Monitoring report form
(Version 03.2)

Monitoring report

Title of the project activity	Hedcor Sibulan 42.5 MW Hydroelectric Power Project
Reference number of the project activity	1620
Version number of the monitoring report	1.0
Completion date of the monitoring report	22/04/2014
Registration date of the project activity	06/06/2008
Monitoring period number and duration of this monitoring period	002 26/04/2011 – 25/12/2013 (the first and last date included)
Project participant(s)	Hedcor Sibulan Inc.
Host Party(ies)	Philippines
Sectoral scope(s) and applied methodology(ies)	Sectoral scope 1: Energy industries (renewable - / non - renewable sources) ACM0002 "*Consolidated baseline methodology for grid-connected electricity generation from renewable sources* (Version 06)"
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	255,796 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	479,566 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	288,248 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	191,318 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Hedcor Sibulan 42.5 MW Hydroelectric Power Project ("Project"), undertaken by Hedcor Sibulan Inc. ("HSI") as the project company, is a cascade development of two run-of-river type hydro power plants; namely, an upstream Sibulan Plant A with an installed capacity of 16.5 MW and a downstream Sibulan Plant B with an installed capacity of 26MW.

The purpose of the Project is to generate carbon neutral electricity harnessing the water of the Sibulan and Baroring Rivers to generated electricity. The energy to be generated is and will be exported to the Mindanao grid. In doing so, the Project will displace fossil fuel-fired power generation of the same grid, contributing to a reduction of greenhouse gases (GHGs).

A.2. Location of project activity

The project site, consisting of the upper and lower project areas, is located approximately 19 kilometers from the south-eastern boundary of Davao City, in the Mindanao Province. The lower project area where Plant B is situated is about a 45-minute drive from the city. The upper project area, where Plant A is situated, is about a 2-hour drive away from the city.

The geographical coordinates for the plants as actually measured after project implementation are as indicated below, where the coordinates are consistent with the PDD:

Table 1: GPS coordinates

Plant	PDD	Actual
Plant A	6°57'45.57"N, 125°22'17.03"E	N6°57'45.8", E125°22'18.0"
Plant B	6°56'25.50"N, 125°26'27.17"E	N6°56'24.5", E125°26'27.7"

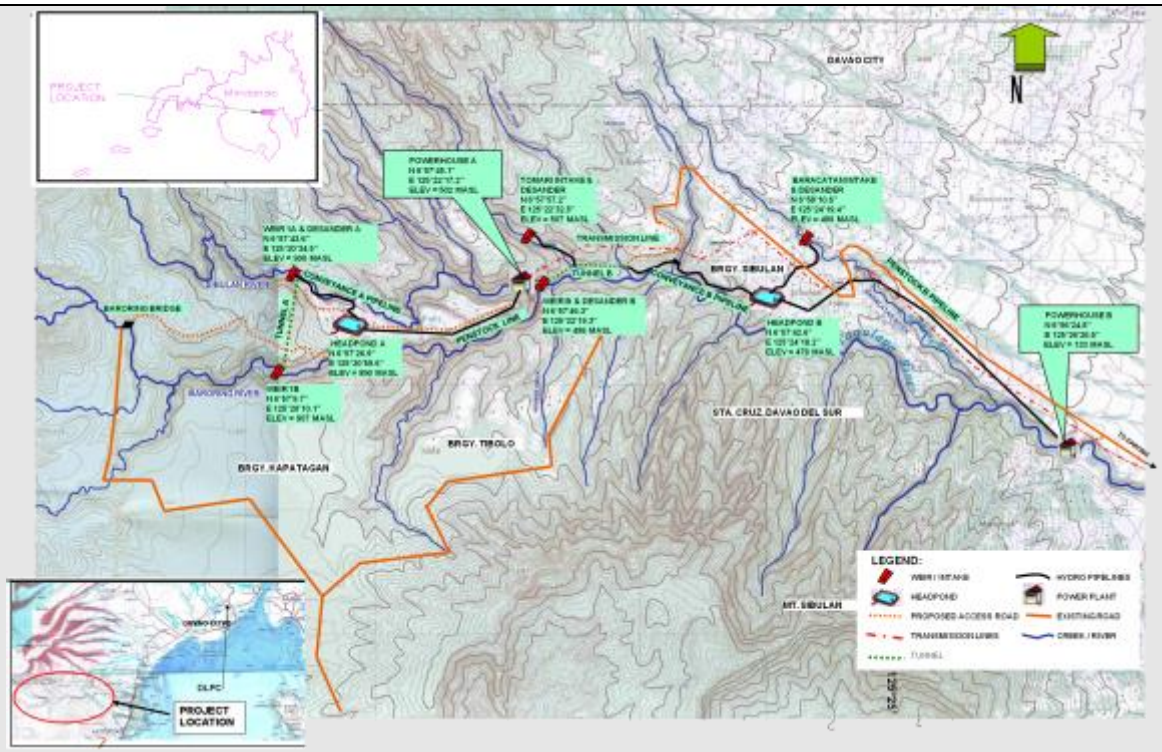


Figure 1: Map indicating Sibulan plant site

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Philippines (host)	Hedcor Sibulan, Inc.	No

A.4. Reference of applied methodology

The approved baseline and monitoring methodology ACM0002 Version 06: *Consolidated baseline methodology for grid-connected electricity generation from renewable sources* ("ACM0002") is applied to the Project.

A.5. Crediting period of project activity

Choice of the crediting period: Renewable (7 years 0 month)

First crediting period: 26/02/2010 – 25/02/2017

Start date of crediting period: 26/02/2010

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

(a) Implementation status

The Project has been constructed and implemented as per the actual schedule described in Table 2 below. During the monitoring period under consideration (i.e. 26/04/2011 – 25/12/2013), there was no event or situation that would impact the applicability of the applied methodology.

