FY2009 CDM/JI Feasibility Study
Summary Report

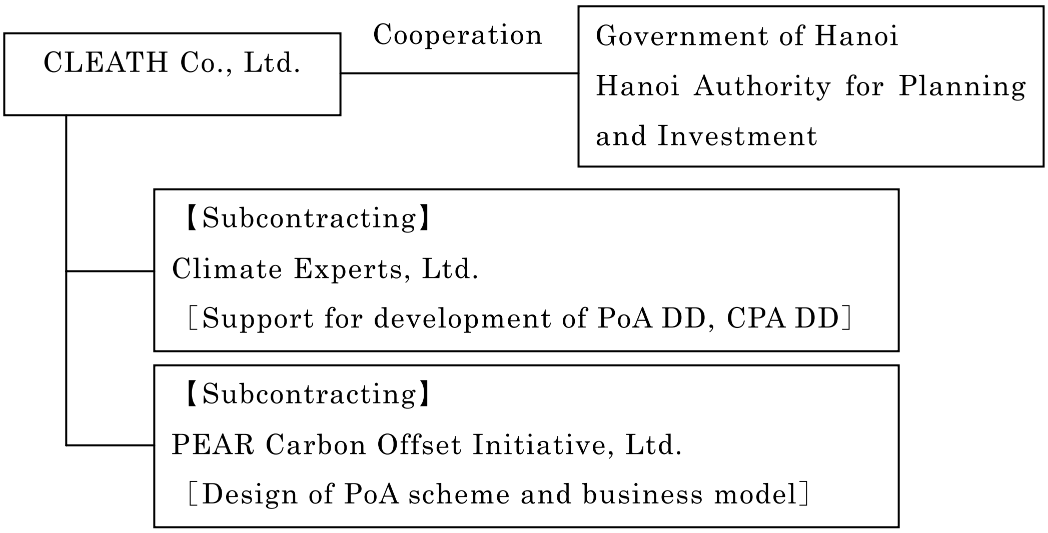
Name of the study

Programmatic CDM Feasibility Study on the installation of efficient fluorescent lamp ballasts in Hanoi and other cities, Vietnam

Study implementation body

CLEATH Co., Ltd.

Study implementation structure



Project outline

1. PROJECT OUTLINE

This Programmatic CDM project is to replace conventional ballasts of straight tube fluorescent lamps to efficient electronic ballasts (inverter type) in public facilities in Vietnam including the cities of Hanoi, Ho Chi Minh and Danang with the aim to reduce CO_2 emission as well as to save energy. This project is supported by Ministry of Natural Resources and Environment of Vietnam and Hanoi City as a part of energy saving policies. A new factory is planned to be built to manufacture inverters used for the project in Hoa Lac High-Tech Park near Hanoi City as requested by the government of Vietnam.

High efficient and energy saving electronic ballast is not prevalent in Vietnam. Instead, cheap and energy consuming ballast and glow starter made by SINO (China) and Philips are widely used. This programme is to promote the switch to high performance and most advanced ballasts, without changing the whole lamp system. This programme is expected to reduce electricity consumption by 40%.

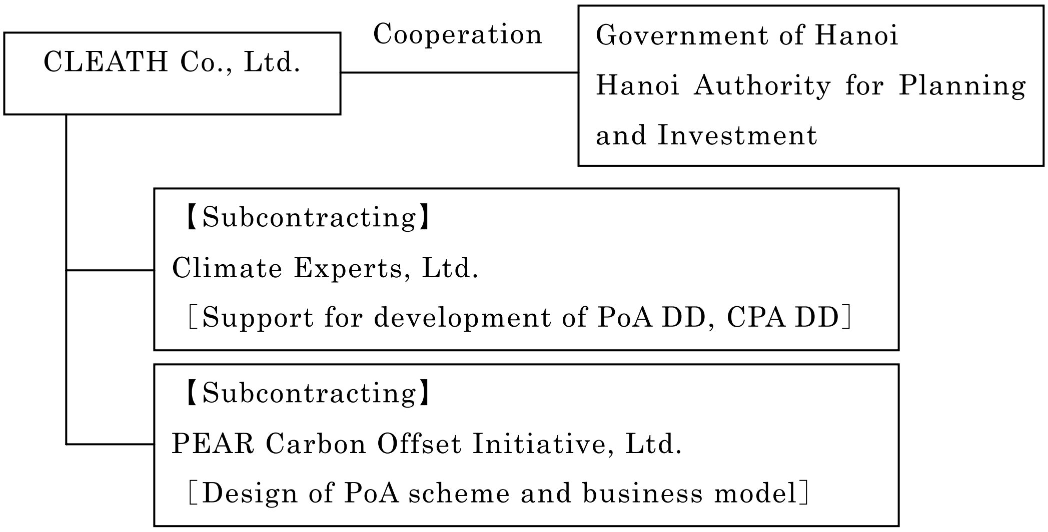
Also, this is one of the few technology transfer CDM projects aiming to transfer all the technology know-how to Vietnam including part manufacturing, procurement and manufacturing, management, and installation.

