Republic of Kenya

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Preparatory Survey on BOP Business on Integrated Electrification through Restoration Technology of Used Batteries

Final Report
(Summary)

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Japan International Cooperation Agency (JICA)

OSA Japan
Battery Bank Systems Co., Ltd.
Kankyou Life Technology Co., Ltd.
Sanei ME Co., Ltd.
IMG Inc.

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1 Research Overview

This is the executive summary of the final report of "Preparatory Survey on BOP Business on Integrated Electrification through Restoration Technology of Used Batteries" in the Republic of Kenya. The research team was formed with members from a consortium of 5 organizations (OSA Japan, Battery Bank Systems Co., Ltd., Kankyou Life Technology Co., Ltd., Sanei ME Co., Ltd. and IMG Inc.).

1.1 Background and Purpose of the Research

1.1.1 Background

Despite the Kenyan government's efforts to improve rural electrification situation in the county mainly by expanding the national power grids, a large number of households in rural areas remains off-grid. Even in the "on-grid" rural areas where the power lines are installed, household electrification rates have not been improved substantially as the residents can rarely afford the connectivity cost. The vast majority of rural population being classified as BOP, the Base of the economic Pyramid, is still forced to rely on traditional fuels such as kerosene and firewood, which causes serious problems on health, livelihood, and environment.

The government's development blueprint "Vision 2030" puts focus on promoting development and use of renewable energy sources. Enhancement of rural electrification is also flagged as a priority. In reality, however, the electrification rate in rural households remains 5% as of 2010, far lower than the targeted 20%[1].

Although the government has been actively promoting use of solar photovoltaic power generation system for rural electrification for years, it is often reported that many of those systems have not been working properly after few years of installation, due to the lack of battery maintenance. Considering these circumstances, the research team formed the hypothesis that a business-based distribution of low-cost, longer-life batteries, with proper maintenance service, could have a large impact on rural electrification in Kenya. The key technology for this business idea that the member company of the consortium holds is to restore used batteries, which enables delivering moderate batteries for lower cost.

1.1.2 Purpose

The objective of this research was to develop and test a business model that contributes to the improvement of living standards of off-grid BOP households through delivering restored, used batteries. In order to financially underpin the BOP business, the development and set up of a stable non-BOP business was the other purpose of this research. The target area is described below.

[1] IEA "World Energy Outlook 2012"

