CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Introduction of inverter air conditioners to private households in Viet Nam

Version 01.1
27/10/2011

A.2. Description of the project activity:

The purpose of the project activity is to reduce CO_2 emissions by facilitating the utilization of more energy efficient air-conditioners and replacing the conventional and more energy intensive air conditioners. The use of technology to improve energy efficiency, the inverter in the case of the Project, enables air conditioners to operate with less electricity consumption compared to the conventional types by varying operation according to the desired temperature. Less electric energy requirement leads to reduction in the usage of fossil fuel-fired grid electricity, resulting in less CO_2 emissions from power plants connected to the grid.

Currently, majority of the households in Viet Nam use conventional, non-inverter type air-conditioners. Under the project activity, Vietnamese Ministry of Industry and Trade (MOIT) will provide subsidy for more energy-efficient inverter air conditioners at the rate of US$ 50 per appliance to facilitate technology deployment.

In the absence of the incentives given by the government subsidy under the project activity, households will continue with the current practice, either through using existing conventional non-inverter air-conditioners or in case of replacement, purchasing new non-inverter air conditioners.

The project activity contributes to sustainable development of Viet Nam in several ways. Firstly, as previously mentioned, the Project contributes to the abatement of global warming by reduces greenhouse gas emissions. Secondly, the Project will be a model-case for the transfer of the state-of-art energy efficient technology which includes the development of the local workforce through training, improvement of technological expertise of the local industry as well as introduction of energy-efficient lifestyle and improvement of quality of life.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Viet Nam (host)	Ministry of Industry and Trade ("MOIT", public entity)	**Yes**
Japan	Mitsubishi UFJ Morgan Stanley Securities, Co., Ltd. ("MUMSS", private entity)	**No**

Mitsubishi UFJ Morgan Stanley Securities, Co., Ltd. (MUMSS) is a CDM advisor to the Project.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Viet Nam

Figure 1: Location of Viet Nam (green)

A.4.1.2. Region/State/Province etc.:

All regions

A.4.1.3. City/Town/Community etc.:

All cities

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The target area of the project activity is entire country of Viet Nam. The provinces of Viet Nam are provided in Figure 2.

Figure 2: Provinces of Viet Nam

A.4.2. Category(ies) of project activity:

Energy demand

A.4.3. Technology to be employed by the project activity:

Description of the project activity

New inverter air-conditioners will be installed in private households. In accordance with the project implementation plan, it is envisaged that installation of 1 million air conditioners will take place in stages as described in Table 1.

Table 1: Number of inverter air conditioners introduced

Year	New addition of inverter	Accumulative number of inverter air conditioners
2013	13,000	13,000
2014	20,000	33,000
2015	50,000	83,000
2016	100,000	183,000
2017	200,000	383,000
2018	300,000	683,000
2019	500,000	1,183,000

The inverter air conditioners and their components will be supplied by Panasonic, a Japanese manufacturer with leading technologies and abundant experience in deploying high quality, energy-efficient appliances in Southeast Asia. Panasonic will utilize as much local or regional input as possible.

Main specifications for the inverter air conditioners installed under the project activity are as follows.[1]

Table 2: Specifications of the Project inverter air conditioner

Model	CS/CU-E12LKR
Cooling Capacity (Btu/hr)	119000
Cooling Capacity (kW)	3.5
Coefficient of Performance (Cooling)	3.98
Energy efficiency rating (Cooling)	13.5718[2]

The core technology is inverter. Inverter air conditioners use a variable-frequency drive to control the speed of the motor and thus the compressor. The variable-frequency drive uses a rectifier to convert the incoming AC current to DC and then uses pulse-width modulation of the DC current within an inverter to produce AC current of a desired frequency. The AC current is used to drive a brushless motor or an induction motor. As the speed of an induction motor is proportional to the frequency of the AC current, the compressors runs at different speeds. A microcontroller can then sample the current ambient air temperature and adjust the speed of the compressor appropriately.

[1] http://www.panasonic.com.au/Products/Air+conditioners/Deluxe+Reverse+Cycle+Inverter/CSCU-E12LKR/Specification

[2] Converted from COP using the conversion factor (EER= 3.41 x COP)

In summary, compared to the air conditioners without inverter function where they can only be either "on" or "off" regardless of the temperature setting, air conditioners with the inverter function can operate at optimal level by varying the heating or cooling action according to the desired temperature leading to improved energy efficiency.

The technologies used in the Project are state-of-the-art proven technologies and thus, the Project is environmentally sound and achieves emission reduction.

Description of the scenario existing prior to the start of the implementation of the project activity

The technology currently being used prior to the start of the project activity is non-inverter air conditioners without any control of motor rotation to optimize energy use according to the set temperature.

Description of the baseline scenario

The baseline scenario as described in detail in Section B.4, is the continuation of the scenario existing prior to the start of the project activity, which is continuing to use existing non-inverter air conditioners or purchasing new non-inverter air conditioners to replace old non-inverter air conditioners.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

Year	Annual estimation of emission reductions in tonnes of CO_2e
01/04/2013 – 31/03/2014	4,329
01/04/2014 – 31/03/2015	10,991
01/04/2015 – 31/03/2016	27,644
01/04/2016 – 31/03/2017	60,950
01/04/2017 – 31/03/2018	127,562
01/04/2018 – 31/03/2019	227,481
01/04/2019 – 31/03/2020	394,012
Total estimated reductions (tonnes of CO_2 e)	**852,971**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	121,853

A.4.5. Public funding of the project activity:

The Ministry of Industry and Trade of Viet Nam will subsidize inverter air conditioners introduced to households under the project activity using Viet Nam's own national budget. However, the Project does not involve any public funding from an Annex I country, including ODA.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

Proposed new methodology "Methodology for introduction of energy efficient air conditioners to households" is applied.

The following tool is also applied:
"Tool to calculate the emission factor for an electricity system" (Version 2.2.1)"

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The Project meets all the applicability conditions of the proposed new methodology as follows.

1) This methodology applies to the project activities in the category of energy demand.	The project activity involves reduction of energy demand by introducing energy-efficient air conditioners.
2) This methodology applies to project activities that involve installation and operation of energy efficient air conditioners in individual households within the project area. This methodology is applicable to the replacement of the existing air conditioners by new inverter energy efficient air conditioners, and/or new installation of energy efficient air conditioner. In the absence of project activity, continuing use of existing conventional less efficient air conditioners and/ or installation of new but less efficient air conditioners of similar rated cooling/heating capacity would occur.	The project activity involves both new installation of inverter air conditioners and replacement of existing non-inverter air conditioners with inverter air conditioners. Only cases where conventional (non-inverter) air conditioners of similar rated cooling capacity would be used in absence of the project activity are selected for subsidy program under the project activity.
3) Electricity delivered from the grid is the only energy used by air conditioners under project and baseline scenario.	In accordance with the baseline survey, the baseline air conditioners only use grid electricity as energy source in the baseline scenario.
4) All households participating in the project activity are connected to a national or regional electricity grid.	Only households connected to a national or regional grid will be allowed to participate in the project activity as a condition of subsidy provision.
5) Energy efficient air conditioners installed under the project activity are new and not transferred from another activity.	The government only provides subsidy for new air conditioners and will require sales receipts of such air conditioners for receiving the subsidy.
6) The rated cooling capacity of the inverter air conditioners installed under the project activity at each household is not significantly smaller (maximum -10%) or significantly larger (maximum +50%) than the baseline air conditioner.	Only cases where the rated cooling capacity of the inverter air conditioners installed under the project activity at each household is not significantly smaller or larger than the baseline air conditioner as stipulated by the methodology are be selected for subsidy under the project activity. Cooling

	capacity of the existing air conditioners are inspected through baseline survey and will be cross checked with cooling capacities and sales receipt of new air conditioners purchased for the Project.
7) Refrigerants that are contained in the inverter air conditioners installed under the project activity shall be CFC free.	Only air conditioners using CFC free refrigerants will be selected for subsidy under the project activity. "CFC free" statement is required on sales receipt.
8) If the project activity involves replacement of existing air conditioners, the refrigerant contained in the existing air conditioner will be recovered and destroyed, or stored in suitable containers within suitable premises to ensure that the recovered, stored refrigerant gases can be monitored and tracked. Stored refrigerant gases may be withdrawn from storage for re-use, or for destruction by a method approved under regulations by the host country and/or pursuant to international treaties signed by the host country under Montreal, Kyoto or other Protocol that may in the future apply.	Subsidy will only be provided under the condition that the refrigerant contained in the existing air conditioners replaced under the project activity will be recovered and destroyed or stored in suit-able containers within suitable premises. In cases where existing air conditioners are replaced, households are required to submit record of refrigerant being recovered and destroyed or stored properly.
9) Location of all energy efficient air conditioner installed under the project activity is traceable throughout the crediting period. In case any household stops the use of air conditioners installed under the project activity, this should be noted in the database and removed from the emissions reduction calculation.	Location of all inverter air conditioners installed under the project activity are recorded on the project database when applications for subsidy are filed and will be monitored throughout the crediting period by regular survey and monitoring checks. Households are also required to report termination of the use of inverter air conditioners.
10) A measure is established within the project area which ensures all households participating in the project activity receive CDM benefit in a form other than CERs.	CER income will be returned to households in a form of increased fund to subsidize more inverter air conditioners when households wish to purchase additional air conditioners.
11) Individual households participating in the project activity agree not to claim CER from the project activity	Individual households will only be able to receive subsidy under the condition that they will not claim CERs from the project activity.
12) A project activity implementation plan that specifies the procedures for establishing the project activity is available and fully documented in the CDM-PDD. The information in the project activity implementation plan includes, but not limited to, the project area, project coordinator details, the total number of energy efficient air conditioners that are planned to be installed under the project activity in the project area over the duration of the crediting period, installation schedule, and data-base management plan.	A project activity implementation plan is documented in Appendix A of the PDD.
13) Lastly, this methodology is not applicable if the	Section B.5 discusses in detail how the use of

identification of baseline scenario conducted prior to the project implementation concludes that the use of energy efficient air conditioner is the most plausible scenario in the project area.	energy efficient air conditioner is not the most plausible scenario in the project area.

