Project design document form
(Version 11.0)

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

BASIC INFORMATION	
Title of the project activity	Grid-connected Solar PV project in Bokhol
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	Version 2.0
Completion date of the PDD	25/05/2020
Project participants	Senergy 2 SAS
Host Party	Republic of Senegal
Applied methodologies and standardized baselines	Sectoral Scope : 1 - Energy industries (renewable - / non-renewable sources)
Sectoral scopes	Methodology: ACM0002 - Grid-connected electricity generation from renewable sources - Version 16.0
Estimated amount of annual average GHG emission reductions	25,666, tCO_2eq. par an

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The “Grid-connected Solar PV project in Bokhol” involves the construction and operation of a solar photovoltaic (PV) power plant 24.38 MW_p (or around 20 MW_{AC}) in Bokhol, department of Dagana, region of Saint Louis, Senegal. The solar PV project will cover an area of 50 hectares, and will be equipped with 92,016 modules of 265 W_p each. It will be connected to the national grid.

The project activity is the installation of a new grid-connected renewable power plant (Greenfield). The baseline scenario is the following: “Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants that are fossil fuel fired power plants.” It is the same as the scenario existing prior to the implementation of the project activity.

The methodology ACM0002 (Version 16.0) is applied since its purpose is the installation of a new grid-connected renewable power plant (Greenfield) as the “electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants”. The average power generation of the project for the next 7 years is estimated at 37,757 MWh per year, resulting in emission reductions of up to 25,666 tons CO_2eq per year.

The village of Bokhol, where the project will be located, is at the frontier between Senegal and Mauritania. The latitude at which the project will be located offers very favourable radiation conditions throughout the year, with a mean yearly average in-plane radiation (P50) of 2,198 kWh / m² per year[1].

In Senegal solar energy is yet largely untapped. However, it is particularly well suited given the scarcity of fossil deposits and the need to fight against climate change. Solar energy is inexhaustible, available anywhere in the world and produces neither waste nor greenhouse gases.

Today, energy consumption in Senegal is still dominated by wood fuels (53 per cent) and less than 4 per cent of villages are electrified. Total capacity of the interconnected system was 584 MW in 2012, 90 percent of which was provided by imported liquid fuel-based thermal plants. Electricity demand has been growing rapidly at a rate of about 6.2 percent per annum over the last decade[2]. Because of the system’s reliance on liquid fuel-based generation (heavy fuel oil and diesel oil), costs of production in Senegal, and tariffs, have remained among the highest in the region. This is enabling solar power to be more competitive than the current mix.

The project is developed by Senergy 2 SAS, a Senegalese development company, who signed a 20 years PPA with SENELEC, the national electricity company of Senegal. Senergy 2 SAS is supported financially by Greenwish Partners and the African Development Bank (AfDB), and gets technical support from VINCI Energies, subsidiary of the major player in the world’s construction market Vinci, for the construction and maintenance of the project plant.

Greenwish Partners is an investment company specialized in the financing of renewable energy projects, mainly in Sub-Saharan Africa. The Company's jurisdiction covers the identification of investment opportunities, financial structuring, legal and tax and management of portfolio assets. Greenwish expects to create a portfolio of 600 MW of solar, hydraulic and wind power plants in Sub-Saharan Africa and provides projects finance.

The African Development Bank Group (AfDB) was selected as Mandated Lead Arranger (MLA) on the debt portion of the project.

Sustainable Development
Being developed and supported by Senegalese entities, the project will help strengthen the knowledge and experience of the country in the development of solar projects.[3] Apart from the following sustainable development benefits for the country and communities around the project site, Senergy 2 SAS committed in an agreement to pay annually and over a period of 25 years 16.000.000 FCFA to the Bokhol Community for compensation of the affected lands and to improve their living conditions.

Energy security and supply

[1] Source: Technical Due Diligence Report – table 34 – Mean expected yield (P50) after weighting.
[2] http://www.reegle.info/policy-and-regulatory-overviews/SN
[3] The plant approval by the Republic of Senegal is provided to the DOE.

The project will improve energy self-sufficiency of the country which is currently heavily reliant on imported fossil fuels. Senegal currently uses about a third of its foreign exchange earnings for oil imports, making it not only highly vulnerable to international price fluctuations of hydrocarbons but also contributing to supply shortfalls, balance of payments and state budget deficits. Renewable Energies, such as the solar project in Bokhol, are considered to address these issues as well as the country's demand for sufficient, best quality, sustainable and low cost energy contributing to a more diversified energy mix.[4] As a consequence, Senegal aims at a total installed Solar PV capacity of 160 MW by 2020.[5]

Finally, the project will generate enough electricity to connect 200,000[6] new consumers to the grid, not to mention Senergy 2 SAS's direct support of households in the villages around the project (installation of lamps, solar kits etc.). This contributes to the state objective of providing electricity access to 70% of Senegal's population by 2017[7] The evidence shows that gaining access to electricity meets significant practical and strategic needs for women and students. For example, good quality light can make performing childcare and household chores, tasks still typically assigned to women, easier and students can study longer and gain access to media. Gender roles can be challenged by women starting paid employment.[8]

Health

Local health conditions are improved as combustion of fossil fuels is avoided in the grid system resulting in less emission of $PM_{2.5}$, NO_x, and SO_2, which cause negative health effects when inhaled. These health effects include premature death, acute respiratory illness, aggravated asthma, chronic bronchitis and decreased lung function.

Employment opportunities

The project will contribute to the local employment throughout its building and operation phases, creating opportunities for local construction workers, operation and maintenance technicians while salary levels (also of sub-contractors) will be verified continuously. It will also induce indirect employment by increasing the competitiveness of local industry from reducing the country's dependency on fossil fuels.

Technology transfer

This type of renewable energy project will assist building capacities in the country, through advanced technology transfer from industrialized countries. The project will introduce solar PV technology, methods and skills in Senegal and demonstrate its applicability and efficiency, thus widening its accessibility. The technology is manufactured by Hanwha Q Cells, South Korea. The technology for large scale solar PV power generation is still at starting stage of consideration in the country. It will be the first initiatives within the region.

Duplication potential

The project will set an example and CDM reference for local stakeholders who expect to implement similar technologies in West Africa.

The proposed CDM project activity is not a Component Project Activity (CPA) that has been excluded from a registered CDM Programme of Activities as a result of erroneous inclusion of CPAs.

A.2. Location of project activity

Host Party: Senegal
Region of Saint Louis, Senegal.
Village of Bokhol[9], Department of Dagana.

[4] Cf. Senegalse Intended Nationally Determined Contributions submitted to UNFCCC in September 2015 (http://www4.unfccc.int/submissions/INDC/Published%20Documents/Senegal/1/CPDN%20-%20S%C3%A9n%C3%A9gal.pdf) and « La Lettre Politique de Developpement du Secteur de l'Energie », October 2012 (http://www.crse.sn/upl/LettrePolitique-2012.pdf)

[5] Cf. Senegalse Intended Nationally Determined Contributions submitted to UNFCCC in September 2015 (http://www4.unfccc.int/submissions/INDC/Published%20Documents/Senegal/1/CPDN%20-%20S%C3%A9n%C3%A9gal.pdf)

[6] Based on the ESIA survey

[7] cf « La Lettre Politique de Developpement du Secteur de l'Energie », p.10, October 2012 (http://www.crse.sn/upl/LettrePolitique-2012.pdf)

[8] Cf. https://www.ashden.org/files/pdfs/reports/Ashden_Gender_Report.pdf

[9] Bokhol is also known as Bokhol, Bokoul : http://fr.getamap.net/cartes/senegal/(sg04)/_bokhol/

Figure 1: Project Location in North Senegal.

In reference to Figure 2 below, geo-coordinates of the project site are as follows:

Point on Figure 2	Latitude	Longitude
A	16°31'02.09"N	15°27'40.60"W
B	16°31'17.14"N	15°27'50.37"W
C	16°31'06.17"N	15°31'06.17"W
D	16°31'03.65"N	15°28'15.06"W
E	16°30'57.75"N	15°28'14.31"W
F	16°30'44.80"N	15°28'05.56"W

Figure 2: Project location

A.3. Technologies/measures

The project activity is the installation of a new grid-connected renewable power plant (Greenfield). The baseline scenario is the following: "Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants, that are fossil fuel fired power plants."

The figure below illustrates the solar PV power plant layout.

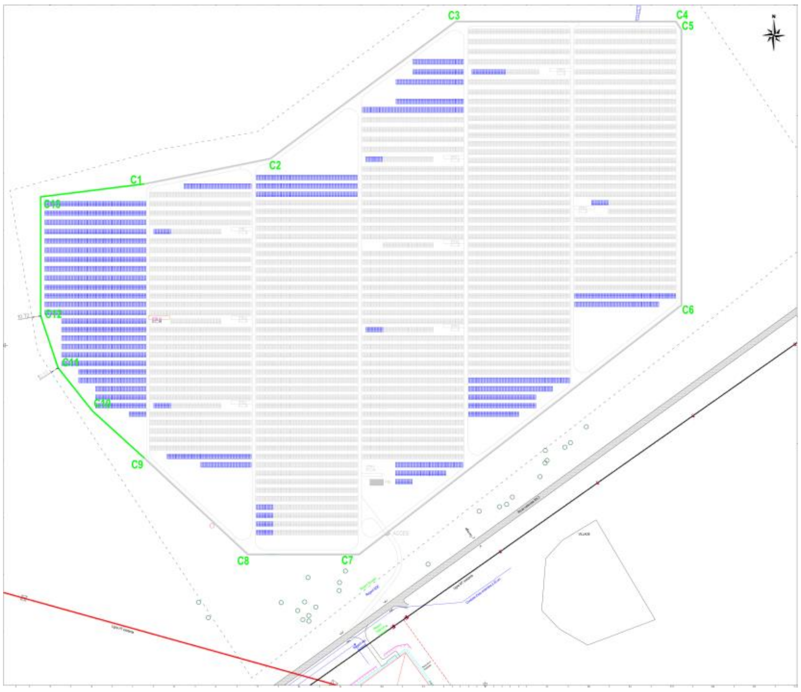

Figure 3: Layout of the solar PV plant

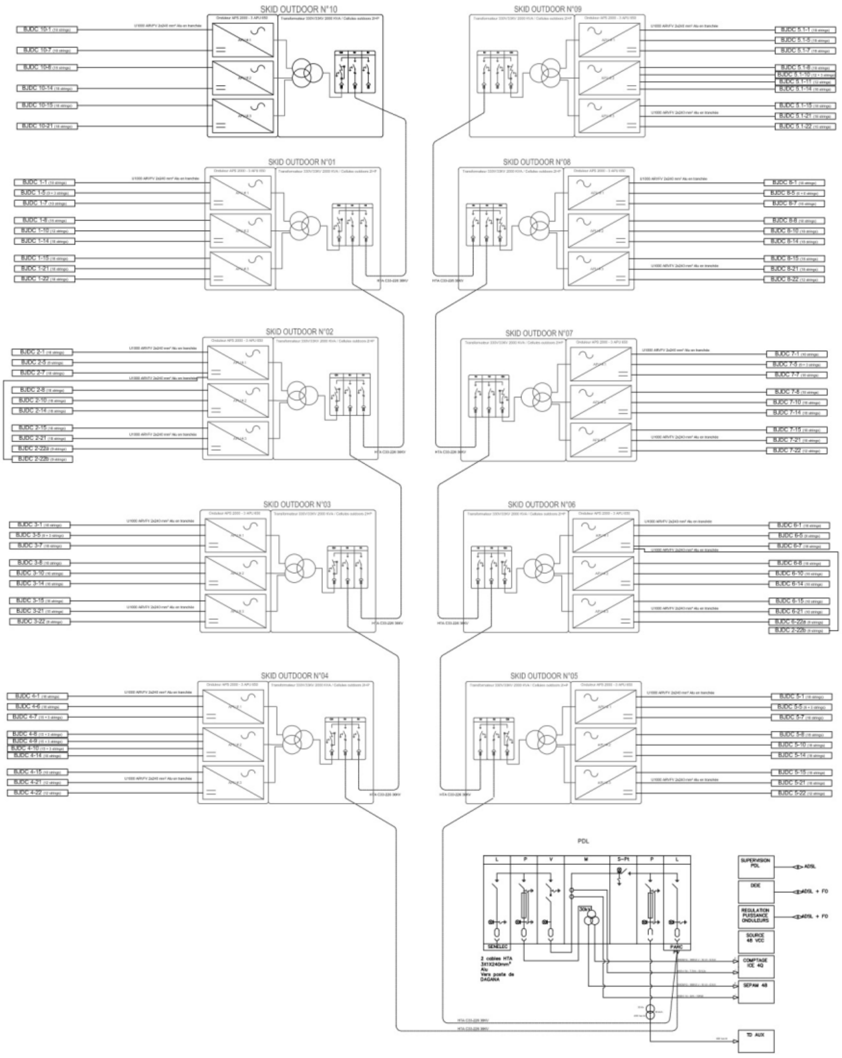

Figure 4: Single line diagram of solar PV plant

The solar PV array field will consist of a 92,016 fields polycrystalline photovoltaic modules of 265 W_p for a total installed capacity of 24.38424 MW_p. Installation will be two-phased.

The modules to be installed are the HSL60S manufactured by Hanwha Solar.

The installation will be formed by photovoltaic modules, which will be arranged in line and inclined at 15º with respect to the horizontal, on an aluminium structure.

The modules are fixed, thus preventing the occurrence of shadows or a variation in their orientation, inclination.

The characteristics of the modules are similar to those shown in the table below:

Peak Power (W_p)	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: Characteristics of the modules based on Standard Test Conditions (STC)

According to the manufacturer's warranty, the average annual power output degradation of the module is conservatively expected not to exceed 0.5 % per year, ending with 71% at the end of the 20th year. A module lifetime is estimated at 20 years.

