Monitoring report form for CDM project activity
(Version 06.0)

MONITORING REPORT		
Title of the project activity	Grid-connected Solar PV project in Méouane	
UNFCCC reference number of the project activity	10327	
Version number of the PDD applicable to this monitoring report	1.5	
Version number of this monitoring report	1.0	
Completion date of this monitoring report	06/07/2018	
Monitoring period number	1	
Duration of this monitoring period	01/05/2017 – 30/06/2018	
Monitoring report number for this monitoring report	MR1	
Project participants	Senergy PV SA	
Host Party	Senegal	
Sectoral scopes	Sectoral Scope : 1 - Energy industries (renewable - / non-renewable sources)	
Applied methodologies and standardized baselines	Methodology: ACM0002 - Grid-connected electricity generation from renewable sources - Version 16.0	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	-	28,993 tCO_2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	40,200 tCO_2e	

SECTION A. Description of project activity

A.1. General description of project activity

The "Grid-connected Solar PV project in Méouane" involves a solar photovoltaic (PV) plant of 29.49 MW in Méouane, department of Tivaouane, region of Thies, Senegal. The solar power plant covers an area of 64 hectares and is equipped with 92,160 modules of 320 W each, connected to the national grid.

Meridiam, FONSIS and Senergy SUARL set up the dedicated project company, Senergy PV SA. SolaireDirect, a top tier French PV developer and contractor has been in charge of the engineering, procurement, and construction (EPC) and operation and maintenance (O&M) through turnkey contracts.

A.2. Location of project activity

The project is located in the village of Santhiou Mékhé, Commune of Méouane, Department of Tivaouane, region of Thiès in Senegal (130km from Dakar). Méouane´s geographical coordinates are 15° 07' 53.52" N and 16° 40' 22.28" W.

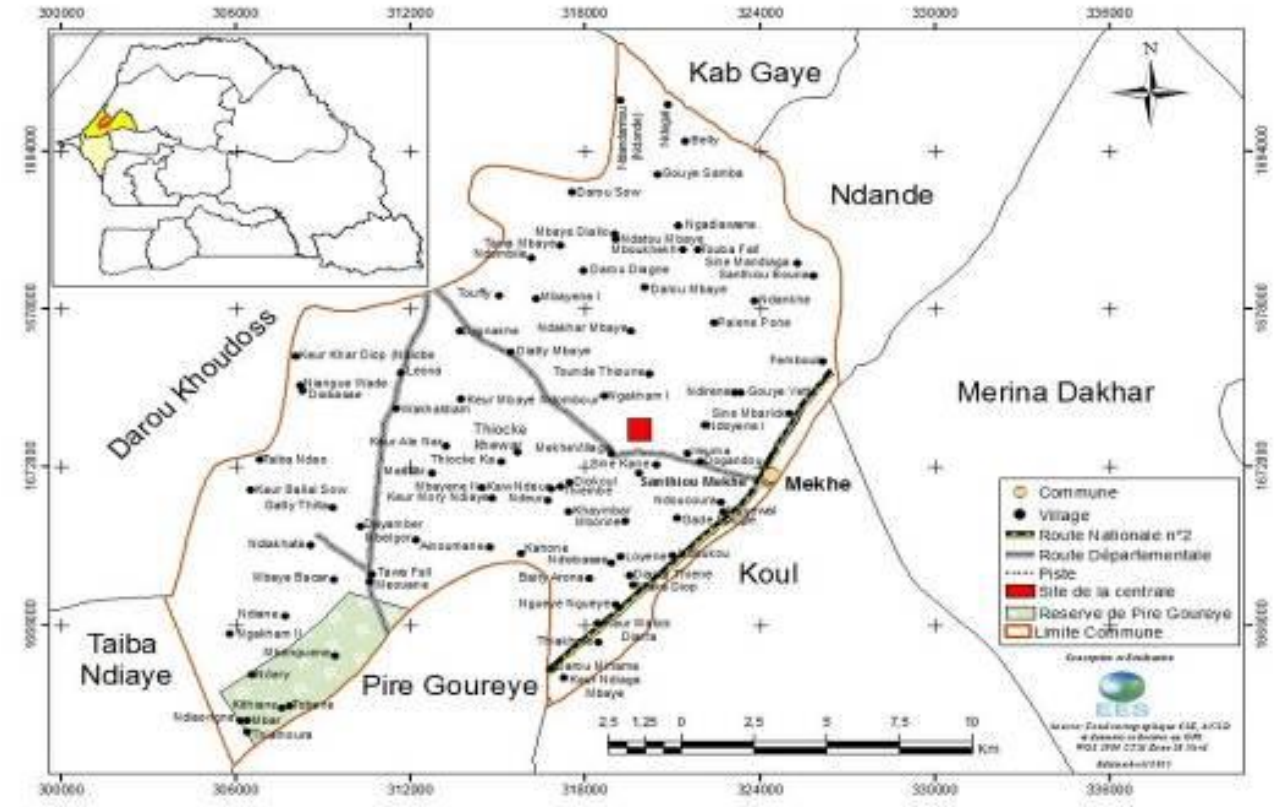


Figure 1: Location of the project[1]

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Senegal	Senergy PV SA	No

A.4. Reference to applied methodologies and standardized baselines

[1]The red square represents the site location.

