Project design document form
(Version 10.1)

BASIC INFORMATION	
Title of the project activity	Grid-connected Solar PV project in Méouane
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	Version 1.6
Completion date of the PDD	18/04/2019
Project participants	Senergy PV SA
Host Party	Senegal
Applied methodologies and standardized baselines	Methodology: ACM0002 - Grid-connected electricity generation from renewable sources - Version 16.0
Sectoral scopes linked to the applied methodologies	Sectoral Scope : 1 - Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	33,992 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 Méouane” involves the construction and operation of a solar photovoltaic (PV) plant of 29.49 MW in Méouane, department of Tivaouane, region of Thies, Senegal. The solar power plant will cover an area of 64 hectares, and will be equipped with 92,160 modules of 320 W each. It will be connected to the national grid.

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 50,004 MWh per year, resulting in emissions reductions of up to 33,992 tonnes CO_2eq per year.

The village of Santhiou Mékhé, where the plant will be located, is around 130 km from Dakar. The latitude at which the plant will be located offers very favourable radiation conditions throughout the year, with an average of more than 2,235 kWh / m^2 per day.

Energy consumption in Senegal is dominated by wood fuels (53 percent of total) and less than 4 percent of villages are electrified. Total capacity of the interconnected system was 864 MW in 2015[1], about 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 this 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.

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.

This project responds to the objectives of the state to increase the production of electricity through the promotion of renewable energies in general and solar PV in particular, in order to achieve an energy mix of 20% by 2017 [3].

The objectives of this solar power plant project are:
• participate in Senegal's energy security and contribute to its self-sufficiency;
• reduce emissions of greenhouse gas by producing electricity without greenhouse gas emissions;
• participate in the development of renewable energy;
• produce electricity without noise, without waste and without water consumption;
• enhance the country's attractiveness for companies in the photovoltaic sector.

The project has been initially developed by Senergy SUARL, a local development company, who signed a 25 years power purchase agreement (PPA) with SENELEC, the national electricity company of Senegal, on June 10th 2014. Early February 2015, Senergy SUARL signed an exclusive agreement with FONSIS and Meridiam in order to finalize the development of the project and raise the financing required.

Meridiam, FONSIS and Senergy SUARL set up a dedicated project company, Senergy PV SA. This project company owns all rights, authorizations and it is the counterpart for all contracts[4] Meridiam is a global developer, investor and asset manager specializing in public and community infrastructure delivered through public-private-partnerships (PPPs) with currently €3 billion equity funds under management. Meridiam has been recognized as the Infrastructure Fund of the Year in 2013 for the third consecutive year by the Infrastructure Journal.

[1] Source: FINERGREEN, March 2016: http://bit.ly/2c2UNou

[2] Based on the Preliminary Information Memorandum provided by the client.

[3] According to the Environmental and social impact assessment

[4] A building permit dated February 19th 2016 has been issued by a representative of the State of Senegal and by the Mayor of Meouane to SENERGY. A decree taken by the sub-prefect has also been published on February 19th 2016 for the approval of the building permit.

Fonds Souverain d'Investissements Stratégiques ("FONSIS") is the sovereign wealth fund of the State of Senegal, abiding by the principles of Santiago alongside the most prestigious international sovereign funds of IMF member countries. FONSIS acts as a development fund with the clear objective to enhance the key strategic sectors of the Plan Senegal Emergent (PSE), the State of Senegal vision to emergence by 2035. FONSIS aims to drastically reduce unemployment and constitute financial reserves for the present and future generations.

SolaireDirect, a top tier French PV developer and contractor will be in charge of the engineering, procurement, and construction (EPC) and operation and maintenance (O&M) through turnkey contracts.

Being developed and supported by Senegalese entities, the project will help strengthening the knowledge and experience of the country on the development of solar projects.

Senegal currently uses more than 35% of its foreign exchange earnings for oil imports, making it highly vulnerable to oil price fluctuations[5]. In the baseline scenario, electricity would have been generated by fossil fuels. The Project will yearly produce electricity in an amount equivalent to the need of more than 50,000 of people with direct consequences of improving health conditions. It will be contributing to the development of Senegal's energy mix and supplying the country's demand in solar energy. It will also contribute to reduce the carbon footprint and shift toward emission free environment.

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

A.2. Location of project activity

Village of Santhiou Mékhé, Commune of Méouane, Department of Tivaouane. Thiès region, Senegal. Méouane´s geographical coordinates are 15° 07' 53.52" N and 16° 40' 22.28" W.

Figure 1: Location of Santhiou Mékhé Village, Commune of Méouane, Department of Tivaouane

[5] According to the Ministry of Renewable, 2011.

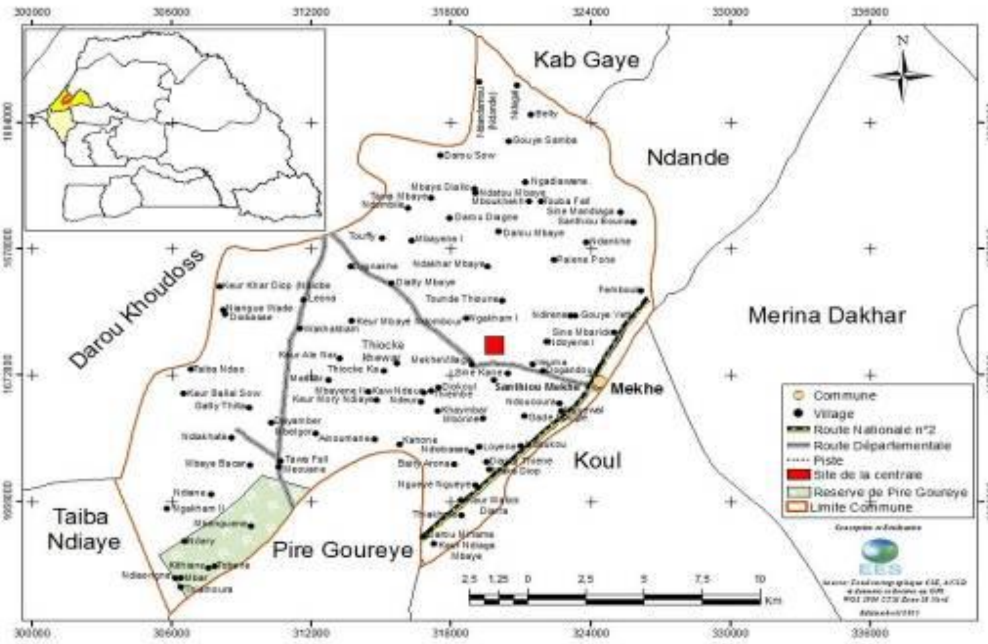

Figure 2: Location of the project[6]

Figure 3: Exact GPS location of the solar plant

[6] The red square represents the site location.

Figure 4: View of the site

A.3. Technologies/measures

The project will rely on solar power sources through photovoltaic conversion technology to produce electricity, which will be fed into the Senegalese grid. Prior to the implementation of the project, the site was not used, neither for agricultural nor industrial purposes. 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", which are, among others, fossil fuel fired power plants.

The PV array will consist of a 92,160 fields polycrystalline photovoltaic modules of 320 W for a total installed capacity of 29,491.2 kW (equivalent to 20,400 kilowatts to the inverter output). The modules to be installed are the JC320M/24-Abs of poly silver frame solar panel manufactured by Renesola.
The installation of a nominal capacity of 29.49 MW will be formed by photovoltaic modules arranged in line, inclined at 15º with respect to the horizontal, on an aluminum structure.

The modules are fixed, thus preventing the occurrence of shadows or a variation in their orientation, inclination. They will be separated by a well-sized space (average of 3 meters).

