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Final Report:

Virtual Minigrid Project Zambia

Leveraging the power of solar and batteries in Sub-Saharan Africa

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1. Summary

Needs on the ground: Many villages in Zambia remain without access to the power grid. While there is trend towards mini grids, they require high capital investments and are very challenging to plan. Therefore, the idea for this REPIC project was to use a highly scalable concept of EnergyHubs that has the potential to be commercially viable.

Technology: The EnergyHub is a containerized battery rental system powered by solar panels. It is self-sufficient which means it can be installed in any area without infrastructure and bring energy to this area. It contains four shelves of LifePo4 latest technology batteries and that can be charged with solar panels with a total capacity of 9kWp that are expandable on both sides of the container for the day operation and can be folded in at night. To be able to charge these small rental batteries at night the EnergyHub contains six batteries that store excess power from the solar panels during daytime to charge the small batteries at night. To ensure charging even during the worst rainy season, it also contains a diesel genset backup.

Concept: The EnergyHhub can provide over 100 families with rental batteries and can be scaled up in case demand increases. These batteries will be rented for a small deposit fee to a family each. The head of the family can register with their National Registration Card (NRC) to gain access and take the battery and light bulbs home for lighting and phone charging. Other appliances that can be connected include solar TV's, music systems, solar fans or laptop charging. When the battery is empty after some days, any family member can bring the battery back to the hub. For a small charging fee, the battery will be charged and can be picked up again to power the appliances the family uses at home.

Pilot Project: The first EnergyHub was installed in June 2019 in the village Nsombo (Zambia) and has been successfully operating over the last months offering the following services to the local community: battery rental, hair-shop, printing and scanning, welding station, freezing space, refrigeration space, entertainment (soccer games and movies). It is also planned to establish a Zanaco Express Agency as well as to offer additional services. Zanaco is Zambia's leading retail bank.

In Togo, a second system was installed in the village of Bodje with an updated overhauled concept, integrated "lessons learned" and the realisation of massive costs savings. The technical specifications remained similar, but to reduce costs further, customers can now also directly borrow light bulbs with integrated batteries.

Outlook: The results are promising as it looks as if a payback time of below two years is realistic. To further strengthen evidence and prepare for a fundraising round, MPower will analyse further data and prepare a concept to implement a series of EnegyHubs on a commercial basis. A further extension of the model could also be to look at combining this with electric mobility.

2. Starting Point

MPower decided to set up the EnergyHubs in areas that are far away from the grid with no grid connection planned for the coming years. After a careful due diligence and a screening of 10+ locations, MPower selected Bodje in Togo and Nsombo in Zambia.

While the general profile is similar, the two locations differ slightly in their profile:

Nsombo, Zambia	**Bodje, Togo**
Population in town: approx.12’000 Population nearby: approx.20’000 Main crops: • Fish farming • Maize • Livestock (poultry, goats, sheep)	Population in town: approx.3’000 Population nearby: approx. 6’000 Main economic activity: • Livestock (poultry, goats, sheep) • Cotton • Soy • Groundnuts • Hibiscus

