FY 2008 CDM/JI Feasibility Study (FS) Programme Report

CDM Feasibility Study for Installation of Solar Water Heating Systems in Viet Nam
Executive Summary

February 2009

Mitsubishi UFJ Securities Co., Ltd.

1. Basic Elements for the implementation of the Project

(1) Location of Project Activity

South of Viet Nam

(2) Summary of the proposed project and background of the project proposal

The purpose of the project activity is for the Energy Conservation Center of Ho Chi Minh City（ECC） to promote installation of solar water heating (“SWH”) systems by providing subsidies to the consumers. Demand for electricity has rapidly increased due to economic development and stable supply of electricity is positioned as one of the most important issues to be tackled in Viet Nam. Through implementing the project, the ECC aims to reduce electricity consumption in households. The project activity will take place in the southern regions of Viet Nam where adequate hours of sunlight can be expected throughout the year. All SWH systems to be installed are passive systems without a forced circulation system or auxiliary heat source, so that all systems installed under the project do not require any energy other than solar energy and use 100% renewable energy.

The ECC has begun pilot installation projects in Ho Chi Minh City and surrounding Binh Duong, Dong Nai, Ba Ria Bung Tau, and Lam Dong Provinces where 500 SWH systems were installed in 2008. The ECC plans to install 22,000 SWH systems in total during five years running up to 2012 based on the evaluation of benefit from the pilot projects.

The proposed project will incorporate projects in various provinces as well as Ho Chi Minh City into one CDM project and implement it as a programmatic CDM project that will eventually expand to all over southern region of Viet Nam.

2. Study Contents

(1) Study Subjects

1. Project plan as programmatic CDM

In order to implement the proposed 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 SWH systems in south of Viet Nam, the boundary of PoA is the southern region of Viet Nam including 21 provinces and Ho Chi Minh City in Southeast and Mekong Delta regions. As CPA can be added to the PoA without limitations within the crediting period, geographical boundaries of each CPA as well as the activity criteria included in each CPA must be clarified. Also, the ECC is the coordinating entity for the PoA and all CPAs in the project activity. In the Study, it is necessary to clarify project implementation structure and the unit of CPA manageable by the ECC.

2. Identification of baseline scenario and determination of emissions reduction

The baseline scenario of the proposed project is foreseen as the use of electricity to supply heated water in the absence of the project activity. Therefore, baseline emission is the amount of greenhouse gas emitted when energy displaced by solar energy is supplied from grid electricity. It is also necessary to clarify in the Study the method to calculate thermal energy displaced by solar energy.

3. Monitoring method

The proposed project will install SWH systems in private households and the number of SWH systems that will eventually be installed is expected to reach tens of thousands. As such, it is financially unrealistic to measure the amounts of heat generated by SWH systems by installing calorimeter in each system. It is important to consider 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. Financial plan

The ECC will implement the project after obtaining budget appropriation from Ho Chi Minch City People's Committee and Ministry of Industry and Trade. However, the budget provided so far is only for the 500 units installed in the pilot projects in 2008 and advertisement campaign. Additional budget is uncertain as it is necessary to apply for and obtain budget allocation from Ho Chi Minch City People's Committee and Ministry of Industry and Trade each year. Therefore, a financial plan is important to implement the project as CDM and utilize revenue from CER sales to sustainably continue the project activity as well as to expand the project to other areas.

(2) Study Implementation Framework

The ECC is the coordinating entity of this project. In the Study, the ECC, based on requests from Mitsubishi UFJ Securities, engages in coordination of fieldworks, technical research, environmental impact assessment, collection of stakeholder comments and providing support to facilitate research activities.

(3) Study Contents

Two fieldworks were carried out in the Study. As part of the fieldwork, meetings with the ECC, SWH systems sales company and a power company were held to discuss progress of the project, technical information about SWH system and its installation plan. Visits were also made to the site where SWH systems are already installed under the pilot project. Also, interviews were held with two Japanese SWH manufacturers to obtain basic information on SWH technology, emissions reduction calculation and monitoring methods. A literature survey was also conducted for this purpose.

