

FY 2009 CDM/JI Feasibility Study (FS) Programme Report

Study Title:

Installing PV LED Lantern throughout Uganda

Main Implementing Entity:

SANYO Electric Co., Ltd.

FS Partners:

- Mitsubishi UFJ Securities Co., Ltd.
Consultant
- Balozi Inc.
Implementer, Distributer

1. Summary of the proposed project and background of the project proposal

This project (“Project”) aims to introduce photovoltaic light emitting diode lantern (“PV LED Lantern”) systems throughout the Republic of Uganda coordinated by Balozi Inc. of Kampala, Uganda (“Balozi”). Presently, residents in un-electrified areas use kerosene lamps which emit carbon dioxide (“CO₂”) and cause disorder of respiratory system.

PV LED Lantern to be distributed in this Project employs high quality and high reliability photovoltaic and storage battery technologies. The geographical boundary of the Project is whole land of Uganda because of the abundance of solar radiation throughout the year.

The purpose of this Project is to reduce the emission of CO₂ and provide safe and bright light to residents by installation of high quality PV LED Lantern to households for an affordable price.

By the operation of this project, 0.077 ton-CO₂/yr of greenhouse gas per set of PV LED Lantern is expected to be reduced. Even the benefit of each PV LED Lantern is small, great benefits are expected by spreading them across the country.

Starting date of this Project is the date when sales system of PV LED Lantern is fixed.

Methodology

Small-scale CDM (AMS) methodology I.A. Ver13.

“Electricity generation by the user”

2. Study Contents

(1) Study Subjects

1) Project plan as programmatic CDM

In order to implement this Project as programmatic CDM, it is necessary to determine boundaries for PoA as well as for each CPA. As the Project's final objective is to install PV LED Lantern throughout Uganda as an alternative of kerosene lamps, the boundary of PoA is whole land of Uganda. As CPA can be added unlimitedly to the PoA within the crediting period, the activity criteria included in each CPA must be clarified. Balozi is the coordinating entity for the PoA and all CPAs in the project activity. In this Study ("Study"), it is necessary to clarify project implementation structure and the unit of CPA manageable by Balozi.

2) Identification of baseline scenario and determination of emissions reduction

The baseline scenario of the proposed project is foreseen as the use of kerosene lamp to supply light in the absence of the project activity. Therefore, baseline emission is the amount of greenhouse gas emitted from kerosene lamps. It is also necessary to clarify in the Study the adequacy of baseline scenario, the usage of kerosene lamp and its emission of greenhouse gas.

3) Monitoring method

This Project is to install PV LED Lantern in private households and the number of PV LED Lantern to be installed is expected to reach millions. As such, it is important to find a monitoring method that is in accordance with an approved methodology, reliable and financially realistic. It is also important to set up a monitoring structure by which all CPA projects' data can be accurately managed.

4) Economical analysis

The Project does not require large-scale plant and thus no initial investment is needed. Therefore, economical analysis with IRR does not fit, so that it is necessary to study the method of analysis.

In Uganda, PV lanterns produced by other manufactures have been already sold in the market. Also, Uganda belongs to East Africa free-trade zone and the inflow of similar products is predicted, trend and market price of competitors' products in the neighboring nations have influence to PV LED Lantern. The prevalence of PV LED Lantern mainly targets households in un-electrified areas. Those people are making a living under US\$1 a day, and included in Bottom of Pyramid ("BOP") and have low buying capacity, so that subsidies from the government and United Nations ("UN") are also important elements. The Study is to clarify the trends of competitors' products, as well as measures and policies in Uganda and its neighboring countries, and activity status of supporting institutions.

(2) Study Contents

Four fieldworks were carried out in the Study. As part of the fieldwork, meeting with DNA, Ministry of Water and Environment, government-affiliated agencies, organizations such as UNDP and JICA were held to discuss technical information about PV LED Lantern and its installation plan. Comments such as the usage of lighting methods, subsidies, and electrification rate were gathered from intellectuals. Also, comments from stakeholders were gathered.