B.3. Description of the sources and gases included in the project boundary:

The spatial extent of the project activity encompasses all inverter air conditioners installed under the project activity. Also included in the project boundary is the electricity grid to which households involved in the project activity are connected.

As per the proposed new methodology, following gases are included in the project boundary:

Source		Gas	Included?	Justification / Explanation
Baseline	Emissions from electricity consumption for operation of non-inverter air conditioners under the baseline scenario	CO_2	Yes	Main source of emissions.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
Project activity	Emissions from electricity consumption for operation of inverter air conditioners under the project scenario	CO_2	Yes	Main source of emissions.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.

A schematic diagram of the project boundary is shown in the following Figure 3.

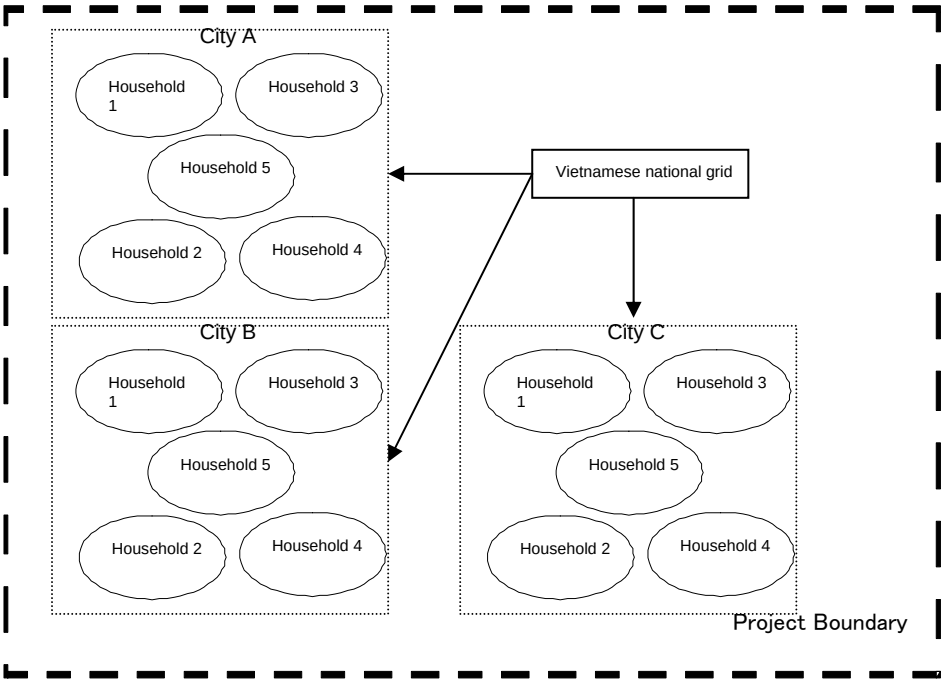

Figure 3: Project Boundary

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The baseline scenario of the project activity is determined in accordance with the proposed new methodology.

The methodology stipulates that the most plausible baseline scenario is identified through the following:

Identify the most economically advantageous air conditioner available in the market prior to the start of the project activity by adopting an investment analysis. The baseline scenario is that the air conditioner available in the market which is the most economically attractive course of action will be installed in individual households in the absence of the project activity.

Due to the lack of official or third-party market analysis of air conditioners, project participants have prepared their own market analysis in the following manner.

(1) Survey of the market

A market survey has been conducted on the new air conditioners currently being sold by appliance retailers operating in major cities of Vietnam. The method is deemed appropriate as it is conservative in a way that the air conditioners surveyed only include new models with presumably higher energy efficiency.

Out of the line-up of air conditioners[3], 38 units have the cooling capacity of approximately 12,000 BTU, which is similar to the air conditioner installed under the project activity. Although the methodology allows for some fluctuation between capacities of baseline and project air conditioners,[4] only the products listed under "12000 BTU" have been selected for the sake of accuracy. The list of 38 air conditioners and their details are described in Annex 3.1.

(2) Comparison of economic attractiveness

Price per unit of cooling capacity has been calculated to compare the economic attractiveness of the 38 air conditioners with similar cooling capacity to the air conditioner installed under the project activity. The product with least investment cost, therefore, most economically attractive is identified as Samsung's model AS12UU, a non-inverter air conditioner with unit investment cost of VND 458 per BTU.

(3) Selection of the most economically attractive air conditioner in the market as the baseline scenario

As described in the analysis mentioned above, the conventional air conditioner that is used in the baseline scenario is identified as Samsung AS12UU, which has the energy efficiency ratio of 10.43 BTU/W.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

In accordance with the proposed new methodology, Steps 1 and 2 of the "Tool for demonstration and assessment of additionality (Version 5.2.1)" are applied to demonstrate additionality of the project activity in the following manner.

Step 1–Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

The following credible and realistic alternatives are identified.

Alternative 1: The proposed project activity is implemented and inverter air conditioners are either newly installed or installed to replace non-inverter air conditioners without assistance from the CDM. *(The project activity without CDM)*

Alternative 2: Existing non-inverter air conditioners are used or new non-inverter air conditioners are introduced for cooling and heating purposes in households. *(Continuation of current practices)*

[3] http://www.pico.com.vn/ProductList.aspx?CategoryId=73&Filter=:383:

[4] Project air conditioner can be up to 50% larger and 10% smaller than the baseline air conditioner.

Sub-step 1b. Consistency with mandatory laws and regulations:

Both alternatives (Alternative 1 and Alternative 2) are in compliance with the mandatory legislation and regulations in Viet Nam.

STEP 2 – Investment Analysis

Sub-step 2a: Determine appropriate analysis method

While the methodology allows for choosing Option II (investment comparison analysis) or Option III (benchmark analysis), Option III is chosen for the project activity.

Sub-step 2b: Apply benchmark analysis

Payback period is chosen as the indicator to conduct benchmark analysis. The benchmark, in this case, is 3.5 years which, according to the preliminary survey conducted for selected households in Hanoi, Ho Chi Minh City and Danang, is indicated as the maximum payback period they would consider when purchasing a new appliance. It is also evident from interviews conducted with air conditioner manufacturers that 3.5 years is the maximum payback period they consider when marketing their products in Southeast Asia including Viet Nam.

Sub-step 2c: Calculation and comparison of financial indicators

Table 3 represents the main data used in the payback period calculations for the Project. The calculations were conducted in a conservative manner and all assumptions are listed below in order to maintain a transparent approach.

Table 3: Data used to calculate payback period

Item	Unit	Value[5]
Cost of the inverter air conditioner installed under the project activity	USD	690
Cost of monitoring equipment	USD	5
Annual electricity consumption per unit in the baseline scenario	kWh/y	4,394
Annual electricity consumption per unit under the project activity	kWh/y	3,377
Electricity saving per unit	kWh/y	1,017
Electricity tariff	USD/kWh	0.0596
Income from electricity saving	USD/y	61

[5] Prices are converted from Vietnamese Dong (VND) using 1,000VND=0.048 USD exchange rate as of 26 September 2011 (http://www.bloomberg.com)

Table 4 demonstrates the result of the calculation of the payback period for the project activity.

Table 4: Results of the calculation of the payback period

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Cost	Initial investment	690	-	-	-	-	-	-
	Monitoring equipment	5	-	-	-	-	-	-
Profit	Income	61	61	61	61	61	61	61
Balance		634	574	513	452	392	331	0
Payback period		7						

It is evident from the calculation the payback period of the project activity without CDM benefits is longer than 3.5 years which surpasses the aforementioned benchmark value. It is clear that the Project will not be implemented without other sources of financial support if the project participant cannot recover investment within the lifetime of the equipment being introduced. The financial hurdle in introducing inverter air conditioners is also apparent from the fact that out of over 300 households interviewed in Hanoi and Ho Chi Minh City, none of the households had a single inverter air conditioner and that there is no other large-scale program like the proposed project activity to introduce inverter air conditioners.