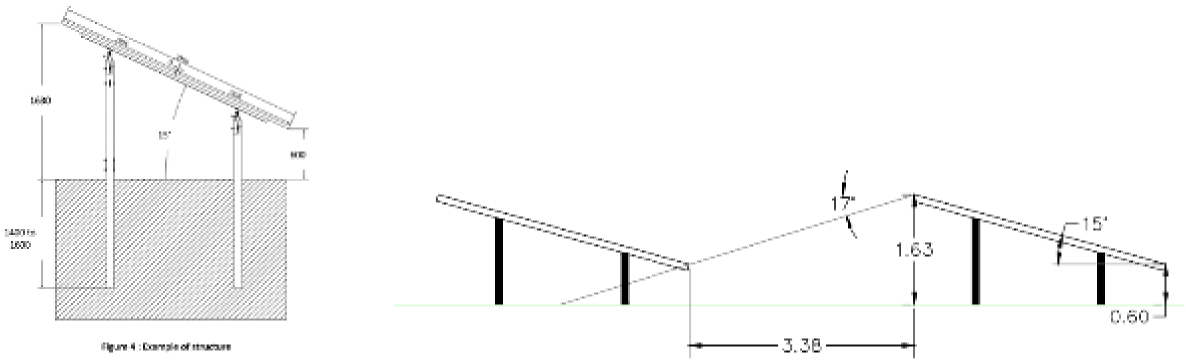

Figure 5: Installation of the panels

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

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

Table 1: Electrical and mechanical characteristics of the modules based on Standard Test

Parameter	Unit	Description
Model		Conext Core XC Series XC 680
Maximum Input Current	A	1 280
Rated AC power	Wp	680 kW
Operating frequency range	Hz	**50**/60 Hz
Maximum efficiency	%	99.1%
Manufacturer		Schneider Electric

Table 2: Technical data of the 36 inverters

Parameter	Unit	Description
Rated capacity	kVA	2040
Rated voltage H/L	V	20-22-**30**-33
Rated frequency	Hz	**50** or 60 Hz
Manufacturer	-	Schneider Electric

Table 3: Technical data of transformers

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 69.1% at the end of the 25th year. A module lifetime is typically over 25 years.

Based on a mean annual global solar radiation potential estimated between 2,104 and 2,235 kWh/m² for the project site and the specifications of the solar PV system, annual output is expected at 51,795.1 MWh (P50) for the first year. The performance ratio (PR) for the first year is estimated at 77.9%. The losses can be attributed to, among others, temperature (9.3%), inverter losses (2%), and reflexion, soiling and shadings (5.9%). The table below describes the total losses expected. After deduction of the 22.1% of losses, the project generates, based on a seven years average 51,024 MWh/yr. The technical availability of the project is estimated to 98%. Consequently, the net electricity delivered to the grid **($EG_{PJ,y}$)**, based on a seven years average, is of 50,004 MWh/yr. These figures are those provided by the EPC contractor (SolaireDirect). On this basis, the load factor is calculated as follows: 50,004 / 29,491 = 1,695 hours over 8,760 hours per year = 19.35%.

List of losses	Type of loss	Loss Value
Reduction of incoming irradiance to PV cells	Horizon shading	**0.0%**
	Soiling & Snow	3.0%
	Reflexion losses (IAM)	2.9%
	Shadings: irradiance loss	0.0%
Losses during the operation of photovoltaic modules	Quality Gain	0.0%
	Low irradiation losses	0.2%
	Temperature losses	9.3%
	Shadings: electrical loss	0.0%
	Mismatch	1.0%
	LID	1.0%
Losses during the operation of electrical components	DC ohmic losses	1.7%
	Inverter: efficiency loss	1.9%
	Inverter: power clipping loss	0.3%
	Inverter: power threshold loss	0.0%
	Inverter: loss over max MPP voltage	0.0%
	Inverter: loss below min MPP voltage	0.0%
	Transformer LV/MV losses	1.0%
	AC ohmic losses LV/MV	0.3%
	Daytime aux consumption	0.7%

	MV/HV transformer losses	0.0%
	Evacuation line	0.8%
Total loss		**22.1%**

Availability losses	Tracking curtailment	0,0%
	Plant unavailability	2,0%
	Grid unavailability	0,0%
Total unavailability loss		**2,0%**

Table 4*:* Description of total losses

Please find below a) a table summarizing the simulated the yield analysis and performance ratio for P50 and P90 for the first year of activity as well as an average over 25 years, b) a description of the Yearly Energy Output for P50, c) the expected annual net power generation (in MWh) for the twenty-five years of production (P50). A simplified figure illustrates the basic energy flow.

	Levels for probability of exceedance	
	50% values will exceed	**90% values will exceed**
Global in-plane irradiation per year	2,235 kWh/m²	2,104 kWh/m²
Performance Ratio the first year	77.9%	74.9%
Specific Yield the first year	1,740 kWh/kW	1,618 kWh/kW
Average yearly performance ratio over 20 years of operation	73.4%	70.6%
Average yearly specific yield over 20 years of operation	1,640 kWh/kW	1,525 kWh/kW

Table 5: Irradiation, performance and specific yield.

The expected annual net power generation (in MWh) breaks down as follows for the 25 years of production (P50):

	Values including Technical Availability		
Year of operation	**Yearly Performance Ratio P50 [%]**	**Yearly Specific Yield P50 [kWh/kW]**	**Yearly Energy Output P50 [MWh]**
1	76.3	1,706	50,759.1
2	75.9	1,697	50,505.3
3	75.6	1,689	50,252.8
4	75.2	1,680	50,001.5
5	74.8	1,672	49,751.5
6	74.4	1,663	49,502.7
7	74.1	1,655	49,255.2
8	73.7	1,647	49,009.0
9	73.3	1,639	48,763.9
10	73.0	1,630	48,520.1
11	72.6	1,622	48,277.5
12	72.2	1,614	48,036.1
13	71.9	1,606	47,795.9
14	71.5	1,598	47,556.9
15	71.2	1,590	47,319.2
16	70.8	1,582	47,082.6
17	70.4	1,574	46,847.1
18	70.1	1,566	46,612.9
19	69.7	1,558	46,379.8
20	69.4	1,551	46,147.9

21	69.0	1,543	45,917.2
22	68.7	1,535	45,687.6
23	68.4	1,528	45,459.2
24	68.0	1,520	45,231.9
25	67.7	1,512	45,005.7

Table 6: Net electricity production on 25 years (P50)