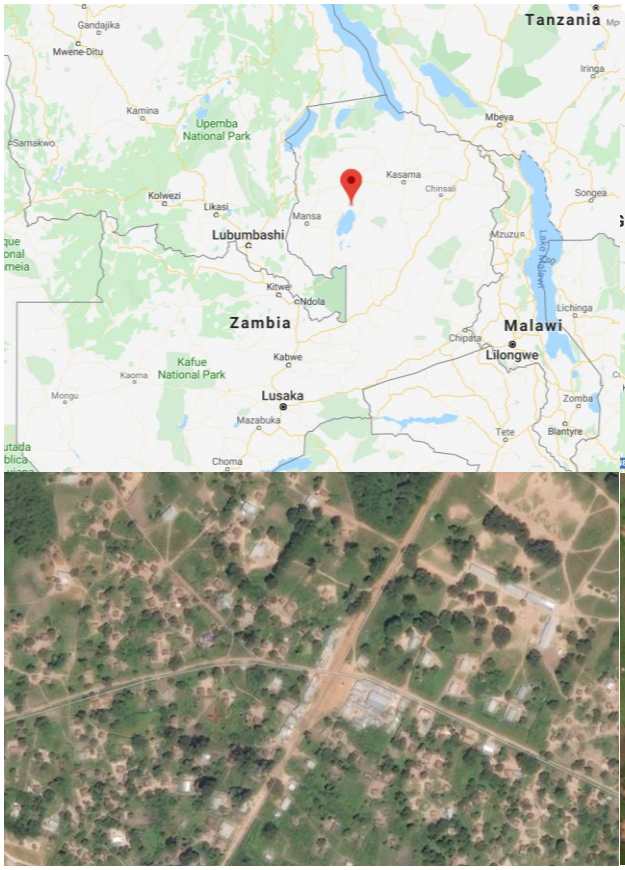


Figure 1: Nsombo, Zambia

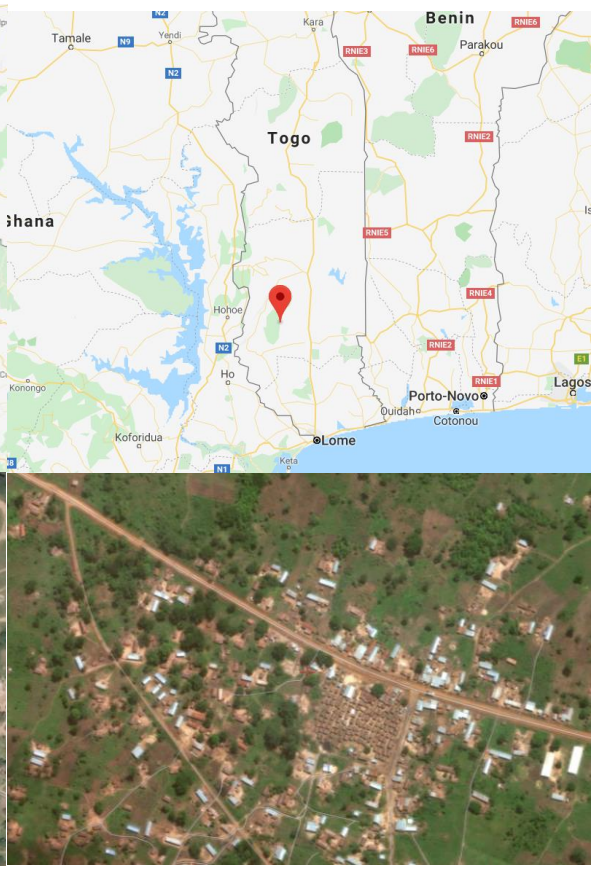


Figure 2: Bodje, Togo

3. Objectives

According to the project proposal there were three main objectives

- Objective 1 - Test customer acceptance: The pilot projects will test customer acceptance of a battery exchange. One key question is whether potential customers would be willing to come to our solar containers and exchange the batteries on a regular basis. Our first field research clearly indicated the acceptance and the enthusiasm for such a model.

- Objective 2 - Experiment with different revenue models and test pricing: By installing two solar containers we can for instance offer and compare two different models: a subscription-based model and a usage-based model (PAYGO).

- Objective 3 - Develop the technological solution and other key components: As the model is new, we would also have to experiment with different solutions and develop appropriate software tools.

4. Project Review

4.1 Project Implementation

1) Partner set-up

The initial idea was to implement the project with a range of partners. This has worked for some areas but proven challenging for others:

Battery suppliers
For the first Hub, the batteries were secured from the partner that was mentioned in the project application (Omnivoltaics) based on a quality assessment that was carried out by ZHAW.

For the second hub, a new supplier was found for the rechargeable bulbs.

Technical partners
MPower started working with Multicon, a specialized German solar container assembler. From the start, there were issues with delays which were only in part due to the special requests made by MPower. Also, it became clear that the cash flow situation at Multicon rapidly deteriorated. To reduce the risk MPower decided to directly pay Multicon's suppliers and decided to only construct one (out of the initially foreseen two hubs).

For the second hub, MPower worked with Ezo Energie, a leading solar installation company in Togo.

Hub management partners
Initially, it was foreseen to operate the Hubs with partner companies under a franchising model. Unfortunately, that did only partially work as expected. In Zambia, MPower received a lot of support from its partner Climate Management during the site selection process. However, thereafter, MPower hired the EnergyHub manager plus a person in Lusaka that would manage the EnergyHub manager. In Togo, the situation

was similar. While initially Mivo Energie expressed interest in managing a Hub they were in the end not interested in taking over the management.