After the fieldworks, information required for PDD production and emissions reduction calculation based on the methodology was organized. Required data were determined and their collection was requested to the ECC. For the previously mentioned tasks, the following outcomes have been achieved.

1. Project planning as programmatic CDM

The project boundary of PoA is South of Viet Nam including 21 provinces and Ho Chi Minh City belonging to southeastern Viet Nam and Mekong Delta regions. The boundary was established in southern region of Viet Nam considering the possibility of getting enough sunny hours to operate SWH systems. At the same time, although the unit of CPA will depend on the installation schedule and

operation structure, the unit will be either a province or centrally governed city (Ho Chi Minh City) because the ECC distributes its budget on province or city basis as the project will also be carried out by each province or city. The ECC is the operational entity that manages the PoA as well as all CPAs. The ECC will install SWH systems and manage information for each CPA, such as the number of SWH systems installed and their locations with the cooperation of Ho Chi Minh Power Company, Power Company 2 that manages southern region except Ho Chi Minh City and the SWH distributors.

2. Identification of baseline scenario and emissions reduction

In this Study, statistics on SWH systems which already installed through pilot projects were obtained from the ECC. Also, data required for emissions reduction calculation were obtained from local meteorology center. Emission factor of Vietnamese national grid is required for the calculation of baseline emissions. In Viet Nam, because Electricity of Viet Nam (EVN) has not made grid data publicly available, it is difficult to collect information regarding national grid. Therefore, it is necessary to obtain the required data on one's own for emission factor calculation. During the fieldwork, research on grid data was conducted through interviews with a Vietnamese consulting company and, Institute of Energy. As a result, the grid emission factor has been calculated using data obtained through the consulting company. The calculation of emissions reduction is elaborated in Sections 3.(1) and 3.(3).

3. Monitoring method

According to small-scale CDM methodology I.C., projects where emissions reduced are less than 5tCO_2 per unit of system are required to have the number of operating systems and annual operating hours of the system measured. The ECC manages the information including number of SWH systems installed in the Project, their owners and locations on its database. Therefore, the number of system units in each CPA will be monitored. However, in order to monitor the number of units actually operating, it is necessary to gather information on systems suspended due to breakdown or carry out investigation on confirming whether the systems are actually in operation or not. It is also not clarified exactly what needs to be monitored for annual operating hours of SWH systems. The most suitable monitoring item for SWH operating hours is described in Section 3.(2).

As for the monitoring implementation structure, it is important to establish a structure where information on SWH systems in all CPAs can be accurately managed on a long-term basis. The ECC will consider the structure capable of carrying out continuous monitoring with the cooperation of Ho Chi Minh Power Company, Power Company 2 and SWH systems sales company.

4. Financial Plan

The ECC will source the budget for the project from Ho Chi Minh City People's Committee and Ministry of Industry and Trade. Although the ECC plans to install 22,000 units of SWH systems in 5 years, the only budget secured is for 500 units that were installed in 2008 as part of the pilot project and cost required for advertisement campaign. It is important to implement the project as programmatic CDM, use CER sales revenue as new subsidy and expand the project to other provinces, so that the project can be continued as well as expanded. In Section 3.(8), financial planning and economic

feasibility of the project when developed as CDM are analyzed.

3. Project Development

(1) Determination of project boundary and baseline scenario

The project boundary of PoA is South of Viet Nam that includes 21 provinces and 1 city belonging to southeastern Viet Nam and Mekong Delta regions. The project boundary of CPA is each province or a city. The ECC will start pilot projects in Ho Chi Minh City, Binh Duong, Dong Nai,Ba Ria Bung Tau, and Lam Dong Provinces. Project activities in each city or province constitute one CPA. In future, projects on provincial basis can be added as new CPAs during the crediting period of the PoA. The ECC is the coordinating entity of PoA and all CPAs under the PoA.