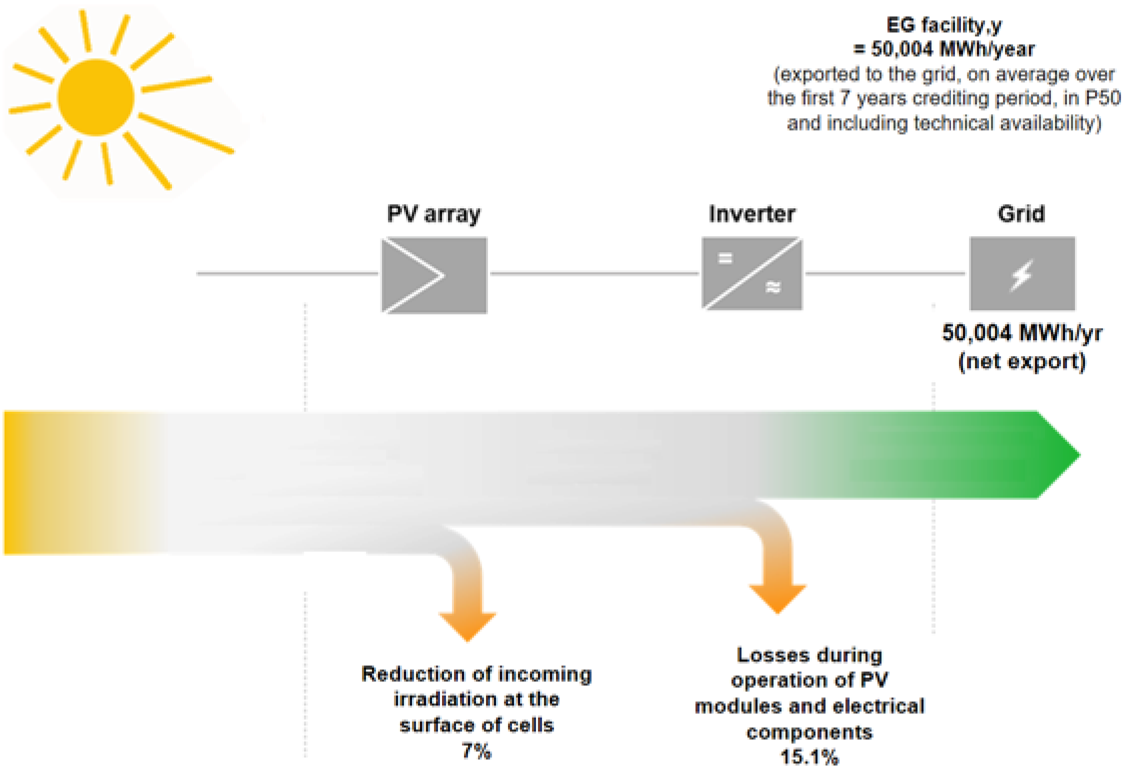

Figure 6: Energy flow with losses

The facility will be connected to the grid via the substation Mékhé (located about 9.5 km of land).

The PV plant connection point designated for this project is located at the 30kV/90kV main distribution substation, and is defined as the upstream connections (side of cable connections) of the new 30kV circuit breaker to be provided and installed, in the 30kV switchgear. In order to receive the new connections for the PV power plant, this high voltage (HTB) substation has to be extended to accommodate the new 30kV/90kV step up transformer.

In terms of monitoring, the SCADA[7] system allows the whole PV facilities to be manually or automatically controlled and monitored:

- Locally, from the equipment and/or HMI[8] installed in Main Distribution Substation
- Remotely, from a dedicated operator console station.

For these purposes, a fiber optic data link connection (protocol to be defined during detailed design studies) and several multi-core control cables (quantities to be defined during detailed design studies) will be routed between the HTB substation and the Main Distribution Substation.

[7] SCADA means Supervisory Control and Data Acquisition.
[8] HMI means Human Machine Interface.

The fiber optic cable and the multi-core control cables will be laid with the 30kV power cable in the same cable trench. The fiber optic data link connection and the multi-core control cables will allow:

- HTB electrical substation's control system to communicate all commands to open and close the incoming circuit breaker of Main Distribution Substation;
- SCADA system to communicate status, alarm, and all information relative to the operation of the PV plant;
- Interconnecting wiring between the protective relays between HTB electrical substation and facilities;
- Interlocking wiring between the electrical devices between HTB electrical substation and facilities;

As for the meter equipment, a multi-metering system (four-quadrant metering; active, reactive, and apparent energy and demand measurements, standard event logs and time-of-use metering, user interface for displaying meter data, etc.) is considered. Two times two meters will be installed at the main distribution substation located at the project site.

The figure below provides an overview of full solar PV system:

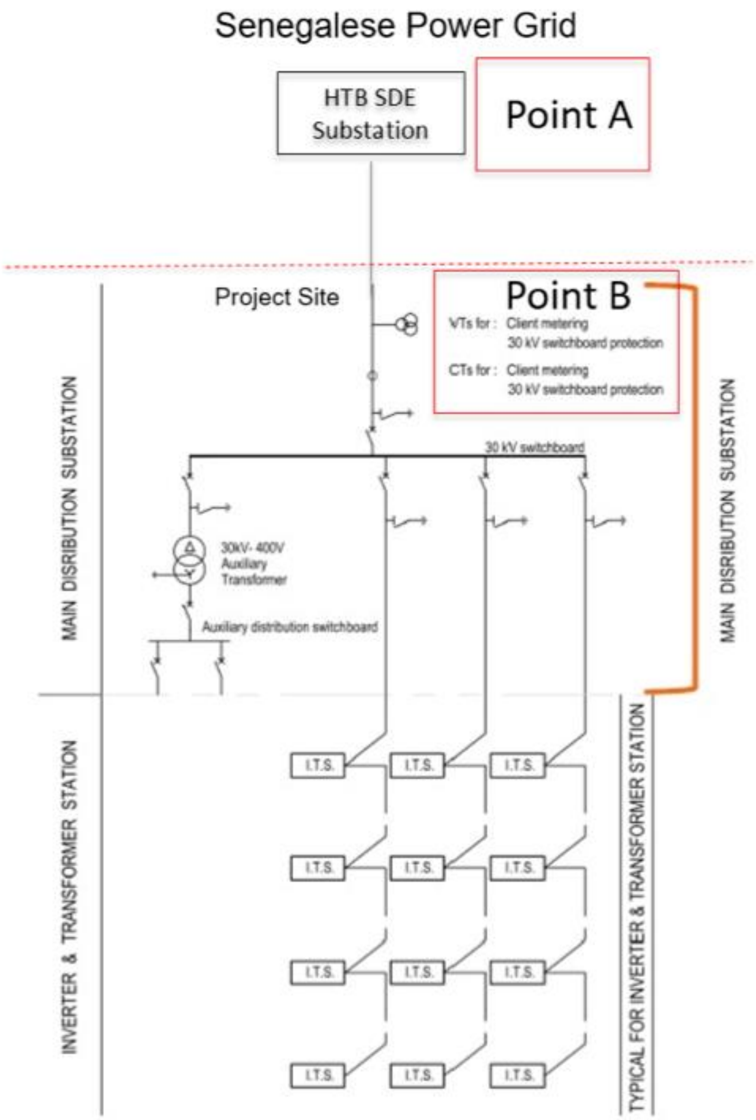

Figure 7: Single line diagram (extract) with metering point

Battery limits	Location	Reference
PV plant connection point	HTB SDE Substation	Point A
Metering point	Main Distribution Substation (30 kV)	Point B
Access road	TBD	

Figure 8: Map with PV plant connection and metering points

The employees of the plant will be trained in the use of the solar technology, which is largely imported from abroad. Since the project participant intends to recruits as a priority local labor (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 other similar project ideas in the host country considering the import and installation of solar PV systems from abroad.

A.4. Parties and project participants

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

Senergy PV SA is owned by Meridiam, FONSIS, Senergy SUARL.

A.5. Public funding of project activity

The project does not involve any public funding.

A.6. History of project activity

This proposed 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 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.7. Debundling

Not applicable.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference 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, EB87, 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 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.	Not applicable as the proposed project activity involves a solar photovoltaic power plant.
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 7: 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, “operating margin” (OM), “build margin” (BM) and “combined margin” (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 latter 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 CO_2 emission factor of biofuels is zero.	There are no biofuels used in the project activity, i.e. the tool is applicable.

Table 8: 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	GHGs	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 activity	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 9: 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.