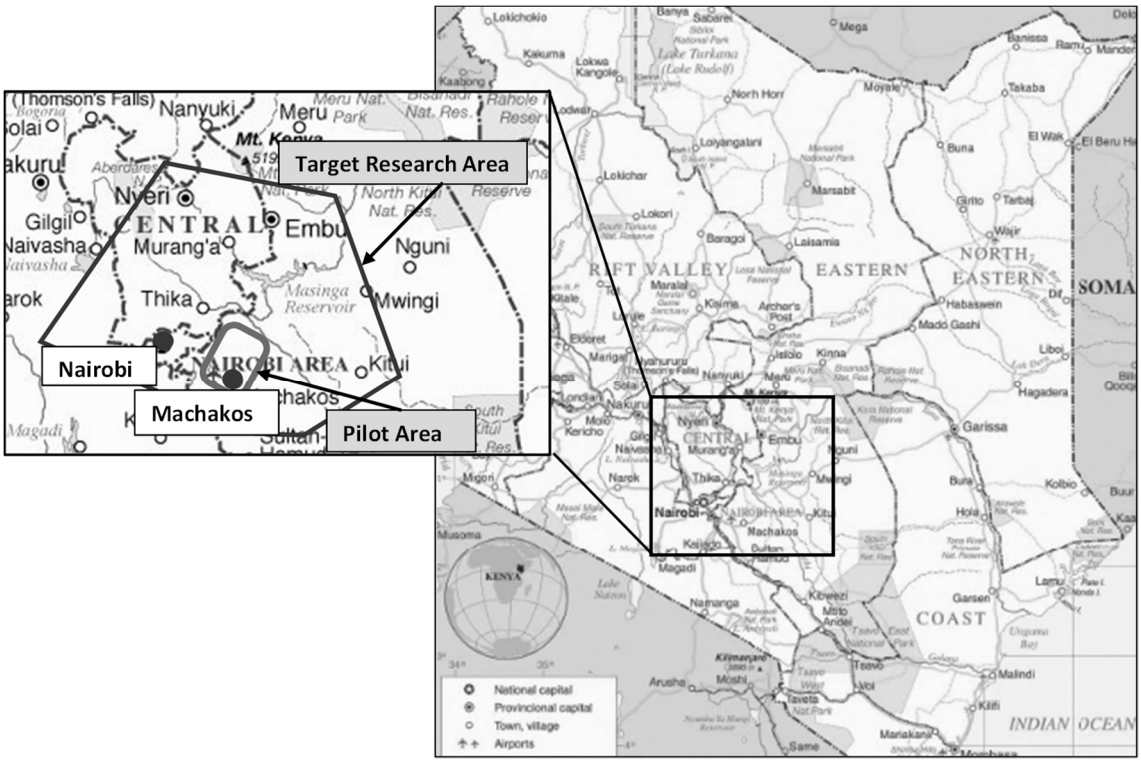

Figure 1-1 Target Research Area

1.2 General Condition in Kenya

1.2.1 Situation of BOPs in Kenya

The majority of the poor in Kenya resides in rural areas. Out of the geographically distributed BOP population in Kenya, poverty rates are highest in the arid and semi-arid regions in the north and north east, the areas with low agricultural potential[2]. The poverty rate in the arid regions (78%) apart from the dense urban areas like Nairobi city was almost twice as high as in the medium and high potential agricultural areas (averaging 41%)[3]. The population distribution by income class shows that approximately 84% of Kenyan people is categorized as the BOP[4].

For the areas distant from the nearby densely populated cities where it is inefficient to expand the nation-wide power grids, the government adopted stand-alone power plants or mini-grids that can provide electricity to neighboring small communities.

In contrast to urban areas where more than 85% of households use electricity as a source of energy for lightening, only about 25% in rural areas can choose that option. Most off-grid BOP households have no choice but to rely on kerosene as their principal energy source.

1.2.2 Battery Market (Brand-new and Used)

Chloride Exide Ltd., a Kenyan local battery manufacturer, holds a dominant position in the market. According to a waste battery recycler whom the research team made an interview with,

[2] World Bank (2013), "Kenya Economic Update"
[3] ditto
[4] JETRO (2010) " BOP business potential needs survey report, energy sector in Kenya"

approximately 120,000 batteries per month are manufactured and sold to Kenya and the other East African Community (EAC) countries. Kenya's automobile market is rapidly expanding due to the increase of the middle class within the rapid population growth. Many global automobile manufacturers are entering the Kenyan market. As a result of this transition to "automobile society", an increasingly larger amount of used batteries are disposed. It is estimated that approximately 370,000 used batteries are disposed annually.

Our research findings postulates that it is likely to find sealed industrial batteries easily in good conditions (high possibility of restoration), which might not be the case for used car batteries. Sealed industrial batteries, however, have wider varieties in voltage level or size/capacity, some types of which might not be applicable to the proposed business model for off-grid BOP households. The research team carefully considered the needs of off-grid BOP households and then decided to focus on a certain type of used battery to be collected and restored for a pilot project in this research.

1.3 Proposed Technology and Products

1.3.1 Technology for Used Battery Restoration

The member companies of the consortium have remarkable advantage in the technology for the restoration of used batteries. The proposed technology for the research was: "Multistage-Loop-Based Cycle Recovery Charging"[5]. The machine with this unique technology examines internal conditions of batteries in detail and refresh/recover them in the most suitable way.

The research team envisaged together with the advanced technology for battery restoration that member companies' know-hows and long experiences in battery restoration business in Japan will enable the development of a feasible business model that adapts to local contexts.

1.3.2 Development of a Prototype Product

In order to meet the needs of off-grid BOP households, two electrical appliances, a cabled LED[6] lamp and a mobile phone charger, were chosen as potential components of the proposed product "restored battery set" through the field survey. A battery management device was also designed and developed to avoid "over discharge" that reduces product life.

The restored battery set consists of a restored battery and lighting system as described below.

[5] This technology and the restoration machine with it were developed by Battery Bank Systems Co., Ltd (Patent Pending).
[6] Light-emitting diode.