The applicable methodology for the project is baseline and monitoring methodologies of approved small-scale CDM (AMS) methodology I.C., "Thermal energy for users with or without electricity" (Version 13)". In the absence of the project activity, people use electric water heaters to supply heated water. Therefore, the baseline emission of the project is the amount of greenhouse gas emitted when energy displaced by solar energy is supplied from the grid electricity. As such, baseline emission is calculated by converting the thermal energy generated by SWH systems into electric energy while the electric energy is assumed to be supplied by grid electricity producing greenhouse gas emissions.

AMS I.C. stipulates that baseline emissions from grid electricity are the product of electricity generated by renewable energy and grid emission factor.

$$BE_y = EG_y \times EF_{CO2}$$

The parameters are defined as follows.

BE_y	＝	The baseline emissions from electricity displaced by the project activity during the year y in tCO_2e.
EG_y	＝	Energy baseline（MWh）
EF_{CO2}	＝	Emission factor for electricity grid in year y (tCO_2/MWh）

The energy baseline is determined based on the difference between the temperature of inlet water of the SWH tank and the outlet temperature of heated water as well as the amount of heated water used. The equation used is as follows.

$$EG_y = [m_d \times d \times 4.186 \times (T_2 - T_1)] / 3{,}600{,}000$$

The parameters are defined as follows.

m_d	=	Amount of heated water used per day (kg /d)
d	=	Annual operating days of SWH system
T_2	=	Outlet water temperature (°C)
T_1	=	Inlet water temperature (°C)
4.186	=	Specific heat of water (kJ /kg /°C)
3,600,000	=	Conversion factor (kJ /MWh)

The temperature of inlet water was determined through research conducted by the ECC at the project site. The temperature of heated water is calculated based on daily average solar energy collection, average area of solar collector and efficiency of solar energy collection. Regarding the amount of daily heated water usage, as 67% of SWH systems use water tanks of more than 180 liters capacity in pilot projects, only the SWH systems with tank capacity of greater than 180 liters will be used in the project to be implemented from 2009. Therefore, the minimum capacity of 180 liters is employed as daily heated water usage to make conservative estimations. As a result, thermal energy required to raise 180 liters of water from 28 to 60 degrees Celsius is the energy baseline in the case of Ho Chi Minh City. The calculation is carried out as follows. As the temperature of heated water is derived from the annual average solar energy collection, the number of annual operating days is set at 365 days.

EG_y = [180×365×4.186×(60-28)] /3,600,000
= 2.44(MWh/year)

The grid emission factor calculated in the Study is 0.52 tCO_2/MWh. By multiplying that with energy baseline, baseline emissions are calculated as 1.27tCO_2.

BE_y =2.44×0.52
=1.27(tCO_2/year)

In project sites other than Ho Chi Minh City, thermal energy required to increase the temperature of 180 liters of water by 32 degrees is displaced by SWH systems according to similar calculations. As such, the baseline emissions for each SWH system are estimated as 1.27 tCO_2/year.

(2) Monitoring Plan

AMS I.C. requires the following two items to be monitored for projects where emissions reduction per unit of SWH system is less than 5tCO_2.

1. Recording annually the number of systems operating
2. Estimating the annual hours of operation of an average system, if necessary using survey methods. Annual hours of operation can be estimated from total output (e.g. tonnes of grain dried) and output per hour if an accurate value of output per hour is available.

As the emissions reduction of the project is estimated at 1.27 tCO_2/year per one unit of SWH system, the above monitoring method is applicable. After the installation of SWH systems, the ECC controls number of units, locations, owners' data of all installed SWH systems. When there is a breakdown or trouble with an installed SWH system, consumers will correspond with the SWH system distributor and request repair. The ECC, with cooperation of SWH distributor, will record the information on the faulty systems in the database. Through this method, the ECC can grasp the number of SWH units in operation. The ECC, with cooperation of Ho Chi Minh Power Company and Power Company 2, will also visit the locations of SWH systems selected through monthly sampling and monitors the number of systems in operation by inspecting whether the actual status of operation. As the average operating hours of SWH system, sunny hours will be monitored. Sunny hours are not used to estimate emissions reduction, however, they are used as supplementary data to confirm there is enough sunlight to produce hot water. The data on sunny hours will be obtained from the weather center in each province. Monitoring will be implemented according to the structure described in Figure 1.

