CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAM ACTIVITY DESIGN DOCUMENT FORM (CDM-SSC-CPA-DD)
Version 01

CONTENTS

Annexes

NOTE:

(i) This form is for submission of CPAs that apply a small scale approved methodology using the provision of the proposed small scale CDM PoA.

(ii) The coordinating/managing entity shall prepare a CDM Small Scale Programme Activity Design Document (CDM-SSC-CPA-DD)[1,2] that is specified to the proposed PoA by using the provisions stated in the SSC PoA DD. At the time of requesting registration the SSC PoA DD must be accompanied by a CDM-SSC CPA-DD form that has been specified for the proposed SSC PoA, as well as by one completed CDM-SSC CPA-DD (using a real case). After the first CPA, every CPA that is added over time to the SSC PoA must submit a completed CDM-SSC CPA-DD.

1 The latest version of the template form CDM-CPA-DD is available on the UNFCCC CDM web site in the reference/document section.

2 At the time of requesting validation/registration, the coordinating managing entity is required to submit a completed CDM-POA-DD, the PoA specific CDM-CPA-DD, as well as one of such CDM-CPA-DD completed (using a real case).

SECTION A. General description of small scale CDM programme activity (CPA)

A.1. Title of the small-scale CPA:

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Electrification project using biomass in NaVen, Xayabury, Lao People's Democratic Republic Ver1.0, 31/03/2008

A.2. Description of the small-scale CPA:

>>

This project, which adopts Na Ven village in Xayabury prefecture as a model, is a project for regional electrification that entails utilizing agricultural waste and other biomass and energy crops such as jatropha (tung) as the energy sources for diesel generators.

Lao People's Democratic Republic (Laos) is currently classed as a least developed country, and the government has made it a top priority to “break away from least developed country status by 2020” in its efforts to eradicate poverty. However, the domestic electrification rate is 47%, and the electrification rate is especially low in rural areas. To contribute to the government target of eradicating poverty, the Ministry of Energy and Mining, which is in charge of regional electrification, currently aims to increase the electrification rate from 47% to 70% by 2010 and 90% by 2020. However, since Laos comprises a lot of small communities dispersed over a wide area, it is difficult to promote electrification through extending the existing electricity infrastructure. Accordingly, it is important to promote off-grid electrification using diesel generators.

Laos is not an oil producing country and it must import all the fuel it uses in diesel generators, however, due to the recent inflation in oil prices and slow development of transportation infrastructure in the country, inflation of fuel prices is pressurizing lifestyles especially in rural areas. For this reason, utilization of oil substitute energy is an important issue and regional electrification based on utilization of renewable energies such as biomass can make a major contribution towards sustainable development in Laos.

This project will be implemented as an individual undertaking (CPA) of the Biomass Electrification Promotion Plan in Laos that is being implemented by the Ministry of Energy and Mining.

The project proposes to jointly combust biogas and bio-diesel with conventional light oil in diesel engine generators that are expected will be newly introduced from now on in line with the electrification policy of the Government of Laos. Through doing this, it will be possible to reduce emissions of greenhouse gases resulting from future predicted power generation and to contribute to promotion of electrification in the country’s non-electrified areas.

Moreover, as a result of the creation of jatropha farms, new jobs will be created and agricultural technology established, and technology for the operation of engines using biogas and bio-diesel fuel will be transferred , thereby contributing to clean development in Laos.

A.3. Entity/individual responsible for the small-scale CPA:

>>

The party responsible for this CPA is the Laos Ministry of Energy and Mining.
Moreover, the Ministry of Energy and Mining is the implementing party for the PoA included in the project.

A.4. Technical description of the small-scale CPA:

A.4.1. Identification of the small-scale CPA:

A.4.1.1. Host Party:

>>

Lao People's Democratic Republic

A.4.1.2. Geographic reference or other means of identification allowing the unique identification of the small-scale CPA (maximum one page):

>>

Na Ven village, Xayabury prefecture (see Fig.1)

A.4.2. Duration of the small-scale CPA:

A.4.2.1. Starting date of the small-scale CPA:

>>

01/01/2009

A.4.2.2. Expected operational lifetime of the small-scale CPA:

>>

15 years

Figure1. Project site map

A.4.3. Choice of the crediting period and related information:

Renewable crediting period

A.4.3.1. Starting date of the crediting period:

>>

01/01/2010

A.4.3.2. Length of the crediting period, first crediting period if the choice is renewable CP:

>>

7 years

The effective period of the PoA is until 2029 and, even if 7 years is added to the CPA, the CPA credit period will fit into the effective period of the PoA.

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

>>

10,010t-CO_2 (14years)

A.4.5. Public funding of the CPA:

>>

The manager of the Programme of Activities is the Ministry of Energy and Mining, and public funding in Laos will be provided for the management conducted by the manager, however, no public funding will be diverted for the CPA.

A.4.6. Information to confirm that the proposed small-scale CPA is not a de-bundled component

>>

This project (CPA) is the first undertaking to be implemented based on the PoA.
Moreover, no projects exist that correspond to the following conditions indicated in this methodology.

1. For the purposes of registration of a Programme of Activities (PoA)[3] a proposed small-scale CPA of a PoA shall be deemed to be a de-bundled component of a large scale activity if there is already an activity[4], which:

   (a) Has the same activity implementer as the proposed small scale CPA or has a coordinating or

3 Only those POAs need to be considered in determining de-bundling that are: (i) in the same geographical area; and (ii) use the same methodology; as the POA to which proposed CPA is being added

4 Which may be a (i) registered small-scale CPA of a PoA, (ii) an application to register another small-scale CPA of a PoA or (iii) another registered CDM project activity

managing entity, which also manages a large scale PoA of the same sectoral scope; and

(b) The boundary is within 1 km of the boundary of the proposed small-scale CPA, at the closest point.

