CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

>>
Mindanao Waste Banana Power Generation Project
Version 1.0
Date: 1 March 2010

A.2. Description of the small-scale project activity:

>>
Purpose of the project Activity

Mindanao Waste Banana Power Generation Project (hereinafter called "the Project") is a power generation project using waste banana stalks instead of the existing fossil fuel. The Foundation for Agrarian Reform Cooperatives in Mindanao Inc. (FARMCOOP) is composed of banana farmers in Davao del Norte, Southeast Mindanao. The banana stalks, after harvesting the fruits are discarded from the packing houses of the FARMCOOP member farms. The stalks are dumped at open disposal sites in the farms. In this project, the banana stalks will be used as methane fermentation materials and the methane gas produced will be used for power generation. The power generation capacity is about one (1) MW.

When this project will be carried out, Celebrate Life Agriventure Philippines Inc. (CLAVI), FARMCOOP, and EJ Business Partners will establish a special-purpose company (SPC) as a Philippine corporation.
The baseline scenario of the project are the generation of methane gas from the decay of open dumped banana stalks and the alternative public grid power consumption through the supply of electric power from this project. In the project scenario, the methane generation from the decay of banana stalks emitted into the atmosphere is avoided. By using methane as power generation materials to supply electric power to the local grid, the amount of the fossil fuel used in the grid is reduced. The greenhouse gas emission will be reduced on the average over a period of 10 years (2012 – 2021) by 9,044 t-CO2e/year through the implementation of this project.
This is a power generation project using banana stalks from agricultural waste. Implementation of the project contributes to sanitary improvement, pollution control of groundwater, reduction of the amount of waste and antipollution measures, such as bad smell prevention from the decay.

A.3. Project participants:

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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)
Republic of the Philippines (host)	-Celebrate Life Agriventure Philippines Inc. (CLAVI) -Foundation for Agrarian Reform Cooperatives in Mindanao, Inc. (FARMCOOP)	No

Japan	EJ Business Partners Co., Ltd. (EJBP)	No

Please refer to the contact information of participants in Annex 1.

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

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Republic of the Philippines

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

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Province of Davao del Norte, Region 11

A.4.1.3. City/Town/Community etc:

>>

Municipality of Carmen

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

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The project site is located within Davao del Norte Province (Region XI known also as Davao region) 40km north of Davao city. The Davao region in particular Davao del Norte and Compostella Valley provinces, is the largest producing region in Philippines.

Fig.A.4.1 Project site location and condition

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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Type and category(ies)

Project activities are renewable biomass power generation with capacity of 1MW with anaerobic digestion. Since the power generation capacity is less than 15MW, it is classified into a small-scale CDM project. As a result, the type and category of the project activities can be defined as follows;

Type "I": Renewable Energy Project
Category "D": Grid connected renewable electricity generation

Furthermore, because of the avoidance of methane generation from biomass decay from the stockpiled banana stalks utilized for anaerobic digestion, the type and category of the project activities can be also defined as follows;

Type "III": Other Project Activities
Category "E": Avoidance of methane production from the decay of biomass through controlled combustion, gasification or mechanical/thermal treatment

Technology/measures

- Anaerobic Digestion
Banana stalks are stored in the stock facility and fed to pre-treatment facility for dewatering and mixing with other biomass residues such as sub-standard banana fruits, and animal manure, etc. Methane fermentation tubs transform the mixed material into biogas for electricity generation through the gas engine generator and the compost will be use in the banana plantation.

- Gas pre-treatment system
Prior to electric generation, biogas must be pre-treated to remove impurities and moisture etc., to prevent the corrosion of the generators and flaring system. The pre-treatment consists of filtration, dewatering, removing of solid impurities and pressurization.

- Electricity generation and grid connection system
The electricity generated using biogas will be delivered to the local grid managed by Davao del Norte Electricity Cooperatives (DANECO). The electricity generator will be installed in accordance with the amount of biogas generated, with a maximum of 1MW generation capacity during the entire crediting period.

- Flaring system
The biogas not used in electricity generation will be flared. Once methane is converted into carbon dioxide, its greenhouse effect is reduced substantially. This will be achieved through the installation of an enclosed auto-ignition flare platform.

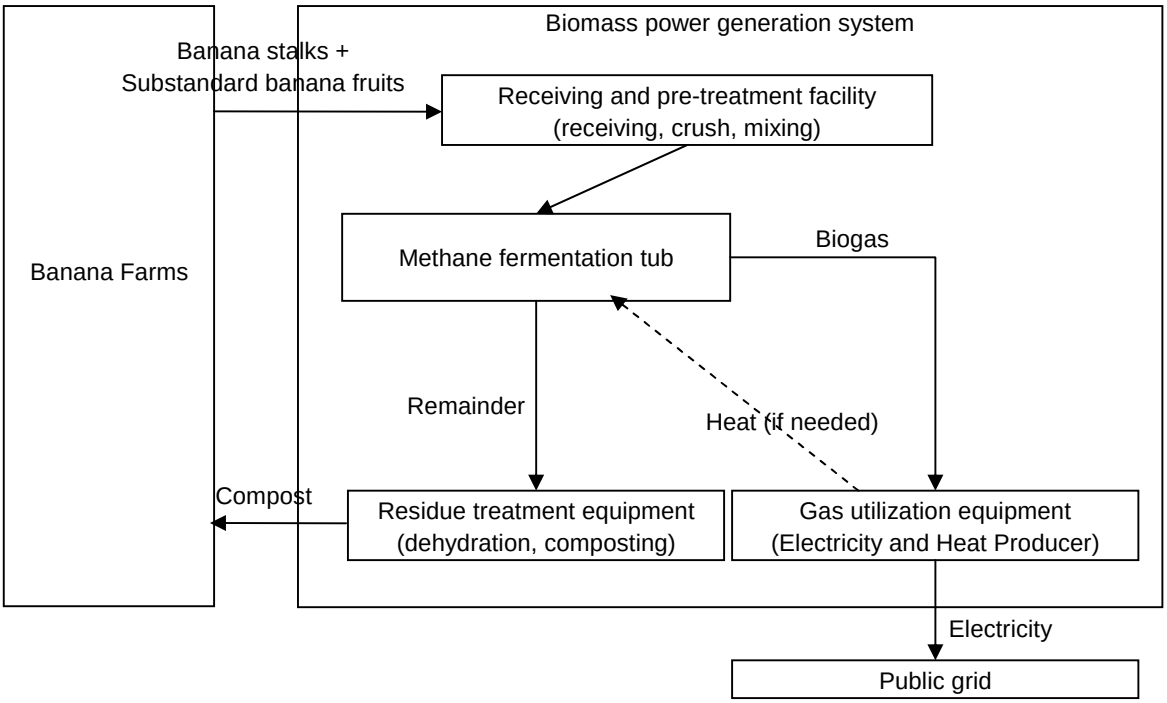

Fig.A.4.2 Plant System Flow

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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Years	Annual estimation of emission reductions in tons of CO_2e 2010.1.1-2019.12.31
2012	4,508
2013	5,709
2014	6,829
2015	7,873
2016	8,846
2017	9,754
2018	10,600
2019	11,389
2020	12,125
2021	12,811
Total estimated reductions (tons of CO_2e)	90,442
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tons of CO_2e)	9,044

A.4.4. Public funding of the small-scale project activity:

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There is no public funding used in this project.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

According to Appendix C of Simplified Modalities & Procedures for small-scale CDM project activities, "de-bundling" is defined as the fragmentation of a large project activity into smaller parts.