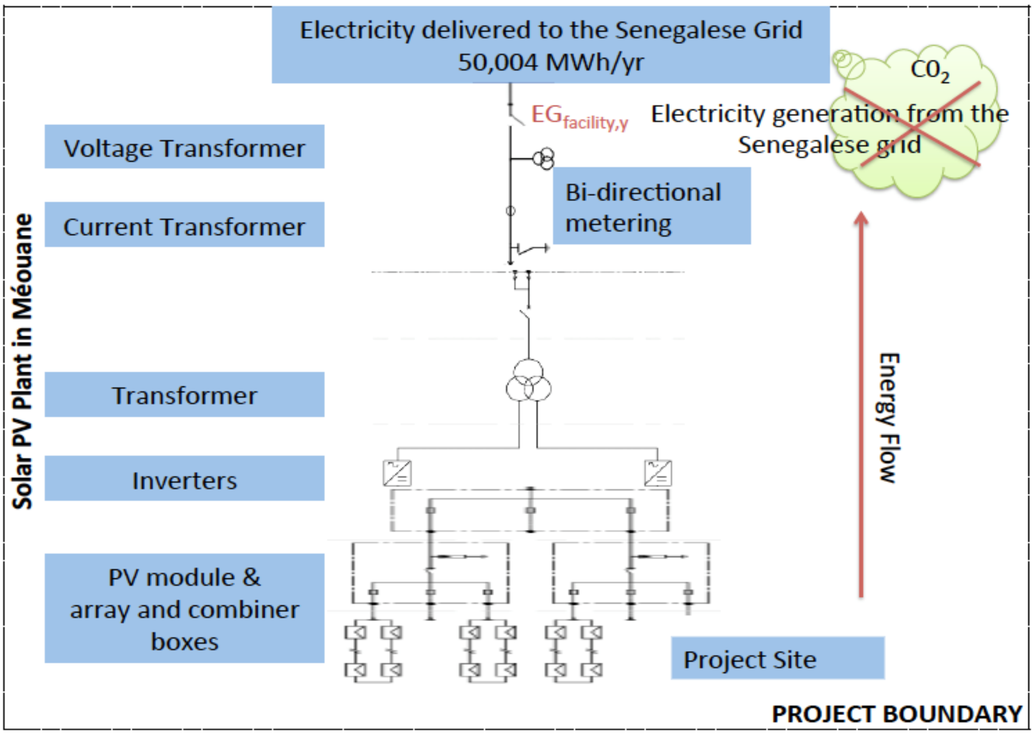

Figure 9: Diagram of the project boundary

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[9], there is only one grid connected solar PV power plant in Senegal, namely the 2 MW CICAD solar PV power 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 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 12/05/2016[10] as per the ceremony of signature of EURO 34.5 Million loan agreement between Senergy Pv SA and PROPARCO for a total investment of Euro 43.2 million. The Prior Consideration Form has been sent to the DNA of Senegal and published on the UNFCCC website on September 8th 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:

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9 see Appendix 4 and ER calculations (excel sheet) provided with the PDD

10 The loan agreement is provided to the DOE.

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

Where:

PE_y	=	Project emissions in year *y* (t CO_2e/yr)
$PE_{FF,y}$	=	Project emissions from fossil fuel consumption in year *y* (t CO_2/yr)
$PE_{GP,y}$	=	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (t CO_2e/yr)
$PE_{HP,y}$	=	Project emissions from water reservoirs of hydro power plants in year *y* (t CO_2e/yr)

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

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 first 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 10: 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[11]. 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 the 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.

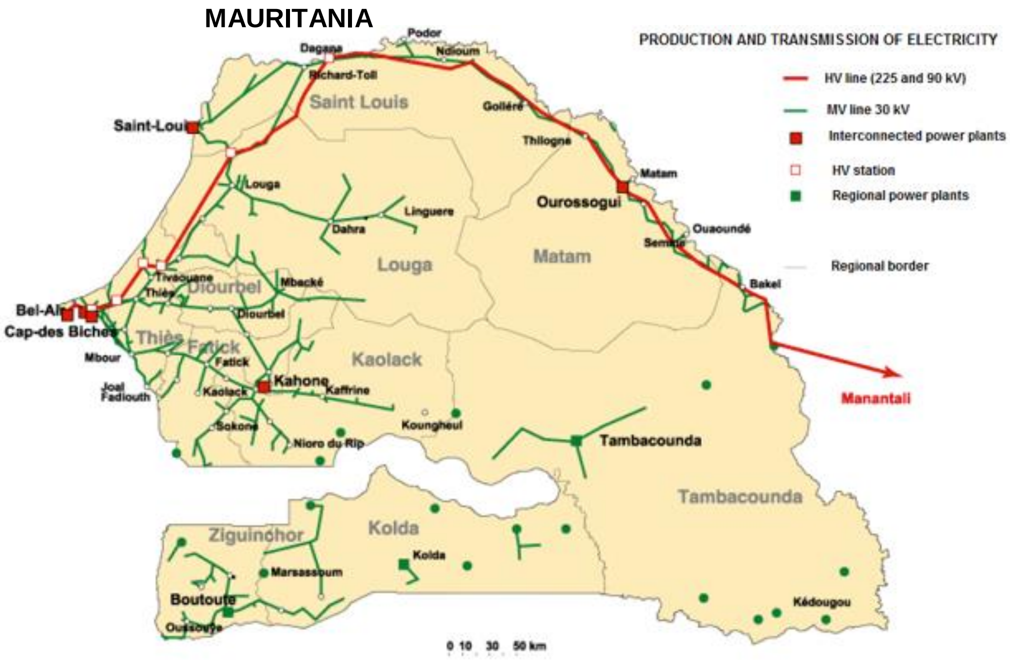

Figure 10: Project electricity system i.e. the Senegalese Power Grid[12]

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

1. the national interconnected grid (main grid)

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

[12] 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)

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

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.[13] 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.

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[13] Energypedia website: https://energypedia.info/wiki/Senegal_Energy_Situation

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.

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.

Option IIb is applied. All the conditions are fulfilled for the proposed project activity:

a) Senegal is classified as a Least developed country.[14]
b) The project activity consists in a grid-connected solar power plant,
c) There is a load shedding program in place in Senegal as mentioned on page 35 of Senelec Activity Report 2012[15]

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.