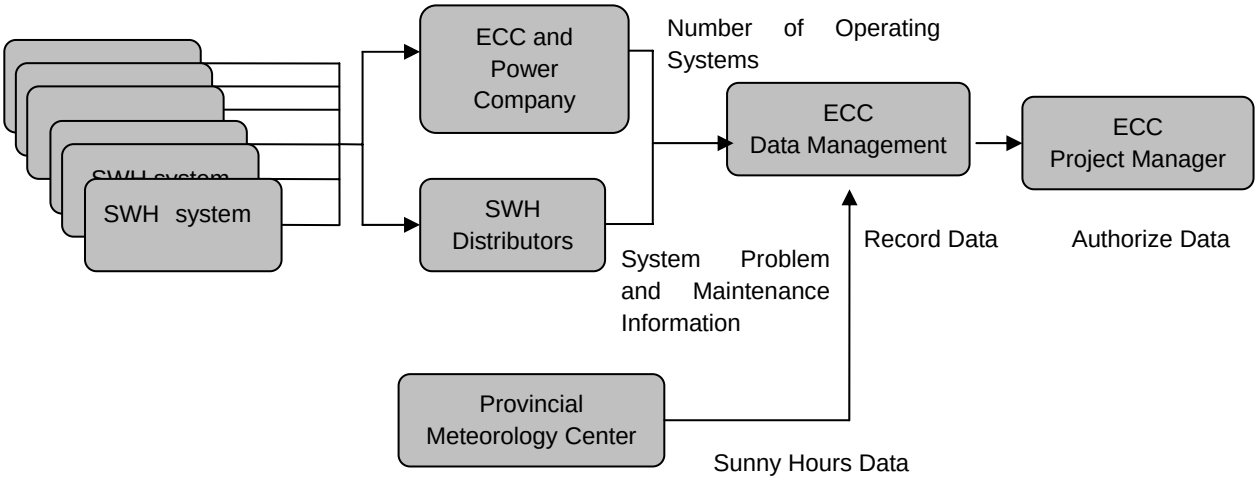

Figure 1. Monitoring structure

Although it is not required by AMS I.C, the ECC is planning to monitor the volume of heated water used and efficiency of solar collector of SWH systems installed under the proposed project after starting project implementation in order to ensure the accuracy and conservativeness of monitoring data.

(3) Greenhouse gas emissions reduction

The SWH systems installed in the project activity are passive systems without a forced circulation system or auxiliary heat source, so that all systems installed under the project do not require any energy other than solar energy. Therefore, there are no project emissions. At the same time, leakage must be considered in accordance with AMS I.C. if the energy generation unit is transferred from another project activity or an existing unit is transferred to another activity. The project activity is new installation of SWH systems not replacement of equipments, therefore, there is no leakage. As such, the emissions reduction of the project activity is equal to the baseline emissions. In other words, there will be 1.27 tCO_2/year of emissions reduction per unit of SWH system. Emissions reduction in

each CPA is estimated as described in Table 2 in accordance with the installation schedule of the ECC (Table 1).

Table 1. Installation schedule

	2008	2009	2010	2011	2012	Total
Ho Chi Minh City	385	1,540	3,850	5,390	5,775	16,940
Binh Duong Province	20	80	200	280	300	880
Dong Nai Province	25	100	250	350	375	1,100
Ba Ria Bung Tau Province	30	120	300	420	450	1,320
Lam Dong Province	40	160	400	560	600	1,760
Total	500	2,000	5,000	7,000	7,500	22,000

(units)