This reluctance is most likely explained by the fact that we could not provide revenue estimates, a clear model was not in place and work input unknown. Finally, MPower decided to manage the first two Hubs in-house in order to maximize learnings and insights for future product improvement.

Management of the EnergyHub managers as well as accounting and cash management turned out to be complex:

- mobile internet is often weak or not available, limiting communication options.
- consistent reporting is difficult to get
- bank branches are sparsely spread in rural areas complicating cash management and mobile money agents only accept a limited amount of cash

One potential solution is to become a micro bank branch ourselves and pay out money to people that are interested in withdrawing money. In Zambia, we have obtained a license to operate as ZanacoExpress agent – essentially a Zanaco bank branch. Due to a delay in the onboarding process, this cannot yet be evaluated on its practicality.

2) Battery rental

Already during the field assessment in Zambia, it became apparent that the batteries would mainly be used for phone charging and lighting. Therefore, already for the first hub in Zambia we decided to include powerbanks as well in our offering. The capacity-adjusted cost of a powerbank is 4-6 times lower than the one of a PAYGO enabled battery. An additional motivating factor was cost and risk. Working with powerbanks allowed us to sell them at cost and then earn our margin on subsequent recharges. To make it work, we had to work with the manufacturer to get 5V light bulbs.

Based on the experience (rental mainly used for lighting and phone charging) from the first hub, the solution was optimized. After consideration of different options and combinations, we opted for rechargeable light bulbs with an integrated battery that could also be used for phone charging:

Nsombo, Zambia	**Bodje, Togo**
	
Powerbanks & 5V bulbs	Rechargeable light bulbs with USB plug

Figure 3: batteries & powerbank models

3) Change of EnergyHub design

During the implementation of the first EnergyHub it became apparent that the cost structure would never become sustainable due to several factors: i) very high cost of logistics (i.e. shipment, import etc.) associated with using a container assembled in Europe ii) high cost of assembly iii) high cost of a tailormade containerized solution vs. using a fixed structure

To stay within budget and find a sustainable solution, MPower decided to adapt its approach in terms of EnergyHub structure and therefore implemented the following changes: i) using an existing fixed structure in a central space in the village / town ii) installation with a local company iii) direct purchasing from manufacturers in China.

These changes resulted in massive cost reductions of over 5 times:

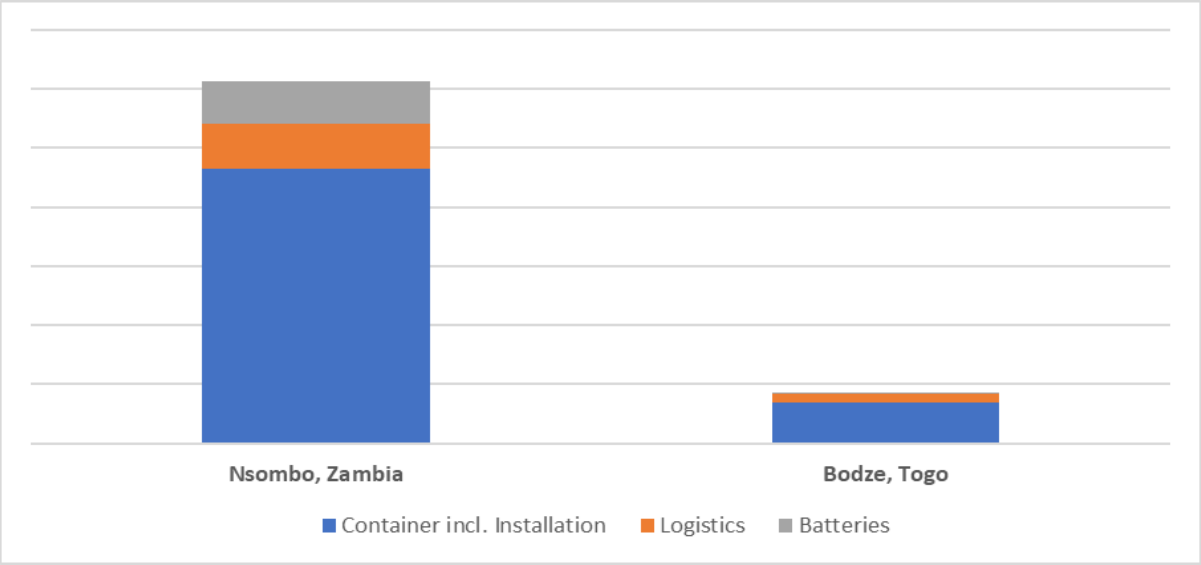


Figure 4: Cost comparison

In addition, there was even an improvement the sustainability of the project itself as the EnergyHub in Togo was relying on Lithium Iron Phosphate batteries with a much higher lifecycle compared to the flooded lead acid batteries used in Zambia. On the other hand, initial battery capacity was chosen to be lower as energy-intensive activities will be limited to high irradiation periods. Also, storage capacity upgrade at a later point is easy to be implemented.