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

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

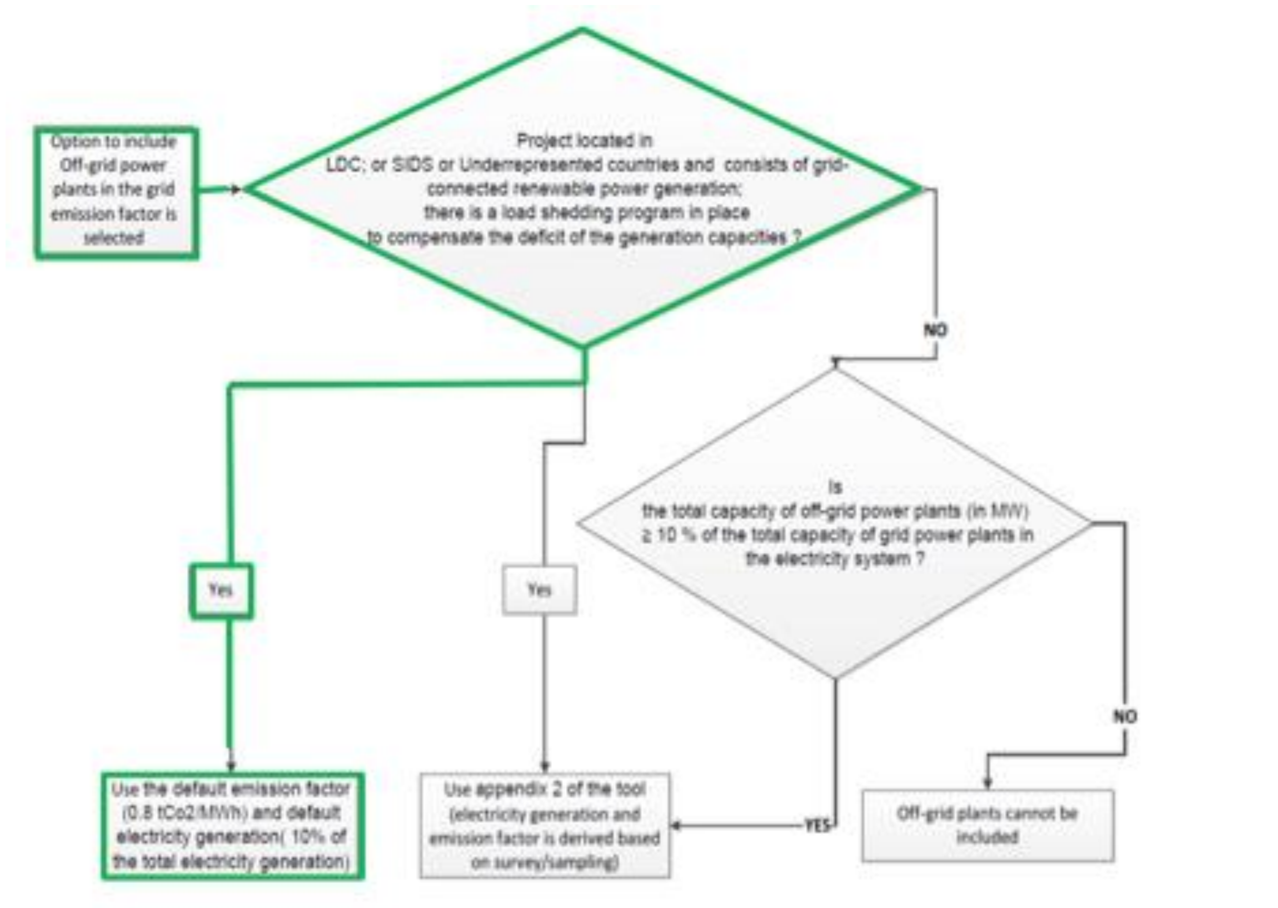
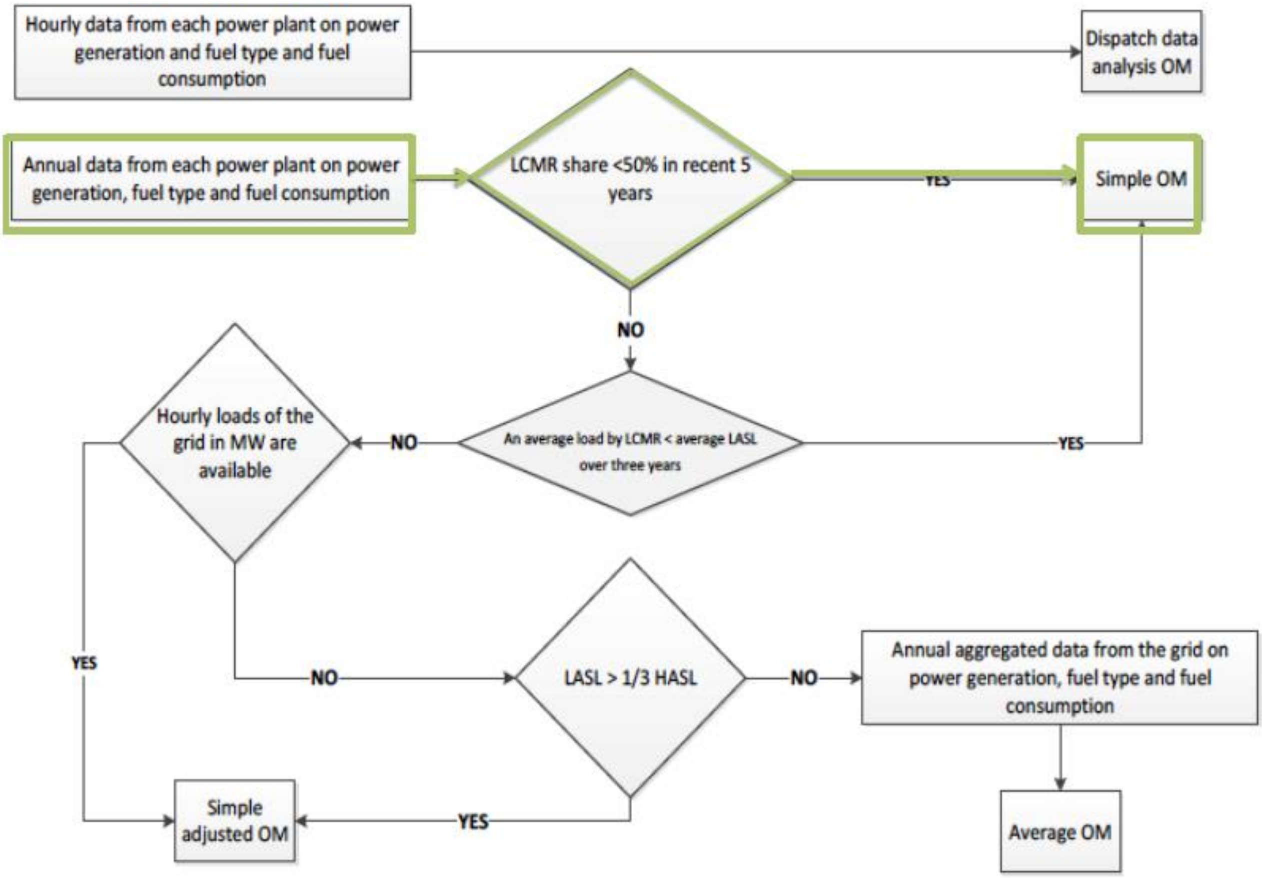


Figure 11: Inclusion of off-grid power plants in the project electricity system

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).



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

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

(ii) Approach 2

$$\text{Share}_{LCMR} = \frac{average\left(EG_{LCMR_{y-4}}, \ldots, EG_{LCMR_y}\right)}{average\left(total_{y-4}, \ldots, total_y\right)}$$ 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 11: Share of low cost must run source[16]

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.

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

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.

> 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, 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[17];
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 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 is 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:

[17] 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.

$EF_{grid,OMsimple,y}$	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)
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:

(a) **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 are not available.

(b) **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[18] for which data on fuel consumption were not available.

[18] 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

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:

a) Documented manufacturer´s specifications (if the efficiency of the plant is not significantly increased through retrofit 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 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" ˡ 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, only 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.
Aveage 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[19]	Type	Net generation in 2015 [MWh]	Cumulated Percentage (%) based on total net electricity generation
Kounoune Power	2007	Fioul résiduel/Mazout	412,871	31.5%
Loc APR	2011	Diesel/ Gasoil	128,442	17.4%
Sococim	2011	Gas natural	-	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%

[19] 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**	

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 recent power plants[20] 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 unit(s) 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} = $SET_{\geq 20\ per\ cent}$.