Sub-step 2d – Sensitivity Analysis

The following assumptions are analyzed to demonstrate that the Project is not financially attractive even under different favourable scenarios:

- The price of inverter air conditioners installed under the project activity is down 10%.
- Electricity tariff is up 10%.

The results of the analysis are that even under the financially favourable conditions, the payback period of the project activity is longer than the benchmark value as indicated in Table 5 and Table 6.

Table 5: Results of the sensitivity analysis
(The price of inverter air conditioners installed under the project activity is down 10%)

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Cost	Initial investment	621						
	Monitoring equipment	5						
Profit	Income	61	61	61	61	61	61	61
Balance		565	505	444	383	323	-	-
Payback period		6						

Table 6: Results of the sensitivity analysis (Electricity tariff is up 10%)

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Cost	Initial investment	690						
	Monitoring equipment	5						
Profit	Income	67	67	67	67	67	67	67
Balance		628	562	495	428	361	-	-
Payback period		6						

The investment analysis clearly indicates that the project activity is not financially attractive without additional benefits brought by alternative sources of income, namely the income from the sales of carbon credits, therefore, the Project is deemed additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Baseline emissions

As per the proposed new methodology, baseline emissions are determined as the CO_2 emissions from electricity would have been consumed by non-inverter air conditioner in operation in the absence of the project activity as expressed in the following equation.

$$BE_y = BE_{EC,y} = EC_{BL,y} \times EF_{CO2,ELEC,y} \quad (1)$$

Where:

BE_y = Baseline emissions in year y (t CO_2/yr)

$BE_{EC,y}$ = Baseline emissions from electricity consumption in year y (t CO_2/yr)

$EC_{BL,y}$ = Quantity of electricity that would be consumed by conventional air conditioners in the absence of the project activity in year y (MWh/yr)

$EF_{CO2,ELEC,y}$ = CO_2 emission factor for electricity from the grid from which electricity is supplied to the air conditioners in the absence of the project activity in year y (t CO_2/MWh)
This value is calculated using the "Tool to calculate the emission factor for an electricity system (Version 2.2.1)".

Determination of electricity consumptions by conventional air conditioners in the absence of the project activity ($EC_{BL,y}$)

Electricity consumption under the baseline scenario is calculated as follows:

$$EC_{BL,y} = n_{ac,PJ,y} \times (1 - DF_y) \times \left(\frac{\eta_{ac,PJ}}{\eta_{ac,BL}} \right) \times \left(\mu_{EC,PGS,y} - \frac{\sigma_{EC,PSG,y}}{\sqrt{n_{ac,PSG,y}}} \right) \quad (2)$$

Where:

$EC_{BL,y}$ = Quantity of electricity that would be consumed by conventional air conditioners in the absence of the project activity in year *y* (MWh/yr)

$n_{ac,PJ,y}$ = The total number of energy efficient air conditioners installed within the project area under the project activity in year *y* (unit). The ex-ante value is stated in the project implementation plan. Updated annually based on the project database managed by project coordinator.

DF_y = Discount factor accounting for project air conditioners that are installed under the project activity but no longer operating in year *y*

$\eta_{ac,PJ}$ = Efficiency of the inverter air conditioner under the project scenario
Representative indicator is selected by the project participant. This is the value of the selected representative indicator for the project air conditioner installed under the project activity. This figure, determined by using one of the two options mentioned in the monitoring methodology is provided in the project implementation plan and fixed throughout each crediting period. This value is updated at the time of each crediting period renewal.

$\eta_{ac,BL}$ = Efficiency of the non-inverter air conditioner under the baseline scenario
This value is identified as the result of baseline scenario determination process in the methodology and determined by using one of the two options mentioned in the monitoring methodology. This value is determined once prior to the start of the project activity and fixed throughout each crediting period. This value is updated at the time of each crediting period renewal.

$\mu_{EC,PSG,y}$ = Mean annual electricity consumption by an inverter air conditioner monitored under the project activity (MWh/yr/unit)

$\sigma_{EC,PSG,y}$ = Standard deviation of annual electricity consumption by an energy efficient air conditioner monitored under the project activity (MWh/yr/unit)

$n_{ac,PSG,y}$ = Total number of energy efficient air conditioners installed in the PSG households under the project activity that is operating in year *y*

Determination of the total number of energy efficient air conditioners installed within the project area under the project activity in year y ($n_{ac,PJ,y}$)

For *ex-ante* estimation, the number of inverter air conditioners installed is based on the project implementation plan developed by the project participants as described in **Table 1**.

Determination of a discount factor accounting for project air conditioners that are installed under the project activity but no longer operating in year y (DF_y)

A random sampling survey is to be conducted in accordance with the methodology. Sample size is determined by the formula given below.

$$n_{ac,rss,total,y} = \frac{z^2 \cdot x \cdot y \cdot N_{PJ,y}}{e^2\left(N_{PJ,y} - 1\right) + z^2 \cdot x \cdot y} \quad (3)$$

Where:

$n_{ac,rss,total,y}$	=	The total number of households included in the sample group for random sampling survey for DF determination.
$N_{PJ,y}$	=	Population size in the project area. The population will be restricted to the number of households participating in the project activity in year *y*.
x	=	Estimate of variance in the primary variables of interest in the survey (0.5)
y	=	1-*x* (0.5)
e	=	Precision level or acceptable margin of error (5% or 0.05)
z	=	Z-value as the value of the standard variate at 95% confidence level, to be obtained from the z-distribution table (1.96)

Although it will be recorded and monitored by the project database, the population size is deemed as equal to the number of households participating in the project activity for the purpose of *ex-ante* estimation. It is also assumed that there is one inverter air conditioner installed per household, therefore $n_{ac,PJ,y}$ is equal to $N_{PJ,y.}$

A discount factor is then calculated using the following equation:

$$DF_y = \frac{n_{ac,rss,stopped,y}}{n_{ac,rss,total,y}} \quad (4)$$

Where:

DF_y	=	Discount factor accounting for project air conditioners that are installed under the project activity but no longer operating in year *y*.
$n_{ac,rss,total,y}$	=	The total number of air conditioners included in the sample group for random sampling survey for DF determination.

$n_{ac,rss,stopped,\,y}$ = The number of air conditioners included in the sample group for random sampling survey for DF determination that are no longer operating.

Determination of the mean annual electricity consumption by an energy efficient air conditioner ($\mu_{EC,PSG,y}$)

The average annual electricity consumption by an energy efficient air conditioner installed under the project activity is calculated applying the following equation:

$$\mu_{EC,PSG,y} = \frac{\sum_j \sum_i EC_{PSG,i,j,y}}{n_{ac,PSG,y}} \quad (5)$$

Where:

$\mu_{EC,PSG,y}$ = Mean annual electricity consumption by an energy efficient air conditioner monitored under the project activity (MWh/yr/unit)

$EC_{PSG,i,j,y}$ = Annual electricity consumption by energy efficient air conditioner *i* in household *j* in PSG, in year *y*
Monitored.

$n_{ac,PSG,y}$ = Total number of energy efficient air conditioners installed in the PSG households under the project activity that is operating in year *y*

Project sampling survey will be conducted to determine mean annual electricity consumption. Sampling size is to be determined using the same Cochran's formula described in Equation (3) of this PDD.

Determination of the standard deviation of annual electricity consumption by an energy efficient air conditioner monitored under the project activity ($\sigma_{EC,PSG,y}$)

The standard deviation of annual electricity consumption by an energy efficient air conditioner installed under the project activity is calculated applying the following equation:

$$\sigma_{EC,PSG,y} = \sqrt{\frac{\sum_j \sum_i \left(EC_{PSG,i,j,y} - \mu_{EC,PSG,y}\right)^2}{n_{ac,PSG} - 1}} \quad (6)$$

Where:

$\sigma_{EC,PSG,y}$ = standard deviation of annual electricity consumption by an energy efficient air conditioner installed under the project activity (MWh/yr/unit)

Determination of total number of energy efficient air conditioners installed in the PSG households under the project activity that is operating in year y ($n_{ac,PSG,y}$)

The number of inverter air conditioners installed under the project activity that is operating is to be recorded on project database. Taking into account the number of energy efficient air conditioner that have stopped operating in the course of the project activity, this value is to be adjusted by the discount factor which is subject to monitoring by sampling.

Determination of grid emission factor ($EF_{CO2,ELEC,y}$)

The emission factor of Vietnam's national grid is calculated in accordance with the "Tool to calculate the emission factor for an electricity system (Version 2.2.1)". The combined margin CO_2 emission factor for grid connected power generation ($EF_{grid,CM,y}$) is calculated as a weighted average of operating margin ($EF_{grid,OM,y}$) and build margin ($EF_{grid,BM,y}$) factors. To determine the combined margin, the procedures provided in the latest version of the Tool are applied.

Step 1. Identify the relevant electric power system

The electricity consumed in the project activity will be delivered by the Vietnamese national grid, the only grid existing in the country.

