CROSSBOUNDARY

Study Design: Bulk Procurement
2020

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Executive Summary

This study tests whether aggregating multiple mini-grid developers' orders for particular components of a mini-grid into a single bulk order reduces the overall procurement costs for developers.

The components required to build a mini-grid account for a significant portion of developers' total capital expenditure – typically 65-75%. Developers currently procure all components on their own, yet some are consistently used by a wide range of developers. As such, aggregating developer demand into a single bulk order could increase developers' negotiating power and lead to lower prices and improved payment terms. This would allow developers to save significantly on capital expenditure costs.

The primary objective of the study is:

1. Determine what impact procuring components in bulk has on the economics of mini-grids, specifically capital expenditure costs.

By nature of the study, the study will involve all the Operator's sites and customers.

The study will assess the impact of procuring components in bulk on one principal matter: (1) grid economics. Capex per connection, working capital financing costs, and cost per unit procured in bulk, among other metrics, will be used to analyze the impact on grid economics.

The study will be delivered by the Operator, with support from technical advisors and other third parties as necessary. This study will involve Crown Agents, a social enterprise with expertise in procurement for solar projects. Crown Agents will gather details of operators' equipment requirements to identify opportunities to aggregate demand and bulk procure specific components. Crown Agents will also be responsible for facilitating execution of preferential pricing agreement(s) between operators and identified supplier(s).

The Study Partners will provide funding for the study, collect all relevant data, and analyze the results as they pertain to each hypothesis. The results will be made publicly available on an anonymized, aggregated basis. The study is expected to run over a one-year period, beginning January 2020.

Study Partners

The following table outlines the role of each partner involved in the study.

Partner	Role
Funder	• Provides funding • Offers strategic oversight for the study
CrossBoundary (CB)	• Manages all aspects of project • Leads study design • Disburses and monitors funds provided to Operator • Leads data collection, including surveying, and data cleaning • Leads analysis and communication of study results
Operator	• Provides insight into study design • Operates the mini-grids involved in the study and leads site implementation of study • Supplies data to CrossBoundary and other partners for analysis
Other partners	**Academic institutions:** • Supports study design • Supports analysis and communication of study results **Crown Agents and other third parties (as identified):** • Supports Operator in site implementation of study

Introduction

Mini-grids are emerging as a viable technology to accelerate access to electricity in Sub-Saharan Africa. However, for mini-grids to become sustainable and scalable commercially, profitability must improve. This study seeks to improve grid economics by answering the question: can developers reduce capital expenditure by joining together to procure components of a mini-grid in bulk volumes leading to reduced prices?

The components required to build a mini-grid account for a significant portion of developers' total capital expenditure – typically 65-75%. Developers currently procure all components on their own, yet some are consistently used by a wide range of developers. As such, aggregating developer demand into a single bulk order could increase developers' negotiating power and lead to lower prices and improved payment terms. This would allow developers to save significantly on capital expenditure costs.

This study, therefore, seeks to:

1. Determine what impact procuring components in bulk has on the economics of mini-grids.

By nature of the study, the study will involve all the Operator's sites and customers.

Experimental Design

Hypotheses

The following table details the hypotheses the study will test and how each will be measured.

Hypothesis	Metric	Source
Grid Economics		
1. Capital expenditure costs will be 7% lower following prototype launch as compared to before prototype launch.	• Capex per connection • Working capital financing costs	• Developer data
a. Cost of components procured in bulk will be 10% lower than that of components procured individually.	• Cost per unit procured in bulk	• Developer data
b. Payment terms of components procured in bulk will be 20% longer than that of components procured individually.	• # of days required to make payment per bulk order	• Developer data
2. The time required to procure equipment for a new grid will be reduced by one month following prototype launch as compared to before prototype launch.	• # of weeks required to procure equipment for a new grid	• Developer data

Site and Participant Selection

By nature of the study, all the Operator's sites and customers are included in the study. There are no control sites for this study.

Duration

The study is expected to run for one year, starting as soon as possible upon the signing of the Operator Agreement. The projected timeline of the study is January 2020 – January 2021. Early results will be analyzed after three months and quarterly thereafter.

The study's duration may be adjusted following initial results or any unforeseen circumstances.

Prototype-Specific Design Decisions

Components Procured

Components procured in bulk will be determined following initial analysis by Crown Agents, who is responsible for identifying opportunities to bulk procure components and facilitating execution of preferential pricing agreement(s) between developers and identified supplier(s). Crown Agents will recommend components and brands most ripe for bulk procurement based on conversations with developers and suppliers. Final selection of components and brands will be made by the community of developers interested in deploying this study. Priority will be given to those components and brands where there is a convergence of interest among developers.