2. If a proposed small-scale CPA of a PoA is deemed to be a de-bundled component in accordance with paragraph 2 above, but the total size of such a CPA combined with a registered small-scale CPA of a PoA or a registered CDM project activity does not exceed the limits for small-scale CDM and small-scale A/R project activities as set out in Annex II of the decision 4/CMP.1 and 5/CMP.1 respectively, the CPA of a PoA can qualify to use simplified modalities and procedures for small-scale CDM and small-scale A/R CDM project activities.

A.4.7. Confirmation that small-scale CPA is neither registered as an individual CDM project activity or is part of another Registered PoA:

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It is demonstrated that the project (CPA) is not registered as a CDM project or part of another PoA by the DNA in Laos.

SECTION B. Eligibility of small-scale CPA and Estimation of emissions reductions

B.1. Title and reference of the Registered PoA to which small-scale CPA is added:

>>

Project for the Promotion of Electrification using Biomass in Laos

B.2. Justification of the why the small-scale CPA is eligible to be included in the Registered PoA:

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The project completely fits with the standard CPA (A4.2) described in the PoA. (The CPA entails power generation using biomass energy (bio-diesel or biogas) and the supply of electricity to households in non-electrified communities. It does not entail connection to the existing power grid. Since the equipment to be newly introduced comprises only new power generating equipment with small capacity (15 MW or less), the CPA satisfies the applicable conditions (Technology / measures) for AMS-I.A.PoA).

B.3. Assessment and demonstration of additionality of the small-scale CPA, as per eligibility criteria listed in the Registered PoA:

>>

The baseline methodology shall use the following approved methodology based on the PoA.

Small-scale methodology AMS-I.A. 'Electricity generation by the user' Version 12
http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_VECB8EZJV6NSM13KPOVCDLO9PBR4OY

The project entails power generation using biomass energy (bio-diesel or biogas) and the supply of

electricity to households in non-electrified communities. It does not entail connection to the existing power grid. Moreover, since the equipment to be newly introduced comprises only new power generating equipment with small capacity (15 MW or less), and the CPA satisfies the applicable conditions (Technology / measures) for AMS-I.A, this methodology can be applied.

The following may be considered as candidate baseline scenarios:

Scenario 1: Maintenance of the status quo (non-electrification)
Scenario 2: Introduction of conventional diesel generators
Scenario 3: Introduction of renewable energy generators

<Concerning Scenario 1>

Laos aims to achieve 90% electrification by 2020 and, although the timing is not definite, it is considered that the non-electrification situation as inferred in Scenario 1 will not be sustained.

<Concerning Scenario 3>

According to the electrification plans, off-grid electrification utilizing renewable energy and diesel generators is being promoted, however, renewable energy generation is currently not being carried out due to technical and funding reasons. Accordingly, since diesel generators are currently being used, it is forecast that such conventional generators will continue to be introduced in the future.

Accordingly, Scenario 2, i.e. introduction of conventional diesel generators, is set as the baseline scenario.

Additionality in the project is demonstrated as follows based on the key criteria indicated in PoA section E5.2.

1. The project is an undertaking for electrification of non-electrified areas in Laos.
   The project target site of Na Ven village is an off-grid village in a non-electrified area.

2. The technology cannot be disseminated by the Laos side unaided.
   Laos is hoping to disseminate biomass energy, however, in reality it cannot realize this due to technical and financial constraints. The technology proposed for introduction in this model project is state of the art technology that has undergone empirical experimentation in Japan, however, so far it has not been tried in Laos. Accordingly, the technology cannot be disseminated unaided by the Laos side and is thus additional.

3. It is clear that GHG emissions will be reduced.
   In the model project (Na Ven village) boundary, five diesel engines of 5 kW output operate for around 4 hours per day. As the policy of electrification in Laos progresses, demand for electricity will increase and diesel engines of similar specifications will be added; consequently, it is estimated that annual emissions during the project period will reach approximately 715 tCO_2 on average. This CPA technology is capable of reducing emissions by approximately 85% through replacing fossil fuels used in diesel engines with biogas and bio-diesel. The reduction in emissions from an

individual project would be small, however, since the technology will be disseminated as a programme, a large greenhouse gases reduction effect can be anticipated.

4. Project economy is too small to allow unaided dissemination by Laos
   Calculation of the model project profitability as Project IRR results in Project IRR of just 8.1% in the case where credit revenue is not taken into account. Accordingly, there is little possibility that the project can be independently implemented in Laos, and implementation as a CPA can be said to be additional.

In consideration of the above, the additionality of the project has been demonstrated.

B.4. Description of the sources and gases included in the project boundary and proof that the small-scale CPA is located within the geographical boundary of the registered PoA.

>>

According to AMS-I.A, the project boundary includes the physical and geographical locations of renewable energy generation facilities as well as the equipment that uses the generated electricity.
Figure 2 and Table 1 illustrate the generation sources and gases included in the project boundary. Moreover, the geographical boundary of the PoA covers the whole of Laos including of course Na Ven village.

Table 1 Generation Sources and Gases Included in the Project Boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Emissions from power consumption	CO_2	Yes	Because, if the CDM project is not implemented, it is predicted that diesel generators will be introduced.
Project Activity	Emissions from onsite power consumption	CO_2	No	Because power consumption arising in line with operation of the bio-diesel refining equipment and gasification plant is negligible.
	Emissions from transportation of biomass	CO_2	No	Because biomass will be transported by manual labour without using trucks, etc.