As a result, intellectuals and residents have great expectations for benefits by the installation of PV LED Lantern. It becomes clear that government of Uganda offers 1) duty exemption for solar related products and 2) subsidies for individuals, schools, and facilities for the installation of PV systems.

Even in electrified areas, many people use kerosene lamps because of its high initial investment to lead in electrical cables. It was also found that there are poor quality similar products made in China and India which use lead acid battery, but because of its low reliability, they have not yet installed enough.

1) Project plan as programmatic CDM

The boundary of PoA is throughout Uganda where government subsidies are given and high irradiation is expected.

This Project aims the installation of PV LED Lantern throughout Uganda, so that project boundary is set to be whole land of Uganda. PV LED Lantern is expected to be released simultaneously throughout Uganda, so that CPA unit is not physical boundary, but a period of 1 year.

Balozi, as a coordinating/managing entity, will verify each CPA with the cooperation of secondary distributors.

2) Identification of baseline scenario and determination of emissions reduction

The baseline scenario of the Project is foreseen as the use of kerosene lamp to supply light in the absence of the project activity. Therefore, baseline emission is the amount of greenhouse gas emitted from kerosene lamps projected from past trend. Study was done to clarify the usage of kerosene lamp and its emission of greenhouse gas as well as alternative energy made by PV LED Lantern.

As a result, the baseline emission for each PV LED Lantern is estimated as 0.077t-CO₂/year. Inherently, as the energy is sourced from a renewable resource, there are no project emissions from each CPA. There is no CO₂ emission derived from fossil fuel by the project activity. Consequently, reduction amount of CO₂ emission equals to the baseline emission, and it is calculated as 0.077t-CO₂/year.

3) Monitoring method

Monitoring this Project is planned in accordance with the monitoring methodology AMS-IA. "Electricity generation by the user" Version 13. According to the methodology, monitoring requires an annual check of all or sampled PV LED Lantern to ensure the operation of PV LED Lantern.

Because a large number of PV LED Lantern to be installed, an annual check of all PV LED Lantern is not feasible. Therefore, samples will be monitored to ensure the operation of PV LED Lantern.

4) Economical analysis

In this Project, SANYO Electric Co., Ltd. sells PV LED Lantern in Uganda. The amount of installation is influenced by subsidies, sales price, specifications and prices of similar products, and affordability for households. It is important to consider CER revenue and its reflection to sales price.

3. Project Development

(1) Identification of baseline scenario and project boundary

The baseline scenario of this Project is foreseen as the use of kerosene lamps to supply light in the absence of the project activity. Therefore, baseline emission is the amount of greenhouse gas emitted from kerosene lamps when lighting source displaced by solar energy.

Since this Project aims the installation of PV LED Lantern throughout Uganda, and Uganda government's subsidies to PV related products are implemented throughout the country, the project boundary is set to be whole land of Uganda. PV LED Lantern is expected to be released simultaneously, CPA unit is not physical boundary, but the period of 1 year.

The project adopts the monitoring methodology AMS-IA "Electricity generation by the user" Version 13 using Option 3. Amount of emission reduction is calculated in accordance with the methodology.

According to the survey held by Ministry of Energy and Mineral Development in 2005, amount of kerosene used at household for lighting source is 2.5L/month, 30L/year. The baseline emission is estimated at 0.077ton-CO₂/year per set of PV LED Lantern.

Parameter	Value	Unit	Description
BE_y		(tCO ₂ / yr)	Emissions in the baseline in year y
$BE_{i,y}$	0.077	(tCO ₂ /yr)	Emissions in the baseline per system i in year y
$FC_{i,j,y}$	30.0	(Litre/ yr)	Amount of fuel consumption of fuel type j (kerosene) per system i in year y
d_j	0.81715	(kg/Litre)	Density of kerosene
NCV_j	0.0438	(GJ / kg)	Net calorific value of kerosene
$EF_{CO_2,j}$	0.0719	(tCO ₂ / GJ)	CO ₂ emission factor for kerosene
N_{PV}		(units)	Number of PV LED lanterns in operation during the year
j	-	-	Fuel type used for combustion (kerosene)