"A proposed small-scale project activity shall be deemed to be a de-bundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1km of the project boundary of the proposed small-scale activity at the closest point.

As there is currently no registered CDM project at the site either large scale or small scale, the project does not meets the criteria on de-bundling.

SECTION B. Application of a baseline and monitoring methodology

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

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- Version 15 of AMS-I.D. Valid from 30 Oct 09, "Grid connected renewable electricity generation"
- Version 16 of AMS-III.E. Valid from 31 Jul 09, "Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment"
- Tool for the demonstration and assessment of additionality
- Tool to determine methane emissions avoided from disposal of waste at solid waste disposal site
- Tool to determine project emissions from flaring gases containing methane

B.2 Justification of the choice of the project category:

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The Methodologies AMS I.D version 13 and AMS III.E version 15.1 are applicable to the projects through the following criteria:

Type I: Renewable Energy Project;
Details of methodology for baseline calculations for CDM projects capacity less than 15MW are available in the "Appendix B of the simplified modalities and procedure for small scale CDM project activities".
Since the project activity is renewable biomass power generation within capacity of 1MW less than 15MW and will generate the electricity for private use and grid selling, it is classified into a small-scale CDM project Type I and category D.Type III: Other Project Activities

Avoidance of methane generation from banana stalk decay, dumped and piled at open yard, through anaerobic digestion will be carried out in this project. Because the estimated emission reduction of the project activity from the avoidance of methane production will be average 5,824tCO2e per year less than 60,000tCO2e per year in any ear of the crediting period, the type and category of the project activities can be defined Type III category E.

B.3. Description of the project boundary:

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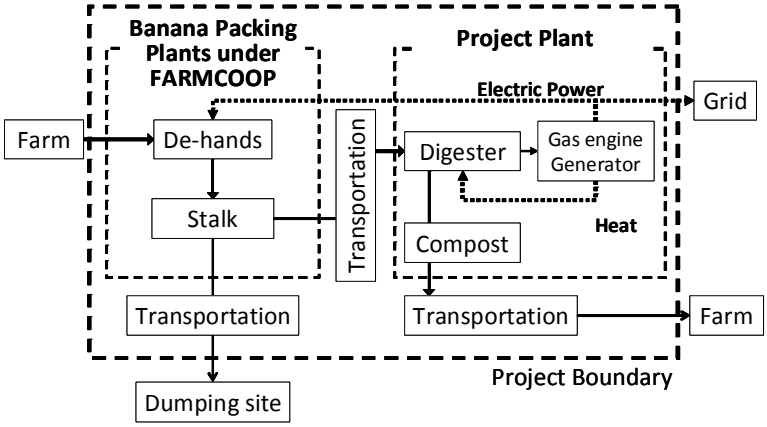
As per the guidelines mentioned in Type I.D. of Annex B of the simplified modalities and procedures for small-scale CDM project activities, project boundary encompasses the physical and geographical site of the renewable generation source. In addition, as per the guidelines mentioned in Type III. E., following 4 conditions are shown,

(a) Where the solid waste would have been disposed or is already deposited and the avoided methane emission occurs in absence of the proposed project activity.
(b) Where the treatment of biomass through controlled combustion, gasification or mechanical/thermal treatment takes place.
(c) Where the final residues of the combustion process will be deposited (this parcel is only relevant to controlled combustion activities).
(d) And in the itineraries between them, where the transportation of wastes and combustion residues and/or residues of gasification and mechanical/thermal treatment process occurs.

The project boundary is defined as between the existing banana packing plants of the FARMCOOP farms located in the province of Davao del Norte, Compostella Valley and the project plant including methane fermentation system, power generation set, composting plant which will be built next to one of the packing plant of this project.
Now, all of banana stalks, which are the biomass residue generated from packing houses, are piled and disposed at the open yard dumping site in each farms. Since the methane production from biomass decay at the dumping site will be avoided by the project activity, these dumping sites are interpreted as outside of the project boundary.
Because the greenhouse gas emission from the transportation of banana stalks to the dumping sites is also reduced by the project activity, it is included in the project boundary. Meanwhile, the project will collect banana stalks from these packing houses, the farthest distance is 40km, this transportation should be included in the project boundary. Furthermore, since the residual matter from digester will be transferred to nearest farm as compost, this transportation is also included in the project boundary.



B.3.1 Project Boundary

B.4. Description of baseline and its development:

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<AMS-I.D>

Without the proposed project activity, CO2 which is generated from public grid will be emitted. The heat produced by this project will not be use for banana processing but of the built-in digester of the project. Therefore, as mentioned in B.2, the Project uses baseline AMS-I.D.

The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient calculated in a transparent and conservative manner. Amounts of baseline emission are from the electric power using fossil fuel at the banana packing plant replaced through the project activity and from the public grid electric supply alternated through the project activity.

<AMS-III.E>

Banana stalks are dumped to the open yard in banana plantation as local common practice.

The baseline scenario is the situation where, in the absence of the project activity, the banana stalks are left to decay and methane is directly emitted to the atmosphere. The baseline emissions are the amount of methane from the decay of the piled banana stalks.

Therefore, as mentioned B.2, the project also includes a methane avoidance component that will use baseline Type III.E.

Detail of calculation methods of AMS-I.D. and AMS-III.E. are described in Annex 3.

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 small-scale CDM project activity:

Approved methodologies for small-scale CDM project activities are part of the Appendix B of the Simplified modalities and procedures for small-scale clean development mechanism project activities. Attachment A to Appendix B is noted information on additionality. According to the documents, Project participants should provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers, (a) Investment barrier, (b) Technological barrier, (c) Barrier due to prevailing practice, and (d) Other barriers.

For determination of project scenario additionality, (a) Investment barrier is confirmed as below:

As first step, followings are the likely future scenarios:
- The proposed project not undertaken as a CDM project activity.
- Stock-piling in banana plantation same as present condition
- Transporting and landfilling to the landfill site
- Open air burning
- The proposed project undertaken as a CDM project activity.

Open air burning is also currently the cheapest waste management option, but since the ban on open air burning in Philippines entered into force, this alternative is not compliant with existing laws, rules and regulations. Therefore, this alternative has been eliminated from the list above.

Transportation and landfilling to the landfill site could also be considered a measure for treatment of biomass residue. However, since this measure needs not only additional transportation fee and landfilling fee but also additional CO2 emission from the transportation activity, this alternative has also been eliminated.

Therefore, without the project activity, all the biomass would have been piled and left in the plantation.

(a) Investment Barriers

Since the project will be generating financial and economic benefits other than CDM related income, then a benchmark analysis approach will be used. The likelihood of development of this project will be determined by comparing the project IRR (Internal Rate of Return), with and without carbon credit revenues against a reasonable benchmark.

The table below illustrates the financial analysis for the project activity with and without carbon revenues.
As shown, the project IRR without CDM related incomes is much lower than with CERs.

The benchmark of the investment for this project is determined to be more than IRR10%, based on the government bond interest rates for ten years in the Philippines (about 7.9%) and the long-term interest rate of the Development Bank of the Philippines(about 10%).