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)

Project participants choose not to include off-grid power plants.

Step 3. Select a method to determine the operating margin (OM)

As no dispatch data is available and must-run/low cost resources constitute less than 50% of total grid generation over the past 5 years (see Annex 3), the simple OM method is used. For the simple OM, ex-ante option is selected.

Step 4. Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated based on fuel consumption and net electricity generation of each power plant/unit (Option A). The following formula is used to calculate Simple OM.

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (7)$$

Where:

Parameter	Unit	Description
$EF_{grid,OMsimple,y}$	tCO_2/MWh	Simple operating margin CO_2 emission factor in year *y*
$EG_{m,y}$	MWh	Net quantity of electricity generated and delivered to the grid by power plant/unit *m* in year *y*.
$EF_{EL,m,y}$	tCO_2/MWh	CO_2 emission factor of power unit *m* in year *y*

m	All power plants/units serving the grid in year *y* except low-cost/ must-run power plants/units
y	The three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex-ante option)

The operating margin emission factor calculations are performed ex-ante using available official data on fuel consumption and electricity generation for each plant connected to the Vietnamese national grid in 2006-2008. All data is summarized in Section B.6.2. Applying the equation as shown in detail in Section B.6.3, the "Operating Margin" emission factor is:

$$\boldsymbol{EF_{OM} = 0.6465\ tCO_2/MWh}$$

Step 5. Calculate the build margin (BM) emission factor

The build margin is calculated as the generation-weighted average emission factor (tCO_2/MWh) of sample of power plants as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (8)$$

Where:

Parameter	Unit	Description
$EF_{grid,BM,y}$	tCO_2/MWh	Build margin CO_2 emission factor in year *y*
$EG_{m,y}$	MWh	Net quantity of electricity generated and delivered to the grid by power unit m in year *y*
$FE_{EL,m,y}$	tCO_2/MWh	CO_2 emission factor of power unit m in year *y*
m		Power units included in the build margin
y		Most recent historical year for which power generation data is available

Applying the equation as shown in detail in Section B.6.3, the "Build Margin" emission factor is:

$$\boldsymbol{EF_{BM} = 0.5064\ tCO_2/MWh}$$

Step 6. Calculate the combined margin baseline emission factor

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (9)$$

Where:

Parameter	Unit	Description
$EF_{grid,BM,y}$	tCO_2/MWh	Emission factor of the build margin.
$EF_{grid,OM,y}$	tCO_2/MWh	Emission factor of the operating margin.
w_{OM}	%	Weighting of the operating margin emission factor.
w_{BM}	%	Weighting of the build margin emission factor.

w_{OM} and w_{BM}, by default, are both valued at 50% .

The baseline emission factor is:

$EF_{EL,y}$ = 0.5764 tCO_2/MWh

Project emissions

Project emissions are calculated in accordance with the following equation.

$$PE_y = PE_{EC,y} = n_{ac,PJ,y} \times \left(\mu_{EC,PGS,y} - \frac{\sigma_{EC,PSG,y}}{\sqrt{n_{ac,PSG,y}}} \right) \times EF_{CO2,ELEC,y} \quad (10)$$

Where:

PE_y = Project emissions in year y ($t CO_2/yr$)

$PE_{EC,y}$ = Project emissions from electricity consumption in year y ($t CO_2yr$)

$n_{ac,PJ,y}$ = The total number of energy efficient air conditioners installed within the project area under the project activity in year y (unit).

$\mu_{EC,PSG,y}$ = Mean annual electricity consumption by an energy efficient air conditioner monitored under the project activity in year y (MWh/yr/unit)

$\sigma_{EC,PSG,y}$ = Standard deviation of annual electricity consumption by an energy efficient air conditioner monitored under the project activity (MWh/yr/unit)

$n_{ac,PSG,y}$ = Total number of energy efficient air conditioners installed in the PSG households under the project activity that is operating in year y

$EF_{CO2,ELEC,y}$ = CO_2 emission factor for electricity from the grid from which electricity is supplied to the air conditioners in the absence of the project activity in year y ($t CO_2/MWh$)
This value is calculated using the "Tool to calculate the emission factor for an electricity system (Version 2.2.1)".

Leakage

Based on the applied methodology, no leakage emissions are considered. It is stipulated in the applicability conditions of the methodology that energy efficient air conditioners installed under the project activity shall not be transferred from or to another activity and the refrigerant of the replaced non-inverter air conditioners must be destroyed or properly stored such actions shall be documented in order to avoid leakage emissions.

Emission Reductions

1. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (11)$$

Where:

ER_y = Emission reductions in year *y* (t CO_2e/yr)

BE_y = Baseline emissions in year *y* (t CO_2e/yr)

PE_y = Project emissions in year *y* (t CO_2/yr)

LE_y = Leakage emissions in year *y* (t CO_2/yr)

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	$FC_{i,m,y}$
Data unit:	

i	Data unit
Coal	kton
Oil	kton
Gas	mm^3

Description:	Amount of fossil fuel type *i* consumed by power plant/unit *m*, in year *y*
Source of data used:	Study, Determination of Emission Factor (EF) of Viet Nam's Power Grid
Value applied:	

	y		
m,i	2006	2007	2008
Coal thermal	5,645.86	6,386.09	6,483.99
Gas turbine	5,743,235.28	5,910,941.84	6,839,114.84
Oil turbine	70.14	163.27	54.35
Oil thermal	397.65	614.06	534.59
FO diesel	16.60	25.15	22.48
DO diesel	6.39	9.16	3.73

Justification of the choice of data or description of measurement methods and procedures actually applied :	Left blank on purpose
Any comment:	Left blank on purpose

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ/mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data used:	Study, Determination of Emission Factor (EF) of Viet Nam's Power Grid
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	Left blank on purpose
Any comment:	Left blank on purpose

Data / Parameter:	$EF_{CO2,m,i,y}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* used in power unit *m* in year *y*
Source of data used:	Study, Determination of Emission Factor (EF) of Viet Nam's Power Grid
Value applied:	as per "Study, Determination of Emission Factor (EF) of Viet Nam's Power Grid"
Justification of the choice of data or description of measurement methods and procedures actually applied :	Left blank on purpose
Any comment:	Left blank on purpose

Data / Parameter:	$EG_{m,y}$
Data unit:	MWh
Description:	Net electricity generated by power plant/unit *m* in year *y*
Source of data used:	Study, Determination of Emission Factor (EF) of Viet Nam's Power Grid
Value applied:	OM

	y		
m,i	2006	2007	2008
Coal thermal	58,989,230	9,836,548	10,055,394
Turbine	26,542,978	29,474,918	33,857,135
Gas turbine	18,838,764	20,023,591	22,396,231
Oil turbine	233,582	557,880	183,088
Recycled heat	7,470,632	8,893,447	11,277,816

FO diesel		80,000	104,626	90,465
DO diesel		25,000	42,000	15,000
Imports		937,000	2,629,000	3,220,000

BM

		y
m,i		2008
A Vuong		168,103.50
SROC Phu Mieng IDICO		241,556.00
Se San 3A		394,894.70
Tuyen Quang		1,136,112.18
Dai Ninh		1,145,108.50
Se San 3		1,131,614.00
Quang Tri		250,804.40
Uong Bi 2		532,000.00
Na Duong		627,930.00
Cao Ngan		708,693.00
Formosa		560,295.00
Nhon Trach		544,808.60
Ca Mau 1&2	Gas	2,106,807.24
	Recycled heat	2,728,872.00
Phu My 2,2		4,141,980.00
Dam Phu My		7,716.00
Cai Lan Vinashin		90,465.01

Justification of the choice of data or description of measurement methods and procedures actually applied :	Left blank on purpose
Any comment:	Left blank on purpose

B.6.3. Ex-ante calculation of emission reductions:

Based on the ex-ante calculation of emission reductions elaborated in Section B.6.1, emission reductions for the first year of the project activity is described in the following. The same calculation is repeated for the subsequent years using project year specific data.

Baseline Emissions

Determination of the total number of energy efficient air conditioners installed within the project area under the project activity in year y ($n_{ac,PJ,y}$)

For *ex-ante* estimation, the number of inverter air conditioners installed is based on the project implementation plan developed by the project participants as described in **Table 1**.

Determination of a discount factor accounting for project air conditioners that are installed under the project activity but no longer operating in year y (DF_y)

In accordance with the methodology, the sample size is determined by the formula given below.

$$n_{ac,rss,total,y} = \frac{z^2 \cdot x \cdot y \cdot N_{PJ,y}}{e^2\left(N_{PJ,y} - 1\right) + z^2 \cdot x \cdot y} \quad (3)$$

Where:

$n_{ac,rss,total,y}$ = The total number of households included in the sample group for random sampling survey for DF determination.