Table 2: Implementation timeline of the project

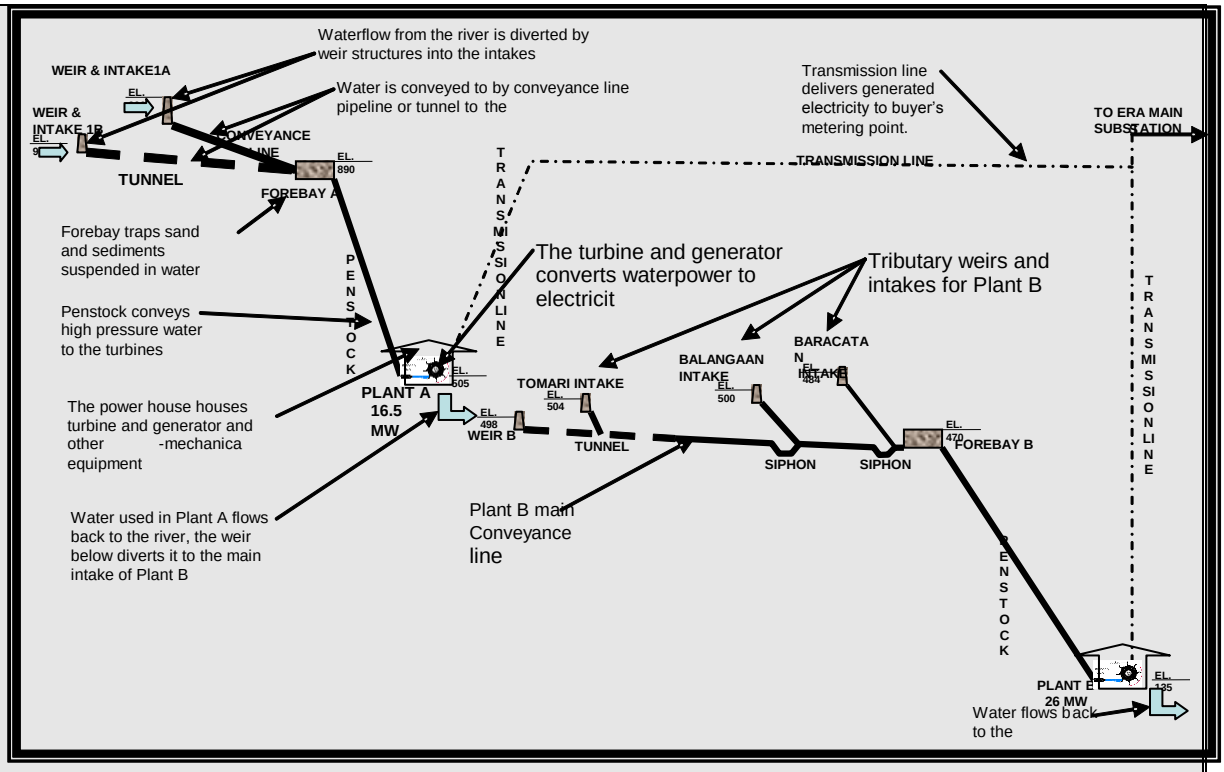
Status	Date
CDM Registration Date	06/06/2008
Starting date of 26MW Plant B	27/02/2010
Starting date of 16.5MW Plant A	11/07/2010
1st Monitoring Period	26/02/2010 - 25/04/2011
2nd Monitoring Period	26/04/2011 - 25/12/2013

(b) Technical description

As per the registered CDM-PDD, the implemented Project is a cascade development of two power plants – the upstream Sibulan Plant A with an installed capacity of 16.5 MW and the downstream Sibulan Plant B with an installed capacity of 26MW. The plants are of the run-of-river type that include an intake weir, short tunnel, surface pipeline, desander, headpond, high pressure surface penstock, surface power plant, substation, switchyard, and transmission line. The plants each house two mutli-jet pelton type turbines and generating units that create power.

No major dam or reservoir has been constructed. Instead, the plants utilize small, off-river head ponds which will regulate the output daily. The two ponds at Plant A and Plant B together allow for sufficient water storage to cater for the peak demand of the off-taker, Davao Light Power Corporation, Inc. (DLPC).

The Plants are connected to the DLPC system through a 69 KV transmission line to DLPC's ERA Main Substation.



B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

The section is left blank intentionally.

B.2.2. Corrections

The section is left blank intentionally.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

The section is left blank intentionally.

B.2.4. Changes to project design of registered project activity

The section is left blank intentionally.

B.2.5. Changes to start date of crediting period

The section is left blank intentionally.

B.2.6. Types of changes specific to afforestation or reforestation project activity

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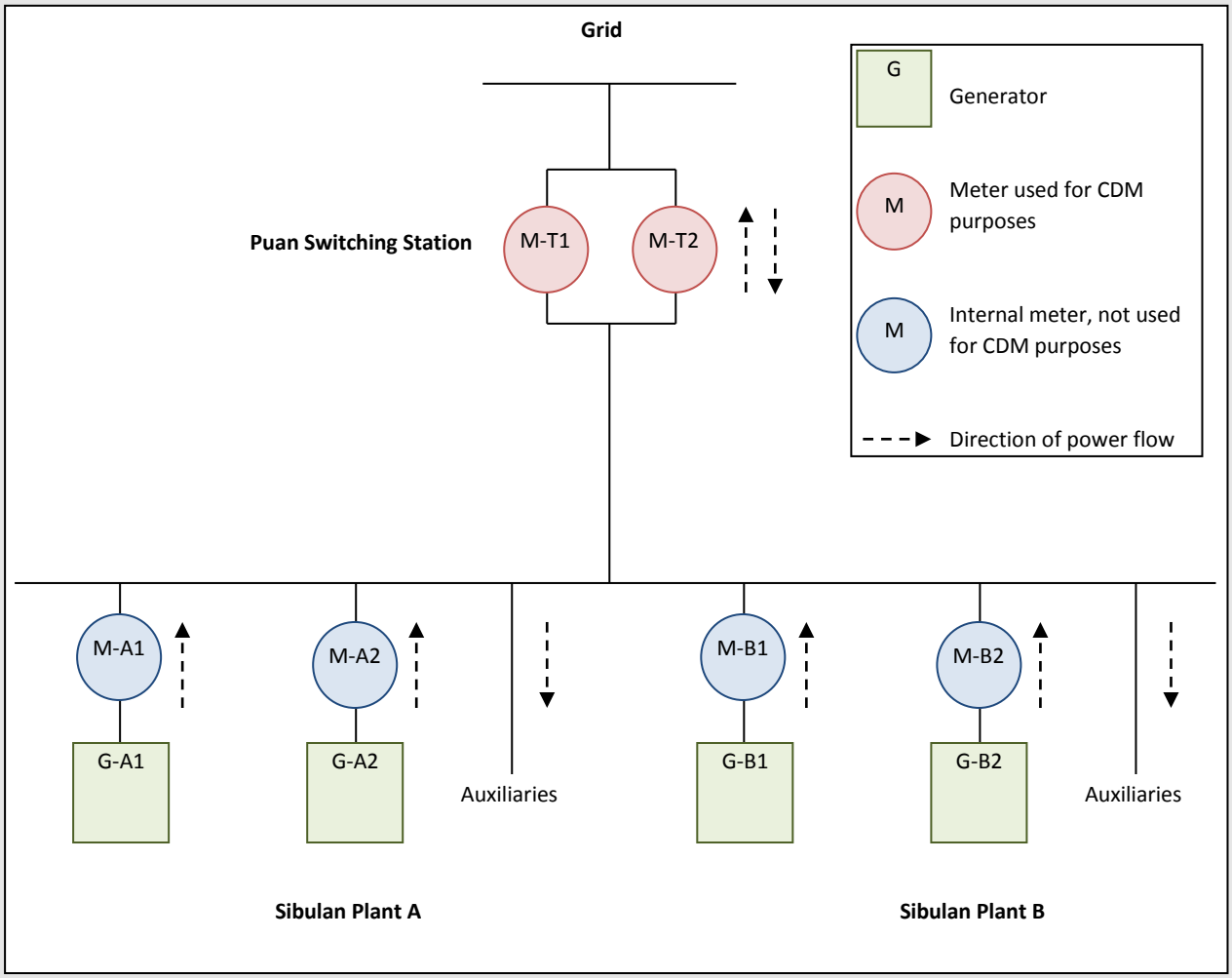
SECTION C. Description of monitoring system