Nsombo, Zambia	**Bodje, Togo**
Installed solar PV capacity: 9 kWp	Installed solar PV capacity: 7.9 kWp
Storage rated capacity: 30kWh	Storage rated capacity: 5kWh
Storage available capacity: 15kWh	Storage available capacity: 4.5kWh
Battery type: Flooded lead acid (OPVZ)	Battery type: LiFePo4
Battery properties: 5k cycles, 50% DoD)	Battery properties: 10k cycles, 90% DoD
Installed output: 8kVa (+ spare 4kVa)	Installed output: 8kVa
Additional aspects: • Remote monitoring • Diesel genset as backup	Additional aspects: • Remote monitoring • Building rented

Table 1: Comparison of technical specifications

4.2 Achievements of Objectives and Results

Results compared to application

Proposal: Objective 1 - Test customer acceptance: The pilot projects will test customer acceptance of a battery exchange. One key question is whether potential customers would be willing to come to our solar containers and exchange the batteries on a regular basis. Our first field research clearly indicated the acceptance and the enthusiasm for such a model.

First results: The battery exchange model seems to work well. Since the start in June 2019, sixty customers have signed up to rent batteries and regularly recharged them. It looks as if most people are using them for phone charging. Recharging period ranges from several times a week to 1-2 time per month (see Annex I for recharging patterns of all seventy customers).

Larger batteries are being recharged fewer times pointing to the fact that daily usage is converging to some degree. Nevertheless, owners of larger batteries seem to consume more energy based on the data that has been gathered so far. According to the local managers, the all batteries are used for lighting and phone charging at home.

	#	**Wh/week**
Powerbank 30Wh	1.0	29.1
108Wh	0.8	81.5
180Wh	0.5	86.7

Table 2: Comparison of typical rental periods

Proposal: Objective 2 - Experiment with different revenue models and test pricing: By installing two solar containers we can for instance offer and compare two different models: a subscription-based model and a usage-based model (PAYGO).

First results: The technical complexity and the very high hardware cost of PAYGO enabled systems has led us to the decision to stay with a down payment and recharge fee.

What we would like to test – however – is a club model where all clients become part of a club and get free recharges etc. after some time. This will likely be tested with the new IT set-up in Togo.

Proposal: Objective 3 - Develop the technological solution and other key components: As the model is new, we would also have to experiment with different solutions and develop appropriate software tools.

First results: On the technology side, we have added other services to make the offering more appealing. This has led to a situation where only roughly one third of revenue is attribute to battery rental and charging (see Figure below). Other services have also significantly contributed towards EnergyHub revenue.

In addition to above services, MPower has also started the process to register as distributor of financial services and the EnergyHub has served as important distribution center for MPower's other business unit which is standalone solar systems (SHS).

All the activities were carried out in accordance with the submitted project plan:

Phase	Deliverable	Status
Planning	Sign franchisee agreements	Signed on April 4th, 2018
Planning	Decide on two EnergyHub locations	1st Hub: Nsombo, Zambia 2nd Hub: Bodje, Togo
Planning	Select the batteries to be used	1st Hub: 180Wh, 108Wh, 10'000mAh power banks 2nd Hub: rechargeable light bulbs
Planning	Define pricing scheme	Pricing finalized for Togo and Zambia.
Planning	Identify local counterpart	1st Hub: Phynious Chilufya and Albert Mwansa 2nd Hub: Kodzo Adzikuma and Hope Edoh
Planning	Define software needs	Have been defined for sales part, for rental, Excel file to be used
Planning	Evaluate potential partnerships	Partnerships with Climate Management, Ezo Energie
Planning	Develop evaluation strategy	Excel file and application in place.
Planning	Fine-tune & revise business plan	Business plan was adjusted by including services.
Implementation	Place product orders	All products ordered and shipped, see financial reports Receipts available upon request
Implementation	Hire local counterpart	1st Hub: Phynious Chilufya and Albert Mwansa 2nd Hub: Kodzo Adzikuma and Hope Edoh
Implementation	Train local HUB managers	1st Hub: Albert Mwansa – fully trained 2nd Hub: Hope Edoh – training ongoing
Implementation	Install and operate the systems	Installation finished on June 15th, 2019 (1st Hub) and December 22nd, 2019 (2nd Hub)
Implementation	Launch additional fundraising	MPower has successfully secured over CHF 2m as a company. However, most of this has been used for the standalone solar business
Implementation	Close monitoring of the HUB operations	Regular reporting activities carried out, remote monitoring working
Implementation	Fine-tune technical solution for scale up	Assembly must happen locally. Potential options for scalable and cost efficient structures will be assessed.
Implementation	Fine-tune software	Improvement of online/offline functionality
Evaluation	Logistics optimization potential	Local assembly, additional improvements in the planning phase.
Evaluation	Pricing structure and willingness to pay	Willingness to pay is tested for a few service
Evaluation	Solar container sizing and placement	The solar container in its current form cannot be used as assembly in Europe is too costly.
Evaluation	Software offering	Rental business needs to be included in the app
Evaluation	Scale-up optimization	See the corresponding section 5.1.

Table 3: Activity reporting

4.3 Multiplication / Replication Preparation

To prepare multiplication and replication, a few steps have been taken:

- **Fundraising**: MPower has been raising equity and debt funds for its core business. Once the EnergyHub model is set, this funding will also be available to building out a network of EnergyHubs.

- **Expansion to other countries**: Besides Zambia, MPower has established local subsidiary companies and teams in Togo and Cameroon. Further market expansion is expected for 2020.

- **Grant applications**: MPower has pitched the EnergyHub concept in a few applications with UNHCR, UN Women, GSMA Foundation, EforA and Swiss Re. Unfortunately, so far without concrete follow-up projects.

- **Presentation with local authorities**: MPower has also introduced the concept to local authorities like the Energy Regulatory Board (ERB) in Zambia and the Agence Togolaise d'Electrification Rurale (AT2ER)

- **Structural design**: MPower is in preliminary discussions with an ETH Chair to carry out a project to design a locally assembled, low cost and redeployable mounting structure for the panels.

Before replication can take place at a larger scale, MPower needs to gather additional data and funds. This phase will most likely be finished by Q2 2020.

4.4 Impact / Sustainability

The EnergyHubs have provided significant benefits to the communities beyond the clean solar power that has been generated. Each EnergyHub has created at least five direct jobs (EnergyHub operator, operator sub, hairdresser, welder, cinema person) and many more indirect jobs.

In addition, the EnergyHubs have become the central meeting point in very rural areas and significantly improved the "lifestyle" of the people living in the village. In the five months of operations in Nsombo almost 4'000 tickets for the cinema and 700 phone recharges have been sold, over 2'000 pages have been printed and 60 people have become regular customers for the battery rental.

Ecological	Unit	At REPIC Project completion
Installed renewable energy capacity	kW	16.9
Renewable energy produced	MWh/year	Approx. 15MWh/year
Economic		
Energy costs (LCOE)	Rp/kWh	n/a, 0.30 to 1.30 CHF/charge
Triggered third-party funding/investments	CHF	None so far.
Local private income generated	CHF	1'000+/month
Social		
Number of beneficiaries	Number	500+
Number of new jobs	Number	10
Number of trained personnel	Number	2

Table 4: Impact KPIs

5. Outlook / Further Actions

5.1 Multiplication / Replication

For MPower to start the scale-up phase, the following main steps need to be carried out in order to be ready to deploy 10s or 100s of hubs:

Technical design:

- **Re-think structural design**: using an existing building and local installation has helped us in dramatically reducing the cost of the system. However, this comes at the price of being dependent on a third-party. Therefore, the ideal solution would be a re-deployable, low-cost and locally assembled design of the 1st EnergyHub. MPower is in preliminary discussions with ETH to carry out a joint project for such a design.

- **Improve remote monitoring:** at the two first EnergyHubs, generation, storage and overall load is monitored. For a better understanding (as well as cross-checking), more granular energy consumption data would be needed. Therefore, different solutions for smart metering that allow tracking of consumption by application will be analysed.