In the economical efficiency analysis of this project, IRR without CERs profit on the sale is estimated as 8.1%, on the other hand, IRR with CERs profit on the sale of 15 U.S. dollars/CO2t is estimated as 12.8%.

Table B.5.1 Investment pay-back year

	IRR
Without CERs	8.1%
With CERs	12.8%

Since IRR (8.1%) without CERs profit on the sale is less than the benchmark. The feasibility of this project is judged to be low when this project is not a CDM project.
This therefore indicates that the investment barrier is existent.

(b) Technological Barriers

Because there is no energy production project utilizing banana stalks in Philippines, the technological barrier is also existent.

(c) Prevailing Barriers
Same as mentioned in (b).

Therefore, as mentioned above, to prove that there is an investment barrier, the additionality of this project is demonstrated.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Details of methodology for baseline calculations for CDM projects of capacity less than 15 MW are available in the "Appendix B of the simplified modalities and procedure for small scale CDM project activities".
Since the project activity is renewable biomass power generation within capacity of 1MW less than 15MW and will generate the electricity to the grid, it is classified into a small-scale CDM project Type I and category D. That is why we use the methodology AMS-I.D.

Furthermore, the avoidance of methane generation from banana stalk decay, which dumped and piled in dumping sites at the plantation, through digesting will be carried out in this project. Because the estimated emission reduction of the project activity from the avoidance of methane production will average 5,824tCO_2e per year, less than 60,000tCO_2e per year in any year of the crediting period, the type and category of the project activities can be defined Type III and category E. That is why we use the methodology AMS-III.E

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

Data and parameters for the methane avoidance component calculation using AMS-III.E:

Data / Parameter:	**Φ**
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	Oonk et el. (1994) have validated several landfill gas models based on 17 realized landfill gas projects. The mean relative error of multi-phase models was assessed to be 18%. Given the uncertainties associated with the model and in order to estimate emission reductions in a conservative manner, a discount of 10% is applied to the model results.
Any comment:	

Data / Parameter:	**OX**
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	In case the project does not occur, the landfill site where the biomass is dumped is not a well managed solid waste disposal sites that are covered with oxidizing material such as soil or compost.
Any comment:	

Data / Parameter:	**F**
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC.
Any comment:	

Data / Parameter:	**DOC_f**
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

<table>
<tr><td>Data / Parameter:</td><td>MCF</td></tr>
<tr><td>Data unit:</td><td></td></tr>
<tr><td>Description:</td><td>Methane correction factor</td></tr>
<tr><td>Source of data used:</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories</td></tr>
<tr><td>Value applied:</td><td>0.28</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>The landfill site where the biomass is dumped, in case the project does not occur, is unmanaged-shallow solid waste disposal sites with depths of less than 5 metres. Meanwhile, according to paragraph 22 of AMS-III.E. ver.5, description about high uncertainty in the estimation of methane emission in stockpiles, Project Participants shall use an MCF value of 0.28.
Therefore, MCF value 0.28 will be applied for this project in conservative assumption.
<table>
<tr><th>Classification</th><th>MCF</th></tr>
<tr><td>Anaerovic managed landfill site</td><td>1.0</td></tr>
<tr><td>Semi-aerobic managed landfill site</td><td>0.5</td></tr>
<tr><td>Unmanaged deep landfill site, depth≧5m</td><td>0.8</td></tr>
<tr><td>Unmanaged shallow landfill site, depth≦5m</td><td>0.4</td></tr>
<tr><td>Stockpile, large surface area to volume ratio</td><td>0.28</td></tr>
</table></td></tr>
<tr><td>Any comment:</td><td>The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.</td></tr>
</table>

<table>
<tr><td>Data / Parameter:</td><td>DOC_j</td></tr>
<tr><td>Data unit:</td><td>-</td></tr>
<tr><td>Description:</td><td>Fraction of degradable organic carbon (by weight) in the waste type j</td></tr>
<tr><td>Source of data used:</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)</td></tr>
<tr><td>Value applied:</td><td>40%</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>Apply the following values for the different waste types j:
<table>
<tr><th>Waste type j</th><th>DOCj
(% wet waste)</th><th>DOCj
(% dry waste)</th></tr>
<tr><td>Wood and wood products</td><td>43</td><td>50</td></tr>
<tr><td>Pulp, paper and cardboard (other than sludge)</td><td>40</td><td>44</td></tr>
<tr><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>15</td><td>38</td></tr>
<tr><td>Textiles</td><td>24</td><td>30</td></tr>
<tr><td>Garden, yard and park waste</td><td>20</td><td>49</td></tr>
<tr><td>Glass, plastic, metal, other inert waste</td><td>0</td><td>0</td></tr>
</table>
Use 50% for DOCj value because the banana stalks contain high fiber and are classified “Pulp, paper and cardboard (other than sludge)” and “wet waste”.</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

<table>
<tr><td>Data / Parameter:</td><td>kj</td></tr>
<tr><td>Data unit:</td><td>-</td></tr>
<tr><td>Description:</td><td>Decay rate for the waste type j</td></tr>
<tr><td>Source of data used:</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)</td></tr>
<tr><td>Value applied:</td><td>0.07</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>Apply the following default values for the different waste types j
<table>
<tr><th colspan="2" rowspan="2">Waste type j</th><th colspan="2">Boreal and Temperate (MAT≤20°C)</th><th colspan="2">Tropical (MAT>20°C)</th></tr>
<tr><td>Dry (MAP /PET <1)</td><td>Wet (MAP/ PET >1)</td><td>Dry (MAP< 1000mm)</td><td>Wet (MAP> 1000mm)</td></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.04</td><td>0.06</td><td>0.045</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.02</td><td>0.03</td><td>0.025</td><td>0.035</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.05</td><td>0.10</td><td>0.065</td><td>0.17</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>0.06</td><td>0.185</td><td>0.085</td><td>0.4</td></tr>
</table>
NB: MAT – mean annual temperature, MAP – Mean annual precipitation, PET – potential evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration.

Use 0.07 for kj value because the banana stalks will be classified similar to “pulp” due to its high fiber contents and the forecast in the Philippine will be classified “Tropical” and “wet”.</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

Data / Parameter:	EF_y
Data unit:	tCO2e/MWh
Description:	CO2 emission factor of the public grid
Source of data used:	
Value applied:	0.487
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value is calculated as a combined margin emission factor.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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In the Approved Small-scale methodology for energy generation units that supply electricity to and/or displace electricity from an electricity distribution system AMS-I.D. and Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment AMS-III.E., the emission reduction is immediately calculated, not by deducting project emissions from baseline emissions.