As the first stage of the Programme of Activities (PoA), electronic ballasts will be installed to the existing fluorescent lamp systems in Hanoi City with the government of Hanoi City as the counterpart (Activity 1). The installation will be expanded in Ho Chi Minh City as the second stage, and in Danang City as the third stage. The outline of Activity 1 includes; project site is Hanoi University, UN registration by the end of 2010, full-scale installation from 2011, installation of 10 million units by the beginning of 2014 and annual greenhouse gas emission reduction of around 1million t-CO_2.

In Vietnam, energy demand is rising with high economic growth. Electricity consumption increased from 25,851GWh in 2001 to 44,932GWh in 2005. Electricity of Vietnam group estimates energy demand in 2010 will increase to 106,724GWh. The increase of electricity consumption triggers construction of new power plants, while containing problems of serious environmental pollution, depletion of natural gas and coal, posing a threat to sustainable development in Vietnam.

Assuming the installation of 10 million ballasts by this project, annual energy saving will be about 1680GWh (estimation depending on preconditions), 400MW by simple calculation. Thus the programme may avoid installation of one large scale thermal power plant, which contributes to sustainable development in Vietnam from the viewpoints of energy resource conservation and energy independence.

2. CONTENT OF STUDY



2.1. Subject of Study

It is necessary to develop a monitoring system such as sampling method, since full measurement of ballasts is impossible.

Also, based on the survey result of the spot and number of ballast installed in Hanoi University, detailed implementation plan shall be developed.

Detailed installation plan and implementation plan shall be developed for public facilities of the central government and Hanoi City in Activity 2 and thereafter.

2.2. Content of Study

A test was conducted for energy saving ratio and others in a large lecture hall, fifth floor, Building B, Hanoi University.

In Vietnam, common electricity distribution system is; one integrating coulometer is installed per building and distribution system has two lines, one for air conditioner, and one for lighting, office devices, computers, fans. A part of lamps especially used in corridors and stairs are not straight tube fluorescent lamps, so these are out of the target to install ballasts. This shows that under existing distribution system it is not possible to monitor the electricity consumption in the project. Wiring is often very rough, some shorted out, others bared or tired. Sometimes breakers to avoid electrical leak and overcurrent are not installed. These may cause accidents such as blackout over the block during construction work, fire caused by electrical leak by touching the wire, break of electrical devices by overcurrent.

Figure 2-1 Map of Hanoi University

The test was to rewire and install ballasts to integrating coulometer and 40W x 2 lights, 36 units, in fifth floor, Building B, Hanoi University. Electricity consumption was measured before/ after installation of ballasts by lighting 24 hours each. Electricity saving ratio achieved 51%.

The test schedule is as follows:

・Power distribution work：January 1 – 17

・Test (without ballast)：January 27, 10:30- February 6, 10:30

・Ballast installation: February 7 – 10

・Test (with ballast)：February 10, 15:15- 20, 15:15

Table 2-1 Result of electricity saving ratio

	Room No.	Beginning of measurement	End of measurement	Electricity consumption	Lighting hour	Average electricity consumption
Before installation of ballast	501	0.5 kWh	458.9 kWh	916.80 kWh	240 h	3.82 kWh/h
	502	26.3 kWh	484.7 kWh			
After installation of ballast	501	480.9 kWh	704.1 kWh	446.40 kWh	240 h	1.86 kWh/h
	502	506.7 kWh	729.9 kWh			
Electricity saving ratio						51.3%

3. RESULTS OF STUDY FOR IMPLEMENTATION OF CDM PROJECT

3.1. Methodology Applied

AMS-II.C Version 13 "Demand-side energy efficiency activities for specific technologies[1]"is applied for the project.

In accordance of the methodology, the grid emission factor of Vietnam is calculated based on AMS-I.D "Grid connected renewable electricity generation[2]".

3.2. Baseline Scenario and Project Boundary

Following scenarios are considered for identification of the baseline scenario for this PoA.