C.1. Monitoring points



C.2. Organizational structure

Consistent with the registered CDM-PDD, an operational and administrative team as outlined below is responsible for monitoring and reporting. The team is composed of a Vice President of Operations, an Operations Manager as well as a group of engineers, operators, technicians and administrative staff.

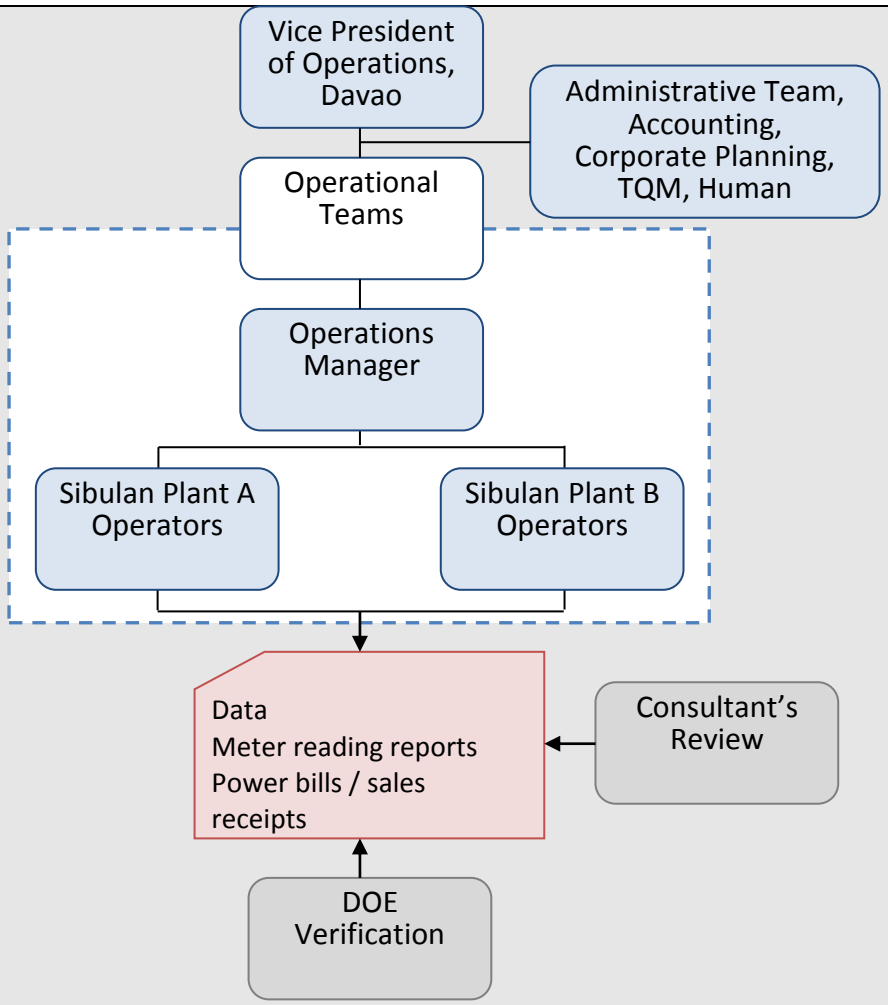


Figure 3: Operational and management structure for monitoring activity

The responsibilities of each team / person are summarized below.

Vice President of Operations, Davao: Final sign off on all data and QA/QC.

Administrative Team, Accounting Corporate Planning, TQM, Human Resources: These groups are all support teams, not directly related to operations and monitoring. However, much of the data for the purpose of double checking the monitored data is sourced here. For example, Accounting is responsible for interaction with DLP and final billing, where the invoice is an important part of QA/QC for the parameter EG_y. Also, Human Resource keeps a comprehensive database of personnel training.

Operations Manager: Oversight of the plants' operations, including managing the maintenance, continuous normal plant operations and maintaining the reliability of the plants.

Sibulan Plant A and B Operators: Responsible for day to day monitoring and reporting to management for any anomalous occurrences.

C.3. Data collection procedures

The collection of data is based on the billing reports submitted to the off-taker DLPC. The data in the billing reports is in turn based on the data downloaded from the revenue meter's internal memory, carried out by a National Grid Corporation of the Philippines (NGCP) representative in the presence of DLPC and HSI representatives. NGCP is the default metering services provider. All data are recorded in accordance with the procedures and stored electronically in a systematic, transparent and traceable manner.

The Operational and Administrative Teams will review the data archived and submit a complete set of documentation, which indicates the calculation procedure as well as the ex-post emission reduction estimate to the Corporate Planning Department for internal verification on a monthly basis.

CDM trainings were provided to operators regularly.

C.4 Emergency procedures for the monitoring system

The plant has a Standard Operation Procedure that is in line with ISO standards.