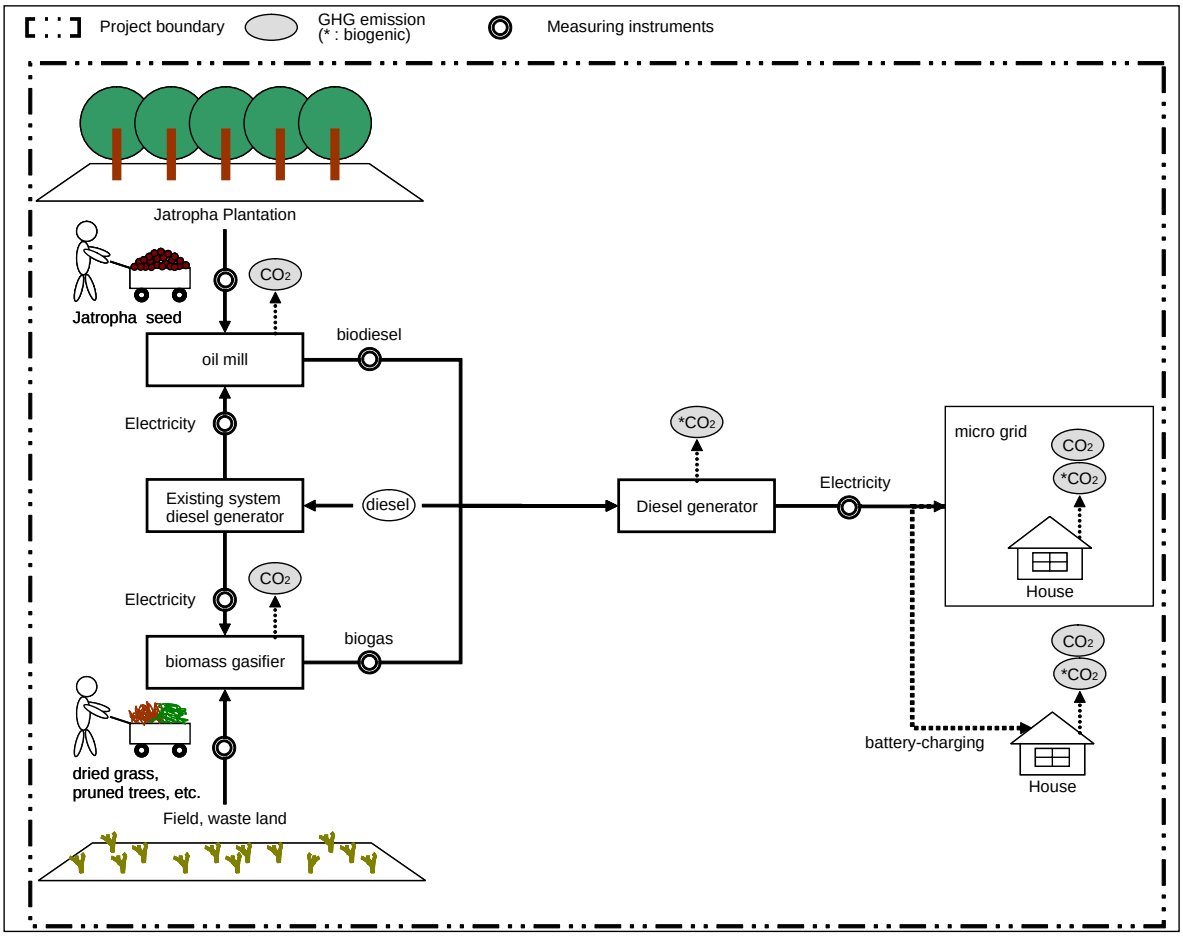

Figure 2 Project boundary

B.5. Emission reductions:

B.5.1. Data and parameters that are available at validation:

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The data and parameters that can be used for validation are as follows.

Data / Parameter:	**O_{all}**
Data unit:	MWh/y
Description:	Generated energy
Source of data to be used:	Measured on site
Value of data applied for the purpose of calculating expected emission reductions	211.992~464.198~
Description of measurement methods and procedures to be applied:	Measured continuously by wattmeter and aggregated at least once per year
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	---

Data / Parameter:	**SFC_i**
Data unit:	m^3 or l/MWh
Description:	Consumption rate by type of fuel
Source of data used:	Measure in advance
Value applied:	---
Justification of the choice of data or description of measurement methods and procedures actually applied :	Light oil 15% Bio-diesel (jatropha oil) 15% Biogas 70%
Any comment:	The value calculated from the amount of fuel consumption and the fuel consumption rate is required for comparison with the generated energy monitored during the project activities. The lower value is used in calculation of the emission reductions.

Data / Parameter:	l
Data unit:	---
Description:	Mean transmission and distribution loss factor
Source of data used:	Data received from the host country government
Value applied:	0.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since electric energy is measured near the receiving side, it is thought that the transmission and distribution loss is taken into account.
Any comment:	This is needed for correction when calculating the amount of fuel consumption from the generated energy.

Data / Parameter:	EC_y
Data unit:	MWh
Description:	Project power consumption
Source of data to be used:	Measured onsite
Value of data applied for the purpose of calculating expected emission reductions	0 (small enough to be ignored)
Description of measurement methods and procedures to be applied:	Measured continuously by wattmeter and aggregated at least once per year
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	---

B.5.2. Ex-ante calculation of emission reductions:

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Advance calculations of emission reductions were implemented as follows.

Annual energy Baseline (fuel consumption)

For calculation of the baseline fuel consumption, AMS-I.A. Option 2 is selected and the following equation is used.

$E_B = \Sigma_i O_i / (1 - l)$

E_B	MWh/y	Annual energy baseline
O_i	MWh/y	Annual generated energy based on the introduced renewable energy technology *i*
L	-	Average distribution loss factor measured in the diesel mini grid introduced under public works or the power distribution company in the independent area

Moreover, O_i is obtained from the biomass contribution (fuel consumption rate) SFC_i in the annual generated energy (O_{all}).

$O_i = O_{all} \times \Sigma_i SFC_i$

O_{all}	MWh/y	Annual total generated energy
SFC_i	%	Contribution (fuel consumption rate) of the used biomass fuel *i* in the total generated energy

Baseline emissions

The following equation is used to calculate baseline emissions:

$BE_y = E_B \times EF_{diesel}$

BE_y	tCO_2/y	Baseline emissions
EF_{diesel}	tCO_2/MWh	Fuel emission coefficient (default value 2.4: ID)

Project emissions

The following equation is used to calculate project emissions:

$PE_y = EC_y \times EF_{diesel}$

PE_y	tCO_2/y	Project activity emissions
EC_y	MWh/y	Project power consumption
EF_{diesel}	tCO_2/MWh	Fuel emission coefficient (default value 2.4: ID)

Leakage

Since the project entails construction of new facilities on the project site but no transfer of equipment, no leakage will be generated.