$N_{PJ,y}$ = Population size in the project area. The population will be restricted to the number of households participating in the project activity in year *y*.

x = Estimate of variance in the primary variables of interest in the survey (0.5)

y = 1-x (0.5)

e = Precision level or acceptable margin of error (5% or 0.05)

z = Z-value as the value of the standard variate at 95% confidence level, to be obtained from the z-distribution table (1.96)

As discussed in Section B.6.1, for the purpose of *ex-ante* estimation, the population size is deemed as equal to the number of households participating in the project activity. Additionally, it is assumed that there is one inverter air conditioner installed per household, therefore, $N_{PJ,y.}$ is equal to $n_{ac,PJ,y}$ where the values are indicated in Table 1. The results of the calculations are listed under $n_{ac,rss,total,y}$ in Table 7.

The discount factor is then calculated as follows.

$$DF_y = \frac{n_{ac,rss,stopped,y}}{n_{ac,rss,total,y}} \quad (4)$$

Where:

$n_{ac,rss,total,y}$ = The total number of air conditioners included in the sample group for random sampling survey for DF determination (unit).

$N_{PJ,y}$ = Population size in the project area. The population will be restricted to the number of households participating in the project activity in year *y* (unit).

x = Estimate of variance in the primary variables of interest in the survey (0.5)

y = 1-x (0.5)

e = Precision level or acceptable margin of error (5% or 0.05)

z = Z-value as the value of the standard variate at 95% confidence level, to be obtained from the z-distribution table (1.96)

Assumptions have been made for *ex-ante* estimation that the there is one inverter air conditioner used in each household participating in the project activity and that 10% of inverter air conditioners stop operating in each year. This is a very conservative figure as the technology provider states inverter air conditioners are very unlikely to fail to operate as long as proper care and maintenance are taken and also taking into account that the number of installation is very small during the first few year of the Project. The discount factor is estimated as follows.

Table 7: Discount factor calculation

	$n_{ac,rss,total,y}$	$n_{ac,rss,stopped,y}$	DF_y
01/04/2013 – 31/03/2014	373	37	0.1
01/04/2014 – 31/03/2015	380	38	0.1
01/04/2015 – 31/03/2016	382	38	0.1
01/04/2016 – 31/03/2017	383	38	0.1
01/04/2017 – 31/03/2018	384	38	0.1
01/04/2018 – 31/03/2019	384	38	0.1
01/04/2019 – 31/03/2020	384	38	0.1

Determination of annual electricity consumption by energy efficient air conditioner ($EC_{PSG,i,j,y}$)

In the project activity, annual electricity consumption by energy efficient air conditioners is monitored by sampling. For *ex-ante* estimation, daily usage data gathered from 336 selected households in Hanoi and Ho Chi Minh City together with the electricity consumption by the project air conditioner were used for the calculation in the following manner.

$$\sum_{i,j} EC_{PSG,i,j,y} = n_{ac,PSG,y} \times CA_{PJ,i.j} \times hr_{i,j} \times DAY_{i,j,y}$$

Where:

$EC_{PSG,i,j,y}$ = Annual electricity consumption by energy efficient air conditioner *i* in household *j* in PSG, in year *y* (MWh/yr/unit)

$n_{ac,PSG,y}$ = Total number of energy efficient air conditioners installed in the PSG households under the project activity that is operating in year *y* (unit)

$CA_{PJ,i.j}$ = Electricity consumption of energy efficient air conditioner installed in the project activity (kW), determined by the capacity of the energy efficient air conditioner multiplied by its average load

$hr_{i,j}$ = The number of hours the project air conditioner *i* is operated in household *j* per day (hr/day). The average of the surveyed data is used for *ex-ante* estimation.

$DAY_{i,j,y}$ = The number of days per year the project air conditioner *i* is operated in

household *j* (d/yr). The average of the surveyed data is used for *ex-ante* estimation.

Table 8 describes result of the calculation of annual electricity consumption by inverter air conditioners installed under the project activity in project sampling group.

Table 8: Annual electricity consumption by inverter air conditioners

	$n_{ac,PSG,y}$	$CA_{PJ,i.j}$	Average load	$hr_{i,j}$	$DAY_{i,j,y}$	$EC_{PSG,i,j,y}$
	(units)	(kW)	0.5	(h/d)	(d/y)	(MWh/yr)
01/04/2013 – 31/03/2014	336	1.75	0.5	7.69	251	1,134
01/04/2014 – 31/03/2015	342	1.75	0.5	7.69	251	1,154
01/04/2015 – 31/03/2016	344	1.75	0.5	7.69	251	1,162
01/04/2016 – 31/03/2017	345	1.75	0.5	7.69	251	1,165
01/04/2017 – 31/03/2018	345	1.75	0.5	7.69	251	1,166
01/04/2018 – 31/03/2019	346	1.75	0.5	7.69	251	1,167
01/04/2019 – 31/03/2020	346	1.75	0.5	7.69	251	1,167

Determination of the mean annual electricity consumption by an energy efficient air conditioner ($\mu_{EC,PSG,y}$)

$$\mu_{EC,PSG,y} = \frac{\sum_j \sum_i EC_{PSG,i,j,y}}{n_{ac,PSG,y}} \quad (5)$$

The mean annual electricity consumption has been estimated based on the aforementioned survey on selected households as follows.

$$\mu_{EC,PSG,y} = 3.4 \text{ MWh/yr}$$

Determination of the standard deviation of annual electricity consumption by an energy efficient air conditioner ($\sigma_{EC,PSG,y}$)

$$\sigma_{EC,PSG,y} = \sqrt{\frac{\sum_{j}\sum_{i}\left(EC_{PSG,i,j,y} - \mu_{EC,PSG,y}\right)^2}{n_{ac,PSG} - 1}} \quad (6)$$

The standard deviation has been estimated based on the aforementioned survey on selected households as follows.

$$\sigma_{EC,PSG,y} = 0$$

These values are applied for ex ante calculations in all years of the crediting period.

Determination of total number of energy efficient air conditioners installed in the PSG households under the project activity that is operating in year y ($n_{ac,PSG,y}$)

The number of inverter air conditioners installed under the project activity that is operating is to be recorded on project database. Taking into account the number of energy efficient air conditioner that have stopped operating in the course of the project activity, this value is to be adjusted by the discount factor which is subject to monitoring by sampling. For *ex-ante* estimation, the number of inverter conditioners to be installed according to the project implementation plan and the discount factor of 0.1 as previously described are used. Table 9 demonstrates the estimated number of inverter air conditioners installed under the project activity and operating during each project year.

Table 9: The number of air conditioners installed under the project activity and operating

	Total number of project air conditioners included in PSG	Number of project air conditioners that stopped operating	Total number of energy efficient air conditioners installed in the PSG households under the project activity that is operating in year *y*
	$n_{ac,rss,total}$	$n_{ac,rss,stopped}$	$n_{ac,PSG,y}$
01/04/2013 – 31/03/2014	373	37	336
01/04/2014 – 31/03/2015	380	38	342
01/04/2015 – 31/03/2016	382	38	344
01/04/2016 – 31/03/2017	383	38	345
01/04/2017 – 31/03/2018	384	38	345
01/04/2018 – 31/03/2019	384	38	346

01/04/2019 – 31/03/2020	384	38	346

Determination of grid emission factor ($EF_{CO2,ELEC,y}$)

Operating Margin

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (7)$$

Power plant types	Fuel comsumption (Coal:kton, Oil:kton, Gas:mm^3)	Electricity generation to grid (MWh)	Emission (t CO_2)
2006			
Coal thermal	*5,645.86*	*8,989,230*	*11,823,610*
Turbine		*26,542,978*	*12,479,578*
Gas Turbine	*5,743,235.28*	*18,838,764*	*12,244,651*
Oil turbine	*70.14*	*233,582*	*234,927*
Recycled heat	*0*	*7,470,632*	*0*
Oil thermal	*397.65*	*1,043,991*	*1,327,593*
FO Diesel	*16.60*	*80,000*	*51,642*
DO Diesel	*6.39*	*25,000*	*20,495*
Imported electricity		*937,000*	*0*
Total	***N/A***	***37,618,119***	***25,702,918***
2007			
Coal thermal	*6,386.09*	*9,836,548*	*13,272,897*
Turbine		*29,474,918*	*13,116,063*
Gas Turbine	*5,910,941.84*	*20,023,591*	*12,570,669*
Oil turbine	*163.27*	*557,880*	*545,394*
Recycled heat	*0*	*8,893,447*	*0*
Oil thermal	*614.06*	*1,834,409*	*2,046,368*
FO Diesel	*25.15*	*104,626*	*79,867*
DO Diesel	*9.16*	*42,000*	*29,088*
Imported electricity		*2,629,000*	*0*
Total	***N/A***	***43,921,051***	***28,544,283***
2008			
Coal thermal	6,483.99	10,055,394	13,378,811
Turbine		33,857,135	14,716,799
Gas Turbine	6,839,114.84	22,396,231	14,535,266
Oil turbine	54.35	183,088	181,533
Recycled heat	0	11,277,816	0
Oil thermal	534.59	1,481,880	1,784,825
FO Diesel	22.48	90,465	71,385