Based on a mean annual global solar radiation potential estimated at 2,198 kWh/m² for the project site[10] and the specifications of the solar PV system, annual output is expected at 34.38 GWh (P50) for the first year of the first project phase unit and additional 7.47 GWh for the first year of the added capacity in the second project phase, which is expected to gain power on 06/10/2019. The losses can be attributed to, among others, optical losses (5.5%), module losses (8.1%) and electrical losses (9.7%)[11]. The figure below describes the total losses expected. After deduction of the losses and by taking into account a technical availability of 97%, the net electricity delivered to the grid **($EG_{PJ,y}$)**, based on a seven years' average, is of 33,868 MWh/yr (phase I) and 7,354 MWh/yr (phase II) (=41,222 MWh in total). These figures are those provided by the EPC contractor (Vinci Energies). On this basis, the load factor is calculated as follows: 41,222 MWh /24.384 MW_p= 1,691 hours over 8,760 hours per year = 19.30% For the first year of operation, the capacity factor has been calculated as 19.59% (cf. ER calculations).

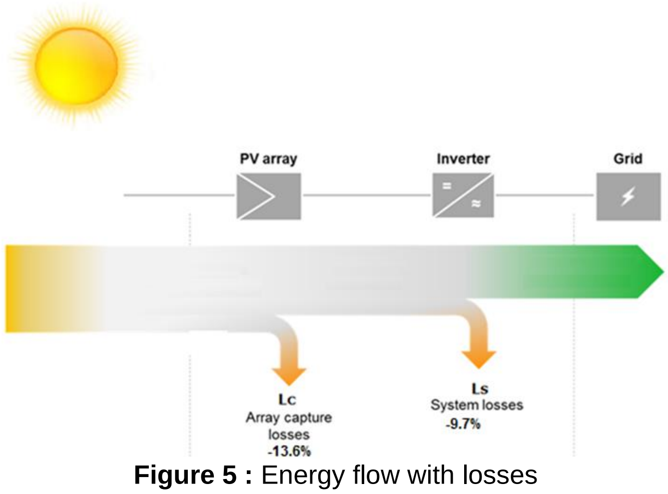

Figure 5 : Energy flow with losses

[10] As per assumption in ER calculations.

[11] Source: Senergy 2 SAS, Yearly MW/year and calculations of the losses versus performance on 20 years.

The simulated yield analysis and performance ratio for P50 for the first year of activity revealed a specific yield of 1,716 kWh/(kW.yr).

The facility will be connected to the grid through a direct connection to Senelec's MV substation located approximately at 75 meters from SENERGY 2 SAS´s photovoltaic plant.

The inverters of the power plant are stored in secured prefabricated cabins, in which a LV/MV transformer for stepping up the voltage to 30 kV will be installed.

The table below provides the technical characteristics of the inverters and transformers:

Parameters	Unit	Description
Model		APS 2000
Maximum Input Current	A	3 × 1,204
Rated AC power	kW	1,950
Operating frequency range	Hz	50/60 Hz
Maximum efficiency	%	98.4%
Manufacturer		WSTECH

Table 2: Technical characteristics of the inverter

Parameter	Unit	Description
Model		TDQ-203F03S5A-99
Rated capacity	kVA	2,000
Rated voltage H/L	V	33,000/330
Rated frequency	Hz	50
Manufacturer	-	Siemens

Table 3: Technical characteristics of the transformer

Metering system

In terms of monitoring, the solar PV power plant will be equipped with at least two electricity meters to monitor the electricity delivered to and received from the grid, of which at least one will be located at the level of the solar PV power plant itself.

Precision of the meters will be +- 0.2 (active energy).

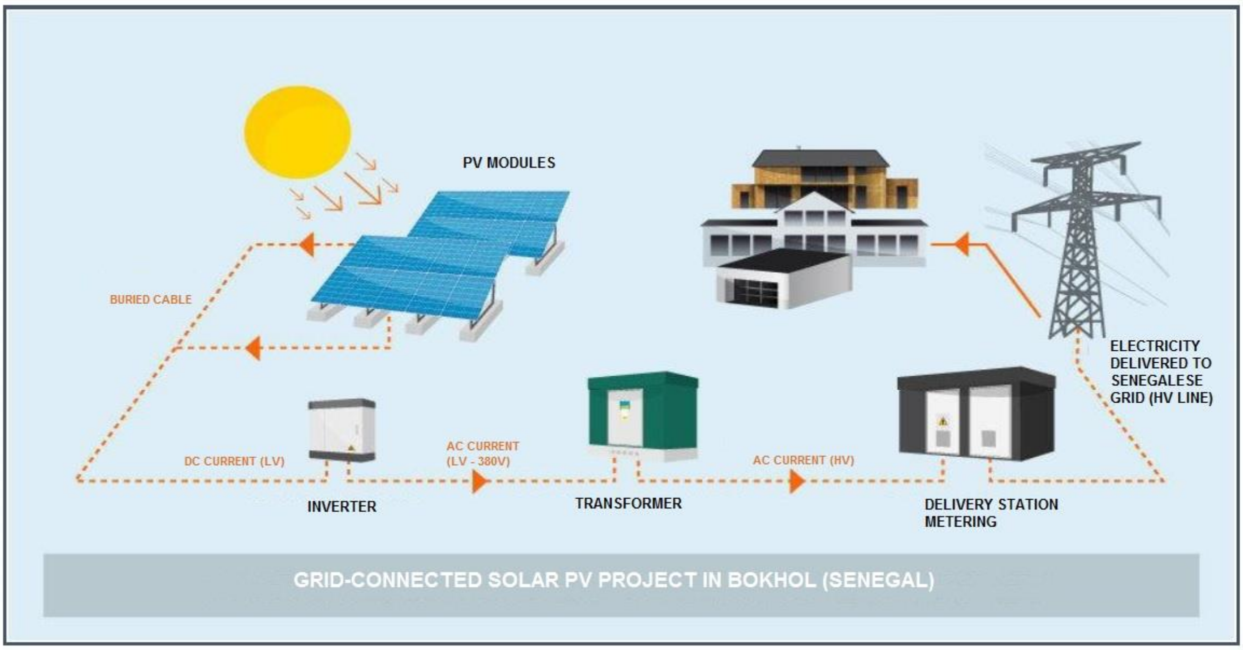

Figure 6: Location of the monitoring equipment in the system

A SCADA[12] system allows the whole PV facilities to be manually or automatically controlled and monitored. The system of supervision and control of the production of the plant is designed as follows:

Locally, from a data acquisition system on site, capable of capturing and storing the information coming from the inverter and the zones including production data, system diagnostics and assistance in real-time.
Remotely, a control system and distance sensitive data management system to ensure the supervision of the plant from headquarters at client's request. Such a system is composed of an Ethernet modem, or GPRS or satellite connected to internet in order to enable a remote data traffic and visualization.
All monitoring data will be accessed remotely via an ADSL connection.

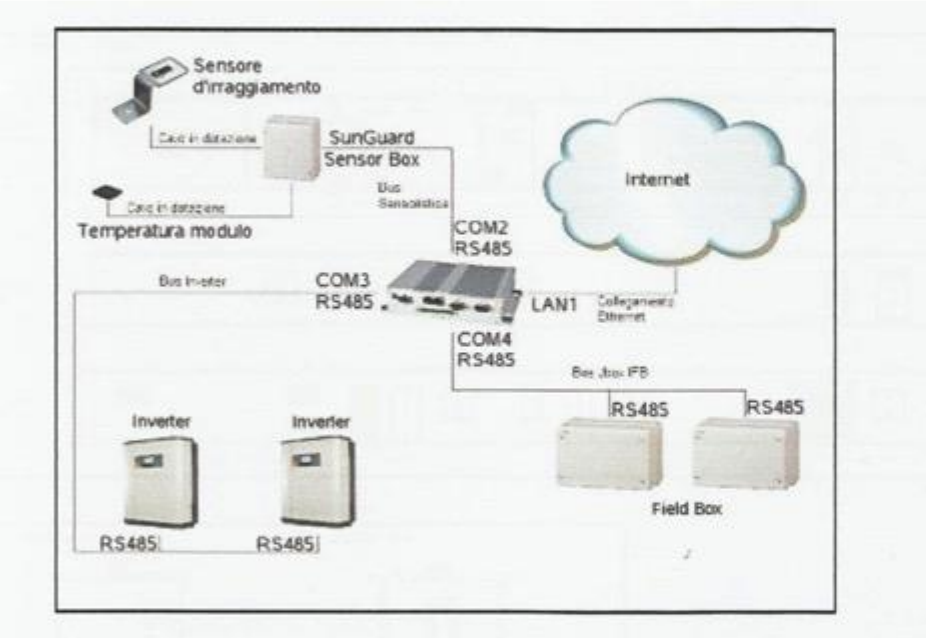

Figure 7: Overview of the control and supervision system

The employees of the plant will be trained in the use of solar technology, which is largely imported from abroad. Since the project participant intends to secure employment for indigenous people (see section E), not only the technology itself but also know-how on solar PV technology use will be transferred to the host Party. This measure and the project as a whole have a kick on effect potential for similar project ideas in the host country, which consider the import and installation of solar PV systems from abroad.

A.4. Parties and project participants

Party 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.5. Public funding of project activity

The project does not involve any public funding.

A.6. Public funding of project activity

The project does not involve any public funding.

A.7. History of project activity

This project is neither registered as an individual CDM project activity nor included in another registered CDM PoA as a CPA nor a project activity that has been deregistered or excluded from a registered CDM PoA. There

[12] SCADA means Supervisory Control and Data Acquisition.

is no registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired, which exists in the same geographical location as the proposed CDM project activity.

A.8. Debundling

Not applicable.

SECTION B. Application of methodologies and standardized baselines

B.1. References to 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. https://cdm.unfccc.int/methodologies/DB/EY2CL7RTEHRC9V6YQHLAR6MJ6VEU83

The methodology also refers to the latest approved version of the "Tool to calculate the emission factor for an electricity system" (Version 5.0, EB 87, Annex 9) which is applied by the project. https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v5.0.pdf

B.2. Applicability of methodologies and standardized baselines

The choice of the ACM0002 methodology is accurate since the proposed project activity respects all the applicability conditions required.

ACM0002 version 16 applicability conditions	Project activity applicability
This methodology is applicable to grid-connected renewable energy power generation project activities that: a) Install a Greenfield power plant; b) Involve a capacity addition to (an) existing plant(s); c) Involve a retrofit of (an) existing operating plants/units; d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or e) Involve a replacement of (an) existing plant(s)/unit(s).	The project activity is a greenfield solar photovoltaic power plant substituting electricity produced on the grid by renewable energy.
The project activity may include renewable energy power plant/unit of one of the following types: - hydro power plant/unit (with or without reservoir), - wind power plant/unit, - geothermal power plant/unit, - PV solar plant/unit, - wave power plant/unit or - tidal power plant/unit;	The project activity is the construction and operation of a solar photovoltaic power plant and hence the methodology is applicable.
In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.	The project activity does not involve any capacity additions, retrofits, rehabilitations or replacements.
In case of hydro power plants, one of the following conditions shall apply: a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density calculated using equation (3) of the methodology ACM0002, is greater than 4 W/m^2; or c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3) of the methodology ACM0002, is greater than 4 W/m^2; or	Not applicable as the proposed project activity involves a solar photovoltaic power plant.

d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3) of the methodology ACM0002, is lower than or equal to 4 W/m^2, all of the following conditions shall apply: - The power density calculated using the total installed capacity of the integrated project, as per equation (4) of the methodology ACM0002, is greater than 4 W/m^2; - Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; - - Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m^2 shall be: a.) Lower than or equal to 15 MW; and b.) Less than 10 per cent of the total installed capacity of integrated hydro power project.	
In the case of integrated hydro power projects, project proponent shall: - Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or - Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore, this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.	Not applicable as the proposed project activity involves a solar photovoltaic power plant.
The methodology is not applicable to: - Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; - Biomass fired power plants/units.	The proposed project activity neither involves - switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site, nor - biomass fired power plants/units.
In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".	The project activity does not involve capacity additions, retrofits, rehabilitations or replacements.
In addition, the applicability conditions included in the tools referred to above apply.	Applicability conditions of the applied tools are justified.

Table 4: Compliance of the project activity regarding ACM0002 applicability conditions.

From the above it is concluded that the project activity meets all the applicability conditions of the methodology ACM0002 version 16.0 "Grid connected electricity generation from renewable sources".

The project activity also meets the following applicability conditions of "Tool to calculate the emission factor for an electricity system".

No	Applicability condition	Applicability to this project activity

1	This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	As part of ACM0002, OM, BM and CM need to be estimated to calculate baseline emissions of the project activity that substitutes electricity in the Senegalese grid. Hence the tool is applicable
2	Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off - grid power plants. In the later, case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in “Appendix 2: Procedures related to off-grid power generation” should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	The emission factor for the project electricity system is calculated for grid power plants and off-grid power plants. Option IIb is applied, i.e. the tool is applicable.
3	In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	Since the project electricity system is not located partially or totally in an Annex I country - it is located in the Republic of Senegal - the tool is applicable.
4	Under this tool, the value applied to the CO2 emission factor of biofuels is zero.	There are no biofuels used in the project activity, i.e. the tool is applicable.

Table 5: Compliance of the project activity project activity regarding applicability conditions of “Tool to calculate the emission factor for an electricity system”.

Other tools mentioned in the methodology are not applicable to this project activity.

B.3. Project boundary, sources and greenhouse gases (GHGs)

	Source	GHG	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam.	CO_2	No	Main emission source (Only for Concentrated Solar Power)
		CH_4	No	Minor emission source (Only for Concentrated Solar Power)
		N_2O	No	Minor emission source
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	No	Minor emission source
		CH_4	No	Main emission source (Only for hydro)
		N_2O	No	Minor emission source
	For hydro power plants, emissions of CH_4 from the reservoir.	CO_2	No	Main emission source (Only for geothermal)
		CH_4	No	Main emission source (Only for geothermal)
		N_2O	No	Minor emission source

Table 6: Boundary of baseline and project emissions.

According to ACM0002 methodology, the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

The project boundary is therefore determined as:
- the project activity site, where the electricity is being produced,
- the grid that the power plant is connected to.

