electricity prices as the main outcome.

## 1.2. Scope and methodology

Given the scale of the project and the systems involved in the project, the local team contracted consultants to carry out the feasibility study. In order to assess the needed system size to serve the electricity demand of a rural community, feasibility studies are often conducted alongside a deep involvement of the community. This is done by sending a team of consultants which is usually at least 8 members (in this case 14) on site for 4-6 days on average. The goal is to interview at least 70% of the households which is challenging as people are travelling, working in the fields, going to church etc. so it needs a lot of perseverance and often several tries per household. If someone is at home, usually people are very open to answering questions as long as the purpose is clear and a community representative joins the auditing team.

Methodology used is as follow:

- Surveys: the consultant hired by AGTM used surveys through a digital platform called Kobo to have maximal transparency and to ease the later on done analysis
- Baseline survery: This was conducted by GAYO and the UoN during the visit to Madagascar
- Field visits: Multiple site visits were conducted in Ambararatabe to directly engage with the local population and assess the on-ground socio-economic context
- Desk research: Doing online research on the village, previous documents on the community

- Using AGT-M contacts to reach out to stakeholders worked with in the past to advice on the engagement with the national government and the local stakeholders

## 1.3. Lessons learned – mythology of the study

1. During the analysis of the study results, the team of AGT-M and the consultants realized that text inputs must be avoided as for some questions, now a thorough cleanup of the data is necessary as e.g. units have been put where only numbers should be possible to enter.
   So, either multiple choice, drop downs or “number only” text fields must be used.

| Value |
|---|
| 33 CH |
| 5KVA |
| 30kw |
| 33 chevaux |
| 18 et 30CH |
| 26 ch, 20kw |
| 26 HP |
| 30 CH |

Figure 2: Example from the load of the existing machinery

| Value |
| --- |
| Abs T1 |
| Abs T2 |
| Absent Potentiel T2 |
| Absent |
| -1 |
| Abs |
| ABS POTENTIELLEMENT T2 |
| ABS |
| Absent Potentiel T3 |
| Absent Potentiel T1 |

Figure 3: Example of the status of the community members (reason why they could not be interviewed)

2. It is difficult to balance between the amount and length of questions, covering still all necessary topics and keep a consistency to keep the results. For performing the studies, a short questionnaire is of course the goal but just asking specific questions can lead to an inconsistency of the results.

# 2. Stakeholder Analysis and Community Engagement

To ensure transparency in the project, the team identified various stakeholders at the national and local level to engage and get feedback.

## 2.1. Identification of stakeholders

- Government agencies: **The Agency for Rural Development (ADER):** They are responsible for both coordination of the efforts of the private sector to electrify communities but also facilitate investments through the preparation of tenders, help with custom-clearance and exemption topics.
- **The Ministry of Energy (MEH) in Madagascar:** covering legislative topics and bigger projects on the megawatt scale. The energy ministry will be only included in the RePower project in a later stage, when it comes to the commissioning of the site, before that they are only informed through ADER.
- **Local communities:** The communities in Madagascar are usually organized in so called "Fokontany" which means neighbourhoods. Each Fokontany has a responsible person who is usually a very respected, elder member of the neighbourhood. The community is thereby represented by each Fokontany and the mayor with his staff. It is very important to keep them well informed and ask for their input as they know best how the cultural and economic conditions are. Also, for each mission, the community must be informed and formally asked for allowance to perform a study, site visit or similar.

  **NGOs and other organizations:** According to the community, no other NGOs are active in the village so far. However, we will include the German Development Agency (GIZ) about two months before we do the commissioning of the mini grid in the following domains:
- **Productive use studies**: to explore further which activities could be performed on top of the already existing. This happens by evaluating the climate and soil conditions to see which agricultural goods are already grown there but not processed locally (the goal is always to have as much of the local value chain as possible within the village) or could be due to the conditions.
- **Productive use consultancy**: the GIZ will present their findings to AGT-M who will of course share this information with the consortium members and the EU Commission.