Component of the Restored Battery Set
➢ Restored Battery: Small lightweight UPS[7] battery (12V sealed, lead-acid battery, 7Ah) ➢ Lighting System: 1) cabled LED bulb 2) multi mobile charger 3) battery connector (to connect battery to battery management device) 4) battery management device

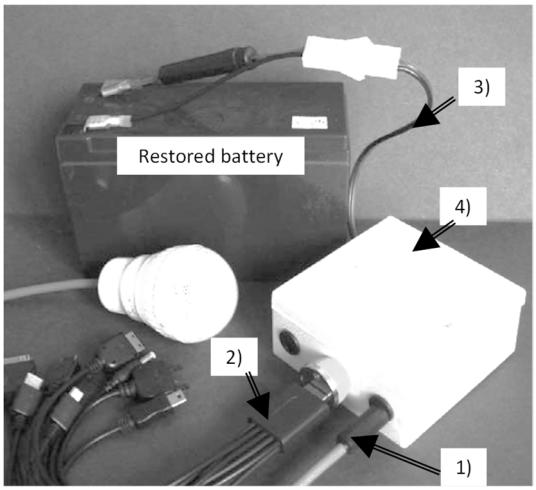

Photo 1-1 Restored Battery Set

One of the significant features of the proposed product is the type of the battery: the research team strategically adopted the small lightweight (approx. 2.5kg) UPS battery. Its weight and handy size make it easy for end user to carry it to markets for charging. Its power capacity (7 Ah) is enough to run all components of the product for days. This is also the typical type used for UPS available in Kenya and thus easy to procure at lower cost, making the retail product price affordable to BOP households (2,500ksh – 3,000Ksh).

The battery management device also has a unique feature which indicates appropriate timing for recharge. User can avoid "over discharge" by this and it helps using the battery for longer period.

[7] Uninterruptible Power Supply: a device that allows computer to keep running for at least a short time when the primary power source is lost.

2 Research Result

2.1 Conclusion

The result of the research leads to the conclusion that the proposed business models, both for BOP and non-BOP, are economically and technically feasible.

2.1.1 Feasibility of the Proposed BOP Business

The key idea of the proposed BOP business model in this research was to deliver restored, used batteries to off-grid BOP households together with battery-powered electrical appliances designed and manufactured by the research team. This key idea remained the same while revisions were made to the model during the research to capture contextual realities.

With regard to the distribution channel of the products (restored batteries and electrical appliances), the original idea was to deliver them to the retail consumers by establishing and operating through internally owned and managed transportation network. The initial findings of the research showed that the internally managed transportation plan may not be cost effective as the actual costing turned out to be much higher than previously expected. The model was then refined by replacing the transportation costs with a new version named by the research team as “Distributor Model”. In this model, distributors play the key role of selling the products to end users and providing battery charge and maintenance services (see below figure 2-1).

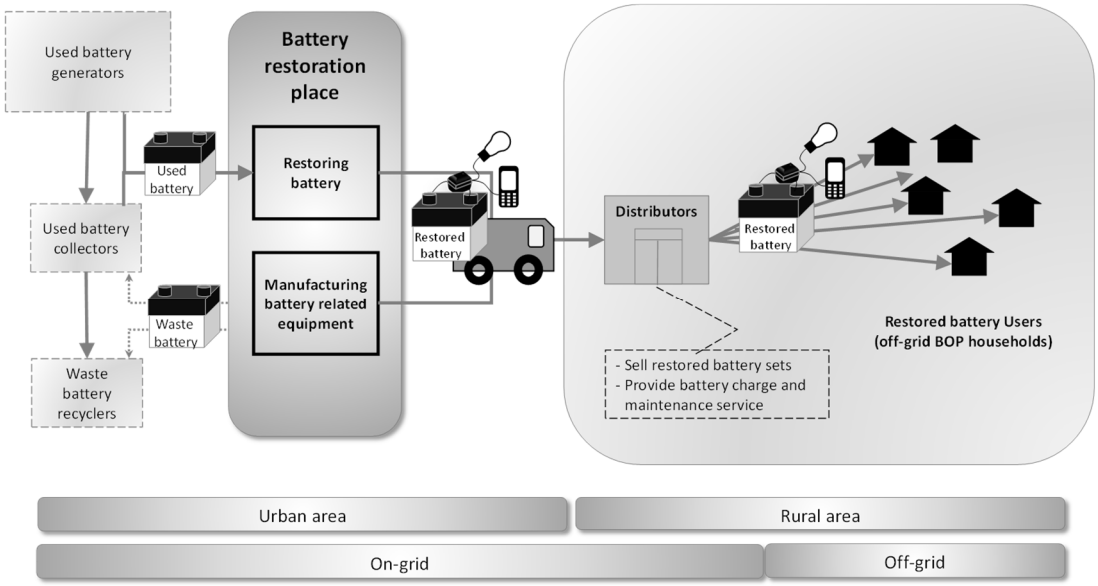

Figure 2-1 Distributor Model

The distributors in this model are mainly selected from local retail kiosks from which BOP households purchase kerosene. The end users of the products are expected to bring their batteries to the distributors for recharge, instead of purchasing kerosene, on their daily occasion to visit market. The small, lightweight (approx. 2.5kg) UPS battery was adopted as it is convenient to carry by the end users.