The approved baseline and monitoring methodology selected for to the proposed project activity is:

ACM0002: Large-scale Consolidated Methodology: Grid-connected electricity generation from renewable sources, Version 16.0.

The methodology also refers to the latest approved version of the "Tool to calculate the emission factor for an electricity system" (Version 5.0, EB87, Annex 9) which is applied by the project.

A.5. Crediting period type and duration

The project activity applies a renewable crediting period of 7 years (i.e. 84 months). This monitoring period belongs to the first 7 years crediting period of the project.

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

The project relies on solar power sources through photovoltaic conversion technology to produce electricity, which is fed into the Senegalese grid. Prior to the implementation of the project, the site was not used, neither for agricultural nor industrial purposes.

The PV array consists of 92,160 fields polycrystalline photovoltaic modules of 320 W for a total installed capacity of 29,491.2 kW (equivalent to 20,400 kilowatts to the inverter output). The modules installed are the JC320M/24-Abs of poly silver frame solar panel manufactured by Renesola.

Table 1: Electrical and mechanical characteristics of the modules

Peak Power (W)	320
Type of cells	Poly Silver Frame
Rated voltage (Vmpp) STC (V)	37.4
Rated current (Impp) STC (A)	8.56
Yield (%)	16.5
Length (mm)	1,956
Width (mm)	994
Thickness(mm)	40

The facility is connected to the grid via the substation Mékhé (located about 9.5 km away).

Relevant implementation dates and events during operation are described in the table below.

Table 2: Relevant implementation dates

Date	Event
24/05/2017 to 31/05/2017	No-load test
27/06/2017	Electrical connection to Senelec grid
11/07/2017 to 25/07/2017	Load tests
26/09/2017 to 06/10/2017	Performance tests under EPC contract & power purchase agreement
28/07/2017	Effective start date of electricity export

Table 3: Relevant events during operation

Date	Event
12/08/2017	Decoupling of the power plant after a lightning strike
14/08 to 20/09/2017	Failure of 2 inverters following the lightning strike
25/10 to 12/11/2017	Decoupling of the power plant following circuit breaker failure at substation SDE (grid)
14/12/2017	Beginning of O&M
10/03/2018	Decoupling for ABB busbar extension at substation SDE (grid)

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

Not applicable

B.2.2. Corrections

Not applicable

B.2.3. Changes to the start date of the crediting period

Following project implementation delays, the start date of the crediting period is postponed from 01/05/2017 to 28/07/2017 (actual commissioning date), in compliance with §278 "Changes to the start date of the crediting period" of the CDM Project Standard.

B.2.4. Inclusion of monitoring plan

Not applicable

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

Not applicable

B.2.6. Changes to project design

Not applicable

SECTION C. Description of monitoring system

The proposed project activity´s monitoring plan complies with the methodology ACM0002 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources (Version 16.0), whereby it is stated that:

"All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated otherwise in the tables of Section 6.1 of ACM0002 Ver. 16. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards".

Therefore, the quantity of net electricity generation supplied by the project plant to the grid is reliably monitored through two calibrated electricity meters installed at Senelec's sub-station and cross-checked with sales records as follows.

The SCADA[2] system allows the whole PV facilities to be manually or automatically controlled and monitored:
- Locally, from the equipment and/or HMI[3] installed in Main Distribution Substation
- Remotely, from a dedicated operator console station.

2x2 electricity meters were installed at the 30 kV delivery point before export to Senelec's substation, 1 Senelec and 1 Senergy PV SA meter at each of the two measuring points (panels connected to ITS1-5-9-10-11-12 & panels connected to ITS2-3-4-6-7-8):

Meter	Serial number
SENELEC1	73068569
SENERGY1	73068570
SENELEC2	73068568
SENERGY2	73068571

[2] SCADA means Supervisory Control and Data Acquisition.
[3] HMI means Human Machine Interface.