A) Voluntary installation or replacement (in existing facilities) of the whole conventional fluorescent lamps to the same or better efficiency ones

B) Voluntary replacement of only conventional electronic ballasts to efficient ones

[1] http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html.
[2] http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

C) Continuation of the current situation to use conventional fluorescent lamps

The option C) is the most plausible scenario which does not have any technical or financial problems for the owner of the facility. Thus, the option C), Continuation of the current situation to use conventional fluorescent lamps, is the baseline scenario for each CPA of this PoA.

This PoA is initially planned to target places controlled by the central government/ Hanoi City government such as offices, schools, hospitals, public facilities in Hanoi City. Further in the later stage it is planned to expand this activity to other major cities (Ho Chi Minh, Danang). Therefore the project boundary is the whole land of Vietnam.

Figure 3-1 Geographical Boundary of the PoA (Vietnam)

In addition, according to the new rule of PoA revised in the 47th meeting of CDM Executive Board, if each of the independent subsystems/measures included in the CPA is no greater than 1% of 60GWh/year, that CPA is exempted from performing de-bundling check. In the case of this PoA, the independent subsystem is each ballast (even each monitoring unit is well under the threshold), and annual energy saving is 0.077MWh that is far less than 1% of 60GWh/year. Therefore, de-bundling check is not required to each CPA of the PoA. That is, it is no problem to have two CPAs in adjacent buildings.

The first stage of this CPA of the PoA is conducted in Hanoi City, targeting Hanoi University as the kick-off CPA （20° 59' 19.78" N to 105° 47' 48.00"E)）, with the boundary of several buildings in the university.

Greenhouse gas sources concerned or unconcerned in the PoA in calculating emission reduction of GHG is as listed below.

Table 3-1 Emission Sources Concerned or Unconcerned in the PoA

	Source	Gas	Included?	Justification / Explanation
Baseline emissions	Power plants servicing the electricity grid	CO_2	Yes	Major emission source
		CH_4	No	Not significant. Excluded for simplification and conservativeness
		N_2O	No	Not significant. Excluded for simplification and conservativeness
Project emissions	Power plants servicing the electricity grid	CO_2	Yes	Major emission source of project emissions
		CH_4	No	Not significant. Excluded for simplification and conservativeness
		N_2O	No	Not significant. Excluded for simplification and conservativeness

3.3. Emission Reductions

(1) Calculation of Emission Factor for the Grid

Emission factor of the grid (Combined Margin) for the PoA is as follows. This value will be used as the fixed value during the crediting period.

Table 3-2 Vietnam Grid CO_2 Emission Factor (CM)

EFgrid,OM,y	$EF_{grid,BM,y}$	$EF_{grid,CM,y}$
tCO_2/MWh	tCO_2/MWh	tCO_2/MWh
0.6135	0.5468	0.5801

(2) Baseline Emission

Baseline Emissions

＝ Grid emission factor×Σ［lighting hour × lamp wattage before the project］

Assumptions: The number of ballast introduced in the project is 10 million units, installed one per 2 straight tube fluorescent lamps. Effective wattage of two lamps is 100W. Lighting hour is 4,200 hours (14hours x 300days), selectively targeting buildings with long lighting hours. The rate of grid losses is the default value of 0.1.

Baseline emission is:

$$BE_y = (1*10^7)\text{units} * 0.5801\ tCO_2/MWh * 100\ W/unit * 4200\ h/y * (1*10^{-6})\ W/MW / 0.9$$
$$= 2.71\ MtCO_2/y$$

(3) Project Emission

Assuming 40% of energy saving is achieved by introducing electronic ballasts in the project, project emission is:

$$PE_y = BE_y * 0.6 = 1.62\ MtCO_2/y$$

(4) Leakage

There is no leakage caused in this project.

(5) Greenhouse Gas Emission Reductions

From above, calculation of Emission reductions *ER* is:

$$ER_y = BE_y - PE_y = 1.08\ MtCO_2/y$$

Around 1 million CO_2 is reduced annually.

As for the first CPA, it is planned to install ballasts to 400W x 2 lamps, 5000sets, thus emission reductions are estimated at 422 tCO_2/y.

Table 3-3　Estimation of Emission Reduction（Activity 1）

Year	Estimation of project activity emissions (t CO2 e)	Estimation of baseline emissions (t CO2 e)	Estimation of leakage (t CO2 e)	Estimation of overall emission reductions (t CO2 e)
2011	661	1,083	0	422
2012	661	1,083	0	422
2013	661	1,083	0	422
2014	661	1,083	0	422
2015	661	1,083	0	422
2016	661	1,083	0	422
2017	661	1,083	0	422
2018	661	1,083	0	422
2019	661	1,083	0	422
2020	661	1,083	0	422
Total	6,610	10,830	0	4,220