- **Productive use sensibilization and training:** based on the results of the report and the following discussion within the consortium, but also between GIZ and AGT-M, several focus activities will be identified. Dedicated sensibilisation and training activities will be developed and performed to increase the liveliness of the success of the selected productive use activities such as oil pressing, and tofu production (as soybeans are locally grown in large quantities but often only used for feedstock even though they could add significant value to the nutrition and create a local value chain as the Tofu can be sold to the bigger cities).
- **Private sector entities:** AGT-M and the GIZ will try to convince private sector entities such as agri-processing companies to increase their activities within the community of Ambararatabe to create jobs and an economic upward spiral. We will support this through cheaper and most importantly reliable electricity supply as it would be the case with diesel-powered or state utility network supply.

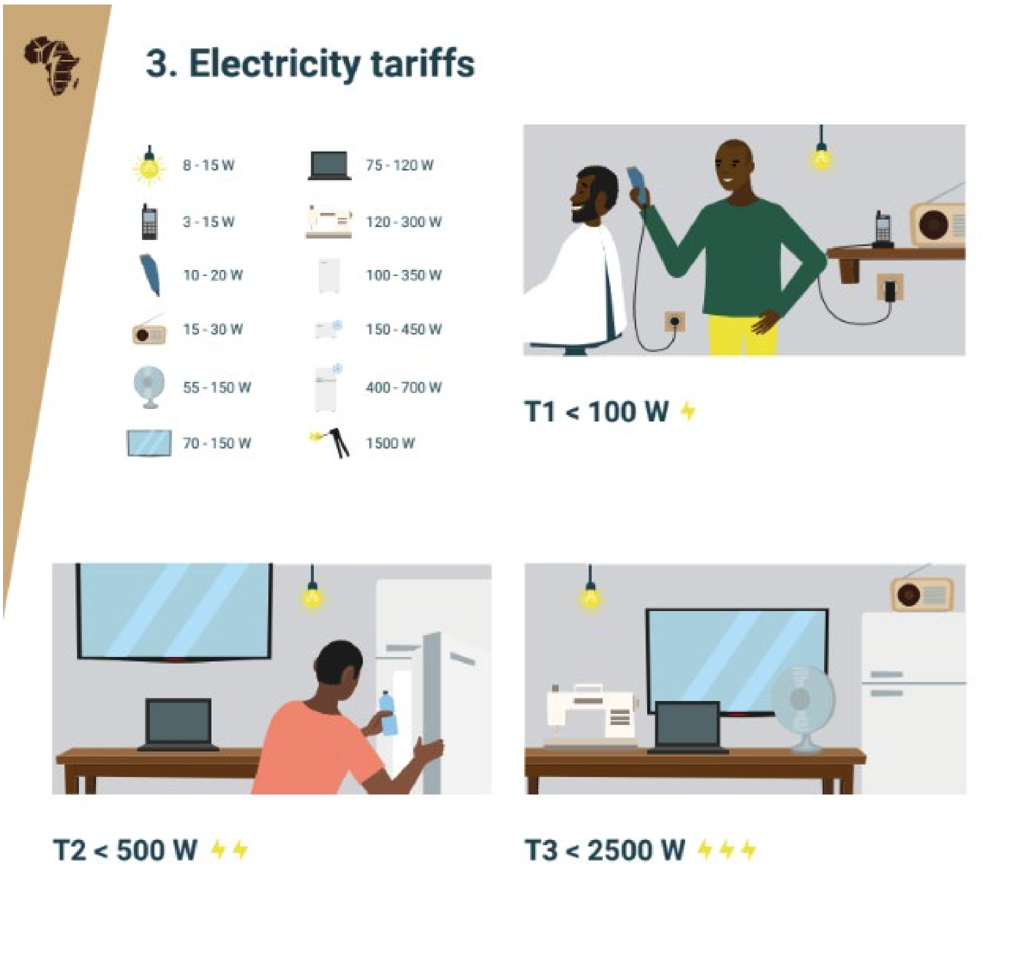
## 2.2. Engagement strategies

**Meetings and consultations:** The most important meeting is before the final decision is taken to electrify a village. This was done in 2021 through a mission of AGT into the area where in-depth consultations have been done with each community to evaluate the willingness to be electrified and of course also the need for it. In any case, it must be avoided to have a “global north centralized thinking” of “we need to bring the blessing of civilisation”. This is the core of our business development. We develop solutions in the global south, for the global south. The specific needs of each community play therefore a major role.

**Workshops and public forums:** Besides the above-described community engagement, there are several public Q&A sessions to inform the population how the tariff system works, how they can get connected etc. For most of them, it is the first time that they have an electricity supply contract. This has proven useful in the past but must be further improved as still there are quite some rumours in the community such as why they have a monthly fixed fee e.g.

- **Non-verbal communication material:** On top of the Q&A sessions we also have comics to explain how things with our electricity work for them, also for people who have difficulties reading.

Figure 4 Here you can find an example of a comic (English version, of course for the




village, it is a Malagasy version). It consists of 4 pages in total.

### 2.2.1. Outcomes of stakeholder engagement

According to the Baseline Survey report from GAYO and UoN, feedback from the community in Ambararatabe highlighted concerns about the cost and availability of energy sources. Most people said that the fuels commonly used in the village are expensive, heavy to carry, and have high upkeep costs. The table below shows the average costs families face for different fuels. While solar equipment is an option, it's too expensive for most families to buy and maintain. As a result, many households rely on cheaper options like wood, which they have to travel to buy and is difficult to handle. Candles, though also used, are costly and can be dangerous, especially for young children, as they can easily cause accidents.