Emission reductions

The following equation is used to calculate emission reductions:

$ER_y = BE_y - PE_y$

ER_y	tCO_2/y	emission reductions

Data and parameters

The fixed values and parameters not monitored in the project are as follows.

Data / Parameter:	**SFC_i**
Data unit:	m^3 or l/MWh
Description:	Consumption rate by type of fuel
Source of data used:	Measure in advance
Value applied:	---
Justification of the choice of data or description of measurement methods and procedures actually applied :	Light oil 15% Bio-diesel (jatropha oil) 15% Biogas 70%
Any comment:	The value calculated from the amount of fuel consumption and the fuel consumption rate is required for comparison with the generated energy monitored during the project activities. The lower value is used in calculation of the emission reductions.

Data / Parameter:	**l**
Data unit:	---
Description:	Mean transmission and distribution loss factor
Source of data used:	Data received from the host country government
Value applied:	0.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since electric energy is measured near the receiving side, it is thought that the transmission and distribution loss is taken into account.
Any comment:	This is needed for correction when calculating the amount of fuel consumption from the generated energy.

B.5.3. Summary of the ex-ante estimation of emission reductions:

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The following table shows the summary of ex-ante calculation of emission reductions.

Year	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2 e)
2010	509	76	0	432
2011	546	82	0	464
2012	679	102	0	577
2013	717	108	0	610
2014	755	113	0	642
2015	794	119	0	675
2016	832	125	0	708
2017	872	131	0	741
2018	911	137	0	775
2019	951	143	0	808
2020	991	149	0	843
2021	1032	155	0	877
2022	1073	161	0	912
2023	1114	167	0	947
Total (tonnes of CO_2 e)	11776	1766	0	10010

B.6. Application of the monitoring methodology and description of the monitoring plan:

B.6.1. Description of the monitoring plan:

>>

The monitoring plan in the representative model project is as illustrated in Figure 3 and below.

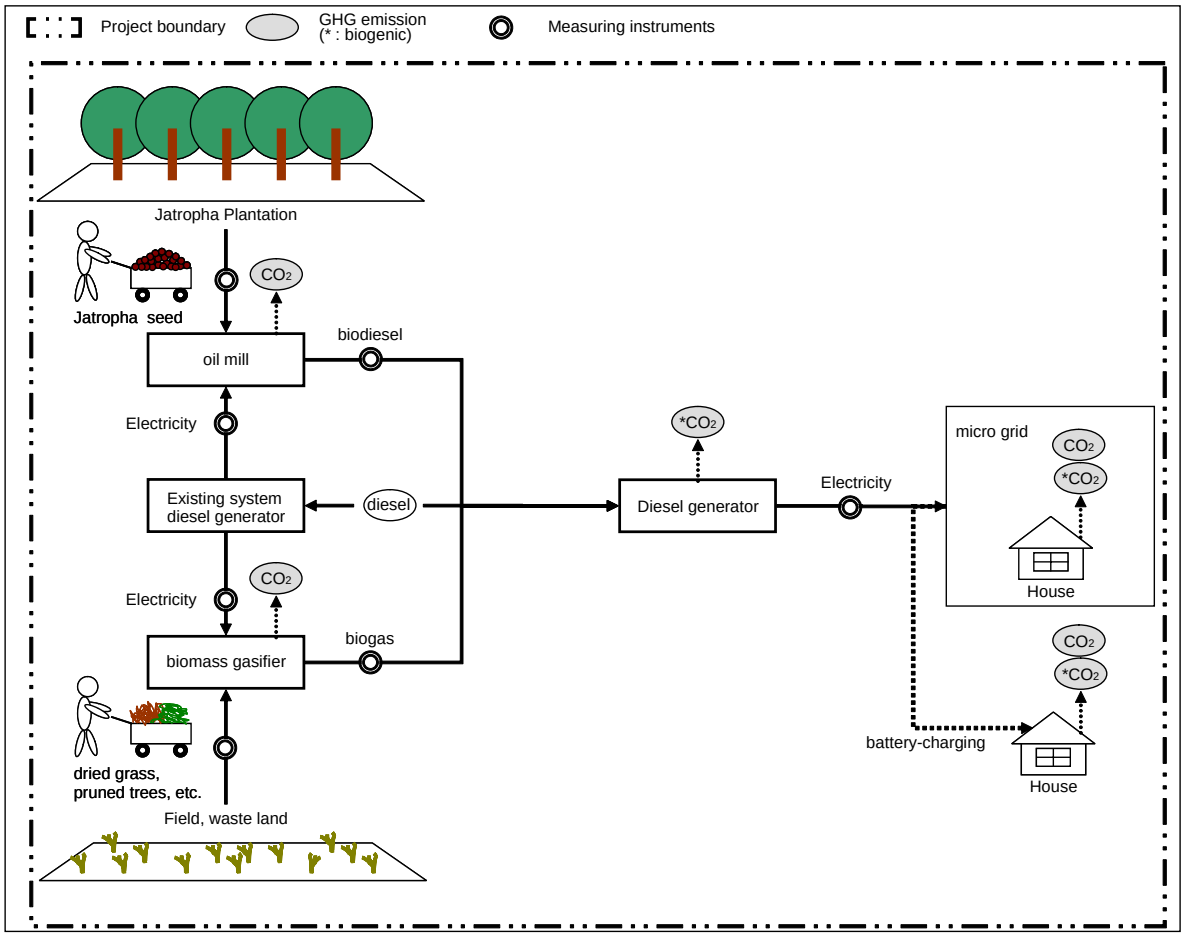

Figure 3 Monitoring plan

The items that will be monitored in the project are as follows.