<AMS-I.D.>

The expected GHG emission reduction through this project units, generation capacity is 1,000kW and consumption itself is 50kW, the GHG emission reduction by the alternative of grid power supply is as follows;

Table B6.3.1 Emission reduction through diesel generation and grid power displacement

Year of operation	Grid power Displacement Emission Reductions ($tCO2e_)$	CO2 emission from use of electricity (tCO2e)	Emission reductions from AMS-I.D. (tCO2e)
2012	3,506	175	3,331
2013	3,506	175	3,331
2014	3,506	175	3,331
2015	3,506	175	3,331
2016	3,506	175	3,331
2017	3,506	175	3,331
2018	3,506	175	3,331
2019	3,506	175	3,331
2020	3,506	175	3,331
2021	3,506	175	3,331
Total	**35,064**	1,753	33,311

<AMS-III.E.>

The expected GHG emission reduction through this project by the avoidance of methane production from banana stalks decay with digestion and combustion including project emission is calculated as follows;

Project Emissions through incremental transportation

Because the project will collect banana stalks from more than 10 packing houses, the farthest distance is 40km, this transportation should be calculated as project emission. Furthermore, since the residual matter from digester will be transferred to nearest farm as compost, this transportation distance can be disregarded.
Therefore, project emissions though incremental transportation is calculated as follows:

$$PE_{y,transp} = (Q_{y,w} / CT_{y,w}) \cdot DAF_w \cdot EF_{CO2} + (Q_{y,ash} / CT_{y,ash}) \cdot DAF_{ash} \cdot EF_{CO2}$$

Using the following values:

Name	Explanation	Value	Remarks
$Q_{y,w}$ (tons)	Quantity of waste type *w* combusted in the year *y*	27,000	Detailed project report
$CT_{y,w}$ (tonnes/truck)	Average truck capacity for waste type *w* transportation,	7	Assumed
DAF_w (km/truck)	Average incremental distance for waste type *w* transportation	26	Calculated from geographical data of all packing plants in conservative assumption
EF_{CO2} (tCO_2/km, IPCC default values or local values)	CO_2 emission factor from fuel use due to transportation		IPCC default value
$Q_{y,ash}$ (tonnes)	Quantity of combustion residues produced in the year *y*	20,000	Assumed
$CT_{y,ash}$ (tonnes/truck)	Average truck capacity for combustion residues transportation	7	Assumed
DAF_{ash} (km/truck)	Average distance for combustion residues transportation	0	Since all of residues will transfer to the farm next to project plant as compost, this can be disregarded.

Using the above value, project emissions are estimated as 111tCO2e/year.

Table B6.3.2 Emission reduction through avoidance of methane production from biomass decay

Year of operation	Avoidance of methane generation (tCO2e)	CO2 emissions through incremental transportation (tCO2e)	Emission reductions from AMS-III.E (tCO2e)
2012	1,288	111	1,002
2013	2,489	111	2,203
2014	3,609	111	3,322
2015	4,653	111	4,366
2016	5,626	111	5,340
2017	6,534	111	6,247
2018	7,380	111	7,094
2019	8,169	111	7,883
2020	8,905	111	8,618
2021	9,591	111	9,304
Total	58,242	1,110	55,379

Leakage is considered to be zero because this project plant is not equipment transferred from another activity.

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

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Table B6.4.1 Gross emission reductions

Operating year	GHG emission reductions by displacement of grid power (tCO2e)	GHG emission reductions by avoidance of methane generation (tCO2e)	Total emission reductions (tCO2e)
2012	3,331	1,002	4,508
2013	3,331	2,203	5,709
2014	3,331	3,322	6,829
2015	3,331	4,366	7,873
2016	3,331	5,340	8,846
2017	3,331	6,247	9,754
2018	3,331	7,094	10,600
2019	3,331	7,883	11,389
2020	3,331	8,618	12,125
2021	3,331	9,304	12,811
Total	33,311	55,379	90,443

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**Qst-product, y**
Data unit:	Tonnes
Description:	amount of banana stalks generated from the packing plants in each year
Source of data to be used:	On site measurement
Value of data	27,000 t/year
Description of measurement methods and procedures to be applied:	On site scale, continuously, 100% of data are monitored.
QA/QC procedures to be applied:	The scale will be calibrated regularly according to manufacturer's regulations.
Any comment:	

Data / Parameter:	**Qst-consump, y**
Data unit:	Tonnes
Description:	amount of banana stalks consumed in the generation plant in each year
Source of data to be used: :	On site measurement
Value of data	27,000 t/year
Brief description of measurement methods and procedures to be applied:	On site solid flow meter or scale, continuously, 100% of data are monitored.
QA/QC procedures to be applied:	The meter will be calibrated regularly according to manufacturer's regulations.
Any comment:	

Data / Parameter:	**Qby_product, y**
Data unit:	Tonnes
Description:	amount of ash transported from the generation plant to neighbouring farmer in each year
Source of data to be used::	On site measurement
Value of data	
Brief description of measurement methods and procedures to be applied:	On site scale, continuously, 100% of data are monitored.
QA/QC procedures to be applied:	The scale will be calibrated regularly according to manufacturer's regulations.
Any comment:	

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Total amount of electricity generation from power plant
Source of data to be used::	On site measurements and cross check through electricity sales receipts
Value of data	
Brief description of measurement methods and procedures to be applied:	On site electricity meters, continuously, 100% of data are monitored and are cross checked with receipts from the Power Supplier Company
QA/QC procedures to be applied:	Electricity meter will be calibrated regularly according to the manufacturer's requirements. Measurement results will be cross-checked with the quantity of invoices from the grid operator to insure consistency
Any comment:	

Data / Parameter:	H (Operating hours)
Data unit:	Hours/year
Description:	Operating hours of the power plant
Source of data to be used::	On site measurement
Value of data	7,200 hours/year
Brief description of measurement methods and procedures to be applied:	On site measurement of the operating hours of the generators, 100% of all data are measured and archived electronically, recording frequency will be annually
QA/QC procedures to be applied:	The meter will be calibrated regularly according to manufacturer's regulations
Any comment:	

Data / Parameter:	CTy
Data unit:	tonnes/truck
Description:	Average truck capacity for banana stalks and digested sludge transportation
Source of data to be used::	Local actual condition
Value of data	t/truck
Brief description of measurement methods and procedures to be applied:	On site truck scale. The weight of all truck for banana stalks and digested sludge transportation should be weighted.
QA/QC procedures to be applied:	The scale will be calibrated regularly according to manufacturer's regulations.
Any comment:	

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B.7.2 Description of the monitoring plan:

>>

The project participants will select a Professional Company (PC) specializing in making the Plant facility to construct and operate the proposed project. Project participants are responsible for supervising the project implementation, performance, and the monitoring activities to be conducted by the professional company.

The selected Professional Company will construct and operate the proposed project and is also responsible for all monitoring activities to assure that all activities are consistent with the Monitoring Plan (see the Annex 4 of this document for more details of Monitoring Plan). PC will handle the monitoring under the supervision of Project participants.

PC will establish a quality management system, which ensures the quality and accuracy of the measured data, including corrective measures in case of non-conformity. The quality management system will include:

- Written procedures for operating facilities, periodic maintenance methods, daily work schedules
- List of personnel and training plan of those people involved
- Responsibility of involved persons
- Reporting system
- Data collection, archiving and accumulating for a written monitoring report for verification
- In the event of accidents, countermeasures will be implemented and documented
- Internal audits
- Instruments for measuring the necessary data will be periodically calibrated (according to the manufacture), a calibration plan will be determined
- Monitoring data will be constantly recorded and archived electronically
- Special storage regulations for monitored data will be determined, including back-up copy

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

>>

Date of completing the final draft of this baseline section: 01/03/2010
Name of person/entity determining the baseline:

Company Name: EJ Business Partners Co., Ltd.
Address: 33-11 Honcho 5-Chome Nakanoku –Ku, Tokyo, Japan
Zip Code: 164-0012

Contact person: Makoto KOSAKA
Tel: +81-3-6382-6222
Fax: +81-3-3383-6244
Email: kosaka-ma@ej-hds.co.jp

Contact person: Taisuke Odera
Tel: +81-3-6382-6222
Fax: +81-3-3383-6244
Email: oodera-ta@ej-hds.co.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:

>>
Operation starting date: 01/01/2012.