All meters are ITRON SL7000 type with accuracy class 0.2S (active), 2 (reactive) and compliant with IEC standards 62053-22 & 62053-23. They have been successfully calibrated and verified at Itron factory on September 14th, 2016.

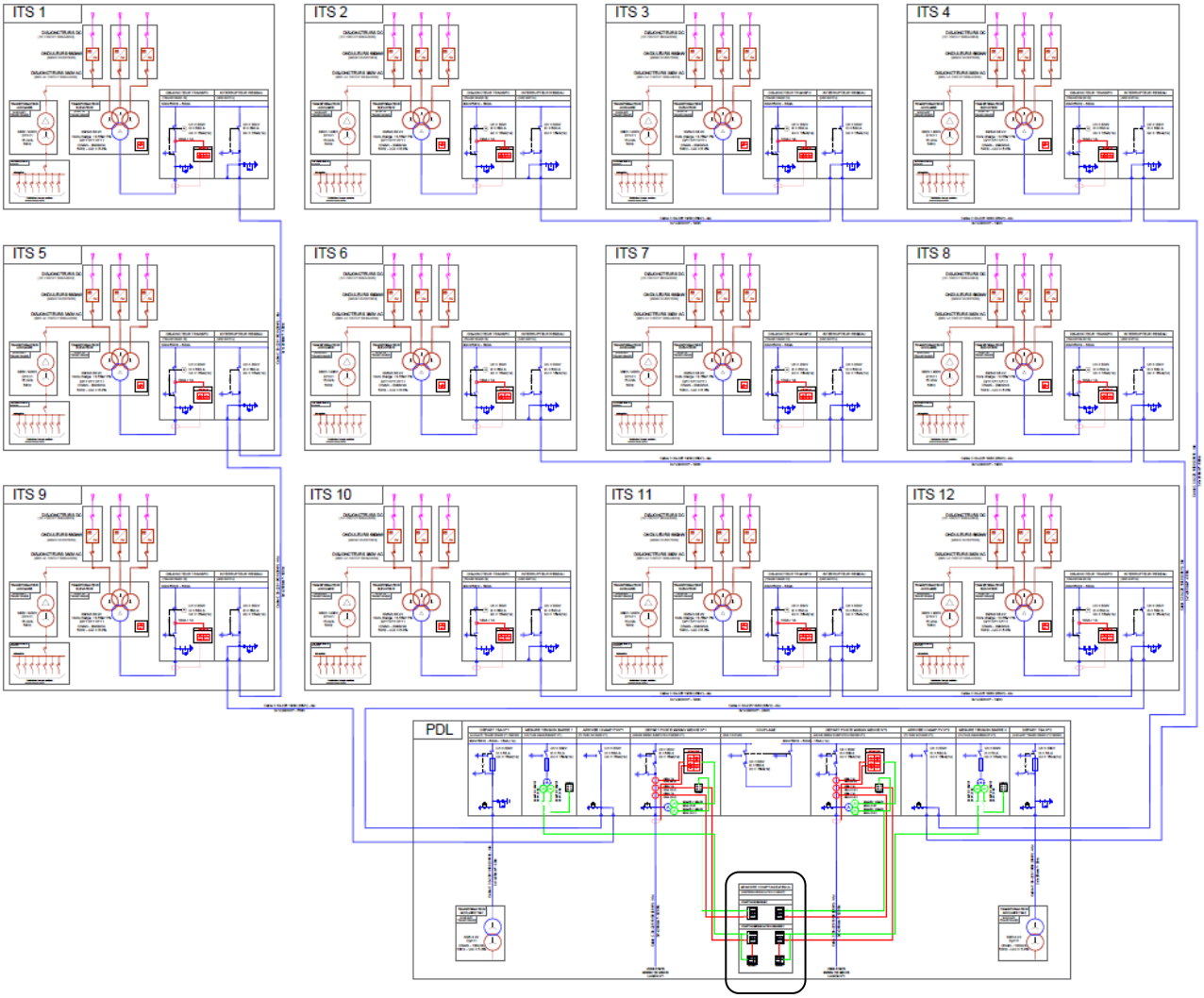
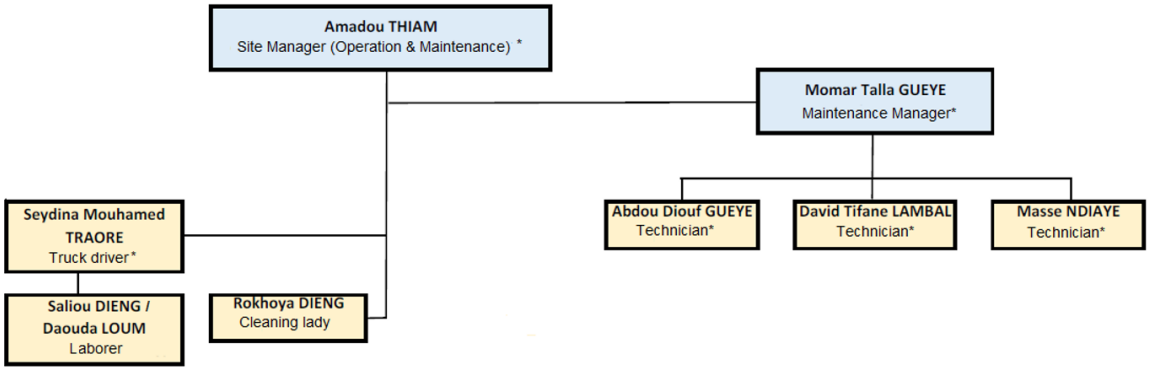