Baseline emissions per PV LED Lantern are calculated as:

$$\begin{aligned}
 BE_y &= \sum_{i=1}^{N_{PV}} BE_{i,y} = \sum_{i=1}^{N_{PV}} \sum_j FC_{i,j,y} \times d_j \times NCV_j \times EF_{CO_2,j} \\
 &= N_{PV} \times 30 \times 0.81715 \times 0.0438 \times 0.0719 \\
 &= N_{PV} \times 0.077
 \end{aligned}$$

(2) Project Emissions

As the energy is sourced from a renewable resource, there are no project emissions from a CPA. There are no emissions derived from fossil fuel consumption or electricity consumption by the project activity.

However, independent monitoring of the scrapping of replaced equipment will be implemented. A check will be performed to determine that the number of PV LED Lantern distributed by the project corresponds to the number of scrapped kerosene lamps. The kerosene lamps will be stored until such correspondence has been checked. The kerosene lamps will then be scrapped and the scrapping will be documented and independently verified. With this method, leakage will not be occurred.

(3) Monitoring Plan

According to the monitoring methodology AMS-I.A. "Electricity generation by the user" Version 13, monitoring shall consist of:

- 1) An annual check of all PV LED lanterns or a sample thereof to ensure that they are still working.

Or

- 2) Metering the electricity generated by all PV LED Lantern or a sample thereof.

In this Project, method 1) is adequate.

Balozi, as an implementer, develops and manages database of all CPAs.

The database includes the following information:

For each PV LED Lantern:

- Name and address of PV LED Lantern owner.
- Distribution date of PV LED Lantern.
- Lot number of PV LED Lantern.
- Name of the distributor of PV LED Lantern.
- Number of kerosene lamps handed over in exchange of PV LED Lantern from its owner.
- Date of return if the distributed PV LED Lantern has any problem.

Those data is collected by Balozi or secondary distributors when they sell PV LED Lantern.

Monitoring is done by secondary distributors by visiting and checking the operational status of samples.

Sampling method is defined in “General guidelines for sampling and surveys for small-scale CDM project activities” by UN. Multi-Stage Sampling will be applied as a sampling method of this CPA

In this project, it is required to monitor kerosene lamps replaced to PV LED Lantern. It is required to match the number of distributed PV LED Lantern and the number of kerosene lamps collected, so that kerosene lamps are kept by Balozi until the implementation of validation, and scrapped after that.

Accordingly, following two items are considered to monitor in this project:

- i) An annual check of sample PV LED Lantern to ensure that they are still working
- ii) Number of scrapped kerosene lamps

Monitoring will be implemented according to the structure described in figure 1.