Table 3-4　Emission reductions in the project

Year	Emission reductions (t CO2 e)
2011	108,000
2012	324,000
2013	702,000
2014	918,000
2015	1,080,000
2016	1,080,000
2017	1,080,000
2018	1,080,000
2019	1,080,000
2020	1,080,000
Total	8,532,000

3.4. Monitoring Plan

(1) Basic Approach

Emission reductions

＝ Grid emission factor×Σlighting hour×［（lamp wattage before the project）－（lamp wattage after the project）］

- Grid emission factor (after correction of grid loss): to be determined in developing Design Documents
- Wattage before/ after the project: to be determined by measuring in replacement. This value is included in inspection items in construction delivery.
- Lighting hour: to be measured if possible (in the form of electricity consumption). If not, a sampling method will be applied.

(2) Basic Approach for Determination of Lighting Time

Stratified Random Sampling is applied in monitoring. Strata consist of “room” or “corridor” (hereinafter collectively called “room”) grouped by lighting time obtained by interview. The amount of energy saving is determined ex post by multiplying each stratum by the difference of wattage measured before/after the installation of new ballasts.

(3) Devices and System for Measurement

A new system to (a) measure (b) process (c) record (d) calculate emission reductions (e) automatically produce monitoring report, based on “lighting hour” per room, is now under development with Cimx corporation. Measurement of electricity is simple and the cost of measuring device may be reduced to around 300 yen by applying simplified on/off measurement using hole device. Further work is required in developing some software and system such as measured data processing (including error handling of signals), signal transfer system to send signals for cloud central processing, alert processing software, automatic monitoring report processing software, etc.

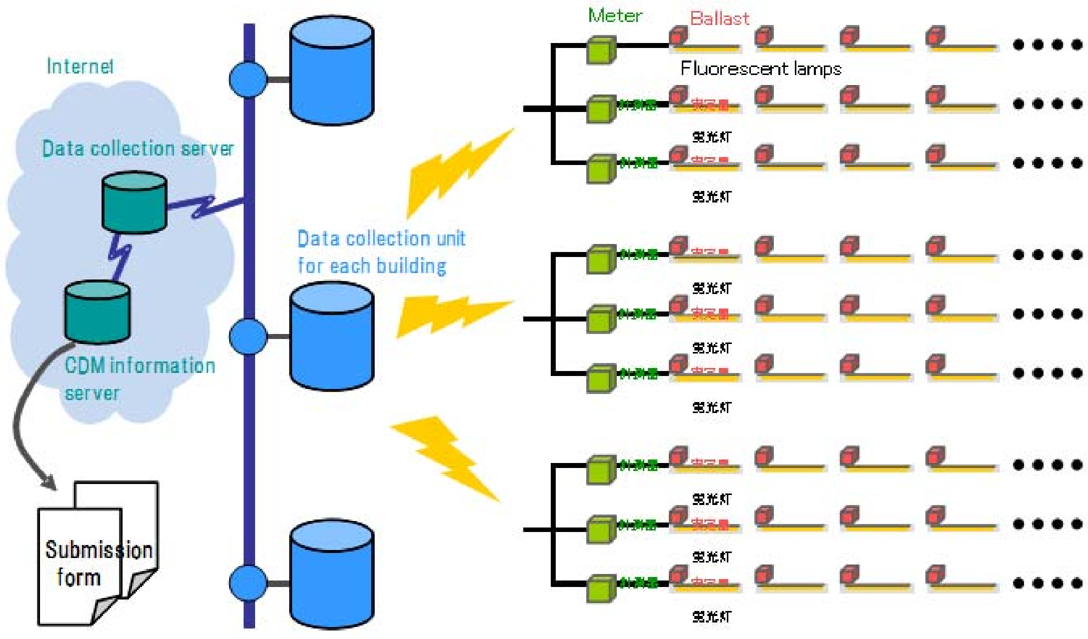


Figure 3-2　Fluorescent lamp ballast monitoring system

(4) Sampling Method

The flow of sampling is provided below.