While implementing the pilot project through applying the distributor model, the research team

analyzed that the designed products were accepted among the BOP customers. Transport costs were notably reduced to the profitable level by appointing distributors in local markets. From these points, the research team concluded that the distributor model was feasible.

2.1.2 Development of Profitable Business

The development of a stable non-BOP business was the other essential task in order to financially underpin the BOP business. At the beginning, the research team anticipated that batteries restoration service, mainly for solar home systems (SHSs), could be the most promising avenue since it was reported from multiple sources that large number of SHSs have been installed throughout Kenya by the government and aid donors. However, the idea turned out to be scarcely feasible from the findings of the research[8].

Among several market opportunities studied in the research, the following two businesses showed profitability: a) selling restored battery sets for middle and upper class households in urban areas: and b) selling the own-manufactured battery life extender to large-volume business users such as SHS distributors.

2.1.3 Next Step

The research team finally made a decision to proceed to the next step of setting up the business in Kenya. Key factors are as follows.

The result of the pilot project and the impact assessment proved that the distributor model is feasible as a BOP business from the following lenses:

a) The proposed products met the needs of off-grid BOP households.
b) Reduction of transport costs ensured profitability.
c) Introduction of the products made varieties of concrete, positive development impacts on socio-economic situation of off-grid BOP households (see 2.3 for more detail).

Moreover, through training BOP entrepreneurs in the pilot project, it was evidenced that most of the proposed products can be manufactured by themselves in house by assembling locally-available parts and components, which drastically reduces the production cost. Multiple non-BOP businesses opportunities were also discovered which could financially underpin the BOP business.

2.2 Business Model

2.2.1 Overview of the Business Model

The planned business model consists of two pillars: 1) collecting, restoring and selling used batteries, and 2) manufacturing and selling battery related equipment.

[8] The major constraints include: (i) installation records have been not maintained in most cases; (ii) the condition of broken batteries of those SHSs are generally too severe to be restored; and (iii) most SHS users can not afford transportation cost for the service.

Table 2-1 Two Pillars of the Entire Business

1) Collecting, restoring and selling used batteries
- Collecting used batteries - Restoring used batteries - Selling-off waste (unrestorable) batteries - Selling restored batteries
2) Manufacturing and selling battery related equipment
- Manufacturing and selling battery lighting system - Selling toolkits of battery lighting system to manufacturing franchisees - Selling the own-manufactured battery lighting system and battery life extender to large-volume business users

There remain uncertainties to be exposed and managed before putting large investments. It is planned to set the first year as the pre-business phase, conducting a test marketing and additional in-depth research as well as finding more potential customers.

The conceptual business structure is designed as per the figure 2-2 below. In this structure local BOP individuals are supposed to participate in playing four different roles throughout the value chain: distributors, manufacturing franchisees, workers of the local subsidiary, and customers.

Distributors procure restored battery sets and battery related equipment from the local subsidiary or from manufacturing franchisees and sell them to end users.

Manufacturing franchisees procure the toolkit for battery lightning system from local subsidiary and assemble them to sell restored battery sets and battery related equipment to distributors or directly to end users.