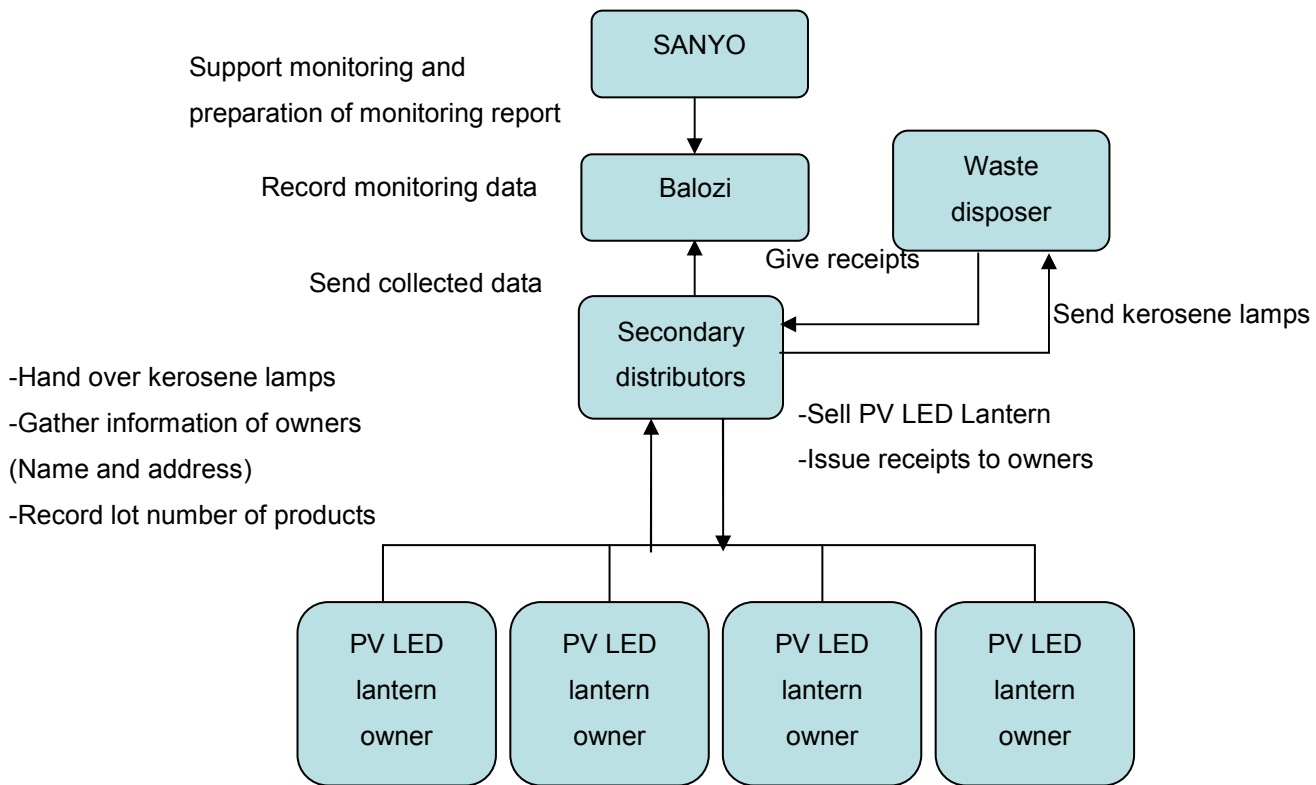


Figure 1. Monitoring structure

(4) CO₂ emissions reduction

CO₂ emission reduction in each CPA and PoA is described in Table 1.

CPA	Number of Installation (thousand)	Year of PoA																	Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
CPA1	50	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9								39.0
CPA2	200		15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4							154.0
CPA3	300			23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1						231.0
CPA4	400				30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8					308.0
CPA5	500					38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5				385.0
CPA6	500						38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5			385.0
CPA7	500							38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5		385.0
CPA8	500								38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	385.0
PoA Total	2,950	3.9	19.3	42.4	73.2	111.7	150.2	188.7	227.2	227.2	227.2	223.3	207.9	184.8	154	115.5	77	38.5	2272.0

Table 1. CO₂ emission reduction by CPA and PoA

(5) Project operation period and crediting period

Project period of each CPA is 10 years considering product lifetime. Starting date of this Project is the date when selling system of PV LED Lantern is fixed. It is reasonable since this Project does not require large-sized facilities or preliminarily activities. Crediting period of PoA is set at 28 years, and that of each CPA is 10 years.

(6) Environmental impact and other indirect impacts

According to Environmental Assessment Guidelines for the Energy Sector issued by NEMA in 2004, project for mini power generator under 5kW does not require EIA. Since the output of PV LED Lantern in this Project is 5W, it does not require EIA. To register this Project as CDM, it is necessary to acquire EIA Clearance from NEMA and submit it to CCU.

(7) Stakeholder Comments

A stakeholder's meeting for the introduction of PV LED Lantern in Uganda was conducted on 13 September 2009 at Busabara village in Entebbe, Uganda. There were 17 participants from the local community. Comments were also gathered from 9 intellectuals in 6 organizations.

Respondents were satisfied with the replacement of kerosene lamps with PV LED Lantern. Comments indicated that the safety and convenience of the PV LED Lantern, especially in a household setting was highly appreciated. No negative comments were received.