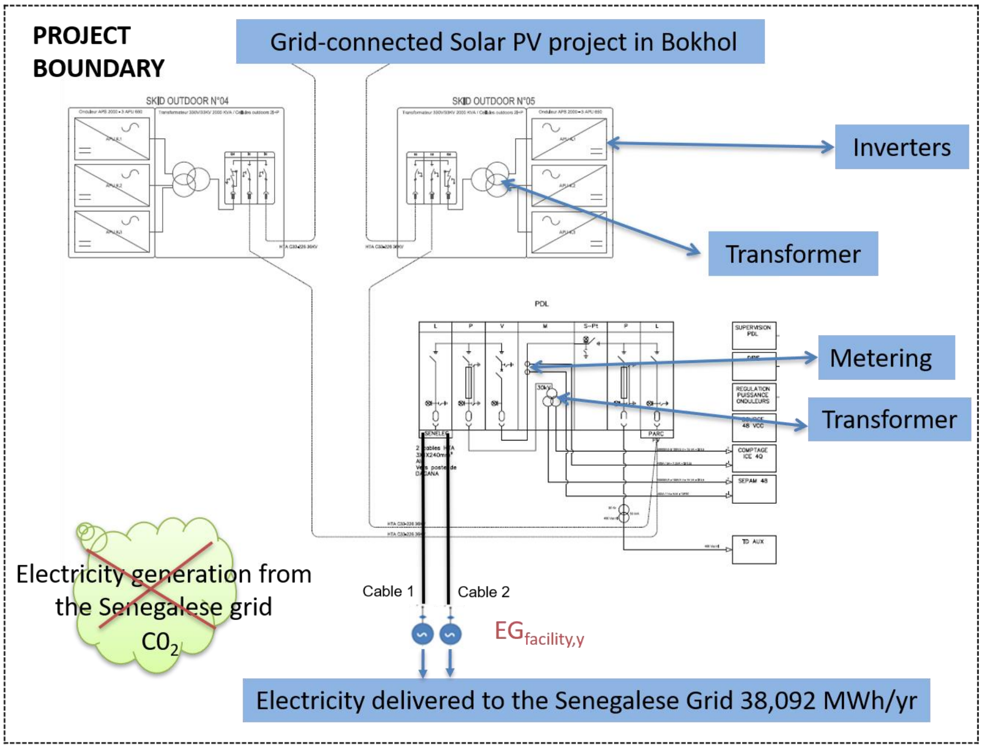

Figure 8: Simplified diagram of the project boundary

B.4. Establishment and description of baseline scenario

According to ACM0002 Version 16.0 and since the project activity is the installation of a new grid-connected renewable power plant (Greenfield) the baseline scenario is the following:

"Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system."

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 to be calculated as described in section B.6.1.

B.5. Demonstration of additionality

Methodology that establishes automatic additionality for the proposed project activity	ACM0002 - Grid-connected electricity generation from renewable sources – Version 16, para. 29-32
Describe how the proposed project activity meets the criteria for automatic additionality in the relevant methodology or standardized baselines.	• The project activity involves the installation of a grid-connected solar photovoltaic technology; • According to Senelec data[13], there is only one grid connected solar PV power plant in Senegal, namely the 2 MW CICAD solar PV plant at the time of PDD submission for registration. The government expects to reach a renewable energy penetration level of 20% by 2017. There is less than 50 MW of solar PV power plant in Senegal. Thus, the project meets the conditions for automatic additionality. • The project proponent will provide information on actual capital cost of the project activity at the time of the first verification. • Request for registration is envisaged until 27 November 2017 applying the simplified procedures contained in version 16.0 of ACM0002. The positive list of technologies and simplified procedures are thus valid.

The start date of the proposed project activity is defined as 02/02/2016 i.e. the approval of an African Development Bank's request (on behalf of the project participant) to the Global Environment Facility of a proposed investment of USD 8 million to support the Bokhol Solar Power Project in Senegal[14]. This triggered the project start including construction works. The Prior Consideration Form has been sent to the DNA of Senegal on November 2nd 2015[15] and published on the UNFCCC website on December 11th 2015.

Requirements of Project Standard Version 09.0 §27 are fulfilled as the project participant has informed the host Party's DNA and the secretariat of the UNFCCC of their intention to seek CDM status in accordance with the Project Cycle Procedure.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

Project emissions

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

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

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)

[13] see Appendix 4 and ER calculations.
[14] The African Development Bank´s request to the Global Environment Facility is provided to the DOE.
[15] Evidence: email has been submitted to the DOE.

$PE_{FF,y}, PE_{GP,y}$ 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.

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.

Baseline emissions

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 to be calculated as follows:

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$$ 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:

$$EG_{PJ,y} = EG_{facility,y}$$ 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 ex-ante by deducting auto-consumption of the power plant and transmission losses from gross annual electricity production (see section A.3).

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

The grid emission factor ($EF_{grid,CM,y}$) is 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 crediting period of the project activity but shall be updated at the renewal of the crediting period of the project activity.

This methodological tool determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the “combined margin” emission factor (CM) of the electricity system. The CM is the result of a weighted average of two emission factors pertaining to the electricity system: the “operating margin” (OM) and the “build margin” (BM). The operating margin is the emission factor that refers to the group of existing power plants whose current electricity generation would be affected by the project activity. The build margin is the emission factor that refers to the group of prospective power plants whose construction and future operation would be affected by the project activity.

This tool provides procedures to determine the parameters indicated in the table:

Parameter	SI Unit	Description
$\mathbf{EF_{grid,CM,y}}$	tCO_2/MWh	Combined margin CO_2 emission factor for the project electricity system in year *y*
$\mathbf{EF_{grid,BM,y}}$	tCO_2/MWh	Build margin CO_2 emission factor for the project electricity system in year *y*
$\mathbf{EF_{grid,OM,y}}$	tCO_2/MWh	Operating margin CO_2 emission factor for the project electricity system in year *y*

Table 7: Main parameters of grid emission factor calculation.

The tool indicates six steps for the calculation of the combined margin (CM) emission factor:

STEP 1. Identify the relevant electricity systems.

For determining the electricity emission factors, identify the relevant project electricity system. Similarly, identify any connected electricity systems.

If a connected electricity system is located partially or totally in Annex I countries, then the emission factor of that connected electricity system should be considered zero.

> In the case of the proposed project activity, there is no connected electricity system connected located partially or totally in Annex I countries.

If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used.

> The DNA of Senegal has not published a delineation of the project electricity system and connected electricity system.

If this information is not available, project participants should define the project electricity system and any connected electricity system, and justify and document their assumptions in the CDM-PDD. Transmission lines between electricity systems should be checked for the existence of significant transmission constraints.
There are no transmission constraints if any one of the following criteria is met:

a) In case of electricity systems with spot markets for electricity: there are differences in electricity prices (without transmission and distribution costs) of less than five per cent between the two electricity systems during 60 per cent or more of the hours of the year; or
b) The transmission line is operated at 90 per cent or less of its rated capacity at least during 90 per cent of the hours of the year.

If the information required to demonstrate transmission constraints (or not) is not publicly available or where the application of these criteria does not result in a clear grid boundary, use a regional grid definition in the case of large countries with layered dispatch systems (e.g. provincial/regional/national).

> The information required to demonstrate if there are transmission constraints (or not) is not publicly available.

A provincial grid definition may indeed in many cases be too narrow given significant electricity trade among provinces that might be affected, directly or indirectly, by a CDM project activity. In other countries, the national (or other larger) grid definition should be used by default. Document the geographical extent of the project electricity system transparently and identify all grid power plants/units connected to the system.

> Senegal is not a large country with layered dispatch systems (e.g. provincial/regional/national) therefore a provincial grid definition is not relevant. Thus, the national grid is the project electricity system.

According to the tool, the reference system is the project electricity system. Hence electricity transfers from a connected electricity systems to the project electricity system are defined as electricity imports while electricity transfers from the project electricity system to connected electricity systems are defined as electricity exports.

> Electricity is transferred from two connected electricity systems to Senegal:
> 1) from Mauritania
> 2) from Manantali and Felou in Mali.

Therefore, electricity coming from Mauritania and Mali will be considered as electricity imports.
In cases involving international interconnection (i.e. transmission line is between different countries and the project electricity system covers national grids of interconnected countries) it should be further verified that there are no legal for international electricity exchange."

In the present case, the operation of the Manantali and Felou hydroelectric power plants are part of the OMVS (Organisation for the Development of the Senegal River). Pursuant to the Convention of 21 December 1978, the OMVS structures (including dams and navigation structures) are "jointly-owned structures", which means that, they are the common and indivisible property of the Member States. The Manantali hydropower complex supplies energy to national electricity companies in Mali (52%), Mauritania (15%) and Senegal (33%). Felou´s hydropower energy is injected into the Manantali power grid[16]. Thus, there are no legal restrictions for the international electricity exchange between Mali and Senegal on one hand and Mauritania and Senegal on the other hand.

The following map shows the geographical boundary of project electricity system i.e. the Senegalese grid. It further shows that the Senegalese electrical grid is interconnected: power plants are physically connected through transmission and distribution lines to the project activity.

Figure 9: Project electricity system i.e. the Senegalese Power Grid[17]

The national utility's generation, transmission, and distribution system consist of three components:

1. The national interconnected grid (main grid)
2. 7 off-grid centres, served mainly by diesel / gasoil or fuel / mazout plants operated by Senelec, APR Energy and Aggreko; and
3. a 225 kV transmission line connecting the hydro power plant Manantali, which is located in Mali.

The main transmission grid is built by a 90 kV national and a 225 kV transmission line connecting the hydro power plants of Manantali and Félou, which are located in Mali. The distribution network consists of:

- 30 kV / 6.6 kV substations
- 7,627 km of MV lines (6.6kV and 30 kV)
- 6,761 km of LV lines
- 3,511 MV/LV transformers

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[16] http://www.portail-omvs.org/en/areas-actions/sectors-activity/energy-omvs-strategic-options

[17] English translation of map provided on the website of the Senegalese regulator of the electricity sector, CRSE (LA COMMISSION DE REGULATION DU SECTEUR DE L'ELECTRICITE). (http://www.crse.sn/upl/CarteElectriciteSenegal.pdf)

For the purpose of determining the build margin emission factor, the spatial extent is limited to the project electricity system, except where recent or likely future additions to the transmission capacity enable significant increases in imported electricity. In such cases, the transmission capacity may be considered a build margin source.

For the proposed project activity, the spatial extent to determine the build margin emission factor is limited to the project electricity system.

For the purpose of determining the operating margin emission factor, the tool require to use one of the following options to determine the CO_2 emission factor(s) for net electricity imports from a connected electricity system:

a) 0 t CO_2/MWh; or
b) The simple operating margin emission rate of the exporting grid, determined as described in Step 4 section 6.4.1, if the conditions for this method, as described in Step 3 below, apply to the exporting grid; or
c) The simple adjusted operating margin emission rate of the exporting grid, determined as described in Step 4 section 6.4.2 below; or
d) The weighted average operating margin (OM) emission rate of the exporting grid, determined as described in Step 4 section 6.4.4 below.

For the proposed project activity, a value of 0 tCO_2/MWh is selected as emission factors for net electricity imports from the connected electricity systems.

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional).

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:
Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation.

Option II aims to reflect that in some countries off-grid power generation is significant and can partially be displaced by CDM project activities that are if off-grid power plants are operated due to an unreliable and unstable electricity grid. Option II may be selected only for determining the operating margin emission factor or for determining both the build margin and the operating margin emission factor, but not for determining the build margin emission factor only. Two alternative approaches are provided to determine the electricity generation by the off-grid power plants and CO_2 emission factor.

As demand for electricity grows a lot faster than its supply, Senegal is facing serious problems. SENELEC lacks an efficient organisational structure and lacks (access to funds for) investments in power plants and transmission-lines in order to cope with the increasing demand. Reserve capacity presently is insufficient, causing frequent (scheduled or unscheduled) outages of whole districts.[18] Therefore option II is selected for the calculation of both the operating and build margin emission factors.

Option IIa: Option IIa requires collecting data on off-grid power generation as per appendix 2 and can only be used if the conditions outlined therein are met.

If Option IIa is selected, off-grid power plants should be classified as per the guidance in appendix 2, that is in different off-grid power plants classes. Each off-grid power plant class should be considered as one power plant *j*, *k*, *m* or *n*.

Option IIb: As an alternative approach, the default CO_2 emission factor and the default value of the electricity generated by the off-grid power plants can be applied for the first crediting period. The following conditions apply to this option:

a) The project activity is located in (i) a Least Developed Country (LDC); or (ii) a Small Island Developing States (SIDS) or in (iii) a country with less than 10 registered CDM projects at the starting date of validation; and
b) The project activities consist of grid-connected renewable power generation; and
c) It can be demonstrated that there is a load shedding program in place to compensate the deficit of the generation capacities.

[18] Energypedia webstite: https://energypedia.info/wiki/Senegal_Energy_Situation

Option IIb is applied. All the conditions are fulfilled by the project:

- Senegal is classified as a Least Developed Country.[19]
- The project activity consists in a grid-connected solar power plant,
- There is a load shedding program in place in Senegal as mentioned on page 35 of Senelec Activity Report 2012.[20]

For the off-grid power plants that choose Option IIb the default value of 0.8 t CO_2/MWh can be used for the CO_2 emission factor.
For the off-grid power plants, the default value of 0.8 t CO_2/MWh will be used for the CO_2 emission factor.

The following default values are used to determine $EG_{m,y}$ for the off-grid plants:

a) The value of 10 per cent of the total electricity generation by grid power plants in the electricity system for the purpose of the operating margin determination;
b) The value of 10 per cent of the electricity generation by grid power plants included in the sample group as per Step 5 for the purpose of the build margin determination.