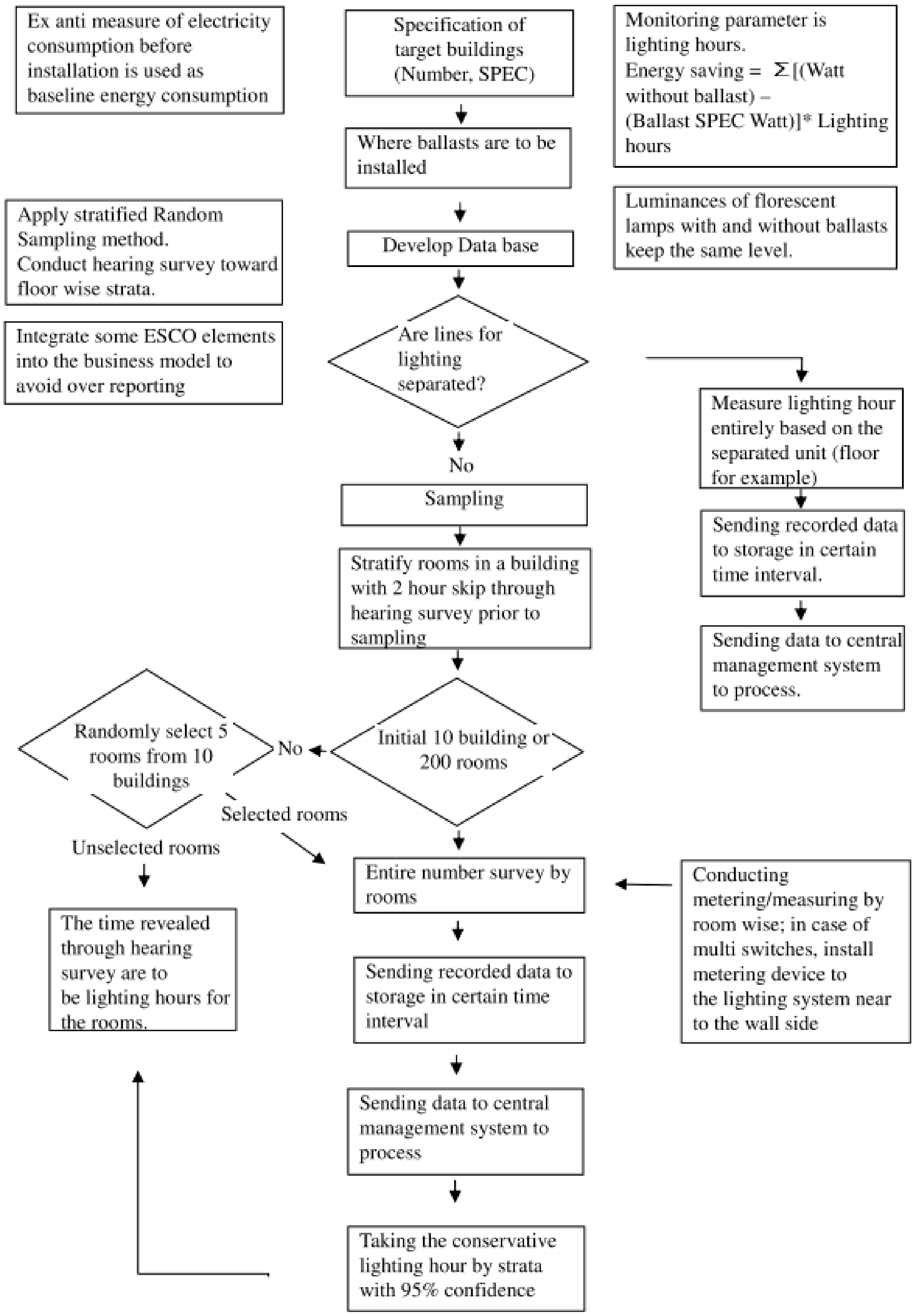


Figure 3-3 Sampling Flow Chart

(5) Calculation of Energy Saving

① Preparation of database on each "room" before implementation of the project. Data includes W value of conventional fluorescent lamp (measured), W value after installation of ballast (measured), usage of room and lamp operation hour (questionnaire).

② Random sampling of 1,000 rooms. Determination of average lighting hour and conservative correction lighting hour of each lighting hour group (with 90% confidence level based on a guideline of EB50).

③ Correction lighting hour:
Average lighting hour by hour group in sampling
− confidence factor・(standard variation of sampled hour group) /√(number of samples in the hour group)

④ Determination of correction lighting hour given above for each lighting hour group.

⑤ Electricity saving＝Σ[ex ante measurement of ΔW]×Correction lighting hour

3.5. Project Period/ Crediting Period

If main problems such as financing become foreseeable, future schedule will be: submission of SSC-PoA-DD, SSC-CPA-DD (generic) and SSC-CPA-DD (specific) to DOE in the early FY2010, local validation by May, completion of Final Validation Report by DOE and request for registration to CDM Executive Board in July and registration in the end of FY2010. Thus, Activity 1 will start in the end of 2010 (ballasts may be imported from China during the very first stage), 1 year will be required to manufacture and install ballasts, so the actual project period will be estimated to be about 9.5 years.