Main opinions of village members are as follows:

- Fires caused by kerosene lamps happen often. Usage of PV LED Lantern reduces fires.
- People can not use kerosene lamp for long time because of the expensiveness of kerosene. PV LED Lantern makes children possible to study during night.

Main opinions of intellectuals are as follows:

- Reduction of disease of respiratory systems
- Reduction of fires
- Reduction of cost of kerosene
- Increase of customers to street booths
- Increase of study time of children
- Reduction of crimes

(8) Project implementation structure

The project implementation structure is described in Figure 2.

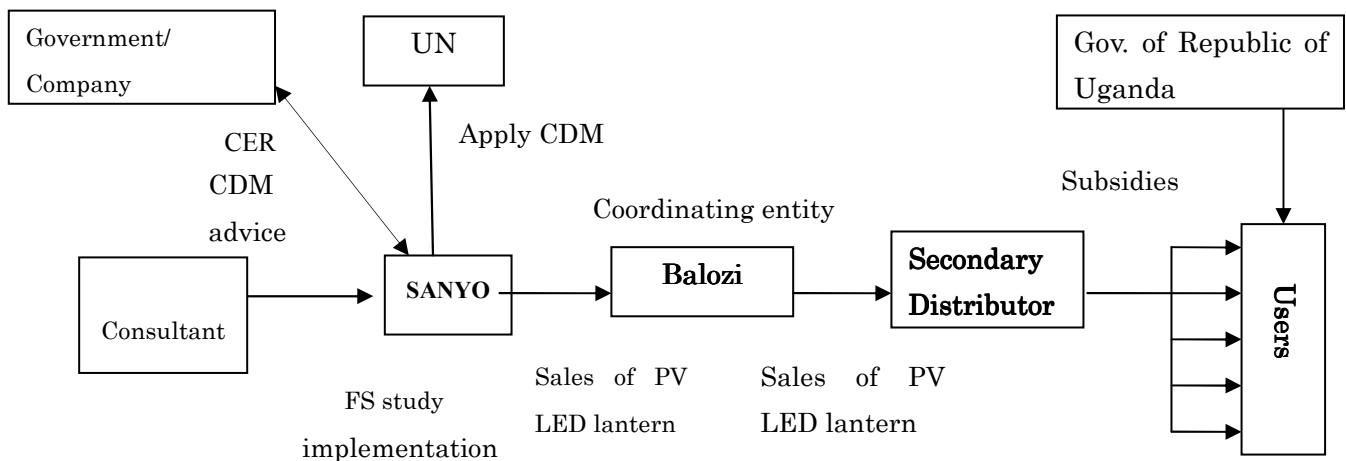


Figure 2. Project implementation structure

(9) Financial plan

This project utilizes 100% SANYO's equity.

(10) Economical analysis

In this Project, 2.95million PV LED Lantern in total are expected to install in 8 years. In the case if this Project was done without CDM, the sales amount would be estimated to be below 10,000 units each year. By hypothesizing the profit of each sales is US\$0.5, the profit of each year is US\$5,000. Such a low profit makes it difficult to continue PV LED Lantern business itself.

By operating this project as CDM, 0.077ton-CO₂/year CER revenue per set is expected. In the case of US\$15 per one ton CER revenue, US\$11.5 per set is expected during expected product life time of 10 years. In the case of US\$10 per one ton CER revenue, US\$7.7 per set is expected for 10 years. Provided that monitoring and product coordination cost will be US\$0.3 per set and give back all CER revenue to product price, the amount of reduction will be US\$8 in the case of US\$15/ ton-CER and US\$4 in the case of US\$10/ton-CER.

Provided all the CER revenue gives back to the sales price of PV LED Lantern prior to receive the CER revenue, the sales price would reach affordable price range. However, if reflection of the CER revenue starts simultaneously with the sales of PV LED Lantern, the business would be run in the red during the sales period, and it doesn't move into black until the end of sales period. It takes approximately 14 - 15 years to move into black by cumulative profits, and it is not realistic to run the business.

On the other hand, in case the CER revenue is reflected to the sales price based on actual CER revenue, amount of reduction to each PV LED Lantern will be increased after 3 years, yet virtually the amount of reduction is small and thus number of installation will be limited.