The electricity meter was replaced in accordance to the Philippines Grid Code. In any case that the records from main meter cannot be used, the data recorded by the backup meter will be used.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	**w_{OM}, w_{BM}**	
Unit:	Fraction	
Description:	Weight of Operating Margin in the Combined Margin, weight of the Build Margin in the Combined Margin	
Source of data:	ACM0002 Version 06	
Value(s) applied):	w_{OM}	0.5
	w_{BM}	0.5
Purpose of data:	Baseline emission calculations	
Additional comment:	N/A	

Data / Parameter:	**CO_2 emission factor**	
Unit:	$kgCO_2/TJ$	
Description:	CO_2 emission factor of fuels	
Source of data:	IPCC 2006 Volume 2 Table 2.2	
Value(s) applied):	Residual fuel oil	77,400
	Gas / diesel oil	74,100
	Coal (anthracite)	98,300
Purpose of data:	Baseline emission calculations	
Additional comment:	N/A	

Data / Parameter:	**NCV**
Unit:	TJ/kt
Description:	NCV of fuels
Source of data:	Philippines Department of Energy

Value(s) applied):	Residual fuel oil: 43 Gas / diesel oil: 46 Coal (anthracite): 23
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

Data / Parameter:	**Density**
Unit:	kg/l
Description:	Density of fuels
Source of data:	Philippines Department of Energy
Value(s) applied):	Residual fuel oil: 0.94 Gas / diesel oil: 0.84 Coal (anthracite): 1
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

D.2. Data and parameters monitored

Data / Parameter:	**Surface area at full reservoir level**
Unit:	m^2
Description:	Surface area of the reservoir / head pond to show the level of project emissions
Measured/ Calculated / Default:	Measured
Source of data:	HSI
Value(s) of monitored parameter:	31,000m^2 (Plant A = 16,900 m^2, Plant B = 14,100 m^2)
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Once at the start of the project activity
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	Project emission calculations
Additional comment:	N/A

Data / Parameter:	**EG_y**

Unit:	MWh
Description:	Electricity supplied to the grid by the Project
Measured/ Calculated / Default:	Measured
Source of data:	HSI through DLPC
Value(s) of monitored parameter:	577,948.5
Monitoring equipment:	Electricity meters
Measuring/ Reading/ Recording frequency:	Monitored continuously, recorded monthly
Calculation method (if applicable):	

Type	Accuracy Class	Serial Number	Calibration Frequency	Date of Last Calibration	Validity
Main (AMETEK Ci20)	0.2	114525 770	1 year (per NGCP)	03/10/2013	02/10/ 2014
Main (NEXUS 1272)	0.2	2004-411-94930	1 year (per NGCP)	19/04/2011	18/04/ 2012

QA/QC procedures:	The measured amount will be double checked against sales receipts. Meters are to be calibrated based on existing procedures that are consistent with ISO standards which have been applied to existing ISO Certified Hedcor, Inc. Plants.
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

Data / Parameter:	**EF_y**
Unit:	tCO_2/MWh
Description:	CO_2 emission factor of the grid
Measured/ Calculated / Default:	Calculated
Source of data:	N/A (calculated)
Value(s) of monitored parameter:	2010: 0.828 2011: 0.832 2012: 0.829
Monitoring equipment:	N/A

Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	$EF_y = w_{OM} \times EF_{OM,y} + w_{BM} \times EF_{BM,y}$, as per Equation 2 of Section E.1.
QA/QC procedures:	N/A
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

Data / Parameter:	**$EF_{OM,y}$**
Unit:	tCO_2/MWh
Description:	CO_2 emission factor of set of plants in the Operating Margin
Measured/ Calculated / Default:	Calculated
Source of data:	N/A (calculated)
Value(s) of monitored parameter:	2010: 0.785 2011: 0.796 2012: 0.790
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	$EF_{OM,y} = EF_{OM,simple\_adjusted,y} = (1-\lambda_y) \times \frac{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \times \frac{\sum_{i,k} F_{i,k,y} \times COEF_{i,k}}{\sum_k GEN_{k,y}}$, as per Equation 3 of Section E.1.1.
QA/QC procedures:	N/A
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

Data / Parameter:	**$EF_{BM,y}$**
Unit:	tCO_2/MWh
Description:	CO_2 emission factor of set of plants in the Build Margin
Measured/ Calculated / Default:	Calculated
Source of data:	N/A (calculated)
Value(s) of monitored parameter:	2010: 0.871 2011: 0.869 2012: 0.868

Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	$EF_{BMy} = \frac{\sum_{i,m} F_{i,m,y} \times COEF_{i,m}}{\sum_{m} GEN_{m,y}}$, as per Equation 3 of Section E.1.2.
QA/QC procedures:	N/A
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

Data / Parameter:	**$F_{i,y}$**
Unit:	Mass or volume
Description:	Amount of fuel consumed type i consumed by each power source / plant
Measured/ Calculated / Default:	Measured and Calculated
Source of data:	Philippines Department of Energy, CDM Baseline Construction for The Electricity Grids in the Philippines, *Tool to calculate the emission factor for an electricity system*
Value(s) of monitored parameter:	Method A: Host country data

Source	Fuel consumed 2010 (L or t)	Fuel consumed 2011 (L or t)	Fuel consumed 2012 (L or t)
Residual fuel oil	1,013	51	165
Gas / diesel oil	360,073	246,162	297,221
Coal (anthracite)	698,180	658,943	682,191

Method B: *Tool to calculate the emission factor for an electricity system*

Source	Fuel consumed 2010 (L or t)	Fuel consumed 2011 (L or t)	Fuel consumed 2012 (L or t)
Residual fuel oil	1,030	51	168
Gas / diesel oil	353,986	242,001	292,197
Coal (anthracite)	686,377	647,804	670,658

For conservatism, the fuel consumption based on host country data and the default efficiencies in the *Tool to calculate the emission factor for an electricity system* were compared, and the lower (Method B) taken for the CER calculations.

Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

Data / Parameter:	**$COEF_i$**
Unit:	tCO_2/ unit fuel
Description:	CO_2 emission coefficient of each fuel type *i*
Measured/ Calculated / Default:	Calculated
Source of data:	IPCC, Philippines Department of Energy
Value(s) of monitored parameter:	Source: CO_2 emission factor ($kgCO_2$/L or t) for 2010, ,2011 and 2012 Residual fuel oil: 3,554.69 Gas / diesel oil: 4,023.25 Coal (anthracite): 2,281.54
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

Data / Parameter:	**$GEN_{j/k/n,y}$**
Unit:	MWh
Description:	Electricity generation of each power source / plant *j*, *k* or *n*
Measured/ Calculated / Default:	Measured

Source of data:	Philippines Department of Energy
Value(s) of monitored parameter:	<table><tr><td></td><td>2010</td><td>2011</td><td>2012</td></tr><tr><td>$GEN_{j,y}$</td><td>3,813,089</td><td>3,052,537</td><td>3,405,835</td></tr><tr><td>$GEN_{k,y}$</td><td>4,589,680</td><td>5,650,113</td><td>5,721,036</td></tr></table>
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

Data / Parameter:	**Plant name (OM)**
Unit:	Text
Description:	Power source / plant for constituting the Operating Margin
Measured/ Calculated / Default:	Measured
Source of data:	Philippines Department of Energy

Value(s) of monitored parameter:	