Table 2. Emissions reduction by CPA

	2009	2010	2011	2012	2013	2014	2015	Total
Ho Chi Minh City	2,445	7,334	14,180	21,514	21,514	21,514	21,514	110,014
Binh Duong Province	127	381	737	1,118	1,118	1,118	1,118	5,715
Dong Nai Province	159	476	921	1,397	1,397	1,397	1,397	7,144
Ba Ria Bung Tau Province	191	572	1,105	1,676	1,676	1,676	1,676	8,573
Lam Dong Province	254	762	1,473	2,235	2,235	2,235	2,235	11,430
Total	3,175	9,525	18,415	27,940	27,940	27,940	27,940	142,875

(tCO_2)

(4) Project operation period and crediting period

The crediting period of PoA is stipulated as maximum of 28 years. Because it is possible to add CPA limitlessly if within the crediting period of PoA, the crediting period of the Project is set at 28 years. As the average life of SWH systems installed in the project is 15 years, the crediting period of each CPA is 7 years with one renewal, totaling 14 years.

(5) Environmental impact and other indirect impacts

Environmental impact assessment is not required for the project in Viet Nam. The project will not impose any negative impact on the environment.

(6) Stakeholder Comments

The ECC collected stakeholder comments in November 2008. The ECC conducted interviews with 60 people who have installed SWH systems as part of the pilot projects. As a result, it was revealed that that electricity consumption declined in households and many people are happy that electricity fee has been reduced due to installation of SWH systems. 97% of the people interviewed responded that “Electricity fee has been reduced”. There were also many comments that expressed satisfaction with the amount of heated water supplied by SWH systems and the convenience. No negative comments have been received for the project activity.

(7) Project implementation structure

The project implementation structure is described in Figure 2.