Software:

- **Accounting:** Launch new version with service income and accounting features

Business case preparation

- **Additional revenue and cost data**: in order to create a credible business plan, we need additional data on revenue and costs for both Hubs. With a few additional months of data, we will have a good basis to calculate financial KPIs (return, payback time etc.) and define the exact business model.

- **Business model:** relaunch discussions with our partners on the ground to define the business model (EnergyHub management internal vs. external)

- **Prepare fundraising:** it is foreseen to conclude the pilot phase in Q2 2020. Afterwards, we will update the business plan and create a pitch deck to raise funds for the scale-up.

5.2 Impact / Sustainability

In the mid-term we seek to operate 100 EnergyHubs:

Ecological	Unit	Mid-term
Installed renewable energy capacity	kW	900
Renewable energy produced	MWh/year	Approx. 800MWh/year
Economic		
Local private income generated	CHF	50’000+/month
Social		
Number of beneficiaries	Number	25’000+
Number of new jobs	Number	500
Number of trained personnel	Number	100

Table 5: Impact KPIs for multiplication

5.3 Transfer of technology and know-how

Technology transfer and empowerment (hence the company name) is at the core of the company's business model (see Figure 8).

Figure 5: MPower's technology transfer model

Internal technology & know-how transfer

When MPower decides to enter a new country, we try to hand over local operations to a local team as soon as possible. Usually, it takes about six months to set up local operations (incl. local company) and hand over the operations to the local team. After hand-over, the global team remains involved to support the local team in all aspects.

In addition to the exchange between the global and local offices, there is also knowledge transfer between the different country entities.

The mechanisms for internal know-how transfers are regular calls & exchanges, annual retreats and internal documentation.

External technology & know-how transfer

Since MPower operates in a B2B set-up, the know-how is then transferred to the local partner companies.

Main mechanisms for external know-how transfer are trainings, meetings, documentation and formalized partnerships with reporting requirements.

6. Lessons Learned / Conclusions

Overall, the EnergyHub concept seems to be scalable and is a success. The concept is working and can be run on a commercial basis. The EnergyHub has brought various benefits to the two villages. The following section will highlight additional lessons learnt beyond what has been discussed already:

- **Regulatory environment:** government licenses to operate the EnergyHub might be needed. While most of the time, the regulatory regimes do not require licenses for projects for auto-consumption of this size, it has become clear that the interpretation of EnergyHub's activity is not always clear. MPower is always in exchange with the relevant authorities to ensure compliance with national laws. In the case of Zambia that extends to the Energy Regulation Board (ERB), the Rural Electrification Authority (REA) and the local politicans (chiefs, headmasters and eldest). Most parties are very supportive, just often slow in communication.

- **Recycling:** so far, this topic has not come up as the volume is still very low and no returns have been made so far. For MPower's overall activities, it has developed a comprehensive recycling strategy (available upon request). The projected lifetime of the system should exceed 10 years.

- **Theft:** has not been a problem so far. The adjustments in the business model (with deposits and recharges and services at the Hub vs. renting out big batteries) has limited that risk. Also the intense due diligence for suitable locations has paid off.

- **Logistics:** Assembling the EnergyHub in Germany and shipping them will not be cost effective and make the EnergyHub's cost prohibitive. Local construction or assembly seems the most feasible way to go. An important lesson learned was that last mile transport of a hub can be very costly, as it requires an heavy duty truck with an onboard crane that can lift the hub. It seems favorable to assemble/ built the hub on its final destination.

- **Competition:** there are three main types of competitors:
    - Solar home system providers: in Nsombo a few potential clients already had pay-as-you-go solar systems. Despite this, we have been able to build a client base. Clients value the lower cost of our system and the higher flexibility.

    - Mini-grid projects and grid extension: If the grid is extended to the village in which we operate it will be more difficult to convince our clients to stick with us. However, even in case of grid extension, there are often high upfront costs related to the connection. Also, once a re-deployable structure will be in place, in the worst case the EnergyHub could simply be moved elsewhere in the worst case.

    - Other companies developing systems similar to the EnergyHub concept. There are other companies that tried similar concepts (battery rental system in Zambia) but they have failed on the operational/ management side or they focus on other specific services (water purification). So far

we are not aware of another competitor that is running an infrastructure providing comparable services to the 2 energy hubs.