DO Diesel	3.73	15,000	11,879
Imported electricity		3,220,000	0
Total	**N/A**	**48,719,874**	**29,963,699**

	2006	**2007**	**2008**	**Total**
Total electricity generation to grid (MWh)	37,618,119	43,921,051	48,719,874	**130,259,494**
Total emission (t CO_2)	25,702,918	28,544,283	29,963,699	**84,210,900**

$$EF_{grid,OMsimple,y} = \frac{84,210,900}{130,259,494}$$

$$= 0.6465$$

Build Margin

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (8)$$

Power plant names	**Year of operation**	**Fuel comsumption (Coal:kton, Oil:kton, Gas:mm^3)**		**Electricity generation to grid (MWh)**	**Emission (t CO_2)**
Set of 5 power plants has just been built					
A Vuong	2008	Hydro power		168,103,50	
Tuyen Quang	2008	Hydro power		1,136,112,18	
Dai Ninh	2008	Hydro power		1,145,108.50	
Nhon Trach	2008	Gas	166.38	544,808.60	378,023
Ca Mau 1&2	2007	Gas	647.24	2,106,807.27	1,431,048
		Recycled heat		2,728,827.00	
Total				**7,829,812.02**	
Set of newly built power plants contributing to 20% of the total electricity supply					
A Vuong	2008	Hydro power		168,103.50	
SROC Phu Mieng IDICO	2006	Hydro power		241,556.00	
Se San 3A	2006	Hydro power		394,895.70	
Tuyen Quang	2008	Hydro power		1,136,112.18	
Dai Ninh	2008	Hydro power		1,145,108.50	
Se San 3	2006	Hydro power		1,131,614.00	
Quang Tri	2007	Hydro power		250,804.40	
Uong Bi 2	2007	Coal	281,759	532,000.00	581,017.63
Na Duong	2005	Coal	532	627,930.00	883,846.37
Cao Ngan	2007	Coal	526	708,693.00	1,081,145.84
Formosa	2004	Coal	495	560,295.00	1,291,302.96

Nhon Trach	2008	Gas	166.38	544,808.60	378,023.07
Ca Mau 1&2	2007	Gas	647.24	2,106,807.24	1,431,047.61
		Recycled heat		2,728,872.00	
Phu My 2,2	2004	Gas	1,159.75	4,141,980.00	2,510,751.14
Dam Phu My	2006	Gas	56.15	7,716.00	133,868.48
Cai Lan - Vinashin	2007	FO	22.48	90,465.01	71,384.99
Total			**N/A**	**16,514,761.12**	**8,362,386.09**
BM EF Calculation result					
Total Emission					8,362,386.09 (t CO_2)
Total Electricity generation to grid					16,514,761.12 (MWh)
BM (2008)					**0.5064 (t CO_2 /MW)**

Combined Margin

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (9)$$

	Weight	**EF (tCO_2 /MWh)**
OM	0.5	0.6465
BM	0.5	0.5064
CM (EF)		**0.5764**

In the first year,

$$EC_{BL,y} = n_{ac,PJ,y} \times (1 - DF) \times \left(\frac{\eta_{ac,PJ}}{\eta_{ac,BL}}\right) \times \left(\mu_{EC,PSG,y} - \frac{\sigma_{EC,PSG,y}}{\sqrt{n_{ac,PGS,y}}}\right) \quad (2)$$

$$= 13{,}000 \times (1 - 0.1) \times \left(\frac{13.5718}{10.43}\right) \times \left(3.4 - \frac{0}{\sqrt{336}}\right)$$

$$= 51{,}414\,(MWh)$$

$$BE_y = BE_{EC,y} = EC_{BL,y} \times EF_{CO2,ELEC,y} \quad (1)$$

$$= 51{,}414\,(MWh) \times 0.5764\,(tCO_2 / MWh)$$

$$= 29{,}635\,(tCO_2)$$

For the rest of the crediting period,

y	$n_{ac,PJ,y}$ (units)	$n_{ac,PSG,y}$ (units)	$EC_{BL,y}$ (MWh)	BE_y (tCO_2)
01/04/2013 – 31/03/2014	13,000	336	51,414	29,635
01/04/2014 – 31/03/2015	33,000	342	130,512	75,227
01/04/2015 – 31/03/2016	83,000	344	328,256	189,207
01/04/2016 – 31/03/2017	183,000	345	723,746	417,167
01/04/2017 – 31/03/2018	383,000	345	1,514,725	873,088
01/04/2018 – 31/03/2019	683,000	346	2,701,194	1,556,968
01/04/2019 – 31/03/2020	1,183,000	346	4,678,642	2,696,769

Project Emissions

$$PE_y = PE_{EC,y} = n_{ac,PJ,y} \times \left(\mu_{EC,PSG,y} - \frac{\sigma_{EC,PSG,y}}{\sqrt{n_{ac,PSG,y}}} \right) \times EF_{CO2,ELEC,y} \quad (10)$$

$$= 13{,}000 \times \left(3.4 - \frac{0}{\sqrt{336}} \right) (MWh) \times 0.5764 (tCO_2 / MWh)$$

$$= 25{,}305$$

For the rest of the crediting period,

y	$n_{ac,PJ,y}$ (units)	$n_{ac,PSG,y}$ (units)	$EC_{BL,y}$ (MWh)	BE_y (tCO_2)
01/04/2013 – 31/03/2014	13,000	336	51,414	29,635
01/04/2014 – 31/03/2015	33,000	342	130,512	75,227
01/04/2015 – 31/03/2016	83,000	344	328,256	189,207
01/04/2016 – 31/03/2017	183,000	345	723,746	417,167
01/04/2017 – 31/03/2018	383,000	345	1,514,725	873,088
01/04/2018 – 31/03/2019	683,000	346	2,701,194	1,556,968
01/04/2019 – 31/03/2020	1,183,000	346	4,678,642	2,696,769

Emissions Reduction

$$ER_y = BE_y - PE_y - LE_y \quad (11)$$

In the first year, emissions reduction is calculated as follows.

= 29,635 – 25,305 – 0

= 4,329

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2 e)
01/04/2013 – 31/03/2014	25,305	29,635	0	4,329
01/04/2014 – 31/03/2015	64,236	75,227	0	10,991
01/04/2015 – 31/03/2016	161,563	189,207	0	27,644
01/04/2016 – 31/03/2017	356,217	417,167	0	60,950
01/04/2017 – 31/03/2018	745,525	873,088	0	127,562
01/04/2018 – 31/03/2019	1,329,487	1,556,968	0	227,481
01/04/2019 – 31/03/2020	2,302,757	2,696,769	0	394,012
Total (tonnes of CO_2 e)	**4,985,090**	**5,838,061**	**0**	**852,971**

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	$n_{ac,PJ,y}$
Data unit:	-
Description:	Total number of energy efficient air conditioners installed within the project area under the project activity
Source of data to be used:	Project database

Value of data applied for the purpose of calculating expected emission reductions in section B.5	01/04/2013 – 31/03/2014: 13,000 01/04/2014 – 31/03/2015: 33,000 01/04/2015 – 31/03/2016: 83,000 01/04/2016 – 31/03/2017: 183,000 01/04/2017 – 31/03/2018: 383,000 01/04/2018 – 31/03/2019: 683,000 01/04/2019 – 31/03/2020: 1,183,000
Description of measurement methods and procedures to be applied:	Project database records the number of energy efficient air conditioners installed under the project activity.
QA/QC procedures to be applied:	Cross-checked with paper records.
Any comment:	Left blank on purpose

Data / Parameter:	$n_{ac,PSG,y}$
Data unit:	-
Description:	Total number of energy efficient air conditioners installed in the PSG households under the project activity that is operating in year *y*
Source of data to be used:	PSG survey conducted by project participant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	01/04/2013 – 31/03/2014: 336 01/04/2014 – 31/03/2015: 342 01/04/2015 – 31/03/2016: 344 01/04/2016 – 31/03/2017: 345 01/04/2017 – 31/03/2018: 345 01/04/2018 – 31/03/2019: 346 01/04/2019 – 31/03/2020: 346
Description of measurement methods and procedures to be applied:	PSG survey conducted and reported annually
QA/QC procedures to be applied:	Cross-checked with paper records.
Any comment:	Left blank on purpose

Data / Parameter:	$N_{PJ,y}$
Data unit:	-
Description:	Population size in the project area in year *y*. The population will be restricted to the number of households participating in the project activity in year *y*.
Source of data to be used:	Project database updated annually

Value of data applied for the purpose of calculating expected emission reductions in section B.5	01/04/2013 – 31/03/2014: 13,000 01/04/2014 – 31/03/2015: 33,000 01/04/2015 – 31/03/2016: 83,000 01/04/2016 – 31/03/2017: 183,000 01/04/2017 – 31/03/2018: 383,000 01/04/2018 – 31/03/2019: 683,000 01/04/2019 – 31/03/2020: 1,183,000
Description of measurement methods and procedures to be applied:	Updated annually
QA/QC procedures to be applied:	Cross checked with the project implementation plan to verify the population size is in line with the project implementation plan.
Any comment:	Left blank on purpose