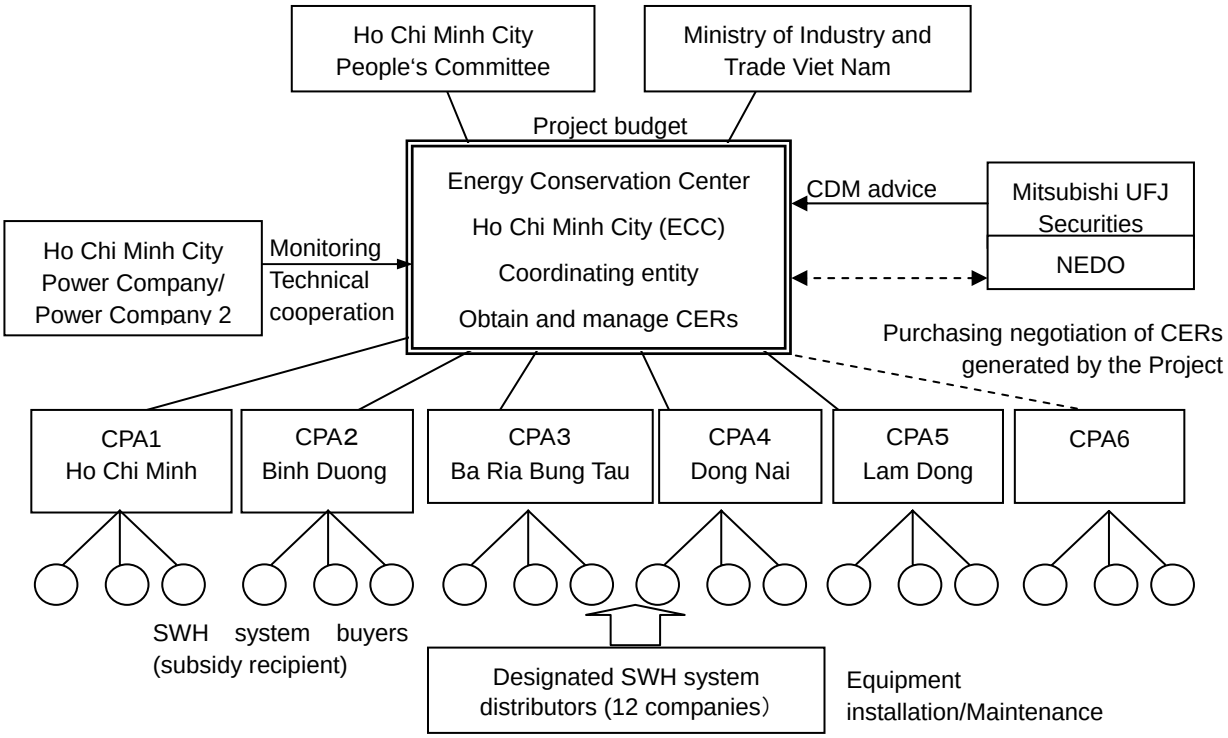

Figure 2. Project implementation structure

(8) Financial plan

In the project activity, the ECC will obtain budget from Ho Chi Minh City People's Committee and Ministry of Industry and Trade then provides subsidies to SWH system consumers. The ECC is planning to install 22,000 units of SWH systems in 5 years, however, the ECC has only secured enough budget for 500 units installed in the pilot projects and cost for advertisement campaign. After 2009, the budget will be determined based on the evaluation of project's impact. In order to obtain the budget, the ECC needs to submit the project plan to Ho Chi Minh City People's Committee and Ministry of Industry and Trade and obtain their approval.

According to the ECC's plan, the total amount of budget required for installation of 22,000 SWH systems in 5 years and project maintenance over 14 years is 1.4 million USD. When the project is implemented as CDM, CER sales revenue can be used as new source of subsidy and will make it possible to install additional SWH systems. An increase in the number of units installed will lead to increase in emission reduction and in turn, increase CER sales revenue. The estimation was made for the case in which CERs are sold and their sales revenue is used as new subsidy. As the increase in the number of SWH systems also increases the cost of monitoring and project maintenance, it is assumed in the estimation that only 90% of CER sales revenue will be used as subsidy. When the CER sales price is 15 USD, it is predicted that approximately 270,000 SWH systems can be installed which is greater than what is estimated in ECC's plan over 14 years by 244,000 units. Also, the project will be making profit in the

7th year and can be expected to produce approximately 6 million USD of operation profit over 14 years. The improved financial status can lead to further expansion of the project.

However, the increase in installed units and resulting expansion of the project area can lead to increased complexity in monitoring and project management which can lead to cost increase greater than what has been estimated. Also, the CER price greatly affects the financial plan.

(9) Analysis of financial feasibility

The project is a public project that does not expect any operational revenue. All revenue from CER sales when the project is implemented as CDM will be used as a new source of subsidies to enable installation of even greater number of SWH systems so the project can be continued in a sustainable manner. In order to maximize the usage of CER sales revenue to expand project operation, it is important to install as many SWH systems as possible in the early stage of the crediting period. By implementing the project as CDM, it would be possible to seek CER buyers or investors for the project. It would also lead to installation of as many SWH systems as possible in the early stage which is important in improving the economic feasibility of the project as well as to continue the sustainable dissemination of the project.

(10) **Justification of additionality**

It is necessary to justify additionality for both PoA and CPA in programmatic CDM.

PoA level

The PoA will be implemented by the ECC in order to mitigate the electricity consumption that keeps increasing with economic development in Viet Nam. The ECC will implement the project by obtaining the budget from Ho Chi Minh People's Committee and Ministry of Industry and Trade, however, the budget is limited and the planned dissemination project will not take place without the PoA Project. The budget secured so far is limited to 500 units installed in the pilot projects and there will be no increase in installation or dissemination to other provinces without the CDM project activity. By implementing the project as CDM, CER sales revenue can be generated to help CPA project implementation and increase the number of installed units which would then enable project expansion.

CPA level

Unless the CPA project is implemented, the SWH system installation project, such as the project activity will not take place. It can be justified by 1) investment barrier, 2) technological barrier and 3) barrier due to prevailing practice.

1) Investment barrier,

The ECC will implement the Project by obtaining the budget from Ho Chi Minh People's Committee and Ministry of Industry and Trade, however, the budget is limited and the only budget secured so far is for 500 units installed in the pilot projects and advertisement campaign. Moreover, as the project is a public project and does not generate any operational revenue, the project plan from the second year onwards depends on the budget allocation from Ho Chi Minh City People's Committee and Ministry of Industry

and Trade. Therefore, it is difficult to continue and expand the project without the CER sales revenue from the CDM project activity.