Budget and Disbursement of Funds

Crown Agents is responsible for providing a budget that accurately reflects the cost of their work. See additional documentation for Crown Agents budget information.

The Operator is responsible for providing a budget that accurately reflects the total cost of equipment procured through agreement(s) negotiated by Crown Agents, inclusive of shipping costs. The budget for this study will represent some proportion of that cost, as necessary to ensure participation. See *Annex 2* for Operator-specific budget information.

Prior to receiving funds, the Operator must submit the following:

- Approved budget
- Signed Operator Agreement (consisting of the Grant Agreement and Study Design)
- Site economic data

Funding of the budgeted amount to support the study will be disbursed by CrossBoundary to the Operator in a single payment upon submission of all required materials.

The Operator is required to maintain a record of all costs incurred in implementing and running the study and must provide receipts reflecting the totality of costs to CrossBoundary. The Operator agrees to use funds solely for the purposes of the study.

CrossBoundary is responsible for monitoring the use of funds for the purposes agreed with the Funder.

Implementation

Operator

The Operator is responsible for implementing the prototype as agreed to in this Study Design. This involves but is not limited to the following:

- Providing Crown Agents with complete information on equipment requirements over the course of the information gathering exercise
- Working directly with the identified supplier to procure all materials negotiated to be purchased in bulk until expiration of the pricing agreement

The Operator will engage with all third parties involved in the study. The Operator is also responsible for identifying and procuring any licenses or other regulatory approval required to implement the prototype. See *Annex 2* for Operator-specific implementation information.

The Operator agrees to inform CrossBoundary of any occurrences that may affect study results. The Operator additionally agrees to disclose any other information pertinent to the study (e.g. GIS data).

Third Parties

This study will involve one third party: Crown Agents, a social enterprise based in the United Kingdom. Crown Agents is responsible for the following:

- Gathering details of operators' equipment requirements, including volume, timelines, and specifications of components
- Identifying opportunities to aggregate demand and bulk procure specific components to realize price reductions
- Negotiating with component manufacturers, global wholesale suppliers, and any other relevant parties to contract preferential pricing agreement(s) between operators and supplier(s) for a defined period of time
- Facilitating operators' discussions with chosen supplier(s) to ensure the pricing agreement is honored, as necessary

Licenses and Other Regulatory Approval

No licenses are required to implement this study.

Data Collection

All data shared through execution of the study is protected by a direct Non-Disclosure Agreement with CrossBoundary. Data will only be shared with partners approved by the Operator as outlined in the Non-Disclosure Agreement on an aggregated and anonymized basis to protect customer information.

Through participation in this study, the Operator agrees to share two types of data: (1) prototype-specific data and (2) site economic data. No surveys will be conducted for this study. The following table details the data the Operator is required to share as part of the study.

Data Type	Metric	Unit	Frequency & Timing
(1) Prototype-Specific Data	**Capex per connection**	Local currency	Monthly for duration of study
	Working capital financing costs	Local currency	Monthly for duration of study
	Cost per unit procured in bulk	Local currency	Once, at outset of study
	Days required to make payment per bulk order	Days	Once, at outset of study
	Weeks required to procure equipment for a new grid	Weeks	Quarterly for duration of study
(2) Site Economic Data	**As shown in *Annex 1***	Various	Once, prior to disbursement of funds

(1) Prototype-Specific Data

Any prototype-specific data required to evaluate the study's success must be shared for control and treatment sites on a regular basis for the duration of the study. Data that will remain constant over time need only be shared once at the outset of the study. All customer-level data should be tagged by smart meter number. See the previous table for a schedule of the required prototype-specific data.

The Operator will share all data with CrossBoundary by uploading files to Odyssey.

(2) Site Economic Data

To assess the study's impact on mini-grid site economics, the Operator will share required site economic data for control and treatment sites. This data will be used to quantify the prototype's effects on Operator revenues, costs, and other important economic drivers.

Site economic data must be provided upon signing of the Operator Agreement, before disbursement of funds. The data should be shared by Operator's completion of the Excel table shown in *Annex 1*, which may be uploaded to Odyssey.

Risks

The following table outlines the risks involved in the study.

