Introduction

Due to the improved efficacy and cost of super-efficient LEDs, a rapidly emerging off-grid solar market promises energy access to tens of millions of off- and weak-grid households and businesses globally. However, relatively little attention and financial investment have been applied to the research and development of energy efficient, high quality, market appropriate end-use appliances for off- and weak-grid consumers, for both households and businesses.

The UK aid funded Low Energy Inclusive Appliances programme (LEIA) aims to accelerate the availability, affordability, efficiency, and performance of a range of low energy inclusive appliances particularly suited to developing country contexts. LEIA was designed with extensive industry consultation regarding the specific challenges and opportunities of the off-grid clean energy access appliance market.

The LEIA programme will be delivered through an international Efficiency for Access Coalition convened by UK aid and Power Africa, involving a range of co-funders including Lighting Global, Rockefeller Foundation, Shell Foundation, Sida, EnDev, Good Energies Foundation, and more. The Efficiency for Access Coalition is coordinated by CLASP, the leading international voice and resource for appliance energy efficiency policies and market acceleration initiatives, working alongside the UK's Energy Saving Trust, which specializes in energy efficiency product verification, data and insight, advice and research.

The Efficiency for Access coalition is now scaling up and bringing together a range of support mechanisms to accelerate energy efficiency in clean energy access efforts, driving markets for super-efficient technologies, supporting innovation, and improving sector coordination.

Background

In agricultural based economies of sub-Saharan Africa, grains (particularly maize) are typically the staple food crop. Off grid grain milling has the potential to increase farming efficiency, increase farmer revenue, and promote food security. Typically mills in off-grid areas are fuel powered and as a result have high operating costs and the potential for negative environmental impacts (e.g. pollution and GHG emissions from diesel generators). Where off grid (solar) mills have been tried the available technology has been found to be inappropriate for the intended use case and no technologies have emerged that can compete with the incumbents.

Research conducted to date has not uncovered any mills in operation that utilize super-efficient brushless DC (BLDC) motors at scale accessible to Bottom of the Pyramid (BoP) end users. Agsol is a company working to change this. Agsol is manufacturing and supplying small agro-processing machines and intends to take these technologies to a global market.

The Efficiency for Access Coalition is seeking a researcher/research team to work closely with Agsol and CLASP to define a variety of use cases of off grid milling, provide a deep dive comparison of technologies and energy provision typologies, and test data collection methodology that could inform actors in the solar milling sector in Africa.

This project will require market, consumer and impact research into a productive use appliance that is of interest to several members of the Efficiency for Access coalition. The expectation is that the provision of this information will mobilize off grid milling companies to understand and address the potential market, and provide data on this market to off-grid energy providers and other distributors that are considering expanding their appliance portfolios to include solar milling appliances.

Attracting new market players and increasing the diversity of market actors has the potential to reduce the capital cost of off-grid agricultural processing equipment and reducing the risk of the market more broadly. In addition, bringing an early stage but super-efficient technology into the market and exploring its viability, is expected to provide a signal to the market on the potential economic advantage, technical feasibility, and market potential of highly efficient productive use technologies. These expected outcomes will contribute to the overall coalition aim of increasing efficiency and reducing cost of low energy inclusive appliances.

<u>Maize processing background</u>

Figure 1 shows the typical maize growing and processing cycle for small holder farmers in Kenya.