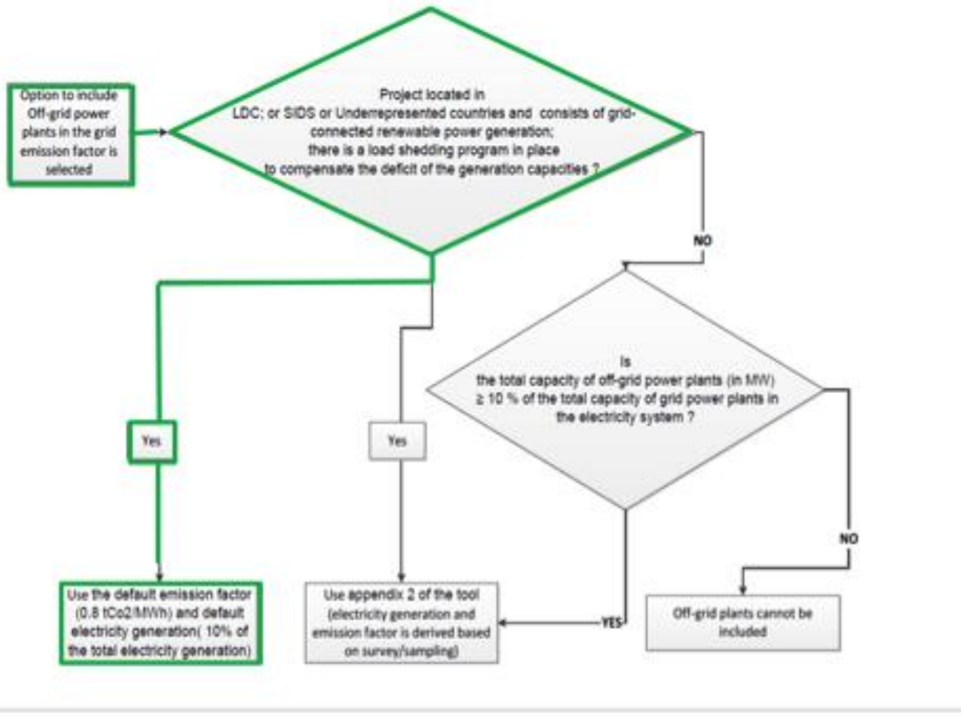

Figure 10: Inclusion of off-grid power plants in the project electricity system

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, which are described under Step 4:

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

The following flow chart provides an overview of OM methods, including data requirement for each method and important conditions that should be met to apply a specific OM method (in green, the selected options).

[19] http://www.un.org/en/development/desa/policy/cdp/ldc/ldc_list.pdf

[20] http://www.senelec.sn/images/pdf/activite%20senelec%202012%20bat.pdf

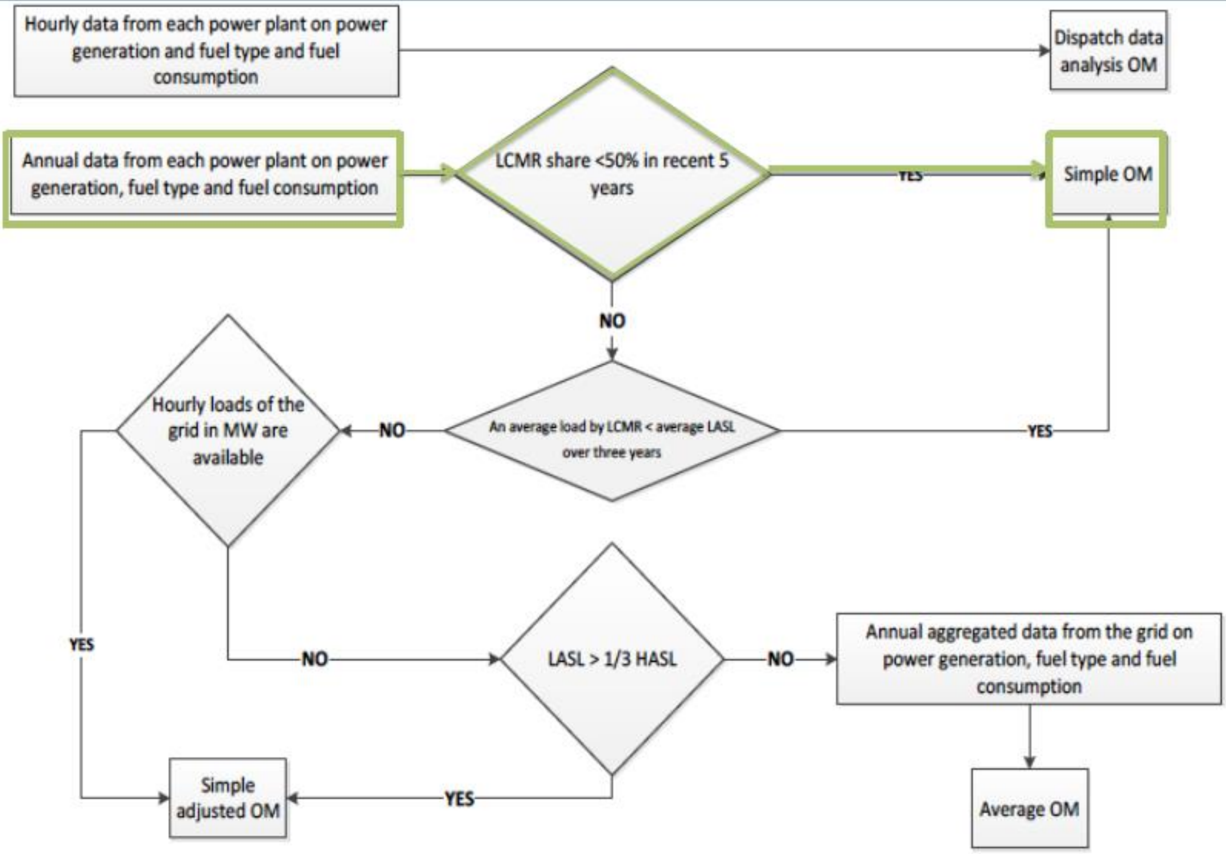

Figure 11: Overview of the application of OM methods

The Simple OM method (a) (option a in paragraph 35) can only be used if any one of the following requirements is satisfied:

a) Low-cost/must run resources constitute less than 50% of total grid generation (excluding electricity generated by off-grid power plants) in:
   1) average of the five most recent years, and the average of the five most recent years shall be determined by using one of the following approaches below or
   2) based on long-term averages for hydroelectricity production (minimum time frame of 15 years).

(i) Approach 1

$$\text{Share}_{LCMR} = \text{average}\left[\frac{EG_{LCMR_{y-4}}}{total_{y-4}}, \dots, \frac{EG_{LCMR_y}}{total_y}\right]$$ Equation (1)

(ii) Approach 2

$$\text{Share}_{LCMR} = \frac{average\left(EG_{LCMR_{y-4}}, \dots, EG_{LCMR_y}\right)}{average\left(total_{y-4}, \dots, total_y\right)}$$ Equation (2)

Where :

$Share_{LCMR}$	Share of the low cost/must run resources (%)
EG_{LCMRy}	Electricity generation supplied to the project electricity system by the low cost/must run resources in year y (MWh)
totally	Total electricity generation supplied to the project electricity system in year *y* (MWh)
Y	The most recent year for which data is available

b) The average amount of load (MW) supplied by low-cost/must-run resources in a grid in the most recent three year […] is less than the average of the lowest annual system loads (LASL) in the grid of the same three years (i.e., average of $LACL_y$, $LACL_{y-1}$, $LACL_{y-2}$).

Approach a) 1) is selected.

	5 years of historical data				
Year	**2011**	**2012**	**2013**	**2014**	**2015**
Power generation including 10% off-grid [MWh]	1,823,709	1,893,752	2,901,192	3,119,326	3,236,531
Power generation excluding off-grid power generation	1,657,917	1,721,592	2,637,447	2,835,751	2,942,301
Low-cost must-run / import [MWh]	257,243	290,317	308,492	318,070	435,498
Share of low cost must run [%]	14.1%	15.3%	10.6%	10.2%	13.5%
Annual share of low cost must run [%] excluding off-grid power generation	15.5%	16.9%	11.7%	11.2%	14.8%
Average share of low cost must run [%] excluding off-grid power generation over five years	12.7%				

Table 8: Share of low cost must run source[21]

Method (a) is applicable as low-cost/must run resources constitute 12.7% i.e. less than 50% of the total amount of the power generation on the grid, in average of the five most recent years.

The dispatch data analysis (Option c) cannot be used because off-grid power plants are included in the project electricity system as per Step 2 above.

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the two following data vintages:

a) Ex ante option: if the ex-ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation.
For off-grid power plants, use a single calendar year within the five most recent calendar years prior to the time of submission of the CDM-PDD for validation;
b) Ex post option: if the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year y-1 may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year y-2 may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.

For the purpose of this project, option a) ex ante option is selected. Thus, the emission factor is determined once at the validation stage, and no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, a 3-year generation-weighted average has been used, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation.

The data vintage chosen should be documented in the CDM-PDD and should not be changed during the crediting period.

For the purpose of this project, the data vintage chosen is 2013, 2014 and 2015. It will not be change during the crediting period.

Power plants registered as CDM project activities should be included in the sample group that is used to calculate the operating margin if the criteria for including the power source in the sample group apply.

[21] Data have been provided by Senelec for the years 2011 to 2015.

In Senegal and at the time of request for registration, there are 5 projects activities and 4 programmes of activities registered under the CDM. Among these projects and programmes of activities, there is no power plant connected to the project electricity system. The only CDM project implying a grid-connected power plant that is already commissioned is Félou Regional Hydropower Project (Ref 3090). This hydro power plant is a low-cost/must-run power plant and is not supplying the project electricity system but the connected electricity system of Mali. Therefore, for these two reasons, therefore, it is not included in the sample group.

STEP 4. Calculate the operating margin emission factor according to the selected method.

Simple OM

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (t CO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The simple OM may be calculated by one of the following two options:

a) Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit [22];
b) 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;
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;
c) Off-grid power plants are not included in the calculation (i.e. if Option I has been chosen in Step 2).

On the case of this project, the CO_2 emission factor of each power unit could be calculated as we have information about the consumption of fossil fuel by power unit as well as their net quantity of electricity generated and delivered to the grid are available. Consequently, option A will be used.

Option A: Calculation based on average efficiency and electricity generation of each plant

Under this option, the simple OM emission factor is calculated based on the net electricity generation of each power unit and an emission factor for each power unit.

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

Under this option, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system,
Option A is chosen.

Under option A, the simple OM emission factor is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Equation (3)

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year *y* (t CO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by CO_2 emission factor of power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (t CO_2/MWh)

[22] Power units should be considered if some of the power units at the site of the power plant are low-cost/must-run units and some are not. Power plants can be considered if all power units at the site of the power plant belong to the group of low-cost/must-run units or if all power units at the site of the power plant do not belong to the group of low-cost/must-run units.

m	All power units serving the grid in year *y* except low - cost/must – run power units
y	The relevant year as per the data vintage chosen in Step 3

Determination of $EF_{EL,m,y}$

The emission factor of each power unit *m* should be determined as follows:

Option A1: If for a power unit *m* data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}$$

Equation (4)

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (t CO_2/MWh)
$FC_{i,m,y}$	Amount of fuel type *i* consumed by power unit *m* in year *y* (Mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	CO_2 emission factor of fuel type *i* in year *y* (t CO_2/GJ)
m	All power units serving the grid in year *y* except low - cost/must – run power units
i	All fuel types combusted in power unit *m* in year *y*
y	The relevant year as per the data vintage chosen in Step 3

Option A1 is applied for all power units except for one power unit, called Sococim Aggreko for which data on fuel consumption were not available.

Option A2 - If for a power unit m only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{EL,m,y} = \frac{EF_{co2,m,i,y} \times 3.6}{\eta_{m,y}}$$

Equation (5)

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (t CO_2/MWh)
$EF_{CO2,m,i,y}$	Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (t CO_2/GJ)
$\eta_{m,y}$	Average net energy conversion efficiency of power unit *m* in year *y* (ratio)
m	All power units serving the grid in year y except low-cost/must-run power units
y	The relevant year as per the data vintage chosen in Step 3

Where several fuel types are used in the power unit, the fuel type with the lowest CO_2 emission factor for $EF_{CO2,m,i,y}$. is used.

Option A2 is applied only to a natural gas power unit called Sococim Aggreko[23] for which data on fuel consumption were not available.

In order to determine $\eta_{m,y}$, the tool to calculate the emission factor for an electricity system, version 5.0 proposes to use either:

c) Documented manufacturer´s specifications (if the efficiency of the plant is not significantly increased through retrofit or rehabilitations) or;
d) for grid power plants: data from the utility, the dispatch center or official records, if it can be deemed

[23] A 10 MW power plant using natural gas has been installed in 2009 at Sococim (Senegal). Source: http://africa.aggreko.com/about-aggreko-africa/aggreko-africa-milestones/?lang=fr-fr

reliable; or

e) the default values provided in the table below in appendix 1 (if available for the type if project plant).

Option a) is not applicable because documented manufacturer´s specifications are not available.
Option b) is not applicable because no data from the utility, the dispatch center or official records are available. Thus, option c) is used.

Sococim Aggreko power plant has been commissioned in 2011. Appendix 1 of the tool to calculate the emission factor for an electricity system (version 05.0, table 1 - default value of efficiency factors for power plants) indicates an efficiency of 37.5% for grid power plants with new units (after 2000). Consequently, the default value of 37.5% will be used to determine the $EF_{EL,m,y}$ of this power plant.

(a) **Option A3** - If for a power unit *m* only data on electricity generation is available, an emission factor of 0 t CO_2/MWh can be assumed as a simple and conservative approach.

Option A3 is applied only to a power unit installed at “Industries Chimiques du Sénégal” [I] for which data on fuel consumption were not available and fuel type unknown. Industries chimiques du Sénégal » is an IPP. Fossil fuel consumption data is not available. Hence a conservative value of 0 is applied.

Determination of $EG_{m,y}$

For grid power plants, $EG_{m,y}$ should be determined as per the provisions in the monitoring tables of the tool to calculate the emission factor for an electricity system, version 5.0

For the purpose of the operating margin determination the option selected to determine *EGm,y* for off-grid power plants is following provision mentioned in Step 2: “The value of 10 per cent of the total electricity generation by grid power plants in the electricity system”

The option a) Simple OM is applied with the ex-ante option. For each crediting period the most recent three historical years for which data is available at the time of the submission of the CDM-PDD to the DOE for validation will be used. At the time of the submission of the CDM-PP to the DOE for validation, data from years 2013, 2014 and 2015 are available.

The amount of fuel type consumed in 2013, 2014 and 2015 in volume was provided by Senelec, the national electricity company of Senegal. Main and secondary fuel types were considered under this calculation.

