Monitoring report form for CDM project activity
(Version 08.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT			
Title of the project activity	Grid connected Solar PV project in Bokhol		
UNFCCC reference number of the project activity	10331		
Version number of the PDD applicable to this monitoring report	2.0		
Version number of this monitoring report	3		
Completion date of this monitoring report	02/07/2021		
Monitoring period number	3		
Duration of this monitoring period	01/10/2019 – 31/12/2020		
Monitoring report number for this monitoring period	1		
Project participants	Senergy 2 SAS		
Host Party	Republic of Senegal		
Applied methodologies and standardized baselines	Methodology: ACM0002 - Grid-connected electricity generation from renewable sources - Version 16.0		
Sectoral scopes	Sectoral Scope : 1 - Energy industries (renewable - / non-renewable sources)		
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 until 31 December 2020	Amount achieved from 1 January 2021
	-	31,462	-
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	33,607		

SECTION A. Description of project activity

A.1. General description of project activity

The “Grid-connected Solar PV project in Bokhol” involves the construction and operation of a solar (PV) power plant of 24.38 MWp (or around 20.03 MWAC) in Bokhol, department of Dagana, region of Saint Louis, Senegal. The solar PV projet will cover an area of 50 hectares, and will be equipped with 92,016 modules of 265 Wp each. It will be connected to the national grid

On 02-February-2016 an African Development Bank’s request (on behalf of the project proponent) to the Global Environment Facility of a proposed investment of USD 8 million to support the Bokhol Solar Power Project in Senegal gained approval. This triggered the project start including construction works in May 2016. Start date of the project is 11-November-2016. The plant has been operational since.
The total GHG emission reductions or removals generated in this monitoring period are 31,462 tCO_2e

A.2. Location of project activity

The project is located in Bokhol, department of Dagana, region of Saint Louis, Senegal. The project site’s geo-coordinates are:

Point on Figure 1	Latitude	Longitude
A	16° 31’ 03” N	15° 27' 42” W
B	16° 30′ 45’’ N	15° 28′ 06’’ W
C	16° 30′ 58’’ N	15° 28′ 15’’ W
D	16° 31′ 04’’ N	15° 28′ 16’’ W
E	16° 31′ 06’’ N	15° 28′ 10’’ W
G	16° 31′ 07’’ N	15° 28′ 06’’ W
H	16° 31′ 17’’ N	15° 27′ 51’’ W
I	16° 31′ 15’’ N	15° 27′ 50’’ W