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

>>
10 years

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:

>>
Not applicable

C.2.1.2. Length of the first crediting period:

>>
Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
The project will start on 01/01/2012.

C.2.2.2. Length:

>>
10 years

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>
The environmental impact assessment system in the Philippines was established under Executive Order No. 1151 in 1977. This system required all government agencies, private groups and corporations to survey in advance the impacts of projects, operations and other activities above a certain scale and make sure that the activities will not have an bad impact on the surrounding environment and health of local citizens, etc. Project operators are required to compile an Environmental Impact Statement (EIS) or an

Initial Environmental Examination (IEE), etc. and to apply for permission to the DENR or local secretariat. If the environmental criteria are complied with, an Environmental Compliance Certificate (ECC) recognizing project implementation is issued.

- Environmental Impact

Air Quality Impact

By law ("Philippine Clean Air Act") about air pollution prevention, non-controlling combustion (direct incineration in the outdoors etc.) of the biomass and waste is forbidden. However, it is a practical disposal method for banana stalks to pile it in the open dumping sites due to the absence of expensive and properly managed incineration processing facility. Therefore, the open dumping of banana stalk to allow natural decomposition is the cheapest alternative of waste disposal.

If the project is not carried out, methane which is a greenhouse gas with 21 times global warming potential than that of CO2 is not processed and collected at all from the decomposition of banana stalk is directly emitted to the atmosphere. Air quality will be improved through the avoidance of methane generation due to the project activities and its direct emission to the atmosphere.

On the other hand, equipment, such as a digester and gas engine, may produce exhaust gas from its operation and maintenance, and may discharge organic and harmful gas. However, these environmental impacts are are very small and could be controlled by high level exhaust management, monitoring, and operation and maintenance. Moreover, the bad smell generated from the banana stalks decay is also minimized or eliminated.

Noise

The project site is in a suburb where the vast banana plantation field has spread around and away from residential areas. The power generation plant is considered to be the main sources of noise can be located at a suitable distance from the residents' sphere of life. It is thought that the noise is controllable to lowest level possible by installing the noisy facilities, such as, the digester, gas engine, generator, etc. in a building while low noise generating equipments outdoor.

Dust

It is expected that generation of dust, especially during the construction period, would be high and could not be avoided. Therefore, sprinkling of water whenever and whenever necessary will be required to suppress dust generation.

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:

>>

According to project scales (plant scale, power generation capacity, area, etc.), the procedure concerning a group classification and a required environmental impact are defined. According to the standard of the procedure concerning the environmental impact indicated in the "REVISED PROCEDURAL MANUAL FOR DENR ADMINISTRATIVE ORDER NO.30 SERIES OF 2003" (DAO 03-30), this project is classified into a waste power generation project. Demand standards differ as follows according to power generation capacity.

- Power generation capacity ≧50MW ==> Submission of EIS Receipt of ECC

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- 1MW≦power generation capacity ≦50MW ==> Submission of IEE Receipt of ECC
- Power generation capacity ≦1MW ==> Submission of PDR Receipt of CNC

Where:

EIS	: Environmental Impact Statement
ECC	: Environmental Compliance Certificate
IEE	: Initial Environment Examination
PDR	: Project Description Report
CNC	: Certificate of Non-Coverage

The planned power generation capacity of this project is 1MW. Submission of PDR is required. If the applications are satisfactory, CNC will be provided.
The procedure will be handled with the project participants.

SECTION E. Stakeholders' comments

>>

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

>>

"The guideline of stakeholder comment collection (INTERIM GUIDELINES ON THE CONDUCT OF STAKEHOLDERS' CONSULTATION UNDER DAO 2005-17)" is shown as the guidance about holding of the stakeholder meeting in the Philippines. It is indicated in the guideline that the following documents are required as record of stakeholder comment collection.

a. Proof of Written Announcement / Invitation
b. List of Participants – containing complete names, specific organizations and sectors/affected groups represented, signatures
c. Minutes of Proceedings – with a section on stakeholder profiling; photos and presentation materials as annexes
d. Summary of Issues and Concerns Raised
e. Proposed Measures to Address Issues and Concerns
f. Site / Vicinity Map

With above documents, project participants will attend the stakeholder meeting.
Based on the guidelines, in order to make the neighbouring communities understand the contents of the CDM project, the data for explanation which includes the explanation of the structure of a CDM project, global warming, and greenhouse gas, etc. will be made. The neighbouring communities' orientation meeting will be held after the SPC is established.

E.2. Summary of the comments received:

>>

The stakeholders that were interviewed by the project proponent are the banana farm owners, farm employees, and the local electric cooperative (Davao del Norte Electric Cooperative, Inc.: DANECO).

The disposal of banana stalks is a burden to Banana farm owners because of additional labour expense so they welcome the possibility of stable supply of electric power from the utilization of waste banana stalks. They also expect a more stable purchase price of substandard banana fruits compared with the volatile present selling price. Moreover, the farm employees expect an increase in job opportunities. The power transmission company also welcomes the additional power generation enterprise, most especially from renewable energy, since there is an existing shortage of electric power in Mindanao.
In the future, according to the standard procedure concerning environmental impact assessment as indicated in the "REVISED PROCEDURAL MANUAL FOR DENR ADMINISTRATIVE ORDER NO.30 SERIES OF 2003" (DAO 03-30), the public scoping includes the provision of global warming and the outline of CDM, etc., that will be scheduled after establishment of the SPC.

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

>>
The local authorities are all very supportive of the proposed project. Therefore, there is no need to modify the project due to the comments received. Environmental Impact Assessment should be taken strictly under the procedural manual for DENR Administrative Order No.30.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Celebrate Life Agriventure Philippines Inc.
Street/P.O.Box:	Highway
Building:	
City:	Casisang Malaybalay City
State/Region:	Bukidnon
Postfix/ZIP:	8700
Country:	Philippines
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E-Mail:	
URL:	
Represented by:	
Title:	President
Salutation:	Mr.
Last Name:	Abejuela
Middle Name:	B
First Name:	Neil
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Organization:	EJ Business Partners Co., Ltd.
Street/P.O.Box:	33-11 Honcho 5-Chome
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E-Mail:	
URL:	www.ejbp.ej-hds.co.jp/
Represented by:	
Title:	
Salutation:	
Last name:	
Middle name:	
First name:	
Department:	

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

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding involved in this project.

Annex 3

BASELINE INFORMATION

< AMS-I.D. >

The amount of baseline emission from public grid electric supply is calculated by multiplying the electric energy from the public grid alternated through the project activity by the emission factor of the grid.

$BE_{power, grid, y} = EG_y * EF_{y, grid}$

Where:

EG_y	: Electric energy from the public grid supplied through the project activity
$EF_{y, grid}$	: Emission factor of the grid

The emission factor is calculated in accordance with the latest version of the AMS I.D and as a tool to calculate the emission factor for an electricity system, because the consumption does not exceed the CDM small scale thresholds as defined by the Executive Board.