The net calorific value of fuel type also came from the data provided by Senelec.

However, due to a lack of information regarding the CO_2 emission factor for combustion, 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, were used.

The simple adjusted OM

The method (b), simple adjusted OM requires the calculation of the annual load duration curve of the grid.

Hourly data are not available. Therefore, the simple adjusted OM is not applicable.

Dispatch data analysis OM

The dispatch data analysis OM emission factor (*EFgrid,OM-DD,y*) is determined based on the grid power units that are actually dispatched at the margin during each hour *h* where the project is displacing grid electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of *EFgrid,OM-DD,y*.

Hourly data are not available. Therefore, the dispatch data analysis OM is not applicable.

Average OM

The average OM emission factor ($EF_{grid,OM-ave,y}$) is calculated as the average emission rate of all power plants serving the grid, using the methodological guidance as described under Step 4 (section 6.4.1) above for the simple OM, but also including the low-cost/must-run power plants in all equations.

When following the guidance of calculation of the simple OM, Option B should only be used if the necessary data for Option A is not available.
Average OM is not applied.

The result of the calculation for a 3 years average gives an Operating Margin of 0.6795 CO_2/MWh.

STEP 5. Calculate the build margin (BM) emission factor.

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: for the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: for the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex ante, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

For the purpose of this project, option 1 is applied.

Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor.

In the project electricity system, there is no capacity addition from retrofits of power plants.

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\ units}$) and determine their annual electricity generation ($AEG_{SET-5-units}$, in MWh);

Name of the power units	Starting date of operation [24]	Type	Net Power generation in 2015 [MWh]	Cumulated Percentage (%) based on total net electricity generation
Kounoune Power	2007	Residual Fioul	412,871	31.5%
Loc APR	2011	Diesel/ Gasoil	128,442	17.4%
Sococim	2011	Natural Gas	-	13.1%
APR EDM	2013	Diesel/ Gasoil	141,986	13.1%
Aggreko CdB	Sep-14	HFO	189,004	8.2%
Aggreko CdB	Jul-15	DO	9,642	1.8%
Aggreko Diass	Oct-15	DO	22,464	1.5%

[24] Starting date of operation have been provided by SENELEC (by email) and submitted to the DOE.

Kahone	2015	HFO/DO	21,393	0.7%
Off grid 10.0%			92,580	
TOTAL GENERATION IN 2015 including 10% off grid power plants			**1,018,383**	

Table 9: Set of 5 power units under consideration.

The set of five power units that have been built most recently represents a gross electricity production (in the year 2015) of 384,489 MWh. These power units are APR EDM, Aggreko CdB 2014, Aggreko CdB 2015, Aggreko Diass, and Kahone.

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20 per cent of AEG_{total} (if 20 per cent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\ per\ cent}$) and determine their annual electricity generation (AEG_{SET-I} , in MWh);

20% of gross electricity production in 2015 (AEG_{total} = 2,942,301 MWh) represented 588,460 MWh.
The 8 most recently built power plants[25] produce a gross electricity production of 925,802 MWh, thus 31.5% of the total net electricity generation. These power units are namely Kounoune Power, Loc APR, Sococim, APR EDM, Aggreko CdB 2014, Aggreko CdB 2015, Aggreko Diass, and Kahone.
.

(c) From $SET_{5-units}$ and $SET_{\geq 20\ per\ cent}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample}); Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin.

In the present case, the build margin emission factor does not include power units that are built more than 10 years ago.
According to the methodological tool, the set of power units (SET_{sample}) that comprises the larger annual generation must be used. In the present case, $SET_{sample} = SET_{\geq 20\ per\ cent}$.

[25] As registered CDM project activity and power plant supplying the connected grid (and not the project electricity system), Felou hydropower plant is excluded.

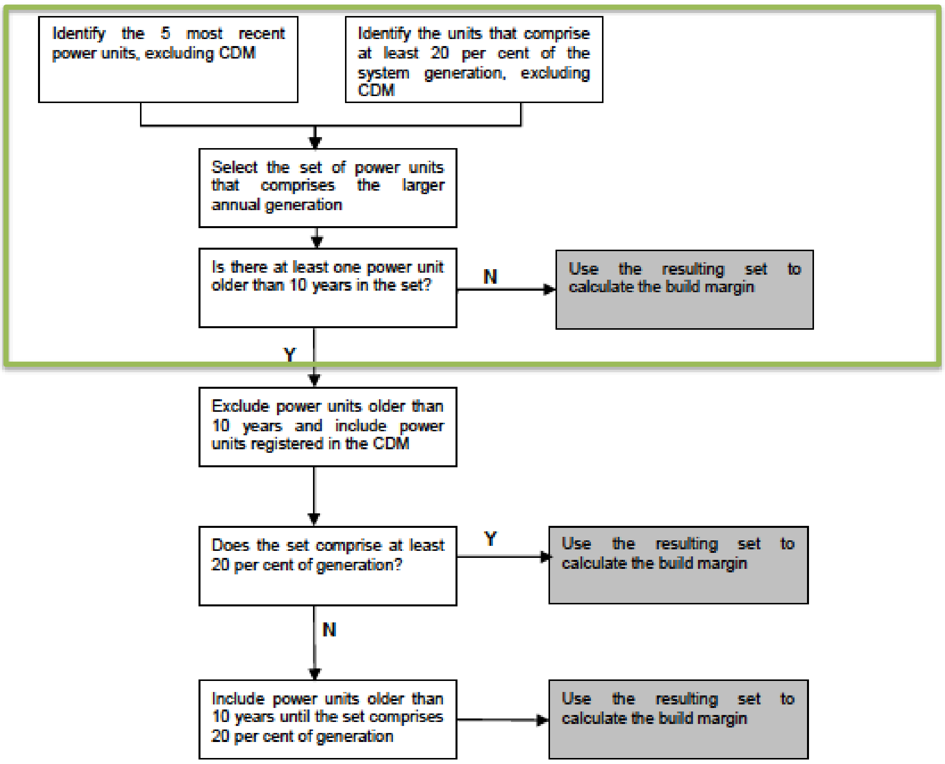

Figure 12: Procedure to determine the sample group of power units *m* used to calculate the build margin

A power plant/unit is a facility that generates electric power. Several power units at one site comprise one power plant, whereas a power unit is characterized by the fact that it can operate independently from other power units at the same site. Where several identical power units (i.e. with the same capacity, age and efficiency) are installed at one site, they may be considered as one single power unit.

As per table above, $SET_{\geq 20 \text{ per cent}}$ represents a net electricity production (in year 2015) of 925,802 MWh. Off-grid power generation is taken into account as determined under step 2.

The build margin emission factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which electricity generation data is available (2015 in present case), calculated as follows:

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

Equation (15)

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year *y* ($t\ CO_2/MWh$)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* ($t\ CO_2/MWh$)
m	=	Power units included in the build margin
y	=	Most recent historical year for which electricity generation data is available.

The CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) should be determined as per the guidance in Step 4 section 6.4.1 for the simple OM, using Options A1, A2 or A3, using for *y* the most recent historical year for

which electricity generation data is available, and using for *m* the power units included in the build margin.
In the case of this project, the CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) should be determined as per option A1.

For the purpose of the build margin determination the option selected to determine *EGm,y* for off-grid power plants is following provision mentioned in Step 2: "The value of 10 per cent of the total electricity generation by grid power plants included in the sample group as per Step 5"

On the basis of data from the table above, the built margin (2015) results in: 0.6808 tCO_2/MWh.

STEP 6. Calculate the combined margin (CM) emission factor

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following method:
(a) Weighted average CM;

(b) Simplified CM.

The flow chart below provides an overview of options available to determine the CM emission factor.

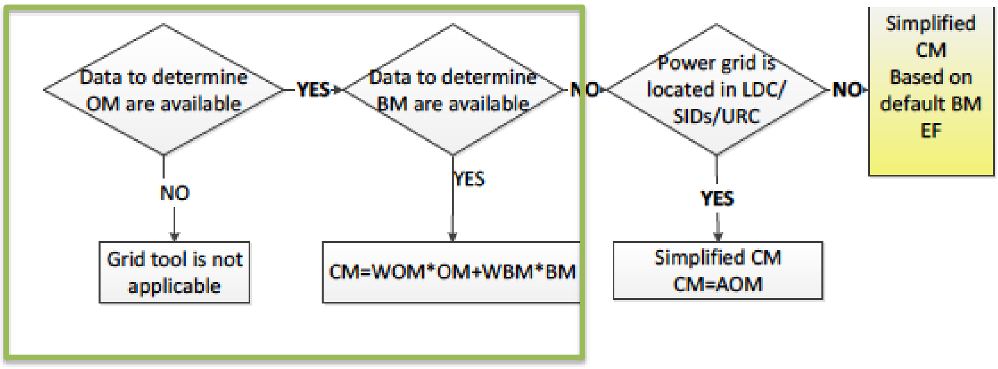

Figure 13: Determination of CM emission factor

For the purpose of this project, the option a) is selected. The combined margin emission factor is calculated as follows:

(a) Weighted average CM;

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$ Equation (16)

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$	=	Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
w_{OM}	=	Weighting of operating margin emissions factor (%)
w_{BM}	=	Weighting of build margin emissions factor (%)

The following default values should be used for w_{OM} and w_{BM}:in case of wind and solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods;

Based on 2013, 2014 and 2015, the combined margin emission factor and grid emission factor value used to calculate the emission reductions of the PV power plant project is 0.6798 tCO_2/MWh.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \qquad \textbf{Equation (13)}$$

Where:
ER_y = Emission reductions in year *y* (t CO_2e)
BE_y = Baseline emissions in year *y* (t CO_2)
PE_y = Project emissions in year *y* (t CO_2e)

B.6.2. 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
Measurement methods and procedures	-
Monitoring frequency	Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option). BM: For the first crediting period, once ex ante. For the second and third crediting period, only once ex ante at the start of the second crediting period.
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

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
Measurement methods and procedures	-
Monitoring frequency	Simple OM: Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) BM: For the first crediting period, once ex ante. For the second and third crediting period, only once ex ante at the start of the second crediting period.
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

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" (Version 05.0.0)
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	Calculation of baseline emissions
Additional comment	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", (Version 05.0.0)
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	Calculation of baseline emissions
Additional comment	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", (Version 05.0.0)
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	Calculation of baseline emissions
Additional comment	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
Measurement methods and procedures	-
Monitoring frequency	Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) BM: For the first crediting period, once ex ante. For the second and third crediting period, only once ex ante at the start of the second crediting period.
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

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
Measurement methods and procedures	-
Monitoring frequency	Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option). BM: For the first crediting period, once ex ante. For the second and third crediting period, only once ex ante at the start of the second crediting period.
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

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).

Measurement methods and procedures	-
Monitoring frequency	Once for the crediting period
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	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% [26]
Choice of data or Measurement methods and procedures	-
Purpose of data	Additionality demonstration
Additional comment	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
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	Additionality demonstration
Additional comment	This parameter is used to confirm the automatic additionality of the project activity. Please refer to B.5

B.6.3. Ex ante calculation of emission reductions

	Value/Result	Unit	Source/reference
Total installed capacity	92,016 x 265 W_p = 24.38424	MW_p	A.3
	37,757	MWh	B.7.1, cf. Excel

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

Net electricity delivered to the grid ($EG_{PJ,y}$)			EG(PJ,y)=EG(facility,y)
Baseline emission factor of Senegalese grid ($EF_{grid,CM,y}$)	0.75 x 0.6795 tCO_2/MWh + 0.25 x 0.6808 tCO_2/MWh = 0.6798	tCO_2/MWh	B.6.1 [$EF_{grid,CM,y} = w_{OM} \times EF_{OM,y} + w_{BM} \times EF_{BM,y}$]
Baseline emissions (BE_y) (after applying discounted values as per para 241(a), Project Standard V.2)	37,757 MWh/yr x 0.6798 tCO_2/MWh = 25,666	tCO_2/y	B.6.1 $BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$
Project emissions (PE_y)	0	tCO_2/y	B.6.1
Emission reductions (ER_y) (after applying discounted values as per para 241(a), Project Standard V.2)	25,666	tCO_2/y	$ER_y = BE_y – PE_y$

YEAR	BE_y (tCO_2)	$EG_{PJ,y}$ (MWh)	$EF_{grid,CM,y}$
			tCO_2/MWh
11/11/2016 -31/12/2016	3,265	4,804	0.6798
2017	23,354	34,355	0.6798
2018	23,237	34,183	0.6798
2019	23,723	34,898	0.6798
2020	27,677	40,714	0.6798
2021	27,538	40,510	0.6798
2022	27,400	40,307	0.6798
01/01/2023 -10/11/2023	23,470	34,526	0.6798
TOTAL	**179, 664**	**264,296**	**/**
Average over 7 years	25,666	37,757	**/**

As per para. 241 a) i) a. of PA Standard V.2.0, CERs are claimed up to an amount calculated based on the increased capacity by 20 per cent of the capacity specified in the originally registered PDD, i.e. the limit of capacity addition would be 4.0068 MW, which corresponds to 98.59% of the effective capacity installed at stage of completion of the second project phase.

Accordingly, effective emission reductions will need to take account of this factor at stage of monitoring after completion of the second project phase.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions	Project emissions	Leakage	Emission reductions
	(t CO_2e)	(t CO_2e)	(t CO_2e)	(t CO_2e)
11/11/2016 -31/12/2016	3,265	0	0	3,265
2017	23,354	0	0	23,354
2018	23,237	0	0	23,237
2019	23,723	0	0	23,723
2020	27,677	0	0	27,677
2021	27,538	0	0	27,538
2022	27,400	0	0	27,400
01/01/2023 -10/11/2023	23,470	0	0	23,470
Total	**179,664**	**0**	**0**	**179,664**
Total number of crediting years	7			
Annual average over the crediting period	**25,666**	**0**	**0**	**25,666**

As per para. 241 a) i) a. of PA Standard V.2.0, CERs may be claimed up to an amount calculated based on the increased capacity by 20 per cent of the capacity specified in the originally registered PDD, i.e. the limit of capacity addition would be 4.0068 MW, which corresponds to 98.59% of the effective capacity installed at stage of completion of the second project phase.