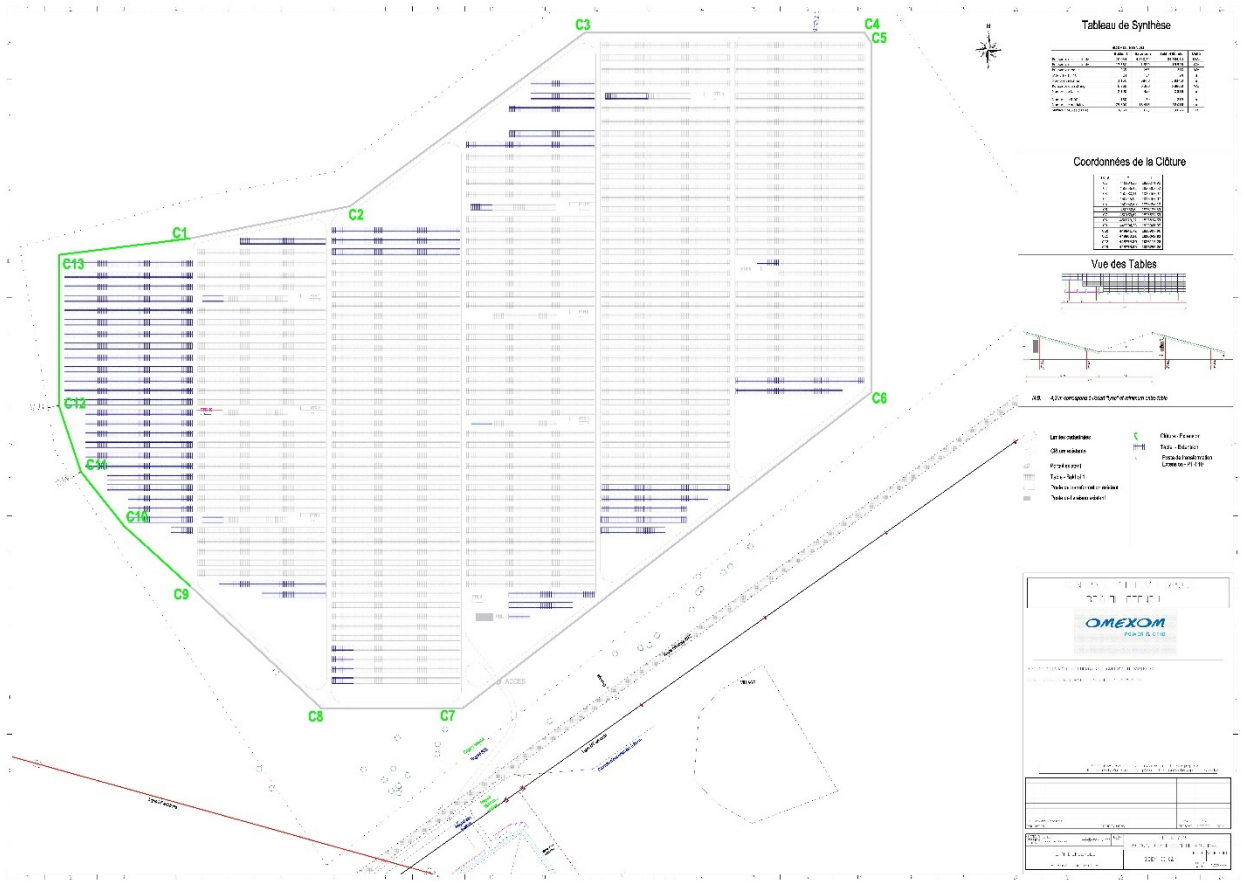

Figure 1: Final project layout

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 2 SAS	No

A.4. References to applied methodologies and standardized baselines

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).

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 92,016 fields polycrystalline photovoltaic modules of 265 Wp for a total installed capacity of 24.38424 MWp. The PV modules are provided by Hanwha solar manufacturer: modules HSL60S.

Peak Power (W)	265
Type of cells	Polycrystalline
Rated voltage (Vmpp) STC (V)	31.1
Rated current (Impp) STC (A)	8.53
Yield (%)	15.9
Length (mm)	1,670
Width (mm)	1,000
Thickness(mm)	32
Weight (kg)	18.5± 0.5 kg

Table 1: Electrical and mechanical characteristics of the modules

The facility is connected to the grid via the substation Dagana via a medium voltage line of 30 kV.

On 02/02/2016 an African Development Bank's request (on behalf of the project proponent) to the Global Environment Facility of a proposed investment of USD 8 million to support the Bokhol Solar Power Project in Senegal gained approval. This triggered the project start including construction works in May 2016. Commissioning of the project, i.e. start of export of electricity to the grid, was on 11-November-2016.

B.2. Post-registration changes

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

>>N/A

B.2.2. Corrections

Post registration change has been approved on 08/09/2020 under reference PRC-10331-001.
See new PDD registered at https://cdm.unfccc.int/PRCContainer/DB/prcp492043174/view

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

Following project implementation delays, the start date of the crediting period had been changed from 01 November 2016 to 11 November 2016.

B.2.4. Inclusion of monitoring plan

>>N/A

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

A Post registration change has been approved on 08/09/2020 under reference PRC-10331-001.

See new PDD registered at https://cdm.unfccc.int/PRCContainer/DB/prcp492043174/view

B.2.6. Changes to project design

A Post registration change has been approved on 08/09/2020 under reference PRC-10331-001. The design of the project was changed to include two phases: the first one, of 20MWp was the project for the first two monitoring period. From this third monitoring period, and on going, a new phase was added, to increase capacity up to 24MWp.
See new PDD registered at https://cdm.unfccc.int/PRCContainer/DB/prcp492043174/view

B.2.7. Changes specific to afforestation or reforestation project activity

>>N/A

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 has been reliably monitored through calibrated electricity meters and cross-checked with sales records.

The fundamental feature of the program provides periodic maintenance to maintain optimum operating conditions of all system components as well as immediate response capacity in case of anomaly.