After Activity 2, although check by DOE is necessary, the same by CDM Executive Board is not, and each Activity may produce credits for the whole crediting period of 10 years. Therefore, through the check by DOE after installation of ballasts, each Activity may acquire credits for 10 years.

The problem of the speed and location of CPA implementation, the answer is currently not clear because of issues of financing, capacity of ballast manufacturing factory, available engineer training program, coordination with local entities. The basic approach is to take early actions to introduce our best potential.

3.6. Environmental Impacts and Other Indirect Impacts

In this project, a new factory will be built in Hoa Lac Hi-Tec Park (HHTP). HHTP is supervised by Ministry of Science & Technology and managed by Hoa Lac Hi-Tec Park Management Board, which will provide government approval of EIA.

3.7. Stakeholders' Comments

Interview with Mr. Vu Hong Khanh, Vice Chairman of Hanoi City government:

> This project decreases electricity consumption in Hanoi City, thus contributes to stable electricity supply as well as decrease of blackout during peak hours. In addition, since the target of project includes city government buildings, hospitals, schools, the project also gives a positive effect on the city budget by reducing electricity expense. Further, it will lessen electricity generation of the coal firing power plant in northern Vietnam thus contributes to alleviation of environmental problems and protection of resources. Therefore, this project is welcomed.

Interview with Mr. Nguyen Dinh Luan, President of Hanoi University:

> This project reduces electricity consumption in Hanoi University, which contributes to stable electricity supply in Hanoi City and Vietnam.

3.8. Project Implementation Structure

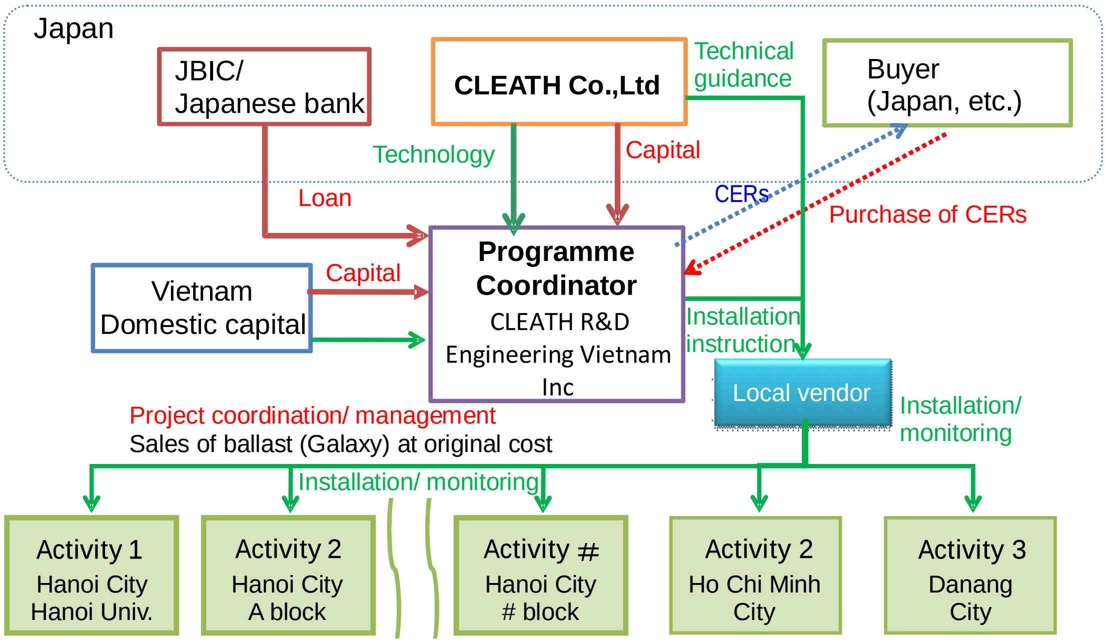


Figure 3-4 Project Implementation Structure

Currently a partner corporation in Vietnam is under selection with the aim to establish the local corporation CLEATH R&D Engineering Vietnam Inc. in March 2010. Implementation structure is as provided above.

3.9. Financial Plan

The total investment cost is JPY9,135.6million, including JPY130 million for construction of factory, JPY9 billion for manufacture and installation of ballast and JPY5.6 billion for validation. In addition, cost for verification and monitoring will be required.

As for construction of manufacturing factory, it is being examined to utilize possible recommencement of overseas investment by JICA.

As for manufacture and installation of ballast, several options are being examined to utilize an investment scheme by Japan Bank for International Cooperation (JBIC), to form a joint venture with a general trading company, or to utilize overseas investment fund by joint venture with a Vietnamese company. A variety of financing ways are being sought including finding CERs buyers after registration by CDM Executive Board. There is a possibility to receive investment from Japanese private banks provided that JBIC guarantees the JBIC investment scheme as the co-investor.