Data / Parameter:	**O_{all}**
Data unit:	MWh/y
Description:	Generated energy
Source of data to be used:	Measured on site
Value of data applied for the purpose of calculating expected emission reductions	211.992~464.198~
Description of measurement methods and procedures to be applied:	Measured continuously by wattmeter and aggregated at least once per year
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	---

Data / Parameter:	**EC_y**
Data unit:	MWh
Description:	Project power consumption
Source of data to be used:	Measured onsite
Value of data applied for the purpose of calculating expected emission reductions	0 (small enough to be ignored)
Description of measurement methods and procedures to be applied:	Measured continuously by wattmeter and aggregated at least once per year
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	---

Data / Parameter:	FC_i
Data unit:	m^3 or l
Description:	Amount of biomass fuel consumption
Source of data to be used:	Measured onsite
Value of data applied for the purpose of calculating expected emission reductions	Amount of jatropha oil: 15.0~25.6 (m^3/y) *Light oil substitution rate 15% Amount of biogas: 377.6~643.8 (1,000m^3/y) *Light oil substitution rate 70%
Description of measurement methods and procedures to be applied:	The operator records the amount of fuel replenishment.
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	The value calculated from the amount of fuel consumption and the fuel consumption rate is required for comparison with the generated energy monitored during the project activities. The lower value is used in calculation of the emission reductions.

Data / Parameter:	MC_i
Data unit:	t
Description:	Amount of biomass fuel raw materials consumption
Source of data to be used:	Measured onsite
Value of data applied for the purpose of calculating expected emission reductions	---
Description of measurement methods and procedures to be applied:	Measure and record using scales
QA/QC procedures to be applied:	Instruments are periodically tested in order to secure accuracy.
Any comment:	The value calculated from the amount of fuel consumption and the fuel consumption rate is required for comparison with the generated energy monitored during the project activities. The lower value is used in calculation of the emission reductions.

In the project, quality control and quality assurance shall be carried out by the following methods.

- ○ The project implementing organization will consist of operating personnel and management.
- ○ Management will prepare written procedures for operating facilities.
- ○ Written procedures, containing daily work contents, periodic maintenance methods and judgment criteria, etc., will be compiled according to appropriate formats.
- ○ Management will check reports from operating personnel and determine there are no problems according to the procedures. If problems are found in such checks, management will implement the appropriate countermeasures with appropriate timing.
- ○ Management will everyday file and store reports from operating personnel according to the procedures.
- ○ In the event of accidents (including the unforeseen release of GHG), management will ascertain the causes, implement and instruct countermeasures to the operating personnel.
- ○ In cases of emergency (including the unforeseen release of GHG), operating personnel will take stopgap measures and implement countermeasures according to instructions from management.
- ○ Measuring instruments will be periodically and appropriately calibrated according to the procedures. Calibration timing and methods will be in accordance with “the monitoring plan”.
- ○ Measured data will be disclosed and open to public comment. Received comments and the steps taken in response to them will also be disclosed.
- ○ Measured data will also be subject to audit by government agencies in the host country.

SECTION C. Environmental Analysis

C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

☐レ Please tick if this information is provided at the PoA level. In this case, sections C.2. and C.3. need not be completed in this form.

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

C.3. Please state whether an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA), in accordance with the host Party laws/regulations:

>>

SECTION D. Stakeholders' comments

D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

☐ Please tick if this information is provided at the PoA level. In this case, sections D.2. to D.4. need not be completed in this form.

D.2. Brief description how comments by local stakeholders have been invited and compiled:

>>

Upon checking with the Water Resource and Environment Agency (WREA), which is the DNA in Laos, comments were collected from stakeholders through conducting direct interviews.

D.3. Summary of the comments received:

>>

The stakeholders in the pilot project are the citizens of Na Ven village, Phiang district which administers the village, and the Xayabury branch of the Ministry of Energy and Mining Electric Power Bureau.

① Phiang district

We agree with this project and wish to give the support necessary for its realization because electrification of rural villages is an important measure for the eradication of poverty.

② Na Ven village (interview with the deputy mayor)

We strongly wish for realization of the project. We anticipate that electrification will contribute to greater economic capability in the village.

③ Ministry of Energy and Mining, Xayabury Branch
Promotion of electrification in non-electrified areas conforms to the policies of the Ministry of Energy and Industry and this branch office. Since we support the study geared to realization of the project, we want to see it actualized.

D.4. Report on how due account was taken of any comments received:

>>

Since all the comments from the stakeholders are supportive of the project, there are no plans to take any particular actions regarding the comments for the foreseeable future.

Annex 1

CONTACT INFORMATION ON ENTITY/INDIVIDUAL RESPONSIBLE FOR THE SMALL-SCALE CPA

Project Participant 1

Organization:	The Chugoku Electric Power Co., Inc.
Street/P.O.Box:	4-33 Komachi, Naka-ku
Building:	-
City:	Hiroshima-shi
State/Region:	Hiroshima
Postfix/ZIP:	730-8701
Country:	Japan
Telephone:	+81-82-241-0211
FAX:	-
E-Mail:	-
URL:	http://www.energia.co.jp/energiae/index.html http://www.energia.co.jp/
Represented by:	-
Title:	Manager
Salutation:	Mr.
Last Name:	Takeyama
Middle Name:	-
First Name:	Takayoshi
Department:	Group Management Division
Mobile:	-
Direct FAX:	+81-82-523-6422
Direct tel:	+81-82-523-6424
Personal E-Mail:	451268@pnet.energia.co.jp

Project Participant 2

Organization:	Shimizu Corporation
Street/P.O.Box:	1-2-3, Shibaura
Building:	SEAVANS SOUTH
City:	Minato-ku
State/Region:	Tokyo
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Country:	Japan
Telephone:	81-3-5441-1111 03-5441-1111
FAX:	-
E-Mail:	-
URL:	http://www.shimz.co.jp/english/index.html http://www.shimz.co.jp/
Represented by:	-
Title:	General Manager
Salutation:	Mr.
Last Name:	Kurita
Middle Name:	-
First Name:	Hiroyuki
Department:	GHG Project Department
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Direct FAX:	+81-3-5441-0469 03-5441-0469
Direct tel:	+81-3-5441-0137 03-5441-0137
Personal E-Mail:	kurita@shimz.co.jp

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The Laos Ministry of Energy and Mining will be the manager of this program activity. Although public funds in Laos will be introduced for management conducted by the manager, no public funds will be made available for the CPA.