2) Technological barrier

SWH systems need to be installed by experts. There also needs to be a proper maintenance structure to respond to troubles after installation. As seen in cases of “install-and-run” where consumer confidence towards SWH market declined due to inadequate service and maintenance structure that took place in Japan, it is not enough to entrust installation and post-installation maintenance service with only the sales agent. Unless the CPA Project is implemented as CDM, it is difficult to establish a structure in which proper installation of equipment and regular inspection of continuous operation can be ensured.

3) Barrier due to prevailing practice

Currently, electric water heaters are commonly used for hot water supply. The reason is that the electric water heater is inexpensive as well as easily installed. It is believed that the installation of SWH systems will not be disseminated without campaigning for economic benefits such as the fact that even though the initial investment is costly, it can be recovered in 4-5 years.

(11)**Future prospects of project development and remaining issues**

In order to implement the project according to plan, securing of the budget is the most essential issue. In addition to the fact that the budget the ECC obtains from Ho Chi Minh City People’s Committee and Ministry of Industry and Trade is limited, the budget will vary depending on annual budget allocation within the government. It is necessary to have a plan through which new subsidy based on CER sales revenue from the project will be disbursed in a stable manner.

Also, as the amount of emissions reduction depends on the accumulative number of SWH systems installed, it is important to install as many SWH systems as possible in the early stage of the crediting period in order to maximize emissions reduction. Therefore, the issue is financial planning for the purpose of installing as many SWH systems as possible in the early stage by implementing the project as CDM and facilitating investment by private businesses.

Moreover, in order to secure CER sales revenue, it is important to improve the accuracy of monitoring. The cost of the monitoring becomes problematic especially for projects such as the project activity where projects with small amount of emissions reduction per system are implemented in many and wide-spread locations for a long time. It is planned to monitor the number of systems in operation through sampling, however, the cost of such monitoring will increase if the number of CPA grows. Also, when a province with small number of installed systems is counted as one CPA, such CPA will have higher sampling percentage in the whole installed systems while trying to secure statistically reliable number of samples. As such, it is important to implement the project and determine the unit of CPA upon full consideration of monitoring cost and CER benefits.

4. Realization of Co-benefit in Host Country

(1) **Evaluation of pollution prevention in host country**

The project does not result in any direct pollution prevention except for reduction of greenhouse gases due to displacement of grid electricity. However, it is hoped that the through reduction of power consumption, the project will contribute to stable supply of power as well as prevention of blackouts. Also, because electric water heaters commonly used at present in Viet Nam are installed in bathrooms, there are many incidents of users getting electric shocks. It was revealed through the interviews conducted during the first fieldwork that households with children especially hold concerns toward electrification incidents caused by electric water heaters and these households are truly happy to have SWH systems installed so they can take showers safely. As such, the project is expected to contribute to improvement of living standards by providing heated water in a safe and stable manner. Also, ECC's advertisement campaign to disseminate SWH systems will not only inform the public of their economic benefits, but will also raise awareness of environmental impact of renewable energy use as well as energy and environmental problems. Therefore, the project is expected as a "co-benefiting type CDM" that will provide the people of Viet Nam with social benefits while contributing to raising environmental awareness that is important in future energy and environmental measures. These co-benefits of the project are not something that can be quantitatively evaluated, however, they can be evaluated through resident survey.

(2) **Proposal of co-benefit indices (in case the Study results in indices worth proposing)**

According to the survey the ECC conducted on 60 people who installed SWH systems, approximately half the people answered that they are expecting environmental benefits in addition to economic benefits. Also, after the ECC's advertisement campaign, about 80 % of the people responded that they have come to care about the environment. As part of the stakeholder comment collection required in the Study, the survey was conducted on households that have actually installed SWH systems. A similar survey, if conducted on households that are not using SWH systems or outside the project area, can be used as a comparison and the effects can be evaluated.