Source (*j* or *k*)	Plant type	Plant name	
		2010 & 2011	2012
j	Coal	Mindanao Coal I Mindanao Coal II	Mindanao Coal I Mindanao Coal II
j	Diesel	Mindanao Energy Systems 1 Cotabato Light Davao Light (Bajada DPP) Gen Santos (SPPC) PB104 Power Barge 117 Power Barge 118 Western Mindanao Power Corp NMPC I (Iligan Diesel Plant) NMPC II	Mindanao Energy Systems 1 Mindanao Energy Systems 2 Cotabato Light Davao Light (Bajada DPP) King Energy Gen Santos (SPPC) PB104 Power Barge 117 Power Barge 118 Western Mindanao Power Corp NMPC I (Iligan Diesel Plant) NMPC II
j	Residual fuel oil		
k	Geothermal	Mindanao I (Mt. Apo) Mindanao II (Mt. Apo)	Mindanao I (Mt. Apo) Mindanao II (Mt. Apo)
k	Hydro	Agus 1 Unit 1 Agus 1 Unit 2 Agus 2 Agus 4 Agus 5 Agus 6 Agus 7 Pulangi 4 Agusan Bubunawan Talomo HEPP Balactasan Kumalarang Mountain View Matling	Agus 1 Unit 1 Agus 1 Unit 2 Agus 2 Agus 4 Agus 5 Agus 6 Agus 7 Pulangi 4 Agusan Bubunawan Talomo HEPP Balactasan Kumalarang Mountain View Matling
k	Solar	Solar Photovoltaic	Solar Photovoltaic
k	Biomass		Crystal Sugar

Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	Baseline emission calculations

Additional comment:	N/A

Data / Parameter:	**Plant name (BM)**
Unit:	Text
Description:	Power source / plant for constituting the Build Margin
Measured/ Calculated / Default:	Measured
Source of data:	Philippines Department of Energy
Value(s) of monitored parameter:	

2010 & 2011		2012	
Plant type	Plant name	Plant type	Plant name
Hydro	Bubunawan	Coal	Mindanao Coal I
Solar	Solar Photovoltaic	Coal	Mindanao Coal II
Diesel	PB104	Diesel	Mindanao Energy System 2
Coal	Mindanao Coal I	Diesel	King Energy
Coal	Mindanao Coal II	Biomass	Crystal Sugar

Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

Data / Parameter:	**λ_y**
Unit:	Fraction
Description:	Fraction of time during which low-cost/must-run resources are on the margin
Measured/ Calculated / Default:	Measured and calculated
Source of data:	NGCP, Philippines Department of Energy, CDM Baseline Construction for The Electricity Grids in the Philippines
Value(s) of monitored parameter:	2010 = 0 (no intersection) 2011 = 0.009 2012 = 0.005

Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	As per steps (i) – (iv) in Section E.1.1, which follows ACM0002 Version 06.
QA/QC procedures:	N/A
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

Data / Parameter:	**$GEN_{j/k/n,y\_IMPORTS}$**
Unit:	MWh
Description:	Electricity imports to the project electricity system
Measured/ Calculated / Default:	Measured
Source of data:	Philippines Department of Energy
Value(s) of monitored parameter:	2010 = 0 2011 = 0 2012 = 0
Monitoring equipment:	Baseline emission calculations
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

Data / Parameter:	**$COEF_{i,j,y\_IMPORTS}$**
Unit:	tCO_2/mass or volume unit
Description:	CO_2 emission coefficient of fuels used in connected electricity system (if imports occur)
Measured/ Calculated / Default:	Measured
Source of data:	Philippines Department of Energy

Value(s) of monitored parameter:	N/A (no imports) for 2010, 2011 and 2012
Monitoring equipment:	Baseline emission calculations
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	Baseline emission calculations
Additional comment:	N/A

D.3. Implementation of sampling plan

No implementation of sampling plan for the Project.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

Consistent with ACM0002 Version 06 and the registered CDM-PDD, the baseline emissions BE_y are calculated as:

Equation 1

$$BE_y = EG_y \times EF_y$$

where:

EG_y = Electricity supplied to the grid by the Project in year *y* (MWh);

EF_y = Emission factor for grid electricity for year *y* (tCO_2/MWh).

The grid emission factor, EF_y, is calculated as the Combined Margin emission factor, which is the weighted average of the Operating Margin emission factor and the Build Margin emission factor, as follows.

Equation 2

$$EF_y = w_{OM} \times EF_{OM,y} + w_{BM} \times EF_{BM,y}$$

where:

w_{OM} = Weight of Operating Margin in the Combined Margin;

w_{BM} = Weight of Build Margin in the Combined Margin;

$EF_{OM,y}$ = Emission factor of set of plants in the Operating Margin in year *y* (tCO_2/MWh);

$EF_{BM,y}$ = Emission factor of set of plants in the Build Margin in year *y* (tCO_2/MWh).

As per the registered CDM-PDD, both the Operating Margin and Build Margin emission factors are to be monitored and determined *ex post*. The steps and values are delineated in the ensuing sections.

E.1.1. Calculation of the Operating Margin ($EF_{OM,y}$)

For the Operating Margin, consistent with the registered CDM-PDD, the Simple Adjusted OM is applied and is calculated according to the following formula.

Equation 3

$$EF_{OM,y} = EF_{OM,simple\_adjusted,y} = (1-\lambda_y) \times \frac{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \times \frac{\sum_{i,k} F_{i,k,y} \times COEF_{i,k}}{\sum_k GEN_{k,y}}$$

where:

λ_y	Fraction of time during which low-cost/must-run resources are on the margin in year *y* (fraction);
$F_{i,j,y}$	Amount of fuel consumed by relevant power sources *j* in year *y*, where *j* refers to the power sources in the grid excluding low-cost/must-run power plants and including any imports to the grid;
$F_{i,k,y}$	Amount of fuel consumed by relevant power sources *k* in year *y*, where *k* refers to the low-cost/must-run power sources in the grid;
$COEF_{i,j}$	CO_2 emission coefficient of fuel *i* used in power sources *j* (tCO_2/mass or volume unit);
$COEF_{i,k}$	CO_2 emission coefficient of fuel *i* used in power sources *k* (tCO_2/mass or volume unit);
$GEN_{j,y}$	Electricity supplied to the grid by source *j* (MWh);
$GEN_{k,y}$	Electricity supplied to the grid by source *k* (MWh).

$EF_{OM,simple\_adjusted,y}$ is calculated based on 2010, 2011 and 2012[1,2] data, as follows:

Step (i) Plot a Load Duration Curve

The hourly system load data was collected and sorted from highest to lowest MW level. This is then plotted against 8,760 hours in the year, in descending order.