Accordingly, effective emission reductions will need to take account of this factor at stage of monitoring after completion of the second project phase.

B.7. Monitoring plan

B.7.1. Data and parameters to be 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*
Source of data	Measured directly with electricity meters at project site. After commissioning of the Project, $EG_{facility,y}$ will be measured directly with power meters at project site. On an ex-ante basis, $EG_{facility,y\ h}$ has been estimated based on a feasibility survey called “Yearly MWh/year and calculations of the losses versus performance over 20 years. Please refer to section A.3. The pre-feasibility survey is also provided to the DOE.

<table>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th rowspan="2">YEAR</th><th colspan="2">Expected net electricity production fed into grid (MWh)</th></tr>
<tr><th></th><th>After taking account of para. 241 (a) of PA Standard</th></tr>
<tr><td>11/11/2016 -31/12/2016</td><td>4,804</td><td>4,804</td></tr>
<tr><td>2017</td><td>34,355</td><td>34,355</td></tr>
<tr><td>2018</td><td>34,183</td><td>34,183</td></tr>
<tr><td>2019</td><td>35,792</td><td>34,898</td></tr>
<tr><td>2020</td><td>41,092</td><td>40,714</td></tr>
<tr><td>2021</td><td>40,886</td><td>40,510</td></tr>
<tr><td>2022</td><td>40,682</td><td>40,307</td></tr>
<tr><td>01/01/2023 -10/11/2023</td><td>34,847</td><td>34,526</td></tr>
<tr><td>TOTAL</td><td>266,641</td><td>264,296</td></tr>
</table>
</td></tr>
<tr><td>Measurement methods and procedures</td><td>Electricity meters.

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>Monitoring frequency</td><td>Continuous measurement and at least monthly recording.</td></tr>
<tr><td>QA/QC procedures</td><td>Electricity outputs will be electronically stored and reading recorded on a record sheet by the operation manager.

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.

At least two meters will be installed at delivery point with +- 0.2 precision (active energy, international calibration standard) measuring delivered and received electricity.

The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier or requirements set by the grid operators:
Requirements set by the meter supplier apply. With respect to frequency of calibration, no periodic calibration is required after initial calibration ex works, neither by national standards, nor by the meter supplier, nor by the grid operator.

Regular maintenance and testing in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements:
In absence of a grid code and stipulations of the meter supplier, national requirements apply. As per Senegalese decree 60-415, in normal circumstances, a periodic verification of the meters is performed on an annual basis.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

B.7.2. Sampling plan

N/A

B.7.3. Other elements of monitoring plan

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 will be reliably monitored through calibrated electricity meters and cross-checked with sales records.

The fundamental feature of the program will provide 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:

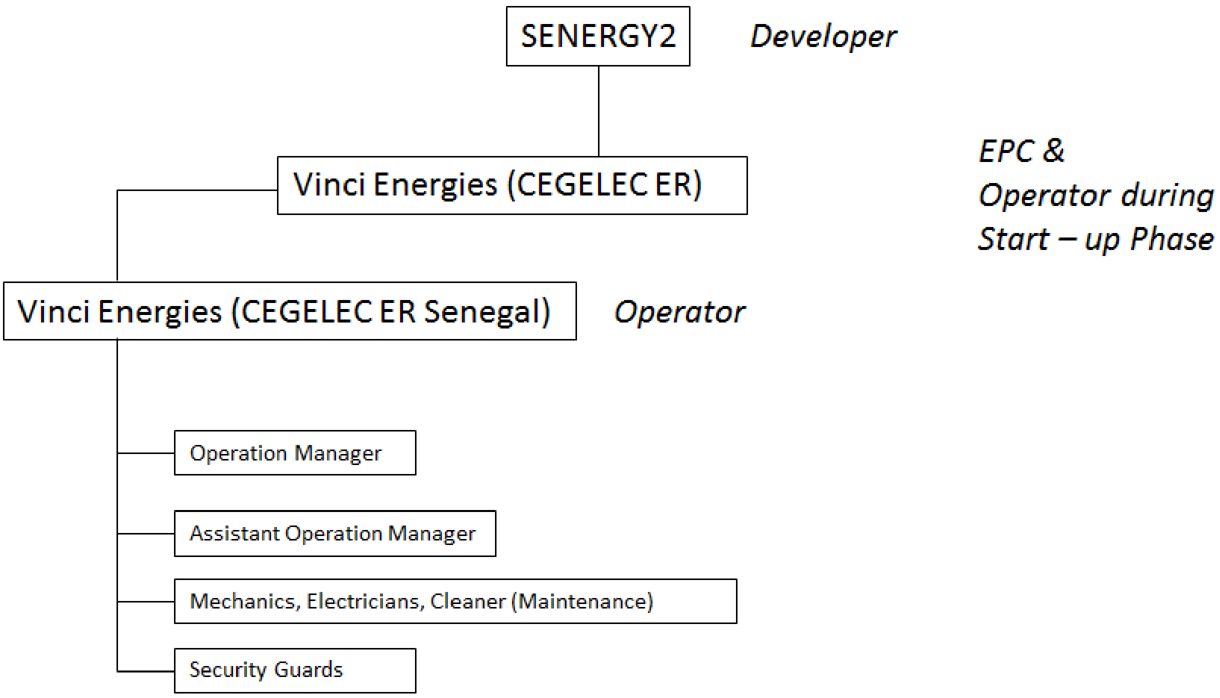

Figure 14: Operational organisation

The legal form of the operator of the power plant is planned to be modified after the start-up phase.

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; and
- Coordinate the DOE work during the verification audit.

The CEO might appoint a CDM coordinator to delegate to him the above specific tasks of monitoring supervision.

The maintenance will be entirely under the responsibility of Vinci Energies.

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

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).

<u>Monitoring team and training</u>

Data collection, consolidation and results analysis will be undertaken by a dedicated team adequately trained, well aware of CDM requirements. This team will not have any 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 shall guarantee the integrity of the work that will be done.

<u>Emergency and trouble-shooting procedures</u>
The immediate response capability will be achieved through the implementation of a system of supervision and control that will transfer real-time all information about the state of the equipment. The operator will provide a team of qualified stakeholders that can react in "real time".

As concerns potential power blackouts, a Standby Power Systems (UPS) will be installed in the PVBOX (containerized plug and play power conversion system) at the onsite delivery point for critical operational equipment requiring power backup. The UPS system installed shall be 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 C. Start date, crediting period type and duration

C.1. Start date of project activity

02/02/2016

The start date of the proposed project activity is defined as per date of approval of an African Development Bank’s request (on behalf of the project participant) to the Global Environment Facility of a proposed investment to support the Bokhol Solar Power Project in Senegal[27]. This triggered the project start including construction works.

C.2. Expected operational lifetime of project activity

The expected operational lifetime of the project activity is 20 years (240 months) from commissioning of the plant.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

The project activity will use a renewable crediting period (3x7 years).

The project initiates the first renewable crediting period.

C.3.2. Start date of crediting period

11/11/2016

[27] The African Developmen Bank´s request to the Global Environmental Facility is provided to the DOE.

C.3.3. Duration of crediting period

7 years (i.e. 84 months)

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

A comprehensive environmental and social impact assessment (ESIA) has been performed in order to ensure that environmental and social aspects are taken into account in the development of the proposed solar project in Bokhol. The ESIA aims at identifying, analysing and predicting the impact of the implementation of the solar power plant on the physical and biological surrounding environment, as well as on the social, cultural and health aspects that could impact the populations.
The approach used to conduct this environmental assessment is fundamentally guided by the requirements of the Environmental Code of Senegal. It also takes into account the regulatory requirements expressed in sectoral codes when applicable to the project.

As part of this ESIA, alternatives to the project were analysed. The analysis of variants was performed for the following topics:

a) Absence of the project;
b) Location of the plant;
c) Production of electric power technology.

For each item, the listing of possible variants is established according to the following three levels and two main trends such as described below:

- Hard (H), positive or negative impacts
- Moderate (M), positive or negative impacts
- or Low (L), positive or negative impacts

where the "hard" level being the most important and "low" the less impacting.

The results of the analysis are the following[28]:
The project will add 20 MW to the installed electricity capacity in Senegal and increase the country's generating capacity. With an annual production of at least 33.9 GWh, the solar power Bokhol will connect 200,000 new consumers to the national grid.

a) Absence of the project

The situation "without project", is equivalent to not implementing the solar power plant and maintain a status quo in relation to land use. This leads to several negative effects:

- a delay in the absorption of the deficit of electric energy production at national level, thus contributing to a financial imbalance of SENELEC, a lack of competitiveness of the Senegalese economy and a negative impact on household economies;
- a lack of opportunity for the community to promote the social private sector investment that can, among other things, help to enhance the value of productive land and improve:
  - (i) the resilience of populations to climate change
  - (ii) access to electric energy,
  - (iii) the infrastructure and quality of basic social services, etc.,
- a lack of opportunities for the state to gain access to tax resources and promote a profitable investment from sovereign wealth funds;
- a lack of socio-economic value of degraded land in the context of low capacity for the populations to counter the resilience effects related to climate change;

This scenario does not correspond to the Senegalese policy nor the economic and social objectives of development of the country. Also, the status quo does not fit the spirit and principles of improvement of the energy sector in Senegal.
Finally, this situation of status quo will impede the communities to access sustainable electricity and, consequently, to benefit from a concrete solution to fight against climate changes. Moreover, the main advantage of situation "without project", namely the preservation of the land, can be restored or improved

[28] Source: Report EIES Volume 1 & 2 “Projet de mise en place d’une centrale photovoltaïque 20 MW dans la Commune de Bokhol” and “ Etude de Danger” drafted by BEIEEC Environnement Suarl, en collaboration avec GERTECS Sarl

through the application of compensatory measures (compensation of biodiversity, restrictions in land use) and cooperative measures.

The project alternatives are studied relating to site selection, the mode of power generation and the choice of the type of renewable energy.

b) Location of the plant

The site location can be justified by the following arguments:

- Technically and financially:
  - (i) by the proximity of SENELEC position to inject electricity into the grid. This is also an environmental and social asset, to the extent that no new network is created;
  - (ii) a significant rate of sunshine.

- Socially and institutionally:
  - (i) the existence of a draft agreement between the municipality and the developer and its validation by the administrative authority;
  - (ii) the social acceptability of the project by Bokhol population, without exception,
  - (iii) the reduction of regional disparity in the production of photovoltaic solar energy (one of the objectives of the sector as defined in the Development Policy-Letter of Energy),
  - (iv) the project implementation site is free from occupation,
  - (v) the quality of the soil is not a major constraint in land use for agricultural purposes.

One of the main constraints to the site is the natural pollution-related to soil erosion, which will require regular cleaning of the panels. This constraint, which can also have negative effects on equipments, is well reflected in the criteria for selection of equipment and operating conditions of the plant.

c) Production of energy

Regarding the mode of production, it is noted that the renewables have several advantages:

- they contribute to the diversification of sources of production,
- they contribute to the energy independence of the country which rate was of 4% in 2004 an is expected to be of 20% in 2020 (Development Policy - Letter for the Energy Sector), etc.;
- they enable a reduction of national GHG emissions
- they have also low operating costs;
- and generate less hazardous waste than fossil fuel production

The main constraint for the solar and which is common with other renewable energy is the requirement of large spaces of land. Consequently, land is a central issue in the environmental and social feasibility. However, the location of the project as well as the compensation measures defined to strengthen the socio-economic capacity of the population could even turn this aspect into an opportunity.
Ultimately, in the range of renewable energy, the choice focused on solar photovoltaic is relevant due to the weather of the acquired land, the country's experience in this field and the options set out in the Development Policy - Letter for the Energy Sector.

Description of the scope and assessment of the sensitivity of the environment

The table below summarizes the scale and sensitivity of the environment in the region.

Environmental Component	Characteristics of the region	Evaluation /Stakes for the region	Compatibility with the project
Climate	- Strongly sunny area with an annual average exceeding 3000 hours; - Weak water zone (annual average 330mm) - Influence of North winds loaded with solid pollutant during the dry season	High (Positive)	Compatible Wind erosion to be taken into account
Geology	- Geology of the Senegalese-Mauritanian basin secondary and tertiary age.	High (Positive)	Land compatible with infrastructure and building operations

Environmental Component	Characteristics of the region	Evaluation /Stakes for the region	Compatibility with the project
Geological resources	- Soil on-site and surrounding areas, is sandy - Soil is low in organic component and very sensitive to wind and water erosion	Low (Negative)	- Soils low in organic component: very high infiltration capacity - Soil-compatible with agricultural and pastoral activities
Superficial Water	Remote areas: - The river system is based on the Senegal River. Lack of water Neighbourhood area - No water	Remote areas: Low (Negative) Neighbourhood area: No impact	Remote areas - Water used for agricultural purposes and food use - alive environments of many animal and plant species Neighbourhood area - No use
Ground water	- No form of use of groundwater is observed on site and its surrounding environment - Superficial groundwater on site is captured at 45 meters - Three aquifers are identified in the project area	Medium (Positive)	- No form of use of groundwater is observed on site and its surroundings - The water supply network pass through the village of Ngambou Thillé and that of Dieri Gaé
Biodiversity	- Unfavourable site for the development and maintenance of wildlife - Vegetation: virtually non-existent - Natural environment: degraded natural - Site located in Diétri	Low (Negative) Medium (Negative)	Low (Negative) - Vegetation on site is disparate - Presence of four (04) species (Ziziphus mauritianan, Tamarindus indica, albida and Acacia radiana) which are: (i) partially protected by the Forestry Code of Senegal, and (ii) threatened in the flora of Senegal Medium (Negative) - Wild life almost non-existent - Presence of a very diverse avifauna - Small weakly diversified fauna
Hotspot	- The project area is not in any sensitive area such as classified forest and pastoral reserve	High (Positive)	- The site is far from sensitive area.
Socio-economic impacts	- No socio-economic impact is identified on the project site	High (Positive)	-The project implementation doesn't lead to any cessation of activity
Human impact	- No populated land is affected by the project	High (Positive)	- The implementation of the project does not

Environmental Component	Characteristics of the region	Evaluation /Stakes for the region	Compatibility with the project
			require displacement of population

Table 10: Criteria taken into account by the EISA and their respective impacts.