Figure 2: Schematic of Solar PV plant with <u>metering</u> points

The organizational structure, roles and responsibilities of personnel for the operation and maintenance of the power plant is shown in the graph below. Technical/maintenance department is responsible for monitoring.



- A labourer and a cleaning lady are locally recruted. The security personnel is locally recruited with full-time contracts, outsourced by EIFFAGE to WESTPOINT SECURITY
* Shared staff between SENERGY and TEN MERINA power plants.

Figure 3: Organizational structure, roles and responsibilities of personnel

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	$EF_{CO2,i,y}$
Unit	t CO_2/GJ
Description	CO_2 emission factor of fuel type *i* used in power unit *m* in year *y*
Source of data	IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories have been applied as no other values can be provided by SENELEC or by the Ministry of Energy.
Value(s) applied	Refer to the Excel sheet of registered ex ante ER calculation
Choice of data or measurement methods and procedures	-
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

Data/Parameter	$NCV_{i,y}$
Unit	GJ/mass or volume unit
Description	Net calorific value (energy content) of fuel type *i* in year *y*
Source of data	All NCV values have been provided by the national power utility (SENELEC).
Value(s) applied	Refer to the Excel sheet of registered ex ante ER calculation
Choice of data or measurement methods and procedures	-
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

Data/Parameter	$EF_{grid,CM,y}$
Unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”
Source of data	As per data provided by Senelec
Value(s) applied	0.6798
Choice of data or measurement methods and procedures	As per the “Tool to calculate the emission factor for an electricity system”
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	According to the methodology, this parameter will be revised at the renewal of each crediting period.

Data/Parameter	$EF_{grid,OM,y}$
Unit	tCO_2/MWh

Description	Operating Margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data	As per data provided by Senelec
Value(s) applied	0.6795
Choice of data or measurement methods and procedures	As per the "Tool to calculate the emission factor for an electricity system"
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	According to the methodology, this parameter will be revised at the renewal of each crediting period.

Data/Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	Build Margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data	As per data provided by Senelec
Value(s) applied	0.6808
Choice of data or measurement methods and procedures	As per the "Tool to calculate the emission factor for an electricity system"
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	According to the methodology, this parameter will be revised at the renewal of each crediting period.

Data/Parameter	$FC_{i,m,y}$
Unit	Mass or volume unit
Description	Amount of fuel type *i* consumed by power unit *m* in year *y*
Source of data	As per data provided by Senelec
Value(s) applied	Refer to the Excel sheet of registered ex ante ER calculation
Choice of data or measurement methods and procedures	-
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	-

Data/Parameter	$EG_{m,y}$
Unit	MWh
Description	Net electricity generated by power plant/unit *m, k* or *n* (or in the project electricity system in case of *EGy*) in year *y* or hour *h*
Source of data	For grid-connected plants, data are provided by the SENELEC. For off-grid power plants, "the value of 10 per cent of the total electricity generation by grid power plants in the electricity system" is used for the purpose of the operating margin determination; "The value of 10 per cent of the electricity generation by grid power plants included in the sample group as per Step 5" is used for the purpose of the build margin determination.

Value(s) applied	Refer to the Excel sheet of registered ex ante ER calculation
Choice of data or measurement methods and procedures	-
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

Data/Parameter	$\eta_{m,y}$
Unit	-
Description	Average net energy conversion efficiency of power unit *m* or *k* in year *y*
Source of data	Among the 3 options below: a) Documented manufacturer's specifications (if the efficiency of the plant is not significantly increased through retrofits or rehabilitations); or b) For grid power plants: data from the utility, the dispatch center or official records if it can be deemed reliable; or c) The default values provided in the table below in appendix 1 (if available for the type of power plant) Option c) is chosen because data for option a) and b) are not available.
Value(s) applied	37.50% for natural gas steam turbine for new units (after 2000).
Choice of data or measurement methods and procedures	-
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Option A2 is used for the calculation of the power unit called Aggreko Sococim, year 2011, 2012, 2013, as data on fuels consumption were not available

Data/Parameter	The percentage share of total installed capacity of the specific technology
Unit	%
Description	The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country
Source of data	Senelec official data
Value(s) applied	0.02% [4]
Choice of data or measurement methods and procedures	
Purpose of data/parameter	Additionality demonstration
Additional comments	The total installed capacity of solar PV is used to prove automatic additionality of the project.