- **Ownership:** ownership of the EnergyHub manager but also the entire community is a critical aspect. Therefore, MPower spends quite some time in onboarding the community, the local authorities as well as the Hub manager. The ideal operational model foresees a performance based salary to the local hub manager, as this incentivises efficient operation and reporting.

- **Maintenance:** overall, the EnergyHub has been light in maintenance. The only maintenance required in relation to the Solar PV has been the regular cleaning of the panels. Besides that, there have been smaller issues related to the other services (printer ink running out, adapter for fridge burnt through). It has proved challenging to source these spare parts locally and transport them to the hub, so a lesson learned is to provide spare parts and use operational material (printer ink, welding sticks) that can be purchased in close proximity to the hub.

- **Energy services beyond battery rental are needed:** We have already added other services that rely on energy (hairdresser, entertainment, refrigeration and welding) and will look for additional options to broaden the revenue base. There seems to be a potential for adding water pumps to provide clean water for the community but also for agricultural irrigation on a metered base. There are plans to install such a service at the Zambian energy hub.

7. Evaluation

See separate evaluation report

8. References

For a live view of solar power production and battery state-of-charge and discharge, MPower can provide a live remote monitoring login upon request.

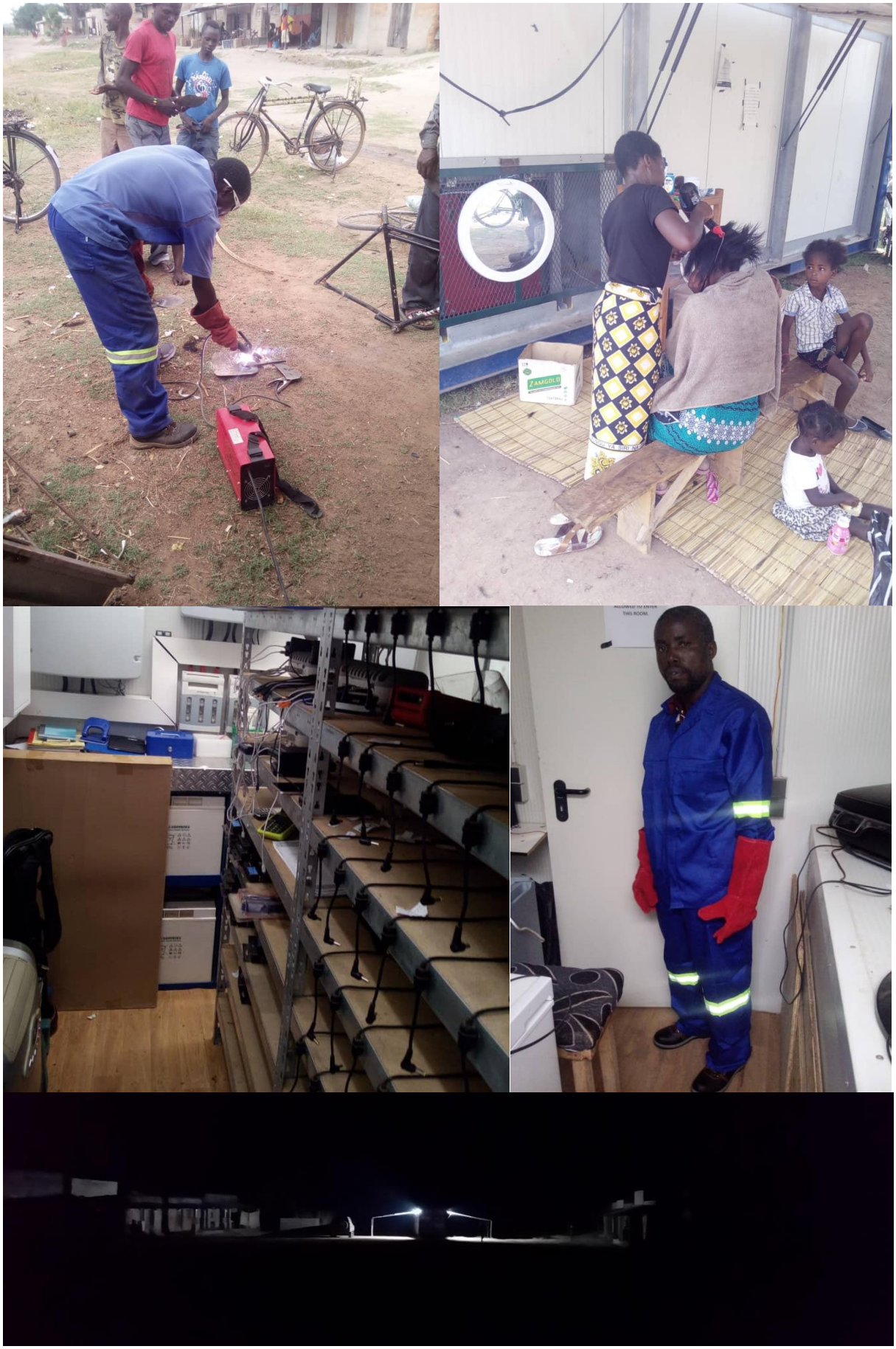
MPower has created a short 3 min and long 5 min video that shows construction and commissioning of its EnergyHub in Zambia.