-

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

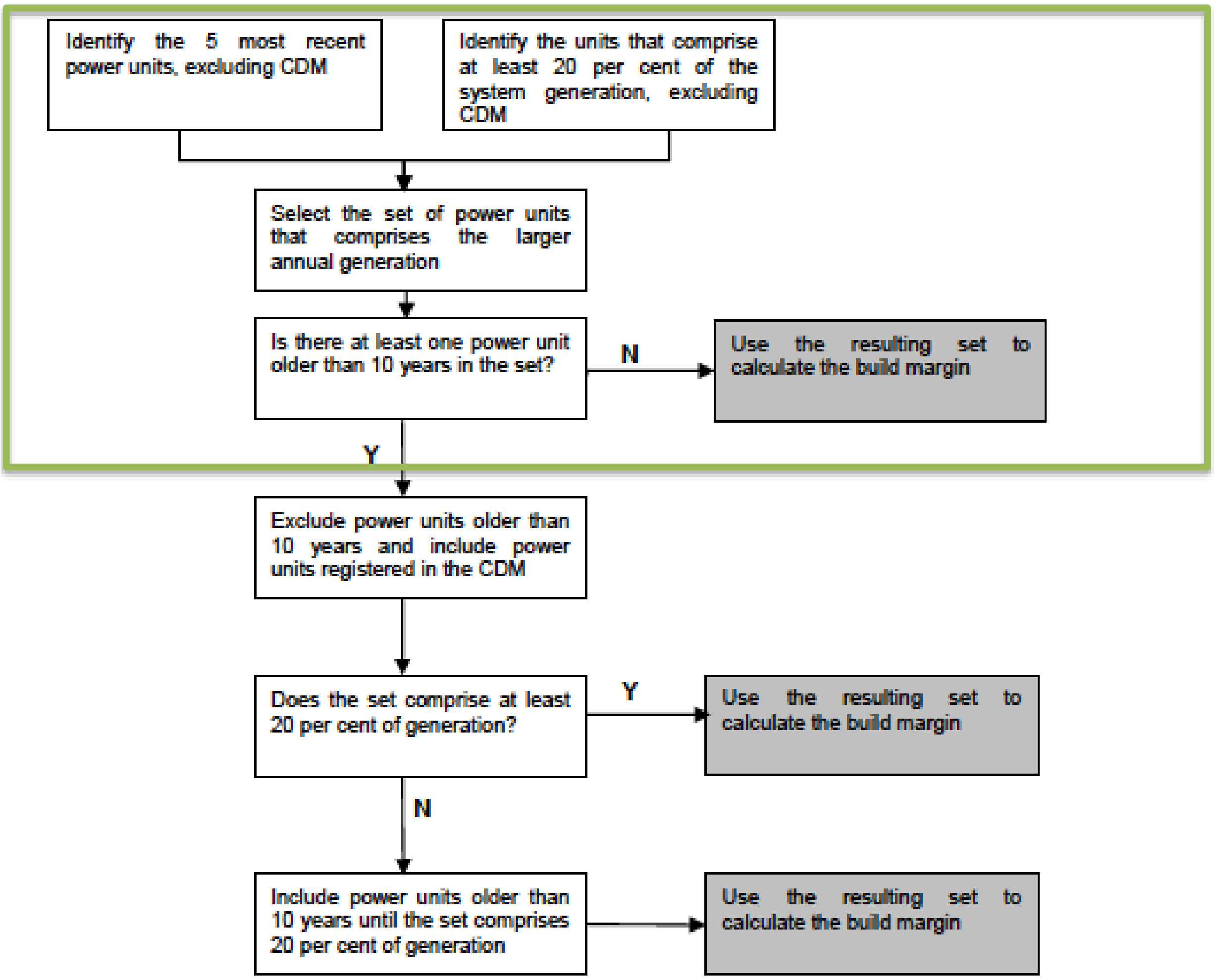


Table 12: Procedure to determine the sample group of power units *m* used to calculate the build margin

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:

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

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 is: 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.

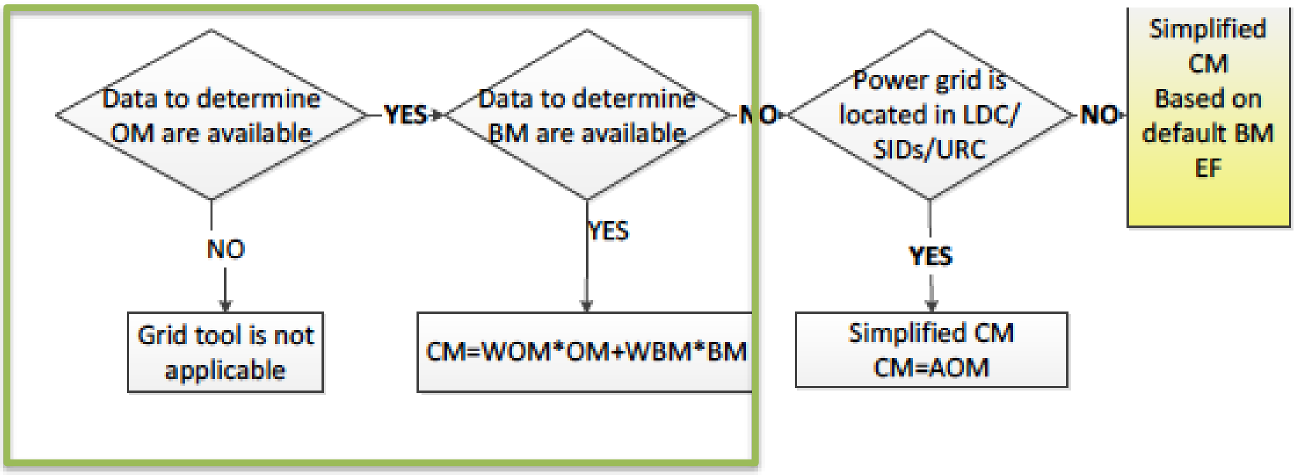


Table 13: Determination of CM emission factor

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:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$ Option (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 0.6798tCO_2/MWh.

Emission reductions

Emission reductions are calculated as follows:

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

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

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

Data/Parameter	$EF_{grid,CM,y}$

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

Data/Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2/MWh
Description	Operating Margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data	As per data provided by Senelec
Value(s) applied	0.6795
Choice of data or measurement methods and procedures	As per the "Tool to calculate the emission factor for an electricity system"
Purpose of data	Calculation of baseline emissions
Additional comment	According to the methodology, this parameter will be revised at the renewal of each crediting period.

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

Data/Parameter	$FC_{i,m,y}$
Data unit	Mass or volume unit
Description	Amount of fuel type *i* consumed by power unit *m* in year *y*
Source of data	As per data provided by Senelec
Value(s) applied	Refer to the Excel sheet of ER calculation

Choice of data or measurement methods and procedures	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.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/Parameter	$EG_{m,y}$
Data unit	MWh
Description	Net electricity generated by power plant/unit *m, k* or *n* (or in the project electricity system in case of *EGy*) in year *y* or hour *h*
Source of data	For grid-connected plants, data are provided by the SENELEC. For off-grid power plants, “the value of 10 per cent of the total electricity generation by grid power plants in the electricity system” is used for the purpose of the operating margin determination; “The value of 10 per cent of the electricity generation by grid power plants included in the sample group as per Step 5” is used for the purpose of the build margin determination.
Value(s) applied	Refer to the Excel Sheet of ER calculation
Choice of data or measurement methods and procedures	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.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	$\eta_{m,y}$
Data unit	-
Description	Average net energy conversion efficiency of power unit *m* or *k* in year *y*
Source of data	Among the 3 options below: a) Documented manufacturer’s specifications (if the efficiency of the plant is not significantly increased through retrofits or rehabilitations); or b) For grid power plants: data from the utility, the dispatch center or official records if it can be deemed reliable; or c) The default values provided in the table below in appendix 1 (if available for the type of power plant) Option c) is chosen because data for option a) and b) are not available.
Value(s) applied	37.50% for natural gas steam turbine for new units (after 2000).
Choice of data or measurement methods and procedures	Once for the crediting period
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
Data 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% [21]
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
Data 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	92,160 x 320 29.49	MW	A.3
Net electricity delivered to the grid ($EG_{PJ,y}$)	50,004	MWh	A.3; B.6.1 Excel sheet EG(PJ,y)=EG(facility,y)
Baseline emission factor of Senegalese grid ($EF_{grid,CM,y}$)	0.75 x0.6795 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)	50,004 MWh/yr x 0.6798 tCO_2/MWh = 33,992	tCO_2/y	$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$
Project emissions (PE_y)	0	tCO_2/y	B.6.1
Emission reduction (ER_y)	33,992	tCO_2/y	$ER_y = BE_y – PE_y$

YEAR	**BE_y (tCO_2)**	**$EG_{PJ,y}$(MWh)**	**$EF_{grid,CM,y}$**

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

			tCO_2/MWh
01/05/2017 -31/12/2017	23,004	33,839	0.6798
2018	34,391	50,590	0.6798
2019	34,219	50,337	0.6798
2020	34,048	50,085	0.6798
2021	33,878	49,835	0.6798
2022	33,708	49,586	0.6798
2023	33,540	49,338	0.6798
01/01/2024 -30/04/2024	11,161	16,418	0.6798
TOTAL	237,949	**350,028**	**/**
Average over 7 years	33,992	**50,004**	**/**

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

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
01/05/2017 -31/12/2017	23,004	0	n/a	23,004
2018	34,391	0	n/a	34,391
2019	34,219	0	n/a	34,219
2020	34,048	0	n/a	34,048
2021	33,878	0	n/a	33,878
2022	33,708	0	n/a	33,708
2023	33,540	0	n/a	33,540
01/01/2024 -30/04/2024	11,161	0	n/a	11,161
Total	237,949	0	n/a	237,949
Total number of crediting years	7 years			
Annual average over the crediting period	**33,992**	0	n/a	**33,992**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	$EG_{facility,y}$
Data 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 meter(s) at project site.