Table 3: Extract of hourly system load for Mindanao grid in 2010

Hour	Date (mm/dd/yyyy)	Time (hh:mm)	System Load (MW)
1	12/2/2010	18:00	1,287.78
2	11/23/2010	18:00	1,286.27
3	12/13/2010	18:00	1,278.77
8,758	4/2/2010	08:00	603.60
8,759	8/13/2010	14:00	601.84
8,760	4/2/2010	07:00	593.60

Table 4: Extract of hourly system load for Mindanao grid in 2011

Hour	Date (mm/dd/yyyy)	Time (hh:mm)	System Load (MW)
1	21/12/2011	18:00	1,297
2	27/10/2011	18:00	1,282
3	14/12/2011	18:00	1,281
8679	24-04-11	8:00	647
8680	18-02-11	3:00	645
8681	22-04-11	10:00	645
8758	23-04-11	2:00	543
8759	22-04-11	8:00	539
8760	22-04-11	7:00	514

Table 5: Extract of hourly system load for Mindanao grid in 2012

[1] Requested and obtained from National Grid Corporation of the Philippines

[2] Full data set submitted to DOE during verification

Hour	Date (mm/dd/yyyy)	Time (hh:mm)	System Load (MW)
1	19-12-12	18:00	1257
2	14-06-12	19:00	1252
3	20-09-12	18:00	1251
8742	01-01-12	10:00	652
8743	06-12-12	4:00	652
8744	25-12-12	6:00	650
8782	05-12-12	1:00	503
8783	05-12-12	4:00	503
8784	04-12-12	13:00	478

Based on the above, the load duration curve is plotted. The curves for 2010, 2011 and 2012 are shown below.

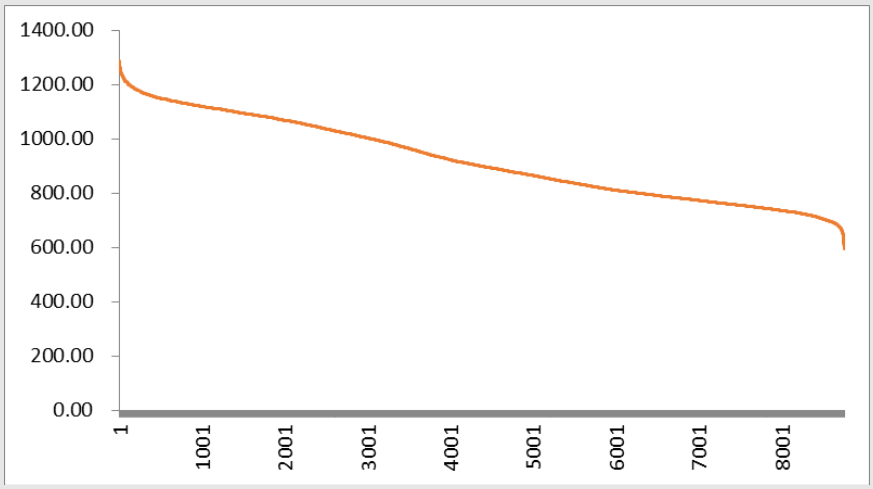


Figure 4: Load duration curve (1) for Mindanao grid in 2010

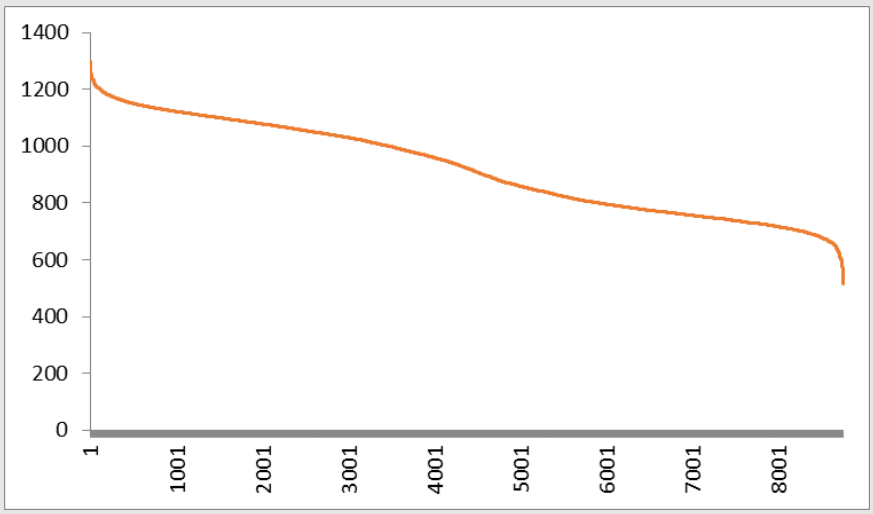


Figure 5: Load duration curve (1) for Mindanao grid in 2011

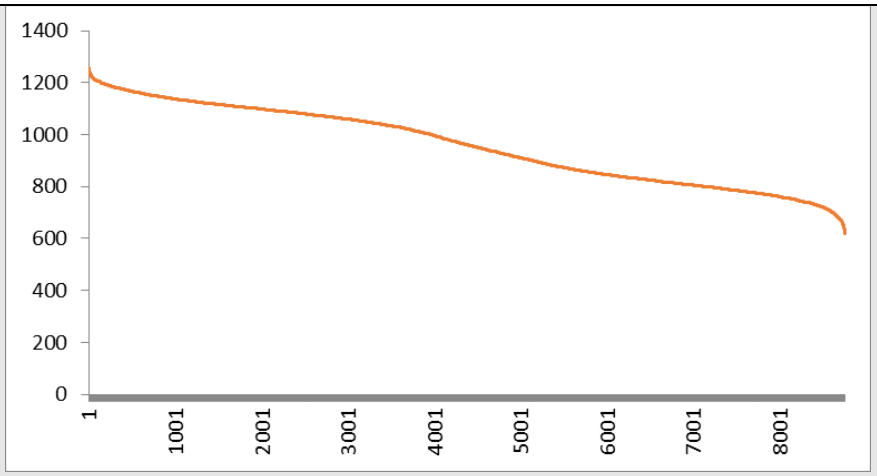


Figure 6: Load duration curve (1) for Mindanao grid in 2012

Step (ii) Organize data by generating sources

The annual generation from low-cost/must-run resources ($\sum_k GEN_{k,y}$) is deduced from the following grid data.

Table 6: Annual power generation for Mindanao grid in 2010, 2011 and 2012[3,4]

Plant Type	Annual Power Generation (MWh)		
	2010	2011	2012
Coal	1,725,839	1,628,848	1,686,314
Oil-based Diesel Oil	 2,082,124 5,126	 1,423,433 256	 1,718,684 837
Geothermal	834,439	840,956	731,089
Hydro	3,753,987	4,807,945	4,913,491
Solar	1,254	1,212	1,320
Biomass	-	-	75,136
Total	8,402,769	8,702,650	9,126,871
Total LCMR	4,589,680	5,650,113	5,721,036

Consistent with ACM0002, hydro and geothermal, solar and biomass power sources were deemed to be low-cost/must-run resources. Generation from these plants totalled 4,589,680MWh, 5,650,113MWh and 5,721,036MWh in 2010, 2011 and 2012 respectively.