Table 3-5 Investment Cost

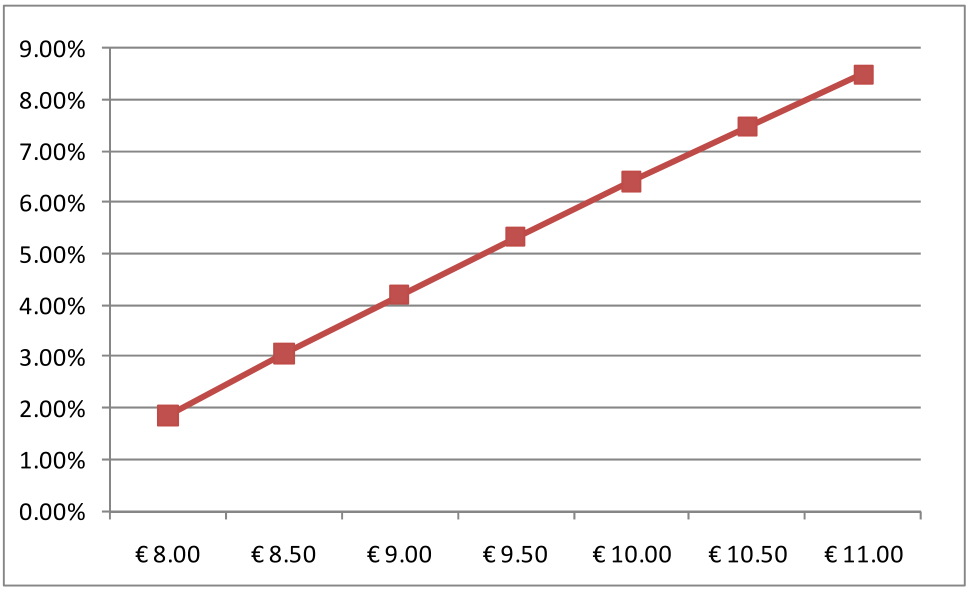
Unit: JPY1,000

Year	1	3	4	5	6	合計
	2010	2011	2012	2013	2014	
Factory construction	50,000	80,000				130,000
Ground leveling/ building construction	50,000	50,000				100,000
Equipment		30,000				30,000
Ballast installation	0	2,000,000	2,000,000	3,000,000	3,000,000	10,000,000
Ballast manufacture/Installation	0	1,800,000	1,800,000	2,700,000	2,700,000	9,000,000
Validation	5,600					5,600
Total investment cost	55,600	1,880,000	1,800,000	2,700,000	2,700,000	9,135,600

3.10. Economic Analysis

In this project, ballasts will be installed in government facilities free of charge, utilizing credit sales revenue. In the case of the credit price of EUR9, internal rate of return (IRR) is 4.2% (see Annex).

Figure 3-5 IRR of the Project



The price of ballast was initially estimated at JPY550, but after the study it turned out to be JPY700~ 800, so the total price of ballast will be estimated at JPY900 including installation fee and maintenance fee. In the case of the credit price of EUR8, IRR will be 1.85%, which implies the possibility of investment recovery.

3.11. Demonstration of Additionality

Diffusion of energy effective electronic ballast is next to nil, and CDM is what drives CLEATH to do business in Vietnam, which clearly demonstrates additionality. The problem is, however, how we can show it.

Demonstration of additionality of PoA entails two different concepts, additionality of PoA and additionality of CPA.

The concept of additionality of CPA is mostly the same of that of CDM project. As for additionality of PoA, guidance is expected to be provided by CDM Executive Board, but it has not been released yet.

In principle, the relation must be clarified between additionality of CPA and additionality of PoA. In the case of this PoA, CLEATH conducts business in Vietnam only because the project applies CDM. This can be regarded as additionality of PoA. Then, in the case of each CPA, if PoA would not be implemented, obviously CPA would not exist, which clearly demonstrates additionality.

The following steps will help more logical demonstration:

① To demonstrate CDM is what motivates CLEATH to do business in Vietnam (additionality of PoA)

② To confirm that high efficient ballast is currently barely familiar in Vietnam (diffusion rate and accessibility in the market)

③ Except for the project by CLEATH and except for CDM, the same kind of project has not been conducted in Vietnam.

④ Taking into these points account, additionality of each CPA is automatically demonstrated.

The above logic may be right theoretically, a few uncertain elements still remain because of the lack of precedents.

①, additionality of PoA, will be fully explained by providing internal documents of CLEATH + the CER revenue-dependent business model. The subject will be CLEATH.