The baseline is the kWh produced by the renewable generating unit multiplied by an emission factor calculated in a transparent and conservative manner as:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered

OR

(b) The weighted average emissions (in kg-CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used. Calculations must be based on data from an official source and made publicly available.

$$\mathbf{EF_y\ (tCO_2/MWh) = W_{OM} \times EF_{OM,y} + W_{BM} \times EF_{BM,y}}$$

$\mathbf{W_{OM}}$	**= The weights is 0.5**
$\mathbf{EF_{OM,y}}$	**= Operating Margin Emissions Factor**
$\mathbf{W_{BM}}$	**= The weights is 0.5**
$\mathbf{EF_{BM,y}}$	**= Build Margin Emissions Factor**

The above equation is provided from "Tool to calculate the emission factor for an electricity system, ver. 02".

Because the data needed by Option (a) are available, Option (a) is chosen under paragraph 11 of AMS-I.D. ver.15 to demonstrate the emission in baseline scenario. The baseline emission coefficients are calculated ex-ante as the followings:

OM: 0.688 tCO2/MWh
BM: 0.285 tCO2/MWh
CM: 0.487 tCO2/MWh

STEP 1. Identify the relevant electricity systems
There are three grids in the Philippines as officially defined by the Philippines Department of Energy and acknowledged by the host country DNA, is. Luzon, Visayas and Mindanao[1]. The project is located at Mindanao Island, thus, the emission factor applicable to the project is the emission factor for the Mindanao grid.

The baseline emission factor (EF) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors.

STEP 2 Choose whether to include off-grid power plants in the project electricity system (optional)
This project will only replace grid electricity not off-grid electricity.

STEP 3 Select a method to determine the operating margin (OM)
The calculation of the operating margin emission factor ($EF_{grid, OM, y}$) is based on one of the following methods:

(a) Simple OM; or
(b) Simple adjusted OM; or
(c) Dispatch data analysis OM; or
(d) Average OM.

Dispatch data analysis (c), as the first methodological choice, cannot be used because dispatch data is not available to the project participants. Simple adjusted OM (b) is neither not feasible to calculate because the number of hours per year operation is not available. The remaining options are simple OM (a) and averaged OM (d).

As per methodology, the Simple OM method (a) can only be used where low cost/must run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production. While Average OM method (d) can be used where low cost/must run resources constitute more than 50% of total grid generation. As per table following table, Mindanao grid has approximately 71.5% of low cost/must run resources.
Additionally, since the detailed data to apply Option (d) and (c) is not available, the use of Average OM method (d) can be justified and applied.

[1] Power Sector Situationer 2008. (http://www.doe.gov.ph/)

Table A Power Generation of Mindanao (Year2003-2005)

Mindanao Grid	2003	2004	2005	Average 2003-2005	Percentage	
Oil-Based	1,713,693	1,915,799	2,319,927	1,983,140	28.47%	
Combined-Cycle	-	-	-	-	0.00%	
Diesel	1,711,563	1,915,500	2,319,772	1,982,278	28.46%	
Gas Turbine	-	-	-	-	0.00%	
Oil	2,129	299	155	861	0.01%	
Coal	-	-	-	-	0.00%	
Natural Gas	-	-	-	-	0.00%	28.47%
Geothermal	861,015	909,815	892,863	887,898	12.75%	
Hydro	3,989,013	4,261,525	4,028,352	4,092,963	58.77%	
Solar		-	1,517	759	0.01%	71.53%
Total Generation	6,563,721	7,087,139	7,242,659	6,964,506		100.00%

*Source: Department of Energy. Power Statistics 2008

STEP 4 Calculate the operating margin emission factor according to the selected method
(d) Average OM

The average OM emission factor ($EF_{grid, OM\text{-}ave, y}$) is calculated as the average emission rate of all power plants serving the grid, using the methodological guidance as described under (a) Simple OM as following:

The average OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (t-CO2/MWh) of all generating power plants serving the system, including low-cost/must-run power plants/units.

The average OM may be calculated:
Option A: Based on the net electricity generation and a CO2 emission factor of each power unit; or
Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

Option B can only be used if:
(a) The necessary data for Option A is not available; and
(b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
(c) Off-grid power plants are not included in the calculation (i.e., if Option I has been chosen in Step 2).

As a result, since necessary data to apply Option A is not available, Option B is applied.

Option B – Calculation based on total fuel consumption and electricity generation of the system

Under option B, the average OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_{i} \left(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y} \right)}{EG_y}$$

Where:

$EF_{grid,OMsimple,y}$ = Simple/Average operating margin CO2 emission factor in year y (t-CO2e/MWh)
$FC_{i,y}$ = Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO2 emission factor of fossil fuel type i in year y (tCO2e/GJ)
EG_y = Net electricity generated and delivered to the grid by all power sources serving the system, including low-cost/must-run power plants/units, in year y (MWh)
i = All fossil fuel types combusted in power sources in the project electricity system in year y
y = The relevant year as per the data vintage chosen in Step 3

For this approach (Average OM) to calculate the operating margin, the subscript m refers to the power plants/units delivering electricity to the grid, including low-cost/must-run power plants/units, and including electricity imports to the grid. Electricity imports should be treated as one power plant m.

As shown in Table B, Average operating margin (OM) = 0.688(t-CO2e/MWh)

Table B Calculated table of Average OM

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Item	2005-2007 Average Electricity Generation	Heat Rate	Fuel Consumption Impact		Carbon Emission Factor	Unadjusted Annual Carbon Emission Impact	Combustion Efficiency	Actual Carbon Emission Impact	Annual Carbon Dioxide Emission Impact	Average OM Emission Factor
Abbreviation	EGy	HR	FCI	FCI	Carbon Emission Factor	CEI	COM EFF	Adjusted CEI	tCO2	EF Simple OM
Data Source	PDOE Powerstats	PDOE	(A) x (B)	[(C) x 1055]/10^1	IPCC	(D) x (E)	IPCC	(F) x (G)	(H) x (44/12)	(I) / (A/1000)
Unit	kwh/yr	BTU/kwh	BTU/yr	TJ/yr	tC/TJ	tC/yr	%	tC/yr	tCO2/yr	
Combined-Cycle	-	6,550	0	0.00	20.20	-	99	-	-	
Diesel	1,982,278	8,900	1.7642E+10	18.61	20.20	375.97	99	372.21	1,364.79	
Gas Turbine	-	14,400	0	0.00	20.20	-	99	-	-	
Oil Thermal	861	8,600	7404600	0.01	21.10	0.16	99	0.16	0.60	
Coal	-	8,900	0	0.00	26.80	-	98	-	-	
Natural Gas	-	6,550	0	0.00	15.30	-	99.5	-	-	
Total	1,983,139								1,365.39	**0.688**

Source: Department of Energy Philippines website, http://www.doe.gov.ph

STEP 5: Identify the group of power units to be included in the build margin

The sample group of power units m used to calculate the build margin consist of either:

(a) The set of five power units that have been built most recently;or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

An analysis was made based on the most recent plants built in the Mindanao grid. It was found that five most recently built power plants' generation does not reach 20% of the total generation. Therefore, the power plant capacity additions in the electricity system that comprise 20% of the generation and that

have been built most recently are included in the sample group (eight power plants in total). The most recently built power plants and corresponding annual power generations are shown in Table C below.