<table>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th>YEAR</th><th>Net electricity production fed into grid (MWh)</th></tr>
<tr><td>01/05/2017 -31/12/2017</td><td>33,839</td></tr>
<tr><td>2018</td><td>50,590</td></tr>
<tr><td>2019</td><td>50,337</td></tr>
<tr><td>2020</td><td>50,085</td></tr>
<tr><td>2021</td><td>49,835</td></tr>
<tr><td>2022</td><td>49,586</td></tr>
<tr><td>2023</td><td>49,338</td></tr>
<tr><td>01/01/2024 -30/04/2024</td><td>16,418</td></tr>
<tr><td>TOTAL</td><td>350,028</td></tr>
<tr><td>Average 7 years</td><td>50,004</td></tr>
</table>
</td></tr>
<tr><td>Measurement methods and procedures</td><td>Two times two electricity meters will be installed at the main distribution substation located at the project site.
Precision of meters: 0.2 (International calibration standard)
A SCADA system allows the whole PV facilities to be manually or automatically controlled and monitored locally or remotely.
Technical/Engineering/Maintenance Department is responsible for measurements.</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 Technical/Engineering/ Maintenance Department under the Plant Manager’s authority.
Cross check of measurement results with records for sold electricity.
The company Solairedirect is responsible for the selection, installation, calibration, servicing, testing and repairing of all energy meters.

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 two times two calibrated electricity meters installed at the main distribution sub-station located at the project site and cross-checked with sales records.

Monitoring organization

The CEO of Senergy PV SA coordinates and endorses 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 of Meridiam might appoint a CDM coordinator to delegate him the above specific tasks of monitoring supervision.

The Technical/Engineering/Maintenance Department consisting of plant technicians will undertake the technical actions required by the monitoring plan, under the Country Manager's authority, to collect and record related data.

Solairedirect is responsible for the selection, installation, calibration, servicing, testing and repairing of all energy meters. The data gathered enables, among other things, to track: power, wattage and voltage input to each inverter; Potential and actual energy produced; Solar irradiation in kWh/m² and temperature of PV modules; Safety alarms.

Recorded data is immediately collected and managed in user-friendly, detailed reports and tables for facilitate analysis. This system is in fact a comprehensive SCADA (Supervision Control & Data Acquisition.

The Accounting/Sales Department (Chief Financial Officer) will crosscheck, reconcile or consolidate data with multiple sources whenever possible. At minimum, data obtained from the electricity meters is to be crosschecked with the electricity sales receipts. This kind of reconciliation activity will be recorded properly as DOE may request for such information during the verification.

Monitoring team and training

Data collection, consolidation and results analysis will be undertaken by a dedicated team adequately trained, 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. **Emergency and trouble-shooting procedures**

In order to avoid equipment or meter breakdowns where generation data can be lost, a second meter will be installed, and regular handwritten timesheets of electronic records timers will be made. As well, a "reconciliation procedure" with the meters of the Senelec could be realized if necessary.

Finally, a Standby Power Systems (UPS) will be installed in the PVBOX (containerized plug and play power conversion system) and in the Main Distribution Substation for critical operational equipment requiring power backup. The UPS system installed 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 b

lackout, 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

13/05/2016
The starting date has been determined as the signature of the loan agreement between SENERGY PV SA and PROPARCO[22].

C.2. Expected operational lifetime of project activity

The expected operational of the project activity is 25 years (300 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. The project initiates the first crediting period.

C.3.2. Start date of crediting period

01/05/2017

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 aspects are taken into account in decisions concerning the proposed establishment of the solar plant. The ESIA itself identifies, analyzes and predicts the impact of the implementation of the plant on the physical, biological, but also social, cultural and health of workers and populations.
The approach used to conduct this environmental assessment is fundamentally guided by the requirements of the Environmental Code Senegal and texts relating thereto. It also takes into account the regulatory requirements expressed in sectoral codes when applicable to the project.
When necessary, he was called to databases and recommendations of the International Finance Corporation (IFC) according to its Performance Standards.

As part of this ESIA, alternatives to the project were analyzed. 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:

- hard (H),
- Moderate (M)
- or low (L);

where the "hard" level being the worst and "low" the most favorable.

The results of the analysis are the following:

a) Absence of the project

[22] The loan agreement is provided to the DOE.

The absence of the project would go against with the key objectives of the new energy policy of the country, namely to ensure the country's energy supply in sufficient quantities and at lower cost and expand people's access to modern energy services.

b) Location of the plant
The site is perfectly suited to the production of a photovoltaic plant of a topographical point of view.

c) Production of electric power technology
To meet energy demand while protecting the environment and the well-being of people with an additional capacity of 29.49 MW, several technologies currently exist for the production of electrical energy.
Five of these technologies have been studied. These are:

- a conventional diesel plant running on Heavy Furnace Oil (HFO);
- a center of the gas turbine type operating kerosene or diesel oil;
- a steam power plant operating on oil;
- a steam power plant running on coal;
- a solar PV plant.

The criteria used to compare different technologies are environmental, safety, health, economic and operational.

Based on this criteria analysis, we hold that the solar plant has the best economic benefits, combined environmental and operational since the project is based on a Public Private Partnership (PPP). SENERGY already has its Power Purchase Agreement (PPA).

In addition, the project was developed in collaboration with local people. It was developed to meet the needs and expectations of the inhabitants of the neighbouring villages, within a framework of legal compensation, fair and transparent, and therefore it has a very strong local acceptance.

Such a plant, like other solar power plants planned will partly solve the problem of energy and achieving the objectives of a government strategy document from 2012 (“Lettre de Politique de Développement du secteur de l'Energie”).

In this study, the environmental components likely to be affected by the project are called Important Elements of the Environment, and their impacts could be major, medium or minor.
The criteria taken into account by the ESIA and their results are summarized in the table below:

Environmental Component	Important elements of the environment	Results of the Environmental and Social Assessment Survey
Atmospheric Environment	Air quality Soundscape	Minor Minor
Surface water and groundwater	Quality of surface water and groundwater	Minor
Terrestrial Ecosystems	Soil Vegetation Fauna and avifauna	Minor Medium (major in construction phase and minor during exploitation) * Minor
Human Environment	Living environment landscape aspect Health and security socio-economic activities	Minor Medium** Minor Major***

Table 14: Criteria taken into account by the ESIA and their respective impacts.

*Impact on the vegetation: Based on this conclusion, the project has agreed to work closely with the forestry sector of Tivaouane to make sure the construction of the plant has the minored consequences possible.

** Impact on the landscape aspects: the project will result in land preparation which involves the clearing and stripping of the surface layers. These actions will lead to a transformation or change in local natural landscape, particularly the environmental components that are local topography, vegetation and visual aspects. The site is crossed by tracks connecting the villages in the vicinity. The installation of the central will separate communities that are frequented through the existing tracks and increase their distance. Similarly, crop fields owners will be forced to bypass the site over a long distance to reach their crop field.

To minimize these impacts, the Project Owner has agreed to put in place the following measures as soon as possible:
- levelling of surfaces;
- rehabilitation of the vegetation cover by developing a landscape aspect in the site;
- the construction of new ways to facilitate the mobility of populations in the vicinity of the site.

The developer has elaborated in collaboration with the Authorities[23] a reforestation program to compensate the losses incurred by deforestation during construction and established a green belt against silting
In addition, it shall be noted that the goal of the Reforestation Programme initiated by the project owner and supported by the authorities is to reintroduce trees in the project landscape, to reinforce and provide a tree nursery in Meouane, provide information and conduct awareness campaign to the local population and local authorities regarding preservation of trees. More specifically, the programme will consist in the implementation of a windbreaks on the North side to reduce wind speed and in the planting of medium size vegetal species at the side of the passageways to make the site more attractive. The following plants will be produce to carry out the programme: Prosopis juliflora : 500 , Acacia mélifera : 2 091 , Eucalyptus camaldulensis : 500 , Gayacum officinalis : 1 500 , Bougainvillier : 2 000 (TOTAL: 6,591 plants). The Programme budget is 2 999 850 F CFA (about 4 573 EUR) disbursed in 2016.