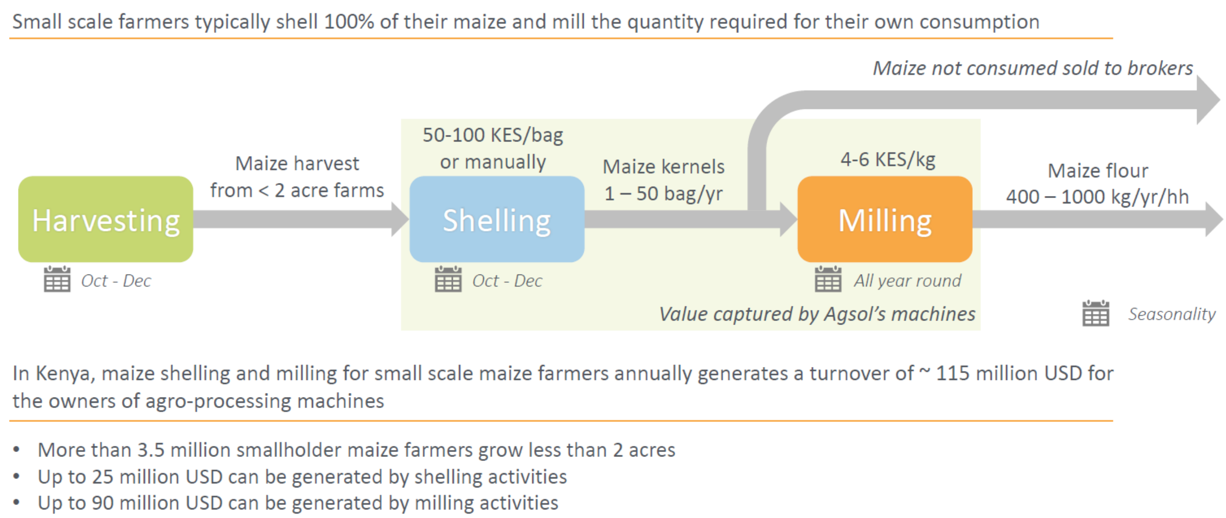

Figure 1: Typical Maize growing and processing cycle for small scale farmers

For small holder farmers who are the primary consumers of their maize harvest, maize milling is at its peak immediately after shelling, then tapers off to a relatively constant output the for remainder of the year until the next harvest. They store maize kernels and mill on an as needed basis for home consumption or sale. For mill operators, income generation would potentially follow this same pattern, where income sharply increases post-harvest and then levels back down as the harvest year progress.

To understand the variation in mill productivity and income generation, pilot duration would have to take account of the post-shelling period (1-2 months) and up to 6 months after. The field pilot portion of this project will begin in October and last for nine months.

Scope of Work

This research will be principally undertaken by a researcher/ research team contracted by CLASP in collaboration with Agsol. The researcher/ research team will function as a member of the Agsol team located in Nairobi and will have primary responsibility and accountability for delivering this project.

This project is divided into 2 stages:

Stage 1: Laboratory trials – Led by Agsol

Functional testing of Agsol mills in a Nairobi lab to prepare for field deployment. This will involve

- Procurement and testing of local AC Motors to be integrated with the milling machine. This will be done by Agsol in conjunction with a mini-grid partner at their labs in Nairobi.
- Testing of BLDC motored machinery using stand-alone solar. This will be done by Agsol in partnership with a stand-a-lone solar partner in Nairobi

Stage 2: Field trials - Led by researcher/research team

After the machines and motors are deemed appropriate based on lab testing, the project will pilot at least 10 maize mills in a variety of deployment modes to collect data and market intelligence on customer segments and acquisition, product design and functionality, and socioeconomic impacts of off-grid mills.

Key areas of inquiry include, technology mapping to use cases and energy production types, operator perceptions of the solutions, operator economics, and operator and end user impact of adopting off-grid milling technology. The typical mill operators envisioned are 1) Fuel mill operators with machines at end of life 2) Operators entering the milling market for the first time 3) farmer collectives/cooperatives

The geographies that are expected be covered by this project are: Kenya, Tanzania, Uganda and Zambia.

As directed by CLASP, the researcher or team contracted for this work will be responsible for the following:

Task 1. Functional testing

- Make available to CLASP the data and outputs of the functional tests carried out by Agsol and in consultation with CLASP agree on the suitability and appropriateness of the machines tested for field deployment.

Task 2: Sensors and metering

- In collaboration with CLASP, review sensor and meter providers to inform the choice of remote monitors for this research effort. This will be via consultations and requests for quotations from applicable companies who responded to a request for information deployed by CLASP.