Annex 3

BASELINE INFORMATION

Electricity demand estimate

The amount of energy generated by diesel engines in this non-electrified area is adjusted according to the amount of power demand (consumption). Accordingly, the future demand for electricity in Na Ven village was estimated assuming the case where electrification policy in Laos is further advanced. This village currently has a population of 3,413 living in 577 households. It was assumed that the number of households increases at a rate of 2.5% (based on past results) and that the number of refrigerators (80L/60kW), which are the most rapidly spreading electrical appliance at this time, increases by 10 units in the initial phase and after that by around 20 units per year.

Moreover, since there are plans from 2012 to operate electric pumps for irrigation water, which is currently pumped by manual labour, electricity consumption in these is also taken into account.

Furthermore, overall power consumption was obtained upon dividing each day into four segments (0~6, 6~12, 12~18, 18~24) and totalling the usage of each electrical appliance.

Table A3-1 Estimated Electricity Demand in Na Ven Village

Year	House holds	Time	Base Power Consumption (kW)	Refrigerators		Pumps (22 kW)		Total Power Consumption (kW)		Annual Power Consumption (kWh)	
				Units	kW	Nov - Mar	Apr - Oct	Nov - Mar	Apr - Oct		
2010	590	0-6	11.8	10	0.6	0.0	0.0	12.4	12.4	27,156	211,992
		6-12	11.8		0.6	0.0	0.0	12.4	12.4	27,156	
		12-18	11.8		0.6	0.0	0.0	12.4	12.4	27,156	
		18-24	59.0		0.6	0.0	0.0	59.6	59.6	130,524	
2011	604	0-6	12.1	30	1.8	0.0	0.0	13.9	13.9	30,397	227,410
		6-12	12.1		1.8	0.0	0.0	13.9	13.9	30,397	
		12-18	12.1		1.8	0.0	0.0	13.9	13.9	30,397	
		18-24	60.4		1.8	0.0	0.0	62.2	62.2	136,218	
2012	619	0-6	12.4	50	3.0	0.0	0.0	15.4	15.4	33,682	283,042
		6-12	12.4		3.0	22.0	0.0	37.4	15.4	53,614	
		12-18	12.4		3.0	22.0	0.0	37.4	15.4	53,614	
		18-24	61.9		3.0	0.0	0.0	64.9	64.9	142,131	
2013	634	0-6	12.7	70	4.2	0.0	0.0	16.9	16.9	36,967	298,810
		6-12	12.7		4.2	22.0	0.0	38.9	16.9	56,899	
		12-18	12.7		4.2	22.0	0.0	38.9	16.9	56,899	
		18-24	63.4		4.2	0.0	0.0	67.6	67.6	148,044	
2014	649	0-6	13.0	90	5.4	0.0	0.0	18.4	18.4	40,252	314,578
		6-12	13.0		5.4	22.0	0.0	40.4	18.4	60,184	
		12-18	13.0		5.4	22.0	0.0	40.4	18.4	60,184	
		18-24	64.9		5.4	0.0	0.0	70.3	70.3	153,957	
2015	665	0-6	13.3	110	6.6	0.0	0.0	19.9	19.9	43,581	330,696
		6-12	13.3		6.6	22.0	0.0	41.9	19.9	63,513	
		12-18	13.3		6.6	22.0	0.0	41.9	19.9	63,513	
		18-24	66.5		6.6	0.0	0.0	73.1	73.1	160,089	
2016	681	0-6	13.6	130	7.8	0.0	0.0	21.4	21.4	46,910	346,814
		6-12	13.6		7.8	22.0	0.0	43.4	21.4	66,842	
		12-18	13.6		7.8	22.0	0.0	43.4	21.4	66,842	
		18-24	68.1		7.8	0.0	0.0	75.9	75.9	166,221	
2017	698	0-6	14.0	150	9.0	0.0	0.0	23.0	23.0	50,282	363,283
		6-12	14.0		9.0	22.0	0.0	45.0	23.0	70,214	
		12-18	14.0		9.0	22.0	0.0	45.0	23.0	70,214	
		18-24	69.8		9.0	0.0	0.0	78.8	78.8	172,572	
2018	715	0-6	14.3	170	10.2	0.0	0.0	24.5	24.5	53,655	379,752
		6-12	14.3		10.2	22.0	0.0	46.5	24.5	73,587	
		12-18	14.3		10.2	22.0	0.0	46.5	24.5	73,587	
		18-24	71.5		10.2	0.0	0.0	81.7	81.7	178,923	
2019	732	0-6	14.6	190	11.4	0.0	0.0	26.0	26.0	57,028	396,221
		6-12	14.6		11.4	22.0	0.0	48.0	26.0	76,960	
		12-18	14.6		11.4	22.0	0.0	48.0	26.0	76,960	
		18-24	73.2		11.4	0.0	0.0	84.6	84.6	185,274	
2020	750	0-6	15.0	210	12.6	0.0	0.0	27.6	27.6	60,444	413,040
		6-12	15.0		12.6	22.0	0.0	49.6	27.6	80,376	
		12-18	15.0		12.6	22.0	0.0	49.6	27.6	80,376	
		18-24	75.0		12.6	0.0	0.0	87.6	87.6	191,844	
2021	768	0-6	15.4	230	13.8	0.0	0.0	29.2	29.2	63,860	429,859
		6-12	15.4		13.8	22.0	0.0	51.2	29.2	83,792	
		12-18	15.4		13.8	22.0	0.0	51.2	29.2	83,792	
		18-24	76.8		13.8	0.0	0.0	90.6	90.6	198,414	
2022	787	0-6	15.7	250	15.0	0.0	0.0	30.7	30.7	67,321	447,029
		6-12	15.7		15.0	22.0	0.0	52.7	30.7	87,253	
		12-18	15.7		15.0	22.0	0.0	52.7	30.7	87,253	
		18-24	78.7		15.0	0.0	0.0	93.7	93.7	205,203	
2023	806	0-6	16.1	270	16.2	0.0	0.0	32.3	32.3	70,781	464,198
		6-12	16.1		16.2	22.0	0.0	54.3	32.3	90,713	
		12-18	16.1		16.2	22.0	0.0	54.3	32.3	90,713	
		18-24	80.6		16.2	0.0	0.0	96.8	96.8	211,992	