An environmental monitoring program will be established to ensure the smooth execution of work during pre-construction and construction phases. This system intends to ensure the respect of:

- the relevant laws and regulations;
- the conditions set by the regulatory authorities;
- the proponent's commitments under authorizations;
- and the measures proposed in the environmental impact study, including mitigation measures.

Conclusion

Energy is one of the most critical inputs for economic growth. The increase of installed capacity in Senegal will reduce electricity prices and ensure a more competitive economy. It will also facilitate social inclusiveness by promoting a more democratic access to electricity.

The implementation of a photovoltaic power plant of 20 MW in the municipality of Bokhol constitutes an adequate response to Senegal's directions in the field of energy, embodied by the strategic option of the energy mix, a major issue for the Government of Senegal. The use of renewable energy, particularly solar PV is a relevant option to mitigate the fluctuations of oil prices, improve the country's energy security and facilitate the financial stability of the sub -sector.

Beyond these technical and economic considerations, the project is characterized by a relatively high environmental and social feasibility. Indeed, it contributes to the achievement of objectives determined at national level. Also, unlike conventional energy, solar PV will not result in air emissions have harmful impacts on health.

The negative effects for this kind of project are more about the loss of land and biodiversity. However, they are limited in the case of the proposed Bokhol solar project. Indeed, the analysis of the baseline shows a progress of desert forehead and a scarcity of water resources that gradually led to land degradation and a net decline of farming and plant cover. However, note that the reversibility of this process is possible under some conditions; hence the importance of supporting these issues in the compensation mechanisms.

Moreover, it is important to emphasize that the establishment of an industry in the area should be seen as an opportunity to facilitate technical and financial support to the community, especially women, to revive agricultural activities through local taxes, capacity building measures under the compensation and social responsibility. Consequently, the project will contribute to the restoration of biodiversity and the development of agriculture.
Furthermore, the project will boost local employment during the construction phase and the operational phase with the establishment of an inclusive recruitment policy.

These positive effects will be obvious if the actions of environmental monitoring are implemented.

D.2. Environmental impact assessment

A thorough environmental and social impact assessment study (ESIA) has been performed and concluded that the solar project in Bokhol will have a positive outcome. A technical committee meeting was held on October 15th, 2015 to validate the environmental and social impact assessment study (ESIA). The environmental licence has been issued on October 20th 2015 by Mrs Cheick Fofana from the Ministry of Environment.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

The overall objective of the local stakeholder consultations is to present the solar power plant to authorities, technical services and local populations. Specifically, it aims at:

- developing a good awareness campaign for all stakeholders, identify impacts and engage the thoughts that are needed;
- identifying economic, social and environmental consequences of the project and appropriate action;

- ensuring that the parties can share their concerns, expectations and recommendations against the project proponent;
- establishing relationships based on trust between the developer and all consolidated stakeholders including the commitments made by each other.

To inform, gather opinions, concerns and recommendations of the project stakeholders, several meetings with stakeholders were organised. As some local stakeholders are illiterate, they were informed via megaphones on cars in public spaces of each community and word-of-mouth. In the below, we describe the most relevant stakeholder consultations. The tables presented in section E.2 summarize the essential comments received from the stakeholders and the responses delivered by the promoter:

a) Early meetings with stakeholders

In order to present the project and before initiating the Environmental and Social Assessment, the promoter of the project met at several occasions with representatives of various technical departments of the ministries concerned, NGOs, private operators, socio-professional groups, local populations, authorities and local authorities, village chiefs and opinion leaders between 2013 and implementation of the Environmental and Social Assessment in 2015. Before each meeting, the project content was presented to the group consulted in terms of economic issues, social, cultural, environmental, as well as in terms of mitigation and improvement measures. At the end of the consultations, it was concluded that there was wide acceptance of this photovoltaic power plant project in the municipality of Bokhol.

b) Meeting with the rural council of Bokhol

Another consultation meeting was organised on 17th of January 2013 with the rural council of Bokhol in the deliberation room of the rural advisory Bokhol. During this meeting, the promoter introduced the technical characteristics as well as its main social and environmental impacts of the project. At the end of the meeting, the rural council agreed to assign 100 hectares of land, 50 hectares in the commune of Durablis and 50 hectares in the commune of Mery.

c) Meeting with the women and men of the community of Bokhol and neighbourhood villages

On the 3rd August 2015, a meeting was held at the community hall of Bokhol with the women and men involved in the community of Bokhol and neighbourhood villages and the consultant in order to discuss the environmental and social impacts of the solar photovoltaic project. Prayers marked the start of the meeting that saw the participation of all segments of the population.
After thanking the participants, the mayor explained the importance of the project.
Following Mayor´s intervention, the consultant addressed the goal of a public consultation as an important part of the environmental assessments, especially in the case of a project financed by the AfDB. He reminded the participants that the purpose of this second public consultation was to note all population´s issues in order to better integrate them during the implementation of the project. Following these introductory presentations, the Mayor of Bokhol asked all men to let the consultant interview women first. Another section of explanation was separately hold with the men.
This approach of holding separate meetings intends to better take into account the concerns of all the members of the population, considering that the separation of men and women will enable a more fluent exchange. A summary of all comments and questions received during the meeting with the women and men of the commune of Bokhol are summarized in the following section E.2 “Summary of comments received”.

E.2. Summary of comments received

The stakeholders are very enthusiastic about the development of the solar plant in the commune of Bokhol.
A number of remarks were addressed to the promoter. The following table is a summary of the most relevant issues discussed, recommendations, and the responses given by the developer or consultant.

a. Early meetings with stakeholders

Administrative and local authorities	Observations, threats	Recommendations	Responses from the Developer
Tax department	- The registration of the land and the legal aspects of land	- Respect the lease application process	The project will respect all the legal procedures relatives to the registration of the land

Administrative and local authorities	Observations, threats	Recommendations	Responses from the Developer
Direction of cadaster	- Allocation of land	- Check if the land is not in dispute between the town halls of Bokhol and Gaya	The project will enter in contact with the town of Bokhol and Gaya to avoid any complications
Livestock Directorate	- Risk of cutting paths taken by livestock in the area; - Risks of accidents with the herds of the area; - Pasture area loss for the farmers of the area	- Plan paths for livestock in the area of the project	We take note of this comment.
Directorate of Hydraulics	- Avoid polluting scarce water of the area - Avoid obstructing the access to temporary ponds and lakes	- Rationalize the use of water for the activities of the central - Equip self-drilling outside the existing system of water that is used to supply the populations - Do not use chemicals in the plant operations	The project being a solar plant, the requirements in water will not be important. However, the promoter will make sure to respect the mentioned requirements.
Labour Force Directorate	- Working conditions - Health - Hygiene - Security	- Respect labor laws - Sign standing contracts which are validated by the departmental inspection - Implement health protection mechanisms for the workers	The promoter will comply with all laws and regulations
Directorate of Water and Forests	- Changing the ecosystem and environmental disruption	- Maintaining ecosystem balance - Receive the advice of technical services during the implementation of the project - Making reforestation plans	Following this meeting, the promoter will initiate a Social and Environmental Assessment in order to identify the risk of the projects and solutions to mitigate them.
Firefighter Directorate	- Manifestation of lightning - Security	- Meet the standards of safety and security- - Install lightning rods	The promoter will make sure that the site is safe and secured.
Regional subsidiary of Senelec	- Solar plant in Bokhol	- It is a good project that will enable to strengthen Senelec´s network	Thank you
Prefecture of Dagana	- Solar plant in Bokhol	- It is a project of high importance as some villages of the region are not yet electrified	Under the agreement signed between the Municipality of Bokhol and Senergy 2, Senergy 2 agrees to contribute to the rural electrification of the direct influence of the project area (Installation of public street lights, providing solar kit, etc.) and that up to 35 million XFA[29]. Alongside the Mayor,

[29] On December 2015, 35,000,000 XAF equal 53,500 Euro based on the currency exchange website : http://themoneyconverter.com/FR/XAF/EUR.aspx

Administrative and local authorities	Observations, threats	Recommendations	Responses from the Developer
			Senergy 2 also negotiate with SENELEC and the Ministry of Energy to promote a general operation of electrification of the area. This helps rural electricity is part of a comprehensive support plan for community development to restore some losses related to services provided by ecosystems, to improve the standard of living and their ability to generate income.
City Council	- Very pleased to develop this project in my territory	- Compliance with the commitments made by the Proponent towards the municipal authorities and population - If possible, provide training sessions to the population allowing them to have the skills required to work in electricity supply central - Make a reforestation campaign - Make sensitization campaigns on environmental protection to the population	As part of an agreement signed between the Municipality of Bokhol and Senergy 2, it is expected that in return the affected lands, Senergy 2 agrees to pay an annual rent of 8,000,000 XFA [30] during a 25-year period. This amount will be reflected in the revenue of the municipality; which will enable the financing of municipal investments.
Village Elders	- Pollution and nuisance	- Prioritize local youth in recruitment - Helping the Muslim community for the completion of the mosque and a Franco Arabic school - Help the community in the construction of basic infrastructure (health post, school sports field) - Meet commitments	As part of an agreement signed between the Municipality of Bokhol and Senergy 2, it is expected that in return the affected lands, Senergy 2 agrees to pay an annual rent of 8,000,000 XFA [31] during a 25-year period. This amount will be reflected in the revenue of the municipality; which will enable the financing of municipal investments.
Population	- We are pleased to see such a project developed in the region - Non-compliance with environmental standards and commitments	- Prioritize local youth in recruitment - Insist on compliance with environmental and safety standards - Fight against deforestation - Prioritize local youth in recruitment - Social works	The promoter has agreed to secure employment for indigenous people with the endorsement of the rural council which 40% for the surrounding villages and 60% for other villages in the rural community on the basic quota of the rural community.

[30] On December 2015, 8,000,000 XAF equal 12,000 Euro based on the currency exchange website : http://themoneyconverter.com/FR/XAF/EUR.aspx

Administrative and local authorities	Observations, threats	Recommendations	Responses from the Developer
	made to the populations		

Table 11: Results of the consultation with the local stakeholder before the initiation of the Environmental and Social Assessment

b. Meeting with the women of the community of Bokhol and neighbourhood villages

Administrative and local authorities	Observations, threats	Recommendations	Responses from the Developer
Badiènou Gox (provide medical support in Bokhol commune) 17 members	- Communication problems to ensure their missions in terms of phone connection and transport	- Make the solar energy provided to support the development of a better communication and transportation systems	A lump sum of 8,000,000 of XFA will be paid annually to the rural council throughout the project operating period
Takky Liggey Association that supports women empowerment 90 members	- Difficulties to get access to land - Even more difficult to get access to water to irrigate the lands - Some women are trained to reforestation practices but no due to the lack of budget, no initiatives are developed -	- The community asks the promoter to assist women to pump water from the lake with solar energy instead of using the fuel that is not profitable;	The promoter has agreed to install solar panels to the surrounding villages. The promoter will also support the association working on power empowerment.
Women from neighborhood Fula villages	- These villages have no hospital, no ambulances, no water, no land, no agricultural production lands. Their only resources come from the production of milk. However, the packaging and conditioning of the milk has to be made in Dagana as the villages don't have a local conditioning plant. And most of the time, the milk ferments during the transport.	- Helping Fula women to establish a local dairy unit. For this purpose, even some solar kits could work as long as it allows them to pack their dairy products	The promoter has agreed to install solar panels to the surrounding villages The promoter will also support the association working on power empowerment
Women from the Meri village	-They express that they were in the same situation as the Fula´s villages with regards to the access of water, health. They also shared that lack of infrastructure for education was also a problem. Most of the time, girls leave school before 17 years old. Could the promoter help them to: - Renovate the maternity? As well as the nursery? - As well, is there is a reforestation project, it would be good to plant fruit trees such as bananas and lemon as well as eucalyptus. It is a project supported by the Ministry of Forests. The revenues of these trees will enable us to finance social initiatives.	- Invest in the education sector by rehabilitating the rooms of the nursery; - Build a new maternity in Bokhol and equip the existing one	- The promoter will support financially the construction of classrooms and health centers - The promoter will also make a donation of medicines and school supplies

Administrative and local authorities	Observations, threats	Recommendations	Responses from the Developer

Table 12: Results of the consultations with women of the commune of Bokhol and neighbourhood villages

c. Meeting with the men of the community of Bokhol and neighbourhood villages

Administrative and local authorities	Observations, threats	Recommendations	Responses from the Developer
Men of Bokhol´s commune and neighbourhood villages (they had prepared a list of their comments when the promoter was consulting women)	- Before, the acquisition of land was made through the family. It is not the case anymore. Now the Commune delivers the land. But the administrative procedure is so slow (up to two years) that lot of people don't request lands anymore. - Land is a fundamental economic issue because young people do not find jobs and are forced to fall back on activities such as agriculture - Some landowners own several hectares while young people are struggling to access small areas of land. This is why we would like some give up their land to make available to those who do not have - The only lands available are in the Diéri where it is almost impossible to get water. The development of Diéri is lacking budget. Therefore arable lands are reducing while the size of the population increases. - The other difficulty in the Municipality lies in the fact that whenever the land is developed, it must be protected against livestock intrusion. In reality, there are areas specifically agricultural, others exclusively pastoral vocation while others can accommodate livestock and agriculture, but provided it is well organized. In the project area, it is difficult for these two activities coexist and it is the farmers who are facing more difficulties - Income-generating activities in the area are usually agriculture and livestock. Most production tools belong to cooperatives and are not sufficient. We need urgently are harvesters and laborers to make the land fertile - Education in the commune is a real problem. It happens to have more than 70-80 students in the same class room. Some villages lack schools. And due to transport difficulties, kids stop going to school before ending their education - Concerning reforestation, it is assumed that all plants are useful. Some are more useful to man, others to the animal. We need trees in Diéri. But if there are trees but that they are not maintained by people, it will have no meaning. It is better to have the following trees: the Sump, Werang the sedeem the sung, the Tamarind, the Kele, mango offering many services, the Lecena.	- Ask some land owners to leave part of their land to people in need - Supporting actors of the agriculture sector to enable them to make small irrigation with solar energy - Make available some modern means of production such as laborers, harvesters, etc. to the local populations - Put in place a transportation system that will drive kids from remote villages to schools. - Allow Diéri´s populations to access to drinking water through solar power	Secure employment for indigenous people with the endorsement of the rural council which 40% for the surrounding villages and 60% for other villages in the rural community on the basic quota of the rural community. Supports financially the construction of classrooms and health centers The promoter will also make a donation of medicines and school supplies Compensation of the families that have been affected by the project in consultation with the rural council

Table 13: Results of the consultations with men of the commune of Bokhol and neighbourhood villages

The consultation process helped to inform and gather opinions, expectations and concerns of the different categories of actors: local, elected local people, men, women, young, old, religious and traditional authorities, local administrative authorities and regional and Technical State services.