As a result of this analysis, it is important to install as many PV LED Lantern as possible, so that economic efficiency of project becomes better. Consequently, the more lanterns are

installed, the more amount of greenhouse gas is reduced.

Therefore, it is important to install PV LED Lantern with subsidies from governments and organizations such as World Bank at early stage.

(11) Justification of additionality

Additionality of PoA is demonstrated according to “Combined tool to identify the baseline and demonstrate additionally”.

Step 1: Identification of alternative scenarios

Step 1a: List of alternative scenarios

Possible alternative scenarios for this Project are followings:

1. Utilization of PV LED Lantern without implementation of PoA, the Project without CDM
2. Utilization of PV lanterns which are currently available in Uganda
3. Utilization of electric lighting
4. Utilization of kerosene lamps, the continuation of the current situation

Step 1b: Consistency of alternative scenarios with enforced mandatory applicable laws and regulations

Alternative scenarios identified in step 1a are in compliance with mandatory legislation and regulations.

Step 2: Barrier analysis

Step 2a: Identification of barriers that would prevent the implementation of alternative scenarios

Scenario 1. Utilization of SANYO PV LED Lantern without implementation of PoA, the Project without CDM

In Uganda, 38% of population lives under poverty line, and GNI of 2007 was US\$340. For that reason, PV LED Lantern (US\$ 65) is extremely expensive for people in Uganda. Even with the subsidy of the government of Uganda, the price is more than 1/10 of their average annual income. However, profit will not be made if the price goes down, and it is impossible to operate this business continuously. In the case of operating this Project as CDM, CER revenue is utilized to lower the price to affordable price.

This PV LED Lantern is developed with the request of Uganda administration officials. This high quality product utilizes SANYO photovoltaic and storage battery technologies. This product is not expected to spread out without this PoA

Accordingly, Scenario 1 confronts investment and technology barriers.

Scenario 2. Utilization of PV lanterns which are currently available in Uganda

PV lanterns made in China and India are now sold in Ugandan market. However, they have low reliability and are returned as defectives, so that they have not spread across Uganda. To avoid the installation of those products into Uganda, Uganda National Bureau of Standards established quality standards. Those products which do not meet the standard can not receive subsidies.

Accordingly, Scenario 2 confronts technology barrier.

Scenario 3. Utilization of electric lighting

The electrification rate of Uganda is 10% throughout Uganda and only 3% in rural areas. Government of Uganda works on the improvement of electrification rate. However, it is difficult to extend electrical grids to low populated rural areas.

Even in electrified area, many households can not connect to grid because of its high costs for connection to electricity.

Accordingly, Scenario 3 confronts investment and technology barriers.

Scenario 4. Utilization of kerosene lamps, the continuation of the current situation

Kerosene lamps are generally used in households throughout Uganda, and there are no barriers.

Step 2b: Elimination of scenarios that are prevented by the identified barriers

The implementation of scenario 1, 2, and 3 are prevented by barriers, so that they are eliminated from alternative scenarios.

Step 3: Investment analysis

Investment analysis is conducted only when there are remaining scenarios in Step 2. In this project, there is only one alternative scenario, so that investment analysis is not conducted.

Step 4: Common practice analysis

As in Step 2, PV lanterns made in China and India are now sold in Ugandan market. However, they have low reliability and are returned as defectives, so that they have not spread across Uganda.

Accordingly, there are no similar project activities in Uganda

From these results of analysis, this PoA is additory.

(12) Probability of operation

This Project utilizes 100% SANYO's equity. The Project receives large expectations not only from government of Uganda, but also from many people as a pioneer of BOP business. SANYO aims sustainable BOP business by reducing the product price with CER revenue and subsidies

from government of Uganda. This project meets Uganda government' s against kerosene lamp campaign, and the implementation as CDM is expected to maximize the effect of widespread of PV LED Lantern.

After this Study, SANYO achieves early implementation of the registration of this project as PoA.

4 . Research of Co-benefit

n/a

5 . Research of sustainable development

n/a