②and following steps, additionality of CPA, will be explained by examining the possibility to introduce electronic ballast other than the business model of CLEATH. The subject will be building owners. Currently it is not clear how to apply Prevailing Practice as a barrier, since guidance on first-of-this-kind is not provided from CDM Executive board. But related description is found in ACM0005 agreed in EB50 and guideline of barrier assessment was also released, so additionality is assumed to be clearly demonstrated especially in terms of accessibility. Necessary evidences are under preparation.

3.12. Implementation Potential

In the case of the credit price of EUR9, IRR will be estimated at 4.2%. CLEATH plans to make an intermediate agreement with a buyer to receive around 90% of secondary CERs price and the amount of difference of ERPA agreement between seller and buyer as a reward.

Taking into account cooperation by Vietnam counterparts and market environments (prevailing types of fluorescent lamps, local customize prospect of the product, amount of CERs), implementation potential is very high at this moment.

The project will be started, however, after the registration of the project is completed and the framework after 2013 is determined, since CER revenue is the only income source of this project. At the present stage, investment stance after 2013 of financing and business companies is obscure thus the final business implementation will be anticipated to be decided after the negotiation result of COP16.

4. RESULTS OF STUDY ON CO-BENEFITS

The project (installation of electronic ballast) does not have direct negative impact on the environment at all, and Vietnamese laws and regulations do not require environmental impact assessment (EIA) for projects of this type. Although EIA is required on factory construction, since the factory is for assembly only and its structure is very simple, negative impact is anticipated to be nil.

On the other hand, hydraulic power plants entail problems such as destruction of biodiversity and forced transfer of residents. Thermal power plants, even though environmental protection measures may be taken in the latest plants, may cause air pollution and waste water pollution in old plants. By reducing public electricity consumption in Hanoi City, pollutants such SOx and NOx will be reduced and construction a new hydraulic power plant will be avoided.

4.1. Proposal to Co-Benefit Indicator

In addition to CO_2 reduction, this project brings about benefits to the whole society, power company and users such as resource saving (energy saving), cost reduction for constructing a new peak power plant by cutting peak electricity, emission reductions of pollutants from power plants, reduction of electricity expense for users, etc.

Construction of a new hydraulic power plant in order to satisfy energy demand may have a problem in maintaining biodiversity and additional construction of a gas/ coal power plant may lead to depletion of domestic resources.

Assuming installation of 10 million ballasts by this project, around 1,680GWh of electricity consumption will be reduced annually (this assumption depends on prior conditions). This project contributes to the sustainable development of Vietnam, which faces resource depletion of natural gas and coal, from the viewpoints of not only conservation of energy resources but also energy independence.

More important aspect is “reduction of peak electricity”. Lamps are used during the very peak hours, thus this project is a well-designed peak-cut DSM (demand side management) programme.

Electricity (kWh) demand boosts up the peak (kW) demand in the evening as well, however low operation rate of peak power plant is one element to worsen financial structure of power company.

Installation of 10 million ballasts will avoid one large scale peak thermal power plant of 400MW class by simple calculation, which improves financial strength of the power company of Vietnam (peak power plant is law in operation rate and very high in cost, so power companies prefer as stable energy supply as possible [3]), thus management resources may be utilized in other measures. This ultimately contributes to the sustainable development of Vietnam.

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[3] In Japan, measures include “power storage” from pumped- storage power generation to increase the proportion of base electricity which has high operation rate (=low power generation cost).

According to a study[4] of International Energy Agency, construction cost of gas-fired power plant is US$ 500/kW, so that of 400MW capacity will be US$200 million. This amount is about 2.6 times of the total cost of the project, which indicates that "decrease of electricity peak" is more efficient measures than "construct a new power plant" for the power company who faces the problem of peak demand increase. Not only the cost, other merits are also significant such as no time lag and easy measurement of the effect. In other words, it is quite doable to conduct this CDM under the investment of power companies. Power companies will be an important possible channel to exploit future financial resources for investment.

As for other benefits, users for example may save electricity expenses by VND2 trillion from annual electricity consumption reduction of 1,680GWh (this means for the power company to improve productivity by improving financial strength, but not to decrease revenue of the saving[5]). In the case of a building of 10,000 m^2 with 2 fluorescent lamps/3.3 m^2, significant electricity saving of VND600 million/year is estimated.

Also, this project may create new employment to 500 people in the manufacturing stage and 2000 people in installation stage.

[4] http://www.iea.org/textbase/nppdf/free/2005/ElecCost.pdf

[5] Although this may imply that the saved electricity may be distributed to additional demands which are currently not satisfied, its possibility is excluded in this study.