Task 3: Literature review and market scoping

- Review existing literature to inform the development of survey questionnaires and selection of interviewees, to ensure that the project builds on existing work and is applicable to the broader off grid milling market.

- Survey representatives from different market segments (e.g. mill operators and farm cooperatives) to gather preliminary data on energy service needs, willingness/ability to pay, preferred financing models, baseline technology use characteristics, and current milling practices.

Task 4: Develop baseline indicators for tracking user impacts

- Utilize data gathered through phase 1 and the literature review and market scoping to develop baseline indicators that can be used to track impacts over the course of the field trials.

Task 5: Solar mill pilots design and research methodology

- In collaboration with CLASP and Agsol, develop a pilot design and research methodology that will allow the research outputs to be generally representative of a variety of use cases/deployment models and potentially be scaled up and/or replicated in other countries and regions. Among a variety of deployment modes, we anticipate: various deployed motor types (BLDC and AC), various energy sources (mini grid and stand-alone solar), different financing models (upfront sale, grant, financing model), different characteristics of operators (e.g. cooperatives, individual users) and different geographies (potentially Kenya, Tanzania, Zambia and Uganda).
- The research methodology should be developed to answers the following questions:

a) Technology

  - What are the differences in 1) performance (e.g. milling rate, power consumption and efficiency); 2) ease of interoperability; and 3) user experience when mills are powered by BLDC versus AC motors?
  - What are the differences in 1) performance; 2) ease of interoperability; and 3) user experience of mills on standalone DC systems versus mills deployed with mini-grids?

b) Usage patterns:

  - How do usage patterns of stand-alone solar powered mills compare with those of mini grids?
  - What are actual daily/seasonal/annual usage patterns of solar mills and how far off the 'optimal' for are they (for both stand-alone solar and mini grids)?
  - What are pricing incentives that should be given to operators of off-grid mills to optimize their usage patterns and align them with productive hours of mini grids?

c) Productivity:

  - What are the technical and ecosystem factors characteristics that drive productivity and what is their actual impact on output?
  - What are the metrics that should be considered to develop a business model for off grid milling as a productive use? What business models have the highest likelihood of success for off grid milling?
  - What is the effect of energy efficiency on productivity, in relation to 1) cost and 2) nature of power (e.g. power spikes)? To what extent does energy efficiency improve the business case for solar milling as a productive use?

d) Catalysts for additional energy services

- What is the extent to which existence of a large solar system native to the machine will extend access to electricity regarding the number and type of appliances used as well as the number of people gaining access?
- What barriers exist to the use of solar mills as catalysts for additional energy services and what resources are needed to drive further uptake?

Task 6. Solar mill pilot preparation

- In collaboration with CLASP and Agsol, identify partners and sites for pilot deployments of at least 10 mills.

Task 7. Solar mill pilot deployment

- In collaboration with CLASP and Agsol, deploy mills and the sensors identified in task 2 to the field sites, monitor and analyse mill performance data generated by sensors, to help answer some of the questions identified in task five as well as the following:
  a) Is real-time monitoring of mills superior to other methods (e.g. surveys) for the understanding customer behaviour?
  b) What field data is most valuable to off grid businesses that are striving to improve product design and service delivery?
  c) What is the most efficient way to collect, store and analyse data?

Task 8. Solar mill pilot data collection

- Identify & contract a sufficient number of enumerators to conduct field surveys to collect qualitative data as detailed below

- Collect baseline information for all pilot sites using baseline indicators developed in Task 4

- Survey mill operators and end users, on a monthly basis, during pilot deployments (9 months) to collect data against the baseline indicators developed in Task 7 and answer the following questions;
  a) How much are potential customers from different market segments willing to pay for off grid solar powered mills? How much are they willing and able to pay for a deposit and monthly payments?
  b) What factors do potential customers consider when purchasing a solar mill, (e.g. quality, efficiency, price, business opportunity, social influence, etc.). How do consumers value capital expenditure vs. operational and other factors when choosing between fuel powered mills and solar mills?
  c) What are potential customers' attitudes towards risk and adaptation of new technologies?