Table C Most recently built plants in Mindanao

Plant	Plant Type	Date of Commisio n	Location	2005 Power Generation (MWh)
PB104	Diesel	2005	Davao city	9,263
Solar Photovoltaic	Solar	2004	Misamis Oriental	1,517
Bubunawan	Hydro	2001	Bukidnon	24,523
Mindanao II(Mt.Apo 2)	Geothermal	1999	North Cotabato	445,379
Talomo	Hydro	1998	Davao city	23,270
GenSan SPPC	Diesel	1998	Sarangani	248,402
WMPC	Diesel	1997	Zamboanga	409,041
Mindano I (Mt. Apo 1)	Geothermal	1996	North Cotabato	447,484
Total				1,608,879

Source: Department of Energy, Philippines

As per Table A above, the total annual electricity generation of Mindanao grid in 2005 is 7,242,659MWh. The 20% of the total amount is 1,448,532MWh. It can be seen that 8 most recently built power plants' generation would cover over 20% of the total generation.

STEP 6: Calculate the build margin emission factor

The build margin emissions factor is the generation-weighted average emission factor (t-CO2e/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO2 emission factor in year y (t-CO2e/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$ = CO2 emission factor of power unit m in year y (t-CO2e/MWh)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available

As shown in Table D, build margin (BM) = 0.285 (t-CO2e/MWh)

Table D Calculated table of BM

			(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Item	Plant Type	Year Comm-issioned	2005 Electricity Generation	Heat Rate	Fuel Consumption Impact		Carbon Emission Factor	Unadjusted Annual Carbon Emission Impact	Combustion Efficiency	Actual Carbon Emission Impact	Annual Carbon Dioxide Emission Impact	Build Margin Emission Factor
Abbreviation			EG	HR	FCI	FCI	Carbon Emission Factor	CEI	COM EFF	Adjusted CEI	tCO2	EF BM
Data Source			PDOE	PDOE	(A) x (B)	[(C)x1055] /10^12	IPCC	(D) x (E)	IPCC	(F) x (G)	(H) x (44/12)	(I) / (A)
Unit			MWh/yr	BTU/kwh	BTU/yr	TJ/yr	tC/TJ	tC/yr	%	tC/yr	tCO2/yr	tCO2/MWh
PB104	Diesel	2005	9,263	8,900	8.24E+10	86.975	20.20	1,756.89	99	1,739	6,378	
Solar Photovoltaic	Solar	2004	1,517									
Bubunawan	Hydro	2001	24,523									
Mindanao II(Mt.Apo 2)	Geothermal	1999	445,379									
Talomo	Hydro	1998	23,270									
GenSan SPPC	Diesel	1998	248,402	8,900	2.21E+12	2332.371	20.2	47,113.89	99	46,643	171,023	
WMPC	Diesel	1997	409,041	8,900	3.64E+12	3840.690	20.2	77,581.95	99	76,806	281,622	
Mindano I (Mt. Apo 1)	Geothermal	1996	447,484		0.00E+00	0.00		-				
Total			1,608,879								459,023	**0.285**

Source: Department of Energy Philippines website, http://www.doe.gov.ph

STEP 7: Calculate the combined margin emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM}$$

Where:

$EF_{grid,OM,y}$ = Operating Margin Emissions Factor (t-CO2e/MWh)
W_{OM} = Weighting of operating margin emissions factor (0.5)
$EF_{grid,BM,y}$ = Build Margin Emissions Factor (t-CO2e/MWh)
W_{BM} = Weighting of built margin emissions factor (0.5)

The combined margin emission factor is calculated as follows:
$EF_{grid,CM,y} = 0.688 * 0.5 + 0.285 * 0.5 = 0.487$ kg-CO_2/kWh

In 2011 when this project will be started, the electricity capacity of project will be 1,000kW and its operating hours will be approximately 7,200 hours (300days). Therefore, the amount of baseline emission from public grid is as follows:

$BE_{power,grid,y} = 1{,}000kw * 24 * 300 * 0.487 =$ **3,506 t-CO2e/year**

<AMS-III.E>

The project also includes a methane avoidance component that will use baseline Type III.E, as defined in paragraph 93 of Appendix B.

The baseline scenario is the situation where, in the absence of the project activity, banana stalks are left to decay and methane is emitted to the atmosphere. The baseline emissions are the amount of methane from the decay of the banana stalks fermented and combusted in the project activity. The Yearly Methane Generation Potential is calculated using the first order decay model based on the discrete time estimate

method of the IPCC Guidelines, as described in category AMS III-G. Baseline emissions shall exclude methane emissions that would have to be removed or combusted to comply with national or local safety requirement or legal regulations.

$$BE_y = BE_{CH4,SWDS,y}$$

Where:

BEy	: Baseline emission of methane production from the decay of banana stalk in the year "y"
$BE_{CH4, SWDS,y}$	: CO2 equivalent GHG emission reduction calculated from the amount of methane production at the final landfill sites

The estimation of the methane emission potential of a solid waste disposal site ($BE_{CH4,SWDS,y}$, in tCO_2e) shall be undertaken using the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site", found on the CDM website.

According to "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site", the amount of methane produced in the year y ($BE_{CH4,SWDS,y}$) is calculated as follows:

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot \left(1 - e^{-k_j}\right)$$

Where:

BECH4,SWDS,y	= Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (t-CO2e)
Φ	= Model correction factor to account for model uncertainties (0.9)
f	= Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWPCH4	= Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	= Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	= Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOCf	= Fraction of degradable organic carbon (DOC) that can decompose
MCF	= Methane correction factor
Wj,x	= Amount of organic waste type j prevented from disposal in the SWDS in the year x (tons)
DOCj	= Fraction of degradable organic carbon (by weight) in the waste type j
Kj	= Decay rate for the waste type j
J	= Waste type category (index)
X	= Year during the crediting period: x runs from the first year of the first crediting period (x = 1) to the year y for which avoided emissions are calculated (x = y)
Y	= Year for which methane emissions are calculated

These parameters are chosen as follows,

Table E Parameters for calculation of methane emissions

Parameter	Value		
φ	0.9	default	
f	0	default	
GWP_{CH4}	21	default	
OX	0	IPCC2006[2]	unmanaged site
F	0.5	IPCC2006	
DOCf	0.5	IPCC2006	
MCF	0.28	IPCC2006	Stockpile
Wj,x	27,000	FARMCOOP	
DOCj	0.4	IPCC2006	
kj	0.07	IPCC2006	

φ and f are determined as default value and GWP_{CH4} has the Global Warming Potential of 21 times than that of carbon dioxide based on the IPCC default value.

In case of the project will not occur, the landfill site, where the biomass was dumped, is not a well-managed solid waste disposal sites that are covered with oxidizing material such as soil or compost. Therefore, OX is determined 0 based on IPCC 2006 Guidelines for National Greenhouse Gas Inventories

F reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. Default value of 0.5 is recommended by IPCC.

Fraction of degradable organic carbon (DOC) that can decompose is recommended as 0.5 by IPCC.