Monitoring organization
The general managerial organisation of the power plant during the operation phase is as follows:

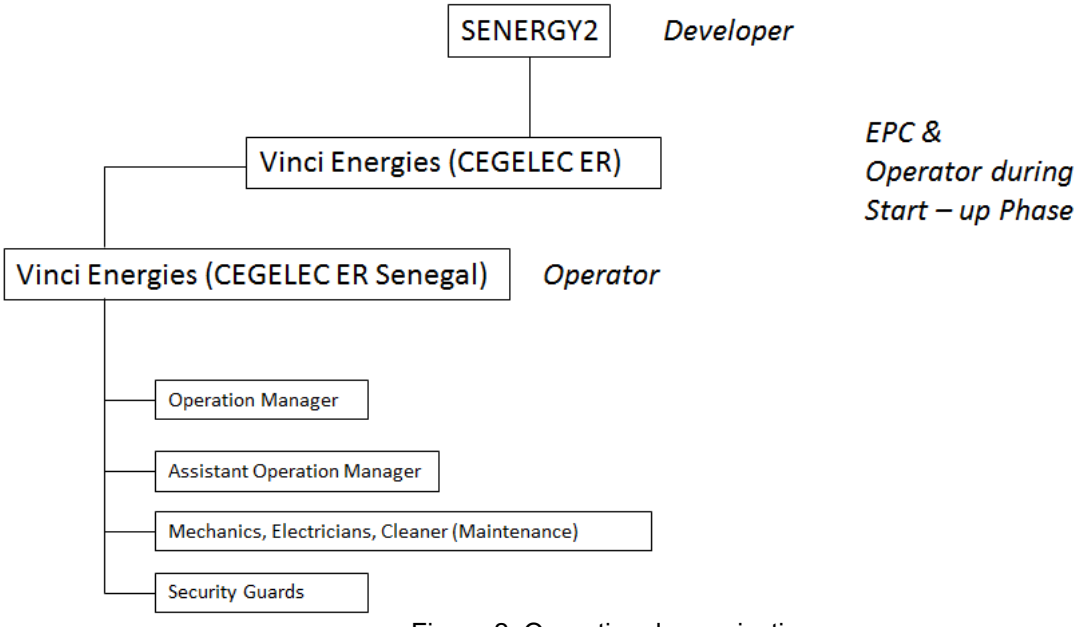

Figure 2: Operational organisation

As concerns the monitoring, the CEO of Senergy 2 SAS has the overall responsibility for all CDM monitoring of the project, including:

- Develop, approve, execute, and improve the CDM Monitoring/Reporting Procedures;
- Organize in-house seminar to inform and train the company staff to the monitoring procedures;

- Ensure that instrumentations and devices are available and properly suited to efficiently perform the monitoring;
- Communicate and coordinate the monitoring work of all business units;
- Validate and electronically archive all monitoring data on a monthly basis throughout the crediting period (and conserve it at least for 2 further years);
- Calculate and report the emission reductions;
- Coordinate the DOE work during the verification audit, and
- Potential appointment of a CDM coordinator to delegate to him the above specific tasks of monitoring supervision.

The maintenance is entirely under the responsibility of Vinci Energies.

Vinci Energies is responsible for the selection, installation, calibration, servicing, testing and repairing of all energy meters. The data gathered enables, among others, to track: power, wattage and voltage input to each inverter; potential and actual energy produced; solar irradiation in kWh/m² and temperature of PV modules; safety alarms.
Recorded data is immediately collected and managed in user-friendly, detailed reports and tables to facilitate analysis. The system used is called SCADA (Supervision Control & Data Acquisition).

Monitoring team and training

Data collection, consolidation and results analysis is undertaken by a dedicated team adequately trained, well aware of CDM requirements. This team has no hierarchical relationships or dependence links with all entities involved to measure net electricity supplied to the grid and to assure the correct operation and maintenance of the measuring equipment. This independence guarantees the integrity of the work that will be done.

Emergency and trouble-shooting procedures
The immediate response capability is achieved through the implementation of a system of supervision and control that transfers real-time all information about the state of the equipment. The operator provides a team of qualified stakeholders that can react in "real time".
As concerns imprecise meter measurements, it is required that the difference in the two meters measurements does not exceed +- 0.5%. If the difference is higher, the dysfunctional meter is identified by Senelec and Senergy 2, adjusted or replaced within 48 hours in accordance with manufacturer guidelines.
As concerns potential power blackouts, a Standby Power System (UPS) is installed in the PVBOX (containerized plug and play power conversion system) and in the Main Distribution Substation for critical operational equipment requiring power backup. The UPS system installed is sized to allow the restart of the installation after 4 hours of power supply interruption (disconnection of the Main Distribution System from the HTB Substation, plant total blackout, disconnection of the PVBOX from the Main Distribution Substation, etc.). Systems that may require UPS power backup are:

- Security and CCTV systems in the PV plant
- Access control
- SCADA system
- Telecommunication system

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 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 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 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 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 grid-connected solar PV in the total installed grid connected power generation capacity in the host country
Source of data	Senelec data and governmental communications
Value(s) applied	0.02%[1]
Choice of data or measurement methods and procedures	-
Purpose of data/parameter	Additionality demonstration
Additional comments	-

Data/Parameter	The total installed capacity of solar PV
Unit	MW
Description	The total installed capacity of solar PV in the host country.
Source of data	Senelec data and governmental communications
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

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

<table>
<tr><td>Source of data</td><td>Electricity meter(s) at project site.

A SCADA system allows the whole PV facilities to be manually or automatically controlled and monitored locally or remotely.
The operation manager is responsible for measurements.</td></tr>
<tr><td>Value(s) of monitored parameter</td><td><table><tr><th>YEAR</th><th>Net electricity production fed into grid (MWh)</th></tr><tr><td>01/10/2019 – 31 /12 /2019</td><td>9,102</td></tr><tr><td>01/01/2020 – 31/12/2020</td><td>37,191</td></tr></table></td></tr>
<tr><td>Monitoring equipment</td><td>Two electricity meters are installed at the delivery point, which is located at the project site.

Make/model: Itron

Type: Itron SL 7000

Precision: 0,2s

Serial number of main meter: 84535816

Serial number of second meter: 73061547</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Continuous measurement and at least monthly recording.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>Gross production – Auxiliary consumption</td></tr>
<tr><td>QA/QC procedures</td><td>Electricity outputs are electronically stored and readings recorded in physical form every day by the technical staff.

Cross check of measurement results with records of sold electricity. The company Vinci Energies is responsible for the operation services, preventive maintenance, corrective maintenance and spare parts management.

Vinci Energies is responsible for the selection, installation, calibration, servicing, testing and repairing of all energy meters.

Two meters will be installed at delivery point with as +- 0.2 precision (international calibration standard) measuring delivered and received electricity. The meters measure correctly if the difference between the two meters does not exceed +- 0.5%. If the difference is higher, the dysfunctional meter will in all cases need to be identified by Senelec and Senergy 2, and then refurbished or replaced within 48 hours in accordance with manufacturer guidelines.</td></tr>
<tr><td>Purpose of data/parameter</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comments</td><td>The electricity meters have been changed from Enerium 300 to Itron SL7000 in November 2020. The Enerium are still installed and serve as back up if necessary.

There was thus a gap in calibration between 13th June 2020 and 9th November 2020 which has been taken into account in the calculation by deducting the uncertainty. Cf calculation sheet</td></tr>
</table>

D.3. Implementation of sampling plan

>>N/A

SECTION E. Calculation of emission reductions or net anthropogenic removals

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

Baseline emissions include only CO2 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:

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

Where:

BE_y = Baseline emissions in year y (t CO2/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 CO2 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" (tCO2/MWh)

Calculation of EGPJ,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:

$$EG_{PJ,y} = EG_{facility,y}$$ 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 ($\mathrm{EF_{grid,CM,y}}$) 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:

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

Where:

PE_y = Project emissions in year y (t CO2e/yr)

$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year y (t CO2/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 CO2e/yr)

$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year y (t CO2e/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 until 31/12/ 2020	From 01/01/ 2021	Total amount
Total	31,462	-	-	-	31,462	-	31,462

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 for this monitoring period in the PDD (t CO_2e)
31,462	33,607

E.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the PDD"

Amount estimated ex ante for 2019*3/12 + amount estimated ex ante for 2020 = 23,723*3/12+27,677=33,607

E.6. Remarks on increase in achieved emission reductions

>>N/A

E.7. Remarks on scale of small-scale project activity

>>N/A

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Document information

Version	*Date*	*Description*
08.0	6 April 2021	Revision to: • Reflect the “Clarification: Regulatory requirements under temporary measures for post-2020 cases” (CDM-EB109-A01-CLAR).
07.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period; • Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods; • Make editorial improvements.
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
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.

Version	*Date*	*Description*
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, 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).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

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