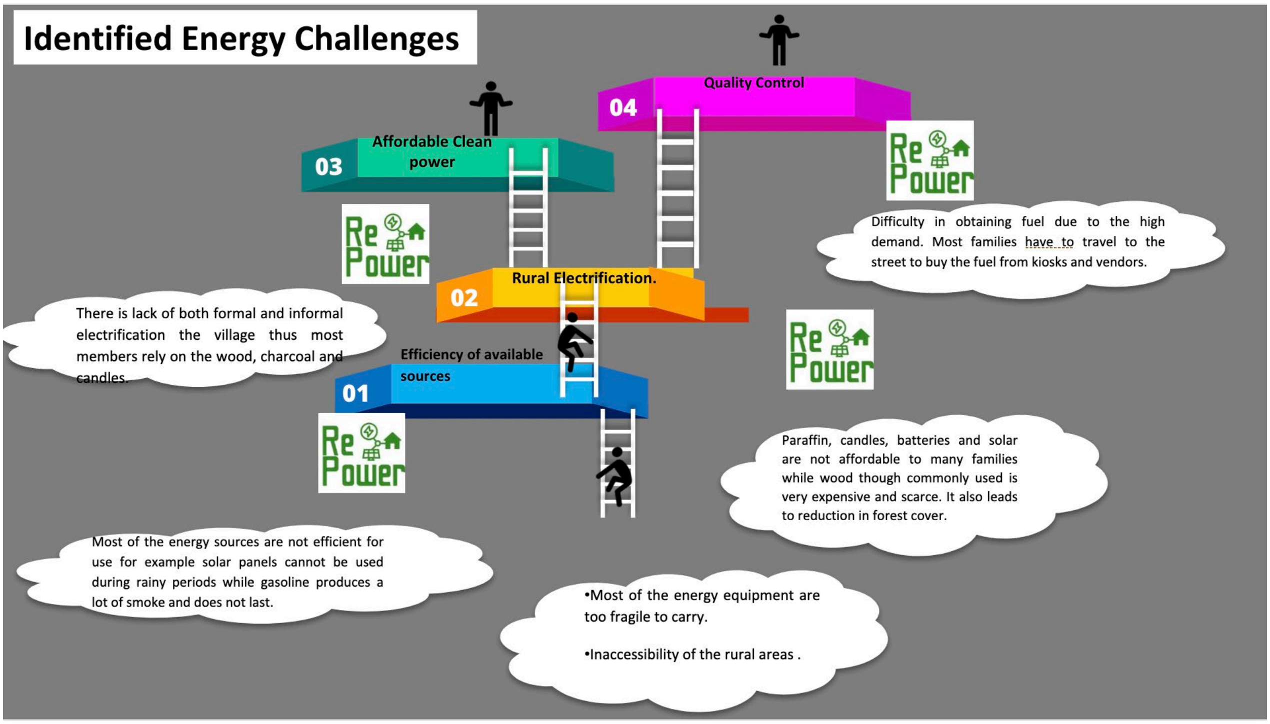



Figure 5: Identified energy challenges in Ambararatabe by GAYO and UoN

Some of the concerns from the rural community people were:

- Can the device be used for production and processing?
- Who will be the people trained on the devices?
- Can the device be used for other income-generating activities?
- How much does the device cost?
- How will water be collected with the device?
- How will you distribute the devices?

**This was also backed up by the feasibility study that also gave a similar perspective of the stakeholder concerns:** Mostly the ability to pay off low-income households have been mentioned. We will therefore add a new tariff to the system which we will call T0. This tariff, specially designed for people who struggle with the payments of the higher tariff classes, works without smart metering but we supply 2 hard-wired LED lamps and 2 USB charging sockets -> no power plug and a flat rate model -> the client pays around 2€/month as a fixed fee and has light and the ability to charge e.g. phones. This model has already been successfully implemented in Ethiopia, Vanuatu and the Philippines by our Swiss partner PowerBlox. **Level of community support and involvement:** The community agreed to support the project will all means which is mainly: providing land, free of charge, for the period of the project and beyond (if we supply electricity which is usually 25 years or more). On top, the community will support with manual labour to a) level the ground for the solar installation etc. b) cut weeds and grass c) sensitizes the neighbours of the site to watch out that no one damages the power plant, submission lines and so on (on top of the 24/7 guard service we will hire locally).

**Challenges and lessons learned:** Expectations for low-income households are usually very high and sometimes unrealistic. Since there are many NGOs in the country, people often expect to get things for free or even get paid for e.g. attending a training session. As AGT-M is a socially and environmentally friendly enterprise but not an NGO, and even though the project is grant funded through the European Commission, the project must be financially viable in order to work even after the 4 years of the project period - as mentioned, usually electricity concession contracts are 25 years in Madagascar. Also, we cannot give things for free to avoid jealousy as other communities in the area will be electrified with lower grant portions (30-40 are usual).