The landfill site that will be dumped the biomass in case of the project not occurred is stockpiles, project participant shall use 0.28 for MCF value in accordance with description of AMS-III.E.

DOCj is chosen as 0.4 based on IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5).
Use 40% for DOCj and 0.07 for kj because the banana stalks contain much fiber like pulps and classified "Pulp, paper and cardboard (other than sludge)" and "wet waste" as shown Table F and G following:

Table F Parameter DOCj for the different types j

Waste type *j*	**DOC_j (% wet waste)**	**DOC_j (% dry waste)**
Wood and wood products	43	50
Pulp, paper and cardboard (other than sludge)	40	44
Food, food waste, beverages and tobacco (other than sludge)	15	38
Textiles	24	30
Garden, yard and park waste	20	49
Glass, plastic, metal, other inert waste	0	0

Table G Parameter kj for the different types j

[2] IPCC 2006 Guidelines for National Greenhouse Gas Inventories

Waste type j		Boreal and Temperate (MAT≤20°C)		Tropical (MAT>20°C)	
		Dry (MAP/PET<1)	Wet (MAP/PET>1)	Dry (MAP<1000mm)	Wet (MAP>1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	0.06	0.185	0.085	0.4

Annex 4

MONITORING INFORMATION

1. Monitoring methodology

In this project, parameters required for verification of the amount of emission reduction are monitored based on the AMS-I.D. and the AMS-Ⅲ.E. Monitoring is based on the direct measurement for the amount of banana stalks digested, combusted and generated electricity in each part of the plant and dynamo, etc. In the monitoring plan, the method of measuring those values by instrumentation apparatus is adopted. The items which should be monitored in this project are shown below.

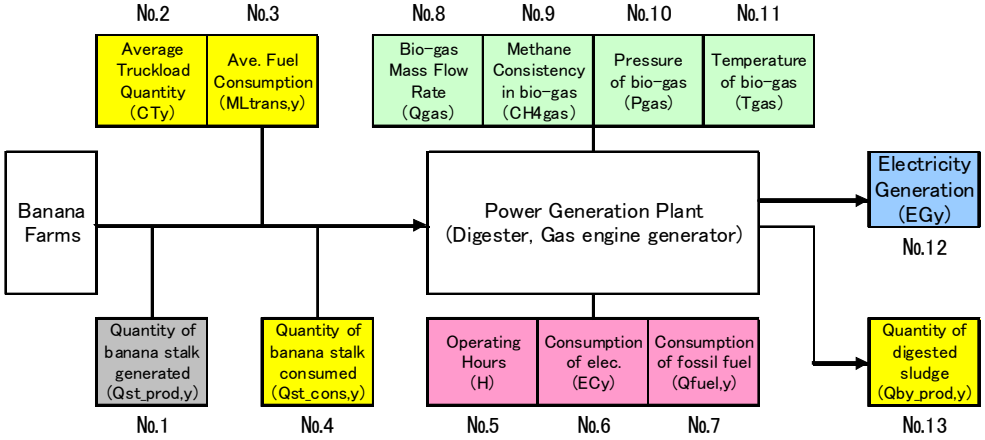

Fig. A Monitoring Flow

No.	Item	Explanation
1	Qst-prod,y	Annual quantity of banana stalks generated in all packing houses
2	CTy	Average truckload quantity
3	MLtrans	Average fuel consumption by truckload
4	Qst-cons,y	Annual quantity of banana stalks consumed in the project plant
5	H	Annual operating hours of project plant
6	ECy	Annual electricity consumption of project plant
7	Qfuel,y	Annual fossil fuel consumption of project plant
8	Qgas	Annual mass flow rate of bio-gas digested from project plant
9	CH4gas	Methane consistency in bio-gas
10	Pgas	Pressure of bio-gas
11	Tgas	Temperature of bio-gas
12	EGy	Annual Electricity Generation of project plant
13	Qby_prod, y	Annual quantity of digested sludge from project plant

It is necessary to specify the amount of banana stalks consumption per unit production of electricity beforehand from equipment specification etc. The electric energy which will be actually generated

should be compared with electric energy calculated from the amount of banana stalk consumption and a unit production of electricity.

2. Monitoring Management

· **CDM Monitoring Manager**
One competent manager, who will be designated by the project developer, will be responsible for this monitoring plan and supervise the collected data. He/She will report monthly to the Management Board (MB) of the project developer about project performance and data. He/She will inform the MB immediately as soon as he/she detects non-conformance in the performance to the mentioned regulations, problems in the performance (e.g. flow meters not working, data not correct). The CDM Monitoring Manager will be the main contact person for the verifiers, as well as Davao del Norte relevant local authorities, during the crediting period.

· **CDM Project Team**
This project team will gather, at least monthly, to discuss the performance of the CDM project. Member of the CDM Project Team includes CDM Monitoring Manager, the MB, and the chief engineer of the project plant. The meeting of the CDM project team can be part of regular meetings, but meeting minutes are recorded as required. In case of non-conformance, each member of the team can call in for a CDM project team meeting.

3. Quality control and quality assurance procedures

Regarding quality control and quality assurance procedures to be undertaken for the monitored indicators, the practices to be implemented in the context of the proposed project are as follows:

· **On site monitoring records**
- Daily readings of all field meters will be filled out in paper worksheets and filed consequently. All data collected will also be entered in electronic worksheets and stored in computer immediately and in discs periodically.
- Periodic controls of the on site monitoring records will be carried out to check any deviation from the estimated ERs following the guidelines for plant operation and monitoring for correction or future references.
- Periodic reports to evaluate performance and assist with performance management will be elaborated.

· **Equipment calibration and maintenance**
- Truck scale, flow meters, hour meter, and other sensors will be subject to regular maintenance and testing according to the technical specifications from the manufactures to ensure accuracy and good performance.
- Calibration of equipment will be conducted periodically according to their technical specifications.

· **Corrective actions**
- Actions to correct deviations from the Monitoring Plan and the guidelines for plant operation and monitoring will be implemented as these deviations are observed either by the operator or during internal audits.

- Except periodic meeting, additional technical meetings among the operator, the MB of the developer will be held, if necessary, in order to define the corrective actions to be carried out.

· **Site audits**
- CDM Project Team will make regular site audits to ensure that monitoring and operational procedures are being observed in accordance with the Monitoring Plan and the guideline for plant operation and monitoring.

· **Training**
- For all employees, involved in this project, a Training Plan will be created. It ensures that both project operational staff and monitoring staff are properly trained to enable them to undertake the tasks required by this Monitoring Plan. Appropriate staff training must be provided before the project starts operating and generating ERs.

· **Documents storage**
- List of monitoring equipment (truck scale, solid flow meter, hour meter, electricity meter, etc.), including their numbers, names, manufacturers, specifications, use requirements, etc.
- Calibration lists and reports, including equipment or parts calibrated, date, method and procedures of calibration, their precision after these procedures, personnel, devices needed, etc.
- Maintenance lists and reports, including equipment or parts maintained, date, method and procedures of maintenance, their performance after these procedures, personnel, devices needed, etc.
- Operational manual of the proposed project
- Meeting minutes of CDM project team meeting
- Non-conformance reports
- Worksheets, monthly and yearly
- Training plan
- Internal audit/inspection reports, including personnel, time, findings, corrective actions, follow-up inspections
- Annual monitoring review

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