The link to the long video: https://www.youtube.com/watch?v=4JUzHjnolNE&t=6s
The link to the short video: https://www.youtube.com/watch?v=QHAEenpKKTY

Annex I: recharging pattern of EnergyHub clients (Nsombo, Zambia)

	Week	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Customer 1	Powerbank	1	1	0	0	0	2	0	2	1	0	2	1	1	1	3	0	2	1	1	3	0	0
Customer 2	Powerbank	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	1	3	4	3	2	2	0
Customer 3	108Wh	1	0	1	0	0	0	0	0	1	0	1	0	2	0	2	0	1	3	1	2	2	0
Customer 4	Powerbank	2	0	1	0	1	0	0	0	0	2	1	0	2	1	0	0	1	2	1	1	1	0
Customer 5	Powerbank	2	0	0	0	1	0	0	0	1	1	1	1	1	1	0	1	1	1	1	1	0	0
Customer 6	108Wh	1	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	1	3	3	2	0
Customer 7	Powerbank	0	0	0	0	0	0	0	0	1	0	1	1	1	1	2	2	0	2	1	2	0	0
Customer 8	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	3	4	2	0
Customer 9	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	2	2	0	1	2	0
Customer 10	180Wh	1	1	0	0	0	0	0	0	1	1	1	1	0	1	1	1	0	1	1	1	0	0
Customer 11	180Wh	1	0	0	1	0	0	0	0	0	1	0	1	1	2	0	1	1	1	0	1	1	0
Customer 12	Powerbank	1	0	1	0	0	0	0	0	1	1	0	0	0	3	0	1	0	1	0	0	0	0
Customer 13	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	1	1	0	0	0
Customer 14		0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	2	1	1	1	0
Customer 15	180Wh	2	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1	0	0	1	0	1	0
Customer 16	180Wh	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	0	1	1	1	1	0
Customer 17	180Wh	1	0	0	0	0	0	0	1	1	0	0	1	0	0	0	1	0	1	0	0	1	0
Customer 18	180Wh	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	1	1	1	0
Customer 19	180Wh	1	1	0	0	0	0	0	0	0	0	0	0	1	0	2	1	0	0	0	1	0	0
Customer 20	180Wh	1	0	1	0	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	1	0	0
Customer 21	108Wh	0	1	1	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	1	0
Customer 22	180Wh	0	0	0	0	0	0	0	0	0	0	2	0	1	1	0	0	0	1	0	1	1	0
Customer 23	108Wh	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	1	1	0	0	0	0
Customer 24	108Wh	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	1	0
Customer 25	Powerbank	1	1	1	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
Customer 26	180Wh	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0
Customer 27	108Wh	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0
Customer 28	Powerbank	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	0
Customer 29	180Wh	1	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Customer 30	Powerbank	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	1	0	0
Customer 31	Powerbank	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	1	0	0
Customer 32	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0
Customer 33	180Wh	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Customer 34	180Wh	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Customer 35	180Wh	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0
Customer 36	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
Customer 37	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0
Customer 38	Powerbank	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Customer 39	Powerbank	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Customer 40	108Wh	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
Customer 41	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
Customer 42		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
Customer 43	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Customer 44	180Wh	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Customer 45		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Customer 46	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Customer 47	108Wh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Customer 48		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Customer 49		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Customer 50		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Customer 51		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Customer 52	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Customer 53	108Wh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Customer 54	180Wh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Customer 55	108Wh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Customer 56		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Customer 57	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Customer 58	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Customer 59	Powerbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Annex II: Pictures EnergyHub Nsombo, Zambia



Annex III: Pictures EnergyHub Bodje, Togo