# 3. Feasibility study

## 3.1. Site Visits and Feasibility Studies

Besides technical aspects such as the to be expected consumption behaviour of our future clients, the socio-economic aspects are very important as a demand analysis could also be done via satellite (so-called GIS data). But to get a better understanding of the mindset and the economic activities such as agriculture but also if there are bigger amounts of trade, food processing etc. possible, is one major factor to evaluate the viability of a project.

## 3.2. Methodology for conducting site visits

The most important factors for the site selection (besides the points mentioned in the previous section) are:

- Road accessibility, not just for us and the goods but also to enable trade and market access for the SMEs of the community.
- Water supply throughout the year: mainly for irrigation, so it makes a huge difference how far the next river is and if it dries out in the dry season as this determines if there is a second harvest or not. Drinking water is not so much of a concern in the region as groundwater wells usually work well but are not sufficient or too precious to use for agriculture.
- Population density within the village centre: this factor largely determines the cost of the electricity network (which usually reflects around 30-40% of the total project cost). If communities are very scattered and the houses widespread, viability might not be given as the connection costs may be too high. So even more important than the total amount of households, the village structure plays a major role.
- Existing economic activities: even though we do what we can to stimulate the economic development of a village, it is very hard to start from scratch, so a minimum of economic activity is a big plus when it comes to the site selection as SMEs such as rice husking mills are a major off taker and therefore have a big influence on the financial viability of the project.
- Data collection techniques: we use 100% Kobo Toolbox as data collection throughout all projects with a unified questionnaire to be comparable through the company. This unified data collection method results in a unified data structure and therefore simplified analysis and system design.