Data/Parameter	The total installed capacity of solar PV
Unit	MW

[4] The total capacity of the Senelec grid in 2015 is equal to 897.97 MW.
http://www.crse.sn/upl/RevisionTarifaire-2016b.pdf

Description	The total installed capacity of the solar PV in the host country.
Source of data	Senelec official data
Value(s) applied	2 MW (at the time of PDD submission for registration)
Choice of data or measurement methods and procedures	-
Purpose of data/parameter	Additionality demonstration
Additional comments	This parameter is used to confirm the automatic additionality of the project activity. Please refer to B.5

D.2. Data and parameters monitored

Data/Parameter	$EG_{facility,y}$
Unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y*
Measured/calculated/ default	Measured
Source of data	Electricity meter(s) at project site.
Value(s) of monitored parameter	**YEAR** / **Net electricity production fed into grid (MWh)** 01/05/2017 - 31/12/2017 / 16,848 01/01/2018 - 30/06/2018 / 25,807
Monitoring equipment	Type: ITRON SL7000 Accuracy class: Cl 0.2S (active) ; Cl 2 (reactive) 1 Senelec and 1 Senergy PV SA meter installed at each of the two measuring points (cells ITS1-5-9-10-11-12 & cells ITS2-3-4-6-7-8): **Meter** / **Serial number** SENELEC1 / 73068569 SENERGY1 / 73068570 SENELEC2 / 73068568 SENERGY2 / 73068571 A SCADA system allows the whole PV facilities to be manually or automatically controlled and monitored locally or remotely. Technical/Engineering/Maintenance Department is responsible for measurements.
Measuring/reading/recording frequency	Continuous measurement and at least monthly recording.
Calculation method (if applicable)	-
QA/QC procedures	Cross check of measurement results with records for sold electricity. The company SolaireDirect is responsible for the selection, installation, calibration, servicing, testing and repairing of all energy meters. A test and calibration of the meters will be carried out after each deviation of more than +- 0.5% but at least once every 6 months, certified by a third party.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

D.3. Implementation of sampling plan

Not applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are calculated as follows:

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \quad \text{Equation (7)}$$

Where:

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

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

Calculation of $EG_{PJ,y}$

Since the project activity consists in the installation of new grid-connected renewable power plant at site where no renewable power plant was operated prior to the implementation of the project activity, it verifies the case of Greenfield renewable energy power plant, option (a) whereby:

$$EG_{PJ,y} = EG_{facility,y} \quad \text{Equation (8)}$$

Where:

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr)

Net electricity generation is calculated by deducting auto-consumption of the power plant from gross annual electricity production.

Calculation of $\mathbf{EF_{grid,CM,y}}$

The grid emission factor ($EF_{grid,CM,y}$) was calculated ex-ante as per the "Tool to calculate the emission factor for an electricity-system" (Version 05.0.0). The emission factor is not monitored during the first crediting period of the project activity but shall be updated at the renewal of the crediting period of the project activity.

E.2. Calculation of project emissions or actual net removals

According to the approved methodology ACM0002, project emissions are calculated as follows:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad \text{Equation (1)}$$

Where:

PE_y = Project emissions in year *y* (t CO_2e/yr)

$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year *y* (t CO_2/yr)

$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (t CO_2e/yr)

$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year *y* (t CO_2e/yr)

$PE_{FF,y}$, $PE_{GP,y}$ and $PE_{HP,y}$ are equal to 0 as the project is an installation of a PV solar plant with no auxiliary fossil fuel consumption.

E.3. Calculation of leakage emissions

No leakage emissions are considered. The emissions potentially arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport etc.) are neglected.

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals (t CO_2e)	Project GHG emissions or actual net GHG removals (t CO_2e)	Leakage GHG emissions (t CO_2e)	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	28,993	-	-	-	28,993	28,993

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO_2e)	Amount estimated ex ante (t CO_2e)
28,993	40,200[5]

E.6. Remarks on increase in achieved emission reductions

Not applicable.

[5] 23,004+34,391/12*6=40,200