Task 9: Model

- Develop a model for assessing the business case for off grid mills as a productive use appliance given inputs such as productivity, energy use & cost, likely priority and early adopter customer profiles and potential income generation of different applications.

Task 10: Report

- Write a report that synthesizes findings from desk research, interviews, surveys and pilot. The report should:
    a) Summarize research methods and lessons learned for deploying similar research projects in the future.
    b) Answer research questions identified under previous tasks and/or identify additional data and research that is needed to answer these questions.
    c) Include identified impact indicators, productive use metrics and models developed.
    d) Analyse and comment on the relative strengths and weaknesses of the data collected by sensors on machines deployed in the field and data collected through other mechanisms and what that means for metrics such as ROI, productivity and social impact.
    e) Make recommendations related to forward looking business plans for companies working in this sector. What indicators should a company looking to expand or enter into the off grid solar milling market be capturing now and in the future? How can credibility of data be assured, from a reporting perspective?

Milestones

Tasks	Milestones & Deliverable	Dates
1	Data and analysis from functional tests.	September 3, 2018
2	Identify sensor and meter provider.	September 28, 2018
3&4	Inception report that includes a summary of literature review, market scoping, laboratory testing, and baseline indicators for off grid milling.	September 28, 2018
5	Pilot design document including questionnaire for collecting data via surveys	October 29, 2018
6	Pilot sites and partners agreed	October 29, 2018
7	Pilot data collection kick off	November 30, 2018
8	a. Baseline data from all pilot sites b. Interim report with lesson learnt from pilot deployment and early indications	January 18, 2019
9	Business case model for off grid mills as a productive appliance	April 26, 2019
-	Complete raw data from all pilots in tabular format	May 31, 2019
10	Draft Report	June 28, 2019
	Final Report	July 26, 2019

Submittal

Individuals that wish to respond to this RFP must complete the LEIA prequalification questionnaire. This is a requirement for all sub-recipients of UK DFID funding. Companies or individual consultants must also register as a CLASP Implementing Partner. Registration is easy, and must be completed via the CLASP website before final submittal.

Interested parties are required to submit two separate proposals: A Technical Proposal and a Financial Proposal. The files should be named as per the following example: “[Contractor Name] _ [Technical/Financial] Proposal_RFP [Name].

The Technical Proposal should not exceed 15 pages in length and must include the following elements:

- A detailed approach and methodology for implementation and management of the project. Include a description of the role of each team member if applicable. [2 to 5 pages]
- A summary of qualifications of key personnel that will be engaged in the assignment. Technical knowledge in the areas of mechanical/electrical engineering is an advantage as well as academic research qualification e.g. PhD/MRes (Master of Research). [2 to 5 pages]
- A summary of regional experience, in Africa, and related experiences of conducting research of this nature and in this context, including any experience deploying pilot research projects in rural areas. [2 to 4 pages]

The Financial Proposal must include the following elements:

- Detailed budget estimate (in US Dollars) outlining fees and expected expenses for the duration of the project. Detailed budget should include all direct and indirect cost estimates for executing the project, detail specifically:
    - a breakdown (in days) of the level of effort associated with the activities and a daily rate.
    - the cost of identifying and contracting enumerators for the duration of the field surveys.

A committee comprised of CLASP and Agsol will evaluate proposals received from respondents. Selection of the candidate will be based upon the following criteria:

- Relevant qualifications, including working knowledge of the off-grid sector, agricultural processing industry and broad technical knowledge in mechanical/electrical engineering.
- Relevant experience in inception and deployment of pilot research programmers
- Total cost.

The deadline for application is **August 17, 2018**. Proposals must be submitted online via the CLASP website.

All questions may be addressed to Makena Ireri at mireri@clasp.ngo. The last date for submission of questions related to this RFP is August 10, 2018. We request all inquiries be made by e-mail and not by phone.