## 3.3. Findings from site visits

**Key findings and recommendations**

The detailed study results are available digitally on the exchange drive as everything has been done digitally, so the granularity and quality of data are excellent. However, this report will focus on some key facts.

For the technical dimensioning of the energy supply system (mini grid), as well as for the financial modelling, the most important part is a) the geographical distribution of the potential clients but more importantly b) the way they intend to use the electricity once distributed.

Type of clients, according to the mission/feasibility study:

- Simple households: 986 or 73.2%
- Households & SMEs: 130 or 9.65%
- SMEs: 52 or 3.86%
- Husking mills: 12 or 0.59%
- Welding: 6 or 0.3%
- Institutions: 18 or 1.34%
  - Church: 13 or 0.97%
  - Health centres: 4 or 0.3%

According to our experience, around 50-60% of the overall consumption of a Mini-Grid in Madagascar comes from Productive Use of Energy (PUE) clients, so SMEs, have a more granular view of what people have responded, being asked what kind of business they intent to start or transform to green electricity:

| grocery shop | 98 |
|---|---|
| shop and bar combo | 17 |
| pharmacy/drug store | 2 |
| restaurant | 2 |
| small kiosk | 33 |
| copy shop | 6 |
| hardware store | 4 |
| microfinance | 2 |
| metal works (welding) | 6 |
| husking mills | 12 |

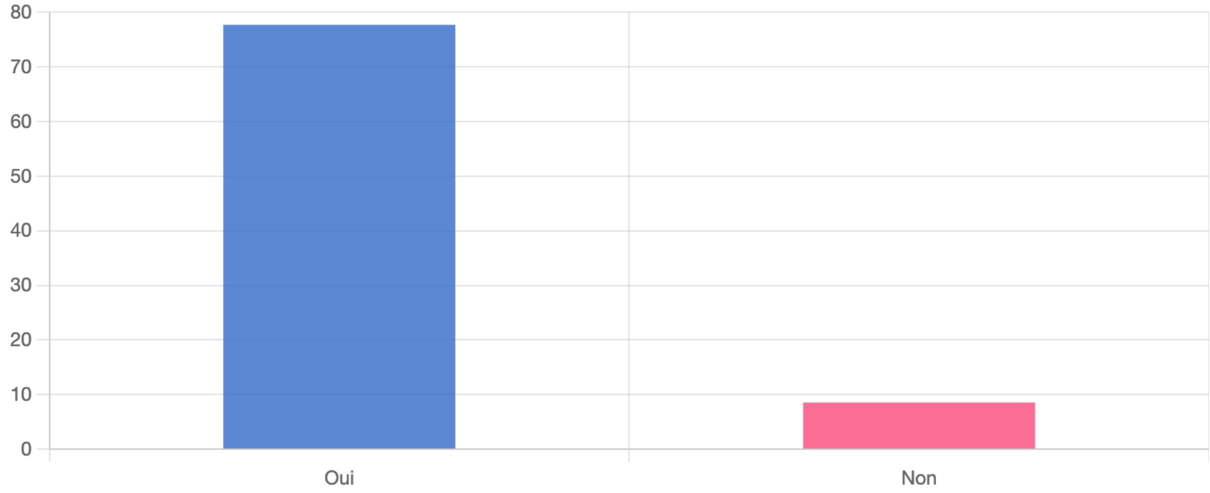
**Absent clients during the survey**

Simple households: 163

Household and SME: 28
SME: 4

**Other economic factors and key findings unrelated to client groups**

1. **Willingness to get connected and ability to pay**




78% have answered that they would get connected, assuming a daily electricity price of 600AR (around 0.12€) per day and a one-time connection fee of 150.000Ar (around 30€).