Estimated Fuel Consumption by Type of Fuel

The project entails mixed combustion of light oil, bio-diesel and biogas, and the proportions of each fuel type in terms of calorific value are 15%, 15% and 70% respectively.

Moreover, the amount of biogas produced from chaff is set at 2 Nm^3/kg. Moreover, the engine load factor is varied according to the amount of energy consumption (this requires confirmation).

Based on the above settings, the estimated fuel consumption for each fuel type is as shown in Table A3-2.

Table A3-2 Estimate of Future Fuel Consumption

Year	Time	Fuel Consumption						Annual fuel consumption		
		Light oil (m^3)		Jatropha oil (m^3)		Chaff (t)		Light oil (m^3)	Jatropha oil (m^3)	Biogas ($1,000m^3$)
		Nov - Mar	Apr - Oct	Nov - Mar	Apr - Oct	Nov - Mar	Apr - Oct			
2010	0-6	1.056	1.497	1.118	1.584	14.1	19.9	14.2	15.0	377.7
	6-12	1.056	1.497	1.118	1.584	14.1	19.9			
	12-18	1.056	1.497	1.118	1.584	14.1	19.9			
	18-24	2.702	3.829	2.859	4.052	36.0	51.0			
2011	0-6	1.103	1.563	1.167	1.654	14.7	20.8	14.8	15.6	393.2
	6-12	1.103	1.563	1.167	1.654	14.7	20.8			
	12-18	1.103	1.563	1.167	1.654	14.7	20.8			
	18-24	2.802	3.970	2.965	4.201	37.3	52.8			
2012	0-6	1.151	1.631	1.218	1.726	15.3	21.7	16.8	17.8	448.4
	6-12	1.889	1.631	1.999	1.726	25.1	21.7			
	12-18	1.889	1.631	1.999	1.726	25.1	21.7			
	18-24	2.906	4.118	3.075	4.358	38.7	54.8			
2013	0-6	1.199	1.700	1.269	1.799	16.0	22.6	17.5	18.5	464.7
	6-12	1.942	1.700	2.055	1.799	25.8	22.6			
	12-18	1.942	1.700	2.055	1.799	25.8	22.6			
	18-24	3.011	4.268	3.186	4.516	40.1	56.8			
2014	0-6	1.248	1.768	1.320	1.871	16.6	23.5	18.1	19.1	481.2
	6-12	1.995	1.768	2.111	1.871	26.6	23.5			
	12-18	1.995	1.768	2.111	1.871	26.6	23.5			
	18-24	3.118	4.418	3.299	4.675	41.5	58.8			
2015	0-6	1.297	1.839	1.373	1.946	17.3	24.5	18.7	19.8	498.2
	6-12	2.049	1.839	2.168	1.946	27.3	24.5			
	12-18	2.049	1.839	2.168	1.946	27.3	24.5			
	18-24	3.229	4.576	3.417	4.842	43.0	60.9			
2016	0-6	1.347	1.909	1.425	2.020	17.9	25.4	19.4	20.5	515.2
	6-12	2.103	1.909	2.226	2.020	28.0	25.4			
	12-18	2.103	1.909	2.226	2.020	28.0	25.4			
	18-24	3.341	4.735	3.536	5.011	44.5	63.0			
2017	0-6	1.398	1.981	1.479	2.096	18.6	26.4	20.0	21.2	532.9
	6-12	2.159	1.981	2.285	2.096	28.7	26.4			
	12-18	2.159	1.981	2.285	2.096	28.7	26.4			
	18-24	3.459	4.902	3.660	5.187	46.0	65.2			
2018	0-6	1.449	2.054	1.533	2.173	19.3	27.3	20.7	21.9	550.6
	6-12	2.215	2.054	2.343	2.173	29.5	27.3			
	12-18	2.215	2.054	2.343	2.173	29.5	27.3			
	18-24	3.577	5.070	3.786	5.365	47.6	67.5			
2019	0-6	1.500	2.126	1.588	2.250	20.0	28.3	21.4	22.6	568.5
	6-12	2.271	2.126	2.403	2.250	30.2	28.3			
	12-18	2.271	2.126	2.403	2.250	30.2	28.3			
	18-24	3.697	5.240	3.912	5.545	49.2	69.7			
2020	0-6	1.553	2.201	1.643	2.329	20.7	29.3	22.1	23.3	586.9
	6-12	2.328	2.201	2.463	2.329	31.0	29.3			
	12-18	2.328	2.201	2.463	2.329	31.0	29.3			
	18-24	3.823	5.417	4.045	5.732	50.9	72.1			
2021	0-6	1.606	2.276	1.699	2.408	21.4	30.3	22.7	24.1	605.5
	6-12	2.385	2.276	2.524	2.408	31.7	30.3			
	12-18	2.385	2.276	2.524	2.408	31.7	30.3			
	18-24	3.949	5.596	4.179	5.922	52.6	74.5			
2022	0-6	1.659	2.352	1.756	2.489	22.1	31.3	23.5	24.8	624.6
	6-12	2.444	2.352	2.586	2.489	32.5	31.3			
	12-18	2.444	2.352	2.586	2.489	32.5	31.3			
	18-24	4.081	5.783	4.318	6.120	54.3	77.0			
2023	0-6	1.714	2.429	1.813	2.570	22.8	32.3	24.2	25.6	643.9
	6-12	2.503	2.429	2.648	2.570	33.3	32.3			
	12-18	2.503	2.429	2.648	2.570	33.3	32.3			
	18-24	4.214	5.972	4.459	6.320	56.1	79.5			

Emission Reductions

Emission reductions were calculated based on the method indicated in section B5.2.