The project is considered acceptable and even raises high hopes on the part of the different actors concerted.

E.3. Consideration of comments received

Please refer to the column “Responses from the Developer” of the two tables above.

Please find below some pictures of the visit on sites:

Figure 15: Public consultation with the women of the commune of Bokhol and neighbourhood villages.

Figure 16: Public consultation with the women of the commune of Bokhol and neighbourhood villages.

SECTION F. Approval and authorization

The letter of host country approval has been issued to Senergy 2 SAS on September 21st, 2016.

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Appendix 1. Contact information of project participants

Organization name	Senergy 2 SAS
Country	Senegal
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Website	www.greenwishpartners.com
Contact person	Mamadou SOW

Organization name	ecosur afrique
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Telephone	+203 4046060
Fax	+230 4681616
E-mail	info@ecosurafrique.com
Website	www.ecosurafrique.com
Contact person	Mr Alexandre Dunod

Appendix 2. Affirmation regarding public funding

N/A

Appendix 3. Applicability of methodologies and standardized baselines

N/A

Appendix 4. Further background information on ex ante calculation of emission reductions

CALCULATION OF OM

EF_{OM}	0.6795	tCO_2/MWh

Name of power units connected to the national grid		FC natural gas,m,y [m3]			FC FO,m,y [tonnes]			FC diesel,m,y [tonnes]			FC gasoil,m,y [tonnes]		
		2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2014	2015
SENELEC	C3	0	0	0	8432	47884	80971	0	0	0	0	0	0
SENELEC	C4	0	0	0	112122	112054	109467	60	0	0	536	964	795
SENELEC	TAG2	0	0	0	0	0	0	1682	0	0	3939	9893	5333
SENELEC	TAG4	0	0	0	0	0	0	9639	0	0	14067	21835	14117
Wartsila	C6	0	0	0	112063	123540	131207	0	0	0	117	93	30
Wartsila	C7	0	0	0	129422	127846	123202	0	0	0	238	10	114
	KAHONE	-	-	-	-	-	4534	-	-	0		-	732
Mitsubishi	Kounoune Power	0	0	0	82994	73757	86905	0	0	0	1121	6847	455
MEGS	GTI	0	0	0	0	0	0	0	0	0	3391	0	0
APR Energy	Location APR	0	0	0	0	0	0	0	0	0	64940	51452	30146
	APR EDM	0	0	0	0	0	0	0	0	0	18603	27822	31825
Aggreko	Sococim	na	na		0	0	0	0	0	0	0	0	0
	AGG. CDB	-	-	-	-	7314	17853	-	0	0	-	18198	28230
	Aggreko Diass 22 MW	0	0	0	0	0	0	0	0	0	0	0	5141
	Solaire CICAD	-	-	-	-	-	-	-	-	-	-	-	-

$NCV_{i,y}$			$EF_{CO2,i,y}$	
Natural gas	34.4860	GJ/t	0.05	tCO_2/GJ
Diesel	42.5331	GJ/t	0.07	tCO_2/GJ
Residual fuel of all power units except Kounoune	38.9252	GJ/t	0.08	tCO_2/GJ
Residual fuel of Kounoune	41.3266	GJ/t	0.08	tCO_2/GJ

Name of power units connected to the national grid		EGm,y [MWh]				
		2011	2012	2013	2014	2015
SENELEC	C3	61,328	68,529	16,580	128,258	226,816
SENELEC	C4	267,680	434,944	520,833	512,148	502,266
SENELEC	TAG2	62,244	10,172	13,330	23,830	12,500
SENELEC	TAG4	3,317	14,241	71,527	62,765	39,429
Wartsila	C6	420,395	414,765	537,480	597,837	628,840
Wartsila	C7	452,612	379,404	630,108	619,141	597,448
KAHONE						21,393
Mitsubishi	Kounoune Power	390,341	382,926	395,301	377,973	412,871
MEGS	GTI	0	16,610	9,985	0	0
APR Energy	Location APR	0	0	281,346	222,251	128,442
	APR EDM			82,971	123,940	141,986
Aggreko	Sococim	0	0	77,986	53,613	0
AGG. CDB					113,994	198,646
Aggreko Diass 22 MW						22,464
Industries Chimiques du Sénégal						9,200
Total EGy without import		**1,657,917**	**1,721,592**	**2,637,447**	**2,835,751**	**2,942,301**
Off-grid		**165,792**	**172,159**	**263,745**	**283,575**	**294,230**
Total EGy + off-grid		1,823,709	1,893,752	2,901,192	3,119,326	3,236,531
Import [MWh]		257,243	290,317	308,492	318,070	435,498

Name of power units connected to the national grid		$EF_{EL,m,y}$ 2013	2014	2015
SENELEC	C3	1.495	1.097	1.049
SENELEC	C4	0.636	0.649	0.645
SENELEC	TAG2	1.302	1.282	1.318
SENELEC	TAG4	1.023	1.074	1.106
Wartsila	C6	0.613	0.608	0.613
Wartsila	C7	0.605	0.607	0.607
KAHONE				0.728
Mitsubishi	Kounoune Power	0.664	0.629	0.622
MEGS	GTI	1.049		
APR Energy	Location APR	0.713	0.715	0.725
APR EDM	(export)	0.692	0.693	0.692
Aggreko	Sococim	0.521	0.521	0.521
AGG. CDB			0.682	0.703
Aggreko Diass 22 MW				0.707
Off-grid	10%	0.800	0.800	0.800

Name of power units connected to the national grid		CO_2 emissions = $EG_{m,y}$ x $EF_{EL,m,y}$ [tCO_2] 2013	2014	2015
SENELEC	C3	24,779	140,723	237,962
SENELEC	C4	331,350	332,288	324,162
SENELEC	TAG2	17,356	30,549	16,469
SENELEC	TAG4	73,202	67,425	43,592
Wartsila	C6	329,695	363,351	385,691
Wartsila	C7	381,086	375,751	362,425
KAHONE		-	-	15,583
Mitsubishi	Kounoune Power	262,414	237,903	256,806
MEGS	GTI	10,471	-	-
APR Energy	Location APR	200,529	158,877	93,088
APR EDM	(export)	57,444	85,912	98,272
Aggreko	Sococim	40,652	27,948	0
AGG. CDB		-	77,689	139,638
Aggreko Diass 22 MW		-	-	15,874
Off-grid	10%	210,996	226,860	235,384
	TOTAL	1,939,976	2,125,275	2,224,947

$EF_{grid,OMsimple,y}$ without import	(t CO_2/MWh)	0.6687	0.6813	0.6874
EG 2013,2014,2015 without import with off-grid	MWh	9,257,049		
$EF_{grid,OMsimple,2013,2014,2015}$ without import with off-grid	(t CO_2/MWh)	0.6795		

CM CALCULATION

EF_{OM}	**0.6795**	**tCO_2/MWh**	
EF_{BM}	**0.6808**	**tCO_2/MWh**	
EF_{CM}	**0.6798**	**tCO_2/MWh**	For wind and solar projects

Appendix 5. Further background information on monitoring plan

N/A

Appendix 6. Summary report of comments received from local stakeholders

N/A

Appendix 7. Summary of post registration changes

Corrections

	Section(s) of PDD revised	Reason(s)	Impact
Small editorial corrections of wording such as • replacement of the term “plant” by “project” or “project activity”, • replacement of the abbreviation “SSA” by “Sub-Saharan Africa”, • replacement of the term “PV array” by “solar PV array field”, • alignment of the indicated solar radiation to assumptions in ER calculations, • replacement of “LT/MT” (low tension/medium tension) by “LV/MV”, • simplification and restructuring of sequence of information provided in section A.3 and B.7.3 to be more concise (notably description of SCADA/metering system, characteristics of connection lines, standby power systems), • clarification of indicated precision of meters provided (for active energy). • specification of “**<u>at least</u>**” two meters to be installed. • Correction of start date of crediting period (postponement from 01/11/2016 to 11/11/2016)	A.1, A.2, A.3, B.3, B.6.3, B.6.4, B.7.1, B.7.3, C.3.2	Improve precision, concision, clarity and consistency in wording. Start date: As approved by UNFCCC secretariat on 18/03/2019.	All parameter values of the registered monitoring plan remain unchanged. Start date: Proposed change to the start date of the crediting period of a registered CDM project activity below one year.

All corrections are in line with ACM0002, V. 16, the actual situation as well as para. 232 of the PA Standard V.2.

Permanent changes to the project design

1) Effective increase of project capacity from 20.03 MW_p to 24.38424 MW_p (92,016 x 265 W_p) installed in two project phases, which is equivalent to around 20 MW or 20 MW_{AC}, as per section A.1 of the registered PDD. The effective increase in capacity is within the control of the project participant (para. 241 (a) (i) a. of PA Standard V.2 applies).

Slight correction/change of combination of number of panels and capacity of each for project phase I (75,600 x 265 W_p instead of initially considered 77,040 x 260 W_p).

Related changes in description of project activity, technologies/measures (module characteristics, number of modules, layout, projected electricity production, load factor, sub-systems and their interconnection) as well as calculation and description of ex-ante emission reductions. In particular, Section A.3 is overhauled to take due account of the additional number of modules installed and consequential changes (shortening/simplification of section).

As per para. 242 of the PA Standard V.2, the table below describes the impact of the changes.

No.	Change(s)	Section(s) of PDD revised	Reason(s)	Impact
1	Effective increase of project capacity to 24.38424 MW_p. Minimal correction/change of combination of number and capacity of panels for project phase I.	A.1, A.3, B.3, B.6.3, B.6.4, B.7.1	Taking due account of inverter solar capacity of the power plant (in MW or MW_{AC} terms) and correcting for the inconsistent use of MW, MW_{AC}, and MW_p/MW_{DC} in the currently registered PDD retaining the total electricity generation capacity of power plant of around 20 MW or 20 MW_{AC} in section A.1 of the registered PDD.[32] Minimal change in preference in terms of configuration of peak panel capacity & number of panels (technical & cost reasons) during project planning.	- Applicability of the applied methodologies: project continues to comply with all applicability criteria and all other provisions of the methodology (cf. section B.2) - Compliance of monitoring plan with the applied methodologies: not affected by change. - Accuracy and completeness in the monitoring: not affected by change. - Additionality: Additionality is not impacted because investment decision was made prior to the date when the country was reaching 50 MW installed capacity. - Scale of project activity: not affected by the change. Project remains large-scale.[33]

[32] Figures expressed simply as MW can be assumed, unless otherwise stated, to refer to the AC output. Cf. https://wiki-solar.org/data/glossary/capacity.html

[33] The inverter load ratio must be in a certain range. For appropriateness of the inverter load ratio, cf. https://www.eia.gov/todayinenergy/detail.php?id=35372

All changes are in line with ACM0002, V. 16, the actual situation as well as para. 240 – 241 and 243 of PA Standard V.2.

Permanent changes to the registered monitoring plan

1) Update of frequency of calibration, maintenance & testing requirements of the electricity meters according to methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” Version 3.0, and para. 81 (c) of Project Standard V.2) and the actual situation.

As per para. 242 of the PA Standard V.2, the table below describes the impact of the changes.

No.	Change(s)	Section(s) of PDD revised	Reason(s)	Impact
1	Update calibration, maintenance and testing requirements of MV electricity meters	A.3, B 7.1, B.7.3	Specifications have not been clear yet or erroneously interpreted (confusion of “testing and inspection” in the power purchase agreement with “calibration”) at stage of project validation. Furthermore, there are no clear “industry standards”, as per ACM0002, Version 16, para. 71 so that the tool is applied to define calibration, maintenance & testing requirements of the meters.	- Applicability of the applied methodologies: Project continues to comply with all applicability criteria and all other provisions of the methodology (cf. section B.2). - Compliance of monitoring plan with the applied methodologies: Instead of “industry standards”, the revised monitoring plan follows methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” Version 3.0 to define calibration, maintenance & testing requirements of the meters. - Accuracy and completeness of monitoring: i) the calibration requirements are revised as per ACM0002 V.16, and remain in accordance with requirements set by the meter supplier ii) the electricity meter will be subject to regular maintenance and testing as per methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” Version 3.0, and para. 81 (c) of Project Standard V.2) and remains in conformity with national requirements. Ad i) The accuracy class of the installed meters remains unchanged and continues to be same as provided in the registered PDD. As the meter supplier states, no periodic calibration of the electricity meter is required to ensure the meter’s accuracy. Cross check of measurement results with records for sold electricity remains in place. Ad ii) The periodic verification (instead of calibration) aims at verifying if the meters are still in conformity with decree 60-415. As per Art. 1 and 2 of the decree, it shall be verified if the meter underwent initial primitive verification and if it meets certain characteristics, particularly in terms precision. The verification determines if the meter is in conformity with the decree or needs to be refurbished or removed from service. - Additionality: not affected by change. - Scale of project activity: not affected by change. - Conservativeness: The changes are in conformity with the actual situation. Instead of “applying” non-defined/unclear industry standards, the changes propose the application of the much more precise and stricter

No.	Change(s)	Section(s) of PDD revised	Reason(s)	Impact
				requirements of the tool, which is considered conservative.

As per para. 230 of the PA Standard, V.2.0, the project participant determines with the DOE that approval by the Board shall be sought.

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).

Version	*Date*	*Description*
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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