2. **Existing, diesel driven appliances**
   3 rice husking mills (SB10, 18hp engine)
   1 rice polisher (5hp engine)
   1 Kubota (small tractor, 5hp)
   2 feedstock mills (16hp)

3. **Current spending on energy sources such as candles, oil for lamps, phone charging, batteries and rental of solar/rechargeable lamps per household**

| energy source | mean price per day in AR | mean price per day in € |
|---|---|---|
| candles | 64.4 | 0.013 |
| petroleum lamps | 67.2 | 0.014 |
| phone charging | 42.7 | 0.009 |
| rental of rechargeable lamp | 67.1 | 0.014 |
| batteries | 21.4 | 0.004 |
| | | |
| current daily energy spending | | 0.05 |
| current monthly energy spending | | 1.59 |

Reference exchange rate as of 07.09.2024: 4.974Ar/€

4. **Average monthly spending (covering food, clothes, transport etc.)**
   240457.43Ar or 48.38€

**Technical, economic, environmental and social impact**
**Technical feasibility:** from a technical perspective, the high altitude and comparably low cloud coverage and humidity of the air immensely help a solar-driven project. Furthermore, there is a high number of agricultural SMEs in the area which will provide the biomass for the BHCP in a large quantity.

**Economic viability:** The community is largely active in the processing and trading of agricultural products. This will immensely help the financial viability of the project as SMEs are by far the most important off takers, usually reflecting 40-60% of the total energy consumption. Also, economic activity and well-functioning value chains are the backbone of community development - which is our goal. Electricity is just one tool to reach that. This economic activity in the community is largely to be explained through two aspects: road access as the national road is close by and a relatively high percentage of people with (national) migration background which leads to a high diversity of agricultural and economic activities within the community as isolated sites often suffer from low external inputs and therefore rely on only a few activities.

**Environmental and social impact:** The environmental impact is expected to be not just neutral but positive as a) diesel appliances will be step by step switched to 100% renewable energy, but also b) burning of rice husk and rice straw will be avoided as we will collect the biomass and use it the BHCP as feedstock.

### 3.4. Recommendations based on site visit findings

- Improvements in how we support SMEs in accessing new, efficient machinery -> micro finance + direct sales of machinery (AGT-M is the lead contact to machine manufacturers, does testing and quality insurance and sells machines directly to SMEs with fair conditions such as warranty and feasible prices)
- Support SMEs also in the supply chain definition -> create contacts to potential offtakers of agricultural products to reduce the margin of middlemen and increase the value creation within the community
- Introduce a low tariff, avoiding expensive installations such as smart meters -> around 2€/month flat rate for light and phone charging to leave no one behind.

# 4. Risk assessment and mitigation strategies

See the risk assessment matrix in Annex I

# 5. Next steps and action plan

In the upcoming months the following tasks are to be done:
"Task 9.3 site preparation" and "task 9.5 grid and connection" – by end of November 2024 to not run into the risk caused by the rainy season which starts mid-December. During the rainy season, especially logistics become very challenging.

Furthermore, the regulatory tasks described in "Task 9.2 Permits" will be done within October. The main task being obtaining the construction permit – this task has been intentionally delayed as of signing the contract with the ministry needed to obtain the construction permit will also cause a strict deadline to start (which is usually 12 months after signing the contract between private sector and ADER). Sub-tasks to be completed for that are:

- Obtaining the environmental permit (only a formality as we use 100% renewable energies, no risk of delaying the project therefore)
- Completing the detailed project planning documents also containing the grid plan, signed environmental permit.

# 6. References

- Detailed stakeholder engagement reports
- GAYO and UoN Baseline Survey Analysis Report
- Site visit reports and data
- Additional technical and financial analysis
- Risk Assessment Matrix