Data / Parameter:	$n_{ac,rss,stopped,y}$
Data unit:	-
Description:	Total number of energy efficient air conditioners included in the sample group for random sampling survey for DF determination that are no longer operating in year *y*.
Source of data to be used:	PSG survey conducted by project participant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	01/04/2013 – 31/03/2014: 37 01/04/2014 – 31/03/2015: 38 01/04/2015 – 31/03/2016: 38 01/04/2016 – 31/03/2017: 38 01/04/2017 – 31/03/2018: 38 01/04/2018 – 31/03/2019: 38 01/04/2019 – 31/03/2020: 38
Description of measurement methods and procedures to be applied:	Updated annually
QA/QC procedures to be applied:	Cross-checked with paper records.
Any comment:	Left blank on purpose

Data / Parameter:	$EC_{PSG,i,j,y}$
Data unit:	MWh/yr
Description:	Annual electricity consumption of energy efficient air conditioner *i* in the household *j* in PSG during the monitoring year *y*

Source of data to be used:	PSG survey conducted by project participant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	01/04/2013 – 31/03/2014: 51,413,651 01/04/2014 – 31/03/2015: 130,511,575 01/04/2015 – 31/03/2016: 328,256,384 01/04/2016 – 31/03/2017: 723,746,004 01/04/2017 – 31/03/2018: 1,514,725,244 01/04/2018 – 31/03/2019: 2,701,194,103 01/04/2019 – 31/03/2020: 4,678,642,202
Description of measurement methods and procedures to be applied:	Electricity meter and recording device installed at selected household in PSG. Metered continuously, recorded monthly, reported annually.
QA/QC procedures to be applied:	Meter calibration is conducted as per manufacturer's specification. Cross-checked with paper records.
Any comment:	Left blank on purpose

Data / Parameter:	$P_{PSG,i,j,y}$
Data unit:	kW
Description:	Power rating of the energy efficient air conditioner *i* in household *j* in PSG during the monitoring year *y*
Source of data to be used:	PSG survey conducted by project participant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	as per PSG survey conducted by project participant
Description of measurement methods and procedures to be applied:	PSG survey conducted and reported annually.
QA/QC procedures to be applied:	PSG survey result is cross checked with catalogue values provided by the air conditioner producer.
Any comment:	The rated cooling capacity of the energy efficient air conditioners installed under the project activity at each household is not significantly smaller (maximum -10%) or significantly larger (maximum +50%) than the baseline air conditioner.

Data / Parameter:	$\eta_{ac,BL}$
Data unit:	-
Description:	Efficiency of the air conditioner available in the market that is the most economically attractive identified though investment analysis.
Source of data to be used:	Official or third-party market research report or a market analysis conducted by the project coordinator. Project participant selects indicator such as COP, APF, or IPLV representing air

	conditioner efficiency applicable to the project activity One of the below two sources can be used: (1) Calculated by the project participant following the industry standard testing procedures. (2) Catalogue values provided by the air conditioner producer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	10.43
Description of measurement methods and procedures to be applied:	If (1) is selected as the data source, the industrial standard testing procedures is followed to derive the selected indicator. Once at the start of each crediting period.
QA/QC procedures to be applied:	The compliance with the industrial standard testing procedures is validated by the DOE at the time of verification.
Any comment:	Left blank on purpose

Data / Parameter:	$\eta_{ac,PJ}$
Data unit:	-
Description:	Efficiency of the energy efficient air conditioner under the project scenario
Source of data to be used:	PSG survey Project participant selects indicator such as COP, APF, or IPLV representing air conditioner efficiency applicable to the project activity One of the below two sources can be used: (1) Calculated by the project participant following the industry standard testing procedures. (2) Catalogue values provided by the air conditioner producer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	13.5718
Description of measurement methods and procedures to be applied:	If (1) is selected as the data source, the industrial standard testing procedures is followed to derive the selected indicator. Once in a crediting period.
QA/QC procedures to be applied:	The compliance with the industrial standard testing procedures is validated by the DOE at the time of verification.

Any comment:	Left blank on purpose

B.7.2. Description of the monitoring plan:

The monitoring of the project activity will be conducted in accordance with the proposed new methodology, "Methodology for introduction of energy efficient air conditioners to households".

As described in Section B.7.1, the majority of the data to be monitored will be collected through the Project sampling group (PSG) survey. The PSG survey will be carried in the following manner.

PSG Survey

2. The project sampling group survey (PSG survey) among households participating in the project activity is conducted and actual annual electricity consumption by energy efficient air conditioners are be monitored.

3. Project participants shall apply the following five steps for PSG survey:

   Step 1: Identification of the project area

   Step 2: Determination of the sample size of the survey

   Step 3: Establishment of sampling database and sampling plan

   Step 4: Implementation of the survey

4. Details of each step are explained as follows:

Step 1: Identification of the project area

The same project area identified during baseline scenario determination is used throughout the project activity.

Step 2: Determination of the sample size of the PSG survey

The minimum sample size of the survey (n) is determined by the formula[6] given previously as equation (3).

Step 3: Establishment of PSG database

A PSG data base is established in accordance with the project activity implementation plan established by the project participant and documented in the CDM-PDD.

The following information shall be included in PSG database:

(a) Project area;

[6] The formula known as Cochran formula for a finite population

(b) Total number of household participating in the project activity in the project area;

(c) A list of households included in PSG (e.g. name, address, number of people in the household);

(d) Information according to sample survey questionnaires included in Appendix B of the methodology for each household included in PSG;

(e) Number of energy efficient air conditioners installed and operating in each household included in PSG.

(f) Annual electricity consumption by each energy efficient air conditioner installed and operating at each household included in PSG.

(g) Any additional information can also be collected on need basis;

Step 4: Implementation of PSG survey

Household included in PSG survey is determined in accordance with the sampling plan. The PSG survey is carried out by using the questionnaires as given in Appendix B to this methodology by visiting selected households within the project area.

The following survey principles shall be applied for the survey:

(1) Systematic random sampling should be ensured;

(2) The starting point of sampling for survey is randomly selected;

(3) The PSG survey is conducted annually.

The overall monitoring process will be operated in the following management structure. Firstly, MOIT will set up a project committee to oversee the entire project activity which will appoint a CDM project general manager to who supervises the day-to-day project and monitoring activities. The CDM project general manager will be responsible for the activities of the technical manager and survey/database manager as well as the activities of each area coordinator who engages in the actual data collection through surveys. The technical manager is mainly responsible for installation and operation of monitoring equipment whereas the survey/database manager is responsible for setting up surveys for baseline and project sampling groups and managing the database for data collected through the surveys. Area coordinators will be appointed for each city participating in the project activity and are responsible for carrying out surveys and data collection in accordance with the instructions from survey/database manager.

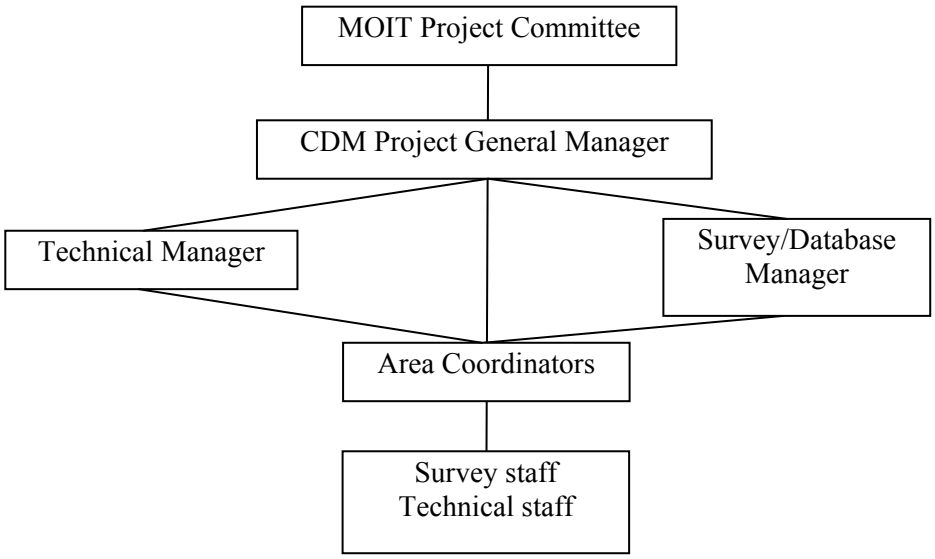

Figure 4: Project management structure

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

The current version of the PDD is completed on 21/10/2011 by:

Clean Energy Finance Committee
Mitsubishi UFJ Morgan Stanley Securities Co., Ltd.
Tokyo, Japan

Phone: +81 3 6213 6815
Fax: +81 3 6213 6175
E-mail: watanabe-hajime@sc.mufg.jp

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

01/04/2013

C.1.2. Expected operational lifetime of the project activity:

14 years, 0 months

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

01/04/2013

C.2.1.2. Length of the first crediting period:

7 years, 0 months

C.2.2. Fixed crediting period:

N/A

C.2.2.1. Starting date:

Left blank on purpose

C.2.2.2. Length:

Left blank on purpose

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

E.2. Summary of the comments received:

>>

E.3. Report on how due account was taken of any comments received:

>>

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Ministry of Industry and Trade of Viet Nam (MOIT)
Street/P.O.Box:	54 Hai Ba Trung
Building:	Hoan Kiem
City:	Hanoi
State/Region:	
Postcode/ZIP:	
Country:	Viet Nam
Telephone:	+84-4-22202222
FAX:	84-4-22202525
E-Mail:	bbt@moit.gov.vn
URL:	
Represented by:	
Title:	
Salutation:	
Last name:	
Middle name:	
First name:	
Department:	
Mobile:	-
Direct FAX:	-
Direct tel:	-
Personal e-mail:	-

Organization:	Mitsubishi UFJ Morgan Stanley Securities Co., Ltd.
Street/P.O.Box:	3-2-20Toyosu
Building:	Toyosu Front, 5th Floor
City:	Koto-ku
State/Region:	Tokyo
Postcode/ZIP:	135-0061
Country:	Japan
Telephone:	(+81) 3-6213-6399
FAX:	(+81) 3-6213-6175
E-Mail:	watanabe-hajime@sc.mufg.jp
URL:	http://www.sc.mufg.jp/english/e_cefc/index.html
Represented by:	Mr. Hajime Watanabe
Title:	Chairman of Clean Energy Finance Committee
Salutation:	Mr.
Last name:	Watanabe
Middle name:	-
First name:	Hajime
Department:	Clean Energy Finance Committee

Mobile:	-
Direct FAX:	-
Direct tel:	-
Personal e-mail:	-

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Although the Vietnamese government will utilize public funding to subsidize energy-efficient air conditioner purchase, the Project does not involve any public funding from an Annex I country, including ODA.

Annex 3:

BASELINE INFORMATION

ANNEX 3.1

Market Survey: The line-up of similar air conditioners

	Make	Model	Cooling Capacity (Btu)	Price (VND)	VND/Btu	EER (BTU/h/w)
1	Samsung	AS12UU	12000	5,490,000	458	10.43
2	Samsung	AS12TU	12000	5,990,000	499	10.84
3	Electroiux	ESM12CRA	12000	6,290,000	524	n/a
4	Sharp	AHA12MEW	12000	6,590,000	549	10.67
5	LG	JC12T1	12000	6,690,000	558	9.5
6	Sanyo	K12AG	12000	6,990,000	583	n/a
7	Midea	MSB12HR	12000	7,090,000	591	8.2
8	LG	F12CE	12000	7,190,000	599	10.5
9	Samsung	AQ12TS	12000	7,290,000	608	9.52
10	Mitsubishi	MSGC13VD	12624	7,690,000	609	9.78
11	LG	JH12T1	12000	7,490,000	624	9.60
12	Electroiux	ESM12HRA	12000	7,590,000	633	n/a
13	Sanyo	K12AGS	12000	7,790,000	649	n/a
14	Sanyo	K12AGH	12000	7,890,000	658	9.58
15	Daikin	FTE335FV1	12000	7,990,000	666	3.1
16	Panasonic	KC12MKH-8	12000	7,990,000	666	10
17	Midea	MSI12CR	12000	7,990,000	666	8.2
18	Sanyo	K12AGHS	12000	8,190,000	683	n/a
19	Samsung	ASV13PS	13000	8,990,000	692	13.7
20	Sharp	AHAP12LMW	12000	8,690,000	724	10.67
21	Sharp	AHAP12MMW	12000	8,890,000	741	10.67
22	Sharp	AHX12MEW	12000	8,990,000	749	11.25
23	LG	V13CP	13000	9,990,000	768	10.5
24	Mitsubishi	MSHA13VD	12450	9,590,000	770	n/a
25	Sharp	AYAP12LW	12000	9,590,000	799	10.95
26	Fujitsu	ASAA12J	12000	9,590,000	799	n/a
27	Sharp	AHXP13LW	13000	10,490,000	807	12.51
28	Daikin	FT35GV1G	12000	9,690,000	808	10.57
29	Toshiba	12SKPX	12000	10,390,000	866	9
30	Toshiba	13SKDX	13000	11,390,000	876	9.31
31	Panasonic	S13MKH-8	12500	11,490,000	919	12.4
32	Mitsubishi	MYSGC13VA	10900	10,690,000	981	9.79
33	Daikin	TKE35GV1	10900	10,790,000	990	11.42
34	Toshiba	13SKCV	13000	12,890,000	992	n/a
35	Daikin	FTKS35EVMA	12000	11,990,000	999	11.70
36	Toshiba	13SKHP	13000	12,990,000	999	9.00
37	Daikin	FTXD35DVMA	11900	11,990,000	1,008	10.57
38	Mitsubishi	MSZGC13VA	12500	12,990,000	1,039	10.38

*Source: http://www.pico.com.vn/ProductList.aspx?CategoryId=73&Filter=:383:

*Price as of 12 September 2011

*Energy efficiency expressed in COP has been converted into EER (EER=3.41 * COP)

ANNEX 3.2

Ratio of low cost/must run sources

Year	2004	2005	2006	2007	2008	**5 year average**
Hydro power (MWh)	17,858,651	16,365,438	19,508,244	22,358,232	25,933,762	**102,051,327**
Total grid generation (MWh)	44,974,169	50,330,468	57,160,493	66,348,589	74,689,636	**293,503,355**
Low cost/ must run ratio	39.71%	32.52%	34.13%	33.74%	34.72%	**34.77%**

Annex 4

MONITORING INFORMATION

Sample format for the survey questionnaire for Project Sample Group (PSG)

PSG Survey:

Objective: A survey would be conducted to establish project and baseline emissions. The households included in this group participate in the project activity.

Procedure:

(a) Population:

(b) Sampling frame: Existing list of household participating in the project activity

(c) Sampling Unit: Households installed energy efficient air conditioner under the project activity

(d) Determine Sample Size: The Sample size is determined using Cochran formula for categorical and dichotomous variables in case of finite population

(e) Sampling Plan: Systematic sampling involves the selection of elements from an ordered sampling frame and adopts equal-probability method, in which every k^{th} element in the frame is selected, where *k*, the sampling interval is calculated as:

Sampling interval *k* = population size (*N*) /sample size (*n*)

(f) Select the sample: Carry out office and fieldwork necessary for the selection of the sample.

Household Profile							
Date of survey					**Respondent Number:**		
Project Area Number:					**Project air conditioner ID number:**		
Name:					**Gender:**	Male	Female
Address:					**Age:**		
					Telephone number:		
Household size:		Adults:		Children:			
Household type:		Single	Nuclear	Joint	Extended		
Note: This information is only used to grasp demographic patterns and will not be directly used for analysis of project emissions.							

- - - - -

Appendix A: Project Implementation Plan

The project implementation plan is carried out according to the following procedure.

Step 1: Conduct investment analysis of the market to determine baseline scenario

Investment analysis of the market in accordance with the applied methodology is conducted prior to the start of the project activity within a reasonable timeframe.

Step 2: Announcement

Ministry of Trade and Industry of Viet Nam makes an announcement of the start of the subsidy project to purchase energy efficient air conditioners. The following information is to be provided in the announcement.

(1) Application procedure

(2) Eligibility

(3) Selection procedure

(4) Requirements for households to participate in the Project

Step 3: Application

Households wishing to participate in the Project submit applications to Ministry of Trade and Industry of Viet Nam in accordance with the procedure set forth in the announcement

Step 4: Selection

Based on the applications received, Ministry of Trade and Industry of Viet Nam checks eligibility of the households that have submitted applications and select households to take part in the Project in accordance with the selection procedure set forth in the announcement.

Step 5: Designation of project areas and coordinators

Ministry of Trade and Industry of Viet Nam designates project areas and groups selected households into specific project areas. Area coordinators will also be appointed for each project area.

Step 6: Installation of energy efficient air conditioners

In accordance with the procedure set forth by Ministry of Trade and Industry of Viet Nam, energy efficient air conditioners are installed in each participating household.

Step 7: Setting up the project database

Information collected through Step 1 through Step 6 is entered into the database.

Step 8: Project start

Energy efficient air conditioners start operating in participating households.

Step 9: Monitoring

Monitoring is conducted in accordance with applied monitoring methodology and monitoring plan described in Section B.7. Monitored data are entered into the project database.

Appendix B:

Air Conditioner Use				
Number of energy-efficient air conditioner units currently installed:				
	Power rating (kW)	Capacity	Energy efficiency rating (COP, APF, IPLV, etc.)*1	Electricity consumption (kWh/year)
Unit 1				
Unit 2				
Unit 3				
Surveyd By:			Date:	
*1: COP: Coefficient of Performance, APF: Annual Performance Factor, IPLV: Integrated part-load Value				