Table A3-3 Emission Reductions

			2010	2011	2012	2013	2014	2015	2016	2017
ex-ante	O_i	MWh/y	176	191	240	255	270	285	301	317
	O_{all}	MWh/y	207	225	282	300	317	336	354	372
	$\sum_i SFC_i$	%	85	85	85	85	85	85	85	85
	E B	MWh/y	176	191	240	255	270	285	301	317
	I	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BE_y	tCO_2e	423	458	575	611	647	685	722	760
	EFdiesel	tCO_2e/MWh	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
	PE_y	tCO_2e	0	0	0	0	0	0	0	0
	EFdiesel	tCO_2e/MWh	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
	ER_y	tCO_2e	423	458	575	611	647	685	722	760

			2018	2019	2020	2021	2022	2023		TOTAL
ex-ante	O_i	MWh/y	333	349	366	383	400	417		
	O_{all}	MWh/y	391	411	430	450	470	490		5,036
	$\sum_i SFC_i$	%	85	85	85	85	85	85		85
	E B	MWh/y	333	349	366	383	400	417		4,280
	I	-	0.00	0.00	0.00	0.00	0.00	0.00		0.00
	BE_y	tCO_2e	798	838	878	918	959	1,001		10,273
	EFdiesel	tCO_2e/MWh	2.4	2.4	2.4	2.4	2.4	2.4		33.60
	PE_y	tCO_2e	0	0	0	0	0	0		0
	EFdiesel	tCO_2e/MWh	2.4	2.4	2.4	2.4	2.4	2.4		33.60
	ER_y	tCO_2e	798	838	878	918	959	1,001		10,273

Financial Indicators

The results of conducting sensitivity analysis on the project IRR assuming Scenario 3 (no CER revenue) described in section B.3 demonstration of additionality are as follows.
In Scenario 3, it is assumed that a 100 kW diesel engine is introduced. Table A3-4 shows the costs and parameters used for calculating the Project IRR in Scenario 3, while Table A3-5 shows the results of Project IRR sensitivity analysis for the case where no CERs are taken into account.

Furthermore, the project implementation period including the construction period is 15 years from 2009 to 2023 (the credit period is 14 years from January 2010 to December 2023).

Table A3-4 Cost and financial parameter

Item		Unit	Value
Initial cost		US$	149,500
Running cost		US$/y	3,360
Tax: corporate profit tax, etc.		%	0
Power sale price		US$/kWh	0.15
Light oil unit price		US$/L	1.00
Jatropha oil unit price		US$/L	0.40
Biomass purchase price		US$/kg	0.004
Exchange rate	Yen⇔US$	Yen/US$	110.0

Table A3-5 Results of Sensitivity Analysis for Project IRR

No CERs

			Reference		
Initial cost	-10%	-5%	±0%	+5%	+10%
IRR	9.57	8.79	8.07	7.39	6.76

			Reference		
Running cost	-10%	-5%	±0%	+5%	+10%
IRR	8.33	8.2	8.07	7.94	7.81

			Reference		
Power sale price	-10%	-5%	±0%	+5%	+10%
IRR	4.01	6.12	8.07	9.9	11.63

			Reference		
Jatropha oil purchase price	-10%	-5%	±0%	+5%	+10%
IRR	8.67	8.37	8.07	7.77	7.46

Biomass purchase price	-10%	-5%	±0%	+5%	+10%
IRR	8.15	8.11	8.07	8.03	7.99

When CER = 10US$/t-$CO_2$

			Reference		
Initial cost	-10%	-5%	±0%	+5%	+10%
IRR	14.59	13.68	12.83	12.04	11.31

			Reference		
Running cost	-10%	-5%	±0%	+5%	+10%
IRR	13.06	12.95	12.83	12.71	12.60

			Reference		
Power sale price	-10%	-5%	±0%	+5%	+10%
IRR	9.40	11.16	12.83	14.33	15.98
			Reference		
Jatropha oil purchase price	-10%	-5%	±0%	+5%	+10%
IRR	13.36	13.10	12.83	12.56	12.29
			Reference		
Biomass purchase price	-10%	-5%	±0%	+5%	+10%
IRR	12.90	12.86	12.83	12.80	12.76

Annex 4

MONITORING INFORMATION

Based on the monitoring methodology, information on each monitoring item is indicated below.

○ O_{all} Generated energy
○ ECy Project power consumption

Watt meters are installed in order to monitor the electric energy generated in the newly installed diesel engines as well as the electric energy consumed inside the generating facilities and gasification plant, etc. High precision watt maters shall be used and properly calibrated according to the maker's specifications.

Electric energy shall be continuously measured and automatically aggregated. Since it is necessary to know the aggregate electric energy rather than the instantaneous electric energy, it is not necessary to make frequent visual checks and take records. As a rule, the display shall be checked for abnormalities at least once per week, and records shall be taken once every month.

○ FCi biomass consumption

The value calculated from the amount of fuel consumption and fuel consumption rate is required for comparison with the generated electric energy monitored during the project activity.
The lower value is used in calculation of the emission reductions.

○ MCi biomass fuel raw materials consumption

Record the amount of raw materials consumed in order to manufacture bio-diesel (jatropha oil) and biogas. In other words, this is to confirm that biomass fuel supplied to the diesel engine is appropriately supplied from within the boundary and that power generation corresponding to that is carried out.

○ Incidentally, concerning the calibration work mentioned above, since there are no international calibration criteria, this work shall be based on the criteria prescribed by the instrument maker.

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