***Impact on socio-economic activities: The land selected for the construction of this project is an agricultural land. They are rainfed fields with a dominance of cassava. These lands are cultivated by the people of the villages of Santhiou Mékhé and Mékhé town while they are owned by the State of Sénegal.
In parallel, the construction of the site will be subcontracted by Solairedirect to specialized local small and medium-sized enterprises (SMEs). This is a job opportunity for local youth, especially for jobs related to civil works and mechanical which have a major impact on the region.
A protocol has been signed between the developer and the lands users for a recovery of their livelihoods and support local development. As well, the recruitment of local labour will be prioritized and will be realized under the supervision of a commission set up by the Sub-prefect of Méouane. The developer will restore their rights through a fair and equitable compensation in accordance with the best practices of donors (Ecuador Principles 3 June 2013 / IFC[24]), and national practices applied in new projects; he will also promote positive discrimination in hiring qualified and unqualified through a permanent contract (CDI) if possible.

Senergy PV SA will also allocate a budget of 64 m FCFA for the construction of a water drilling i.e. around 97 709 EUR which will contribute to improve productivity of existing crops and therefore will improve the livelihood of the population

To summarize, the study showed that the project to build a solar power plant of 29.49 MW in Santhiou Mékhé will not contribute to air pollution or the pollution of soil and subsoil. However, it could have negative impacts at the social and biological level. Measures have been agreed with the developer to limit these consequences.

D.2. Environmental impact assessment

A thorough environmental and social impact assessment study (ESIA) has been performed according to International Finance Corporation standards that concluded a positive outcome. A technical committee has held end of 2015. The ESIA approval is expected in 2016.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

The overall objective of the request for information, communication with stakeholders is to present the solar power plant construction project with its features and its specificity to authorities, technical services and local populations. Specifically, it aims to:
- develop a good awareness campaign for all stakeholders, identify impacts and engage the thoughts that are needed;

[23] Please refer to the document introducing the Reforestation Programme, dated March 2016 and elaborated with the Water and Forest Sector of Tivouane depending of the Forestry Inspection Service of Thiès, Management of Forests, Water and Hunting, Ministry of Environment and Nature Conservation.

[24] http://www.equator-principles.com/index.php/equator-principles-3

- identify and take into account the economic, social and environmental consequences of the project and appropriate action;
- ensure that the parties can share their concerns, expectations and recommendations against the project proponent;
- establish 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, three stages were necessary:

a) Meeting with administrative and municipal authorities

To define the geographic scope of this study a project implementation zone recognition was planned on 29 January 2015 by the proponent (with its technical and financial partners: Solairedirect, FONSIS and MERIDIAM). This visit allowed meeting with local authorities such as the Prefect of the department Tivaouane, the Sub-Prefect of Méouane, the Mayor of the municipality of Méouane, the village chief Santhiou Mékhé informing start of the study impact required for this type of project.

b) Institutional meetings

The second phase was called institutional meetings with relevant regional technical services established in the region of Thies and in the department of Tivaouane. Preliminary newsletters with a descriptive summary had been previously sent to all the services from March 9th to 13th 2015.
These institutional meetings helped inform branches of the State on the proposed construction of this solar plant in Santhiou Mékhé, to obtain their views, concerns and recommendations. Alongside these, individually meetings were held with the heads of regional and departmental services, the City Council Méouane convened for the occasion an extraordinary general meeting on April 10th 2015 for exchanges between the promoter, the Cabinet and local officials on economic issues, political and social project in the town of Méouane.

c) Meetings with concerned villages
Meetings were hold in each of the villages directly under influence of the project where men, women, young, old, elders, religious authorities and traditional, field owners were free to express their opinions, call the consultant and get an idea about the ins and outs of the project. These meetings allowed the team of consultants to take the opportunity to compare the socio-economic realities as experienced by the people themselves and the references of content collected in the preliminary phase of the impact study.

Analysis of the reactions of all grades encountered allows to state with certainty that the project has been well received by them. They welcome the choice focused on their community and positively enjoy the participatory approach of the firm.

E.2. Summary of comments received

a) Results of the consultations with administrative and municipal authorities

Local, regional service chiefs and local councillors have unanimously magnified this project in the department of Tivaouane district Méouane. It reflects the materialization of the Emergent plan for Senegal (PSE[25]) in its energy component, and therefore, must have the support of everyone.
However, the relevance of the project did not stop to reflect on a number of concerns to find solutions to make it more acceptable to the population.
The following table is a summary of the most relevant issues discussed, recommendations, and the responses needed by the developer or consultant.

Administrative and local authorities	Observations, threats	Recommendations	Responses from the Developer
Prefect of the department of Tivaouane	- Job creation - Development of the locality;	- Make data and evaluation available to the commission as soon as possible	- The promoter has asked the Chairman of the Committee to express the needs of the

[25] In French "Plan Sénégal Emergent" http://www.finances.gouv.sn/index.php/finances/136-resume-du-plan-senegal-emergent

Administrative and local authorities	Observations, threats	Recommendations	Responses from the Developer
Magatte DIALLO	- Attract investment and boost the local economy.	- Prioritize the local workforce in recruitment.	community for the effective start of the work; - The recruitment of local labor will be a priority.
Sub Prefect of Méouane Richard Birame FAYE	- Important project for the country; - Project aligned with national development policy; - Strong support of the Sub-Prefect to the project.	- Assess and pay relatives taxes; - Work along with the sub-prefecture for the recruitment of the local labor - Work along with the neighbored districts for the project implementation.	- The Commission will be required to develop a census work plan and assess the compensation amounts.
Technical Services of Tivaouane Forestry, Urbanism, animal husbandry	- Availability of technical services for the project support; - location not known by the services; - Very high surface for the solar plant (64 ha); - Changes in vegetation cover for livestock, disrupting element.	- Make an inventory (flora and fauna); - Organize a visit with the forestry agency of Tivaouane; - Clearing permit for deforestation; - Respect of all the commitments made to the people during land acquisition.	- The firm will approach the relevant departments for obtaining all permits required before and during the construction of the plant; - A protocol between land owners and promoter is signed and will be respected; - A visit will be organized with a topographer to the final delimitation of the site.
City Council Méouane Bara NDIAYE	- Delay in the start of work, - Impact of the line that will transport energy produced in other lands; - Number of workers at each stage of the project; - Non-compliance of engagements; - Construction of a drill to compensate the land acquisition; - Inform additional impacted villagers by the new site to involve them in the protocol - Why couldn't we give 10% of the actions to the owners of the agricultural lands? - Impacts of the solar park on the health of populations	- Reforestation and monitor reforestation, - Make the local populations benefit from the electricity produced by the plant; - make women benefit from the project impacts; - To respect the protocol - Support for "daaras" (Koranic schools) - Priority given to local workers of the region - To hire women for solar panels cleaning - To compensate former owners who let their land without being cultivated for two years.	- Memorandum of agreement signed between the developer and the land owners for a recovery policy livelihoods and support local development; - Signature of an agreement for the monitoring of the protocol; - The sponsor may not give shares to offset the loss of land but will follow the conclusions of the counting commission and compensation evaluation; - Priority recruitment of local labor with the solicitation of the departmental commission for recruitment Méouane led by Deputy Warden; - Farmer affected will be compensated.
Regional Inspectorate for Water and Forests of the region of Thies (IREF)	- Presence of protected species in the area; - Destruction of vegetation cover; - Changing the habitat function for	- Make an inventory of species (flora and fauna and take the necessary steps); - Comply with the tree-cutting regulation and	- The recommendations will be considered and will be subject to special treatment during the realization