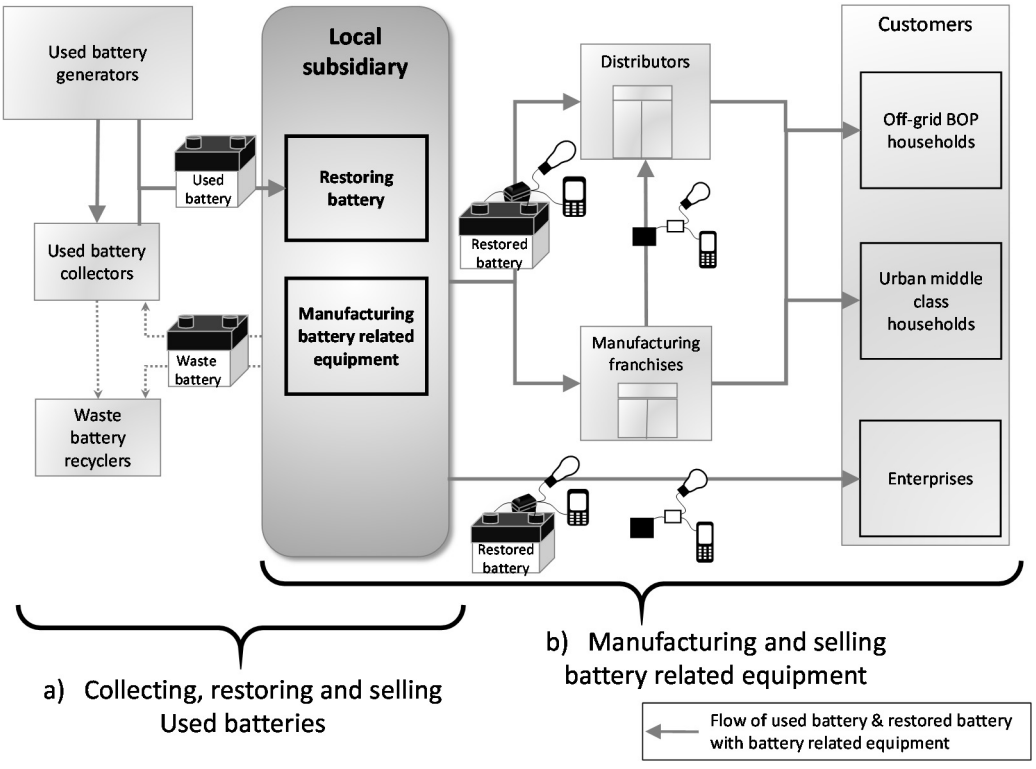

Figure 2-2 Conceptual Business Structure

2.2.2 Planned Timeline for Business Development

The post research timeline for business development is planned as per the figure 2-3 below. The local subsidiary will be set up and full-scale business will be launched after a year of preparation phase. The targets in the first year are to mark above the break-even point and to fund-raise business expansion in the second year.

The targets for the fourth year include an annual turnover of 50 million Ksh. It is also planned to review the entire business for "selection and concentration" in order to gain a foothold in the Kenyan market for long-term growth.

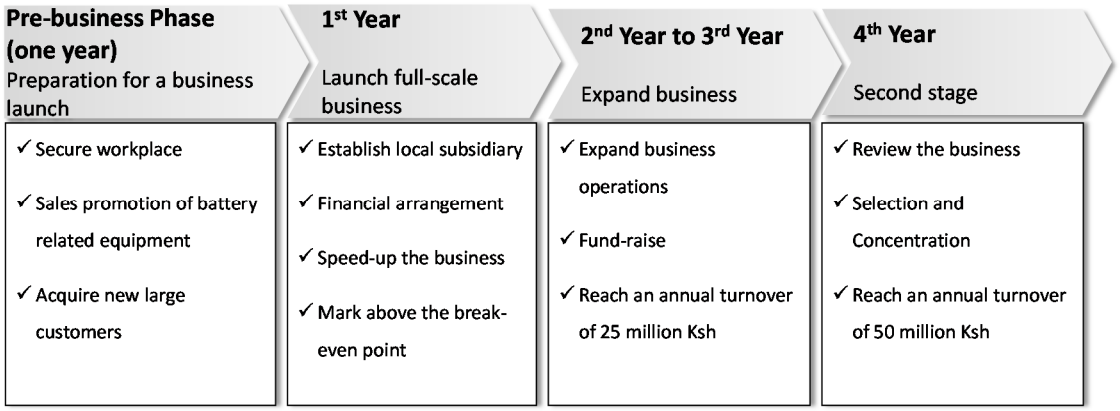

Figure 2-3 Timeline for Business Development

2.3 Development Impact

2.3.1 Impact Assessment

The research team conducted interviews with potential customers as a baseline survey for the purpose of gaining a picture of pre-intervention living situation of the off-grid BOPs in the pilot areas. The interviews were held by using the questionnaire designed with following indicators.

After the customers used the products for a certain period of time, the impact assessment was carried out in order to assess the impact made by the products distributed through the "Distributor Model" on off-grid BOP households[9].