Step (iii) Fill Load Duration Curve

The average load (in MW) from low-cost/must-run resources in a year is calculated by dividing the total generation from low-cost/must-run resources, determined in Step (ii) as 4,589,680MWh, 5,650,113MWh and 5,721,036MWh in 2010, 2011 and 2012 respectively, by 8,760 hours of the year. This gives an average load of 524MW in 2010, 645MW in 2011 and 651MW in 2012s.

[3] Philippines Department of Energy, www.doe.gov.ph
[4] As per AM_CLA_0038, the data from the year previous to generation is used

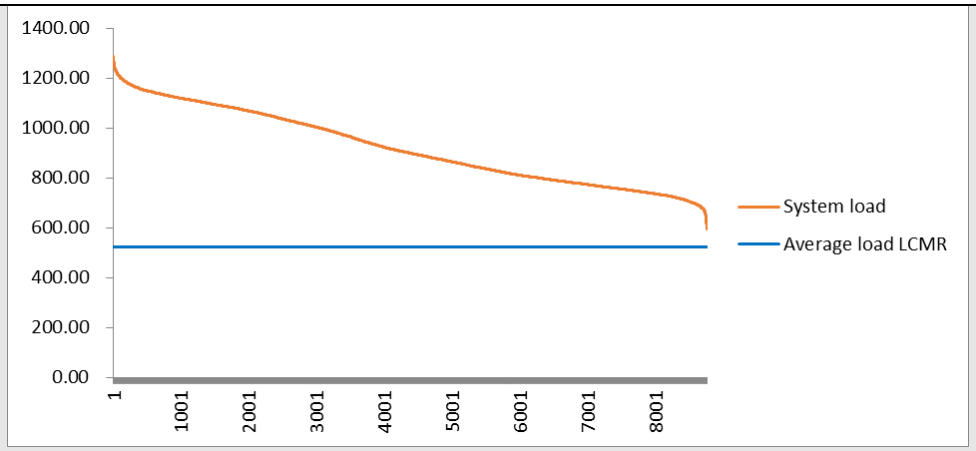


Figure 7: Load duration curve (2) for Mindanao grid in 2010

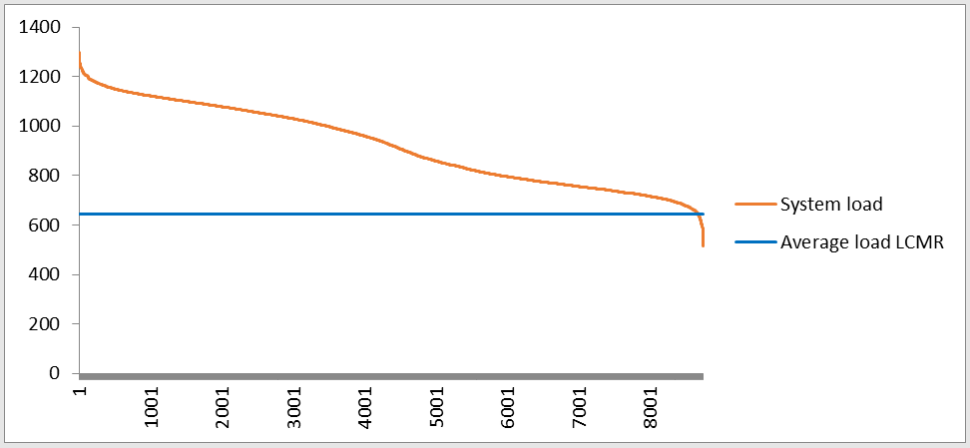


Figure 8: Load duration curve (2) for Mindanao grid in 2011

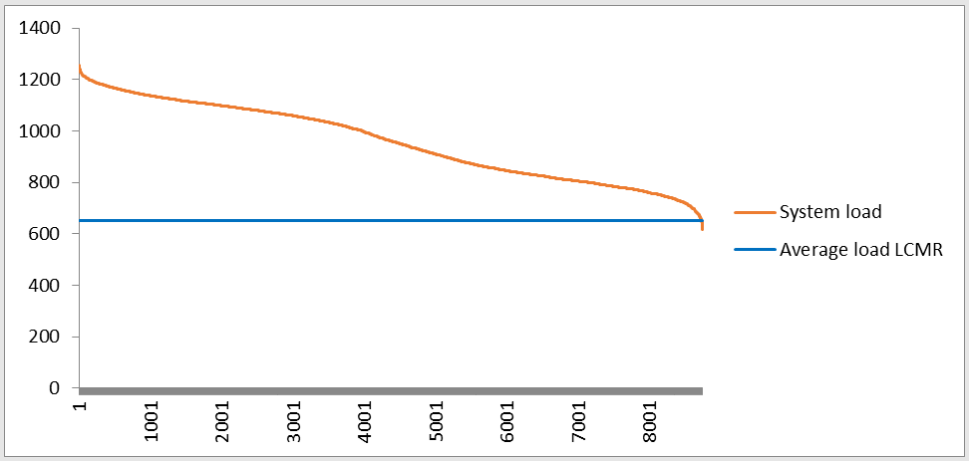


Figure 9: Load duration curve (2) for Mindanao grid in 2012

Step (iv) **Determine the number of hours per year for which low-cost/must-run sources are on the margin.**

The fraction of time during which low-cost/must-run resources are marginal is the number of hours to the right of the intersection of the two lines as shown for 2011 and 2012 in Figure 8 and Figure 9 respectively. As the lines intersect at the 8,680th hour in 2011 and 8,743th hour in 2012, the low-cost/must-run resources are considered to be marginal for 80 hours (8,760 hours – 8,680 hours) of the year 2011 and 41 hours (8,784 hours – 8,743 hours) of the year 2012. This is divided by the

total number of hours in the year to obtain λ_y, which is 0.009 and 0.005 in 2011 and 2012 respectively. For 2010, the lines do not intersect. Hence, λ_y for 2010 is 0.

The next step is to calculate the Simple Adjusted OM emission factor using Equation 3. As the power sources *k* – low-cost/must-run plants – consist of hydro, geothermal and solar resources, emission from this source is considered zero. Therefore, Equation 3 can be simplified to the following.