Risk	Description	Probability	Mitigation
AMDA members outside of the Lab's priority geographies become aware of reduced prices	AMDA members outside of Kenya, Tanzania, Nigeria, and Zambia learn of the negotiated pricing agreement and become frustrated they do not have access to the same reduced prices	High	• Work closely with AMDA to communicate to all members proactively and clearly • Consider giving AMDA members outside of the Lab's priority geographies access to the reduced prices
Developers can't agree on technical specifications for components procured in bulk	Developers do not agree on the brand or technical specifications of components to be procured in bulk, thus reducing the group's negotiating power	Medium	• Bulk procure the most commoditized and standardized components across developers • Make clear the rationale for each brand and type of component chosen for bulk procurement
Not enough developers are interested in procuring components in bulk	Few developers express interest in bulk procuring the selected components, thereby making bulk procurement infeasible	Low	• Fund an agreed-upon proportion of developers' costs of equipment procured in bulk
Third party does not deliver on commitments	Third party does not identify a supplier(s) in a timely manner, or does not negotiate a price sufficiently low to make the prototype worthwhile	Low	• Choose reliable third party • Negotiate clear contract with third party outlining responsibilities and expected timelines
Chosen supplier does not honor pricing agreement through expiry	Chosen supplier breaks the pricing agreement before the date of expiry and stops honoring the reduced price	Low	• Choose reliable and established supplier • Outline clear terms of exit in pricing agreement

Analysis and Evaluation

Full analysis and evaluation of the study's results will be performed by the Study Partners.

Analysis

Study Partners will thoroughly evaluate each hypothesis against the metrics outlined in this Study Design, both periodically throughout the study and at the study's end.

CrossBoundary will analyze to what extent the prototype improves the mini-grid business model and quantify the benefit or cost to developers of incorporating the prototype into their standard operations. CrossBoundary will do this by applying observed changes in revenues and costs to its proprietary financial model. The resulting impact on project IRRs and cash flows will be evaluated under different scenarios. CrossBoundary will then recommend improvements to the prototype's design and implementation, to be incorporated into a later study or taken up directly by developers.

Dissemination of Results

Quarterly throughout the study, CrossBoundary will publish a brief report, or *Innovation Insight*, capturing the study's results against each hypothesis in an anonymized and aggregated form. At the end of the study, CrossBoundary will publish a complete report capturing the study's final results as well as the Lab's recommendations on scaling, further testing, or discarding of the prototype. The reports will be made publicly available and shared with stakeholders engaged in CrossBoundary's work, including but not limited to mini-grid operators, donors, investors, and government agencies. Findings may also be disseminated through sector events, such as conferences and workshops. Other Study Partners may publish anonymized and aggregated study results in peer-reviewed academic journals.

Annex 1: Site Economic Data

Key Project Economic Data
LC = Local Currency

Instructions: Please complete all cells colored blue. Note some rows are optional.

Input	Unit	Name of Site 1	Name of Site 2	Name of Site 3	Name of Site 4	Name of Site 5
Mini-Grid Sizing						
Number of Connections	#					
PV Generating Capacity	kW_p					
Battery Inverter size *(optional)*	*kVA*					
PV Inverter Size *(optional)*	*kVA*					
Diesel Generator Set *(optional)*	*kVA*					
Battery Storage *(optional)*	*kWh*					
Battery Regular Depth of Discharge Limit *(optional)*	*%*					
Number poles *(optional)*	*Poles per site*					
Diesel Use *(optional)*	*litre/month*					
kWh Produced from Diesel *(optional)*	*kWh/month*					
Diesel Cost *(optional)*	*LC/litre diesel*					
Diesel Expenditure *(optional)*	*LC/month expenditure*					
Night time consumption as % of total consumption *(optional)*	*%*					
Total CapEx						
Project Development Cost	*LC*					
Generation CapEx	*LC*					
Distribution CapEx	*LC*					
Labour CapEx	*LC*					
Logistics CapEx	*LC*					
OpEx						
Annual OpEx (historical)	*LC /site/year*					
Annual OpEx (projected)	*LC /site/year*					
Revenue						
Average tariff	*LC /kWh*					
Average consumption	*kWh/month/customer*					
15-year Consumption Forecast	*kWh/month/customer*	*See table below*	*See table below*	*See table below*	*See table below*	*See table below*
15-year ARPU Forecast	*LC /month/customer*	*See table below*	*See table below*	*See table below*	*See table below*	*See table below*

Consumption and Revenue ForecastDevelopers may specify assumptions rather than a specific consumption/revenue forecast e.g. annual escalation of 5%
Note: You may specify assumptions rather than a specific consumption/revenue forecast (e.g. annual escalation of 5%)

Year	*Unit*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Average Monthly Consumption Per Customer	*kWh/ month /customer*															
Average Monthly Revenue Per Customer	*LC / month /customer*															
Implied Tariff	*LC/kWh*	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check	Automatic formula for sense check

Annex 2: Operator-Specific Information

Budget

The following budget has been agreed to for execution of the study with [developer] in [country].

Implementation Plan

The following implementation plan has been agreed to for execution of the study with [developer] in [country].