Table 2-2 Indicators for Impact Assessment of Restored Battery Sets Introduction

Indicator		Item	Target	Method	Result	Unit
Physical Factor	Brightness	illuminance measurement	LED lamp, Kerosene lantern etc.	lux meter	numeric data comparison	lux
Life Style	Lighting hours	lighting hours	LED lamp, Kerosene lantern etc.	interview	lighting hours	hour(s)/ day
Educational Factor	Study	study hours	household (first-born child)	interview	study hours	hour(s)/ day
		easy to read	household (first-born child)	interview	easy-to-read comparison	rate
Economical Factor	Expenditure	amount spent	LED lamp, kerosene lantern etc.	interview	expenditure comparison	Ksh/ month

[9] More than 70% of users (interviewees) had used the restored battery sets for over two months. The whole samples ranges from 1 to 24 weeks.

Indicator		Item	Target	Method	Result	Unit
	Expenditure	amount spent	mobile charging	interview	expenditure comparison	Ksh/ month
	Side income	amount earned	side business of household	interview	income comparison	Ksh/ month
Social Factor	Family time	hour(s)	household	interview	hour(s) /day	hour(s)/ day
Health Factor	Discomfort	smell	household	interview	Y/N	rate
		air pollution, Soot	household	interview	Y/N	rate
	Health problem	headache	household	interview	Y/N	rate
		sore throat	household	interview	Y/N	rate
		sore eyes	household	interview	Y/N	rate
Sanitation & Hygienic Factor	Kitchen hygiene and sanitation	contamination	persons who prepares food	interview	Y/N	rate
	Food safety while eating	uncomfortableness to eat food due to hard to see food	household	interview	Y/N	rate

2.3.2 Key Findings of the Impact Assessment

The assessment shows that immersion of the products (restored battery sets) made varieties of concrete, positive development impacts on socio-economic situation of off-grid BOP households.

It is confirmed that the restored battery sets have greatly reduced the use of traditional light sources such as kerosene lantern. As a result, the majority of BOP customers made positive responses to all indicators for the health, sanitation/hygiene, and physical factors. The products brighten up the customers' living space much better than kerosene lanterns, in a healthier way without any health hazards. The products were also successful to relieve the BOP customers inconvenience / uncomfortableness while dining in dim light. Although the research team was forced to give priority to subjective indicators due to time and resource constraints, it is not exaggeration to say from the result of the assessment that the product will also contribute to the improvement of health and sanitation situations of BOP households.

Some positive impacts were also seen on the indicators for educational, economic and social factors, although the data was not enough to suggest direct causal relations. Through training BOP entrepreneurs in the pilot project, the research team concluded that it was feasible to appoint them as distributors and manufacturing franchisees, which makes a different impact by contributing to their income generation.

3 Collaboration Opportunities with JICA Projects

The research identified some opportunities for the planned business to collaborate with JICA projects. Among the ongoing projects in Kenya are two areas such as: 1) rural electrification promotion using renewable energy, and 2) improvement of waste treatment in Nairobi.

1) Rural electrification promotion using renewable energy

The proposed model in this research might be eligible for one of the rural electrification models that JICA has made efforts to develop together with Kenya's Rural Electrification Authority under "Project for Establishment of Rural Electrification Model Using Renewable Energy". The know-hows the research team gained through the process of BOP entrepreneur training will also contribute to "Project for Capacity Development for Promoting Rural Electrification Using Renewable Energy" being implemented with Jomo Kenyatta University of Agriculture and Training (JKUAT).[10] The experts from the business side will share their know-hows and experience with teachers and students of JKUAT through seminars and other interactions. The close collaboration with these JICA projects is expected in return to make positive marketing impacts on the planned business.

2) Improvement of solid waste treatment

The team has exchanged series of information with JICA's "Project for Capacity Development of Solid Waste Management of Nairobi City" during this research, i.e. making a list of reliable waste collectors/recyclers etc. It is expected to seek continuous synergies in the next steps as well.

Besides the opportunities with the ongoing project implemented in Kenya as mentioned above, the research team also expects potential collaboration with JICA's human exchange initiatives indicated as below.

1) Private-sector partnership volunteer program

For the preparation of the business extension towards the neighboring countries in EAC in the future, it is essential to understand the local context of targeted market. The member companies of the research team may consider the option of dispatching their staff under JICA's Private-sector partnership volunteer program.

2) African Business Education Initiative for Youth (ABE Initiative)

Under the masters course and internship program of ABE Initiative, a number of competent youth leaders from Kenya and other African countries are studying in universities and companies in Japan. The study team will seek the opportunities to advertise the studied business model among them with an aim to partnering consequently extending the business to different areas in Kenya or other countries.

[10] This project aims to improve capacity of JKUAT for human resource development in the field of rural electrification.