Equation 4

$$EF_{OM,simple\_adjusted,y} = (1 - \lambda_y) \times \frac{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}}{\sum_j GEN_{j,y}}$$

Table 7: 2012 statistics for fossil fuel fired plants in Mindanao grid

Plant Type	Annual Power Generation (MWh)			Fuel Consumption (TJ)		
	2010	**2011**	**2012**	**2010**	2011	**2012**
Coal	1,725,839	1,628,848	1,686,314	16,205	658,943	682,191
Oil-based						
Diesel	2,082,124	1,423,433	1,718,684	19,550	246,162	297,221
Oil	5,126	256	837	48	51	165
Total	3,813,089	3,052,537	3,405,835	35,803	905,156	979,577

The above data is used in conjunction with IPCC values as provided in Section D.1, to obtain a weighted average emission factor of 0.785 tCO_2/MWh. Adjusting for $\lambda_y = 0$ the Simple Adjusted OM emission factor is:

$EF_{OM,simple\_adjusted,y}$ = (1-0) x 0.785 tCO_2/MWh
= 0.785 tCO_2/MWh

Repeating the same steps for 2011 and 2012 gives 0.796 tCO_2/MWh and 0.760 tCO_2/MWh respectively.

E.1.2. Calculation of the Build Margin ($EF_{BM,y}$)

The Build Margin is calculated as the generation-weighted average emission factor of a sample of power plants *m*, as follows.

Equation 5

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \times COEF_{i,m}}{\sum_m GEN_{m,y}}$$

where

$F_{i,m,y}$ Amount of fuel consumed by sample group *m* in year *y*, where sample group *m* consists of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently;

$COEF_{i,m}$ CO_2 emission coefficient of fuel *i* used in sample group *m* (tCO_2/mass or volume unit);

$GEN_{m,y}$ Electricity supplied to the grid by sample group *m* (MWh).

As can be seen in Table 8, the five newest plants represent 20% of the total grid power generation.

Table 8: Build Margin power plants[5]

Plant Name	Year Commissioned	Power Generation (MWh)			Fuel Consumption (L or t)		
		2010[6]	2011[7]	2012[8]	2010	2011	2012
Bubunawan Hydro	2001	61,320	61,320	61,320	0	0	0
Solar Photovoltaic	2004	8,760	8,760	8,760	0	0	0
PB104	2005	0	0	0	0	0	0
Mindanao Coal I	2006	1,725,839	1,628,848	1,686,314	698,180	658,943	682,191
Mindanao Coal II	2006						
Sibulan Hydro (the Project)	2010	N/A	N/A	N/A	N/A	N/A	N/A
Mindanao Energy System 2	2012			0			0
King Energy	2012			0			0
Crystal Sugar	2012			75,136			0
Total Generation		1,632,833	1,698,928	1,761,450			
% Total Grid Generation		20.0%					

The CO_2 emission factor for the Build Margin is calculated in the same manner as the Operating Margin. The Build Margin is therefore 0.871 tCO_2 / MWh for 2010, 0.869 tCO_2 / MWh for 2011 and 0.868 for 2012.

E.1.3. Calculate the baseline emission factor (EF_y)

The baseline emission factor is calculated as the Combined Margin, which is the weighted average of the Operating Margin and Build Margin emission factors, as given in Equation 2. Default weightings of 50% each, as given in Section D.1, are used.

The simple average of 0.785 tCO_2/MWh and 0.871 tCO_2/MWh is 0.828 tCO_2/MWh. The baseline emission factor is therefore 0.828 tCO_2 / MWh for year 2010. For 2011 and 2012, the simple average results in 0.832 tCO_2 / MWh and 0.829 tCO_2 / MWh respectively.

E.1.4. Calculate baseline emissions (BE_y)

The baseline emission is calculated by multiplying the electricity supplied by the Project to the grid with the baseline grid emission factor, as per Equation 1.

Since the Sibulan plants supplied 577,948.5 MWh of electricity during this monitoring period, the total baseline emissions is 479,566 tCO_2

E.2. Calculation of project emissions or actual net GHG removals by sinks

According to ACM0002, project emissions may arise for hydro power projects with new reservoirs. The Project is run-of-the-river type that does not require a reservoir. It only has small head ponds for the purpose of regulating daily output. The size of these head ponds are such that no project emissions need to

[5] Philippines Department of Energy

[6] No publicly available generation data for "Bubunawan Hydro", "Solar Photovoltaic" and "PB104" plants. For the most conservative estimate theoretically possible, assumed maximum load for the first two renewable plants, and zero load for PB104 diesel plant.

[7] No publicly available generation data for "Bubunawan Hydro", "Solar Photovoltaic" and "PB104" plants. For the most conservative estimate theoretically possible, assumed maximum load for the first two renewable plants, and zero load for PB104 diesel plant.

[8] No publicly available generation data for "PB104", "Mindanao Energy System 2" and "King Energy" plants. For the most conservative estimate theoretically possible, assumed zero load for the three diesel plants.

be accounted for, as shown in the following table.

Table 9: Power density of the Sibulan plants

Plant	Installed Capacity (MW)	Head Pond Surface Area (m^2)	Power Density (W/m^2)
Plant A	16.5	16,900	976
Plant B	26	14,100	1,844
Total	42.5	31,000	1,370

The power density of the Project is well over $10W/m^2$. Therefore, there are no associated project emissions.

E.3. Calculation of leakage

ACM0002 Version 06 stipulates that neither positive nor negative leakage in relation to activities such as power plant construction, fuel handling and land inundation are not to be accounted for. No leakage is associated with the Project.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks ($t CO_2e$)	Project emissions or actual net GHG removals by sinks ($t CO_2e$)	Leakage ($t CO_2e$)	Emission reductions or net anthropogenic GHG removals by sinks ($t CO_2e$)
Total	479,566	0	0	479,566

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks ($t CO_2e$)	255,796	479,566

E.6. Remarks on difference from estimated value in registered PDD

As can be seen in Section E.5, a significant difference in CERs between the estimated value in the PDD and MR has been observed, where the amount of CERs in the MR is greater by 89%.

The CER amount is a product of (a) the electricity supplied to the grid by the Project (EG_y) and (b) the CO_2 emission factor of the grid (EF_y), where for the 32-month monitoring period:

(a) The electricity supplied to the grid by the Project was higher than the estimated performance in the PDD by 3%.
(b) CO2 emission factor of the grid, which is to be monitored *ex post* as per the registered PDD, increased significantly – by 83% – largely due to the commissioning of two large coal plants in Mindanao.

The 3% increase of electricity generation as compared to the PDD is well within the sensitivity analysis conducted in the PDD, and can be considered negligible. It would not be an overstatement to state that the increase in CERs is solely caused by the change in the grid emission factor, which in no way affects the Project's additionality. Hence, no further discussion is made

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	288,248	191,318

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Document information

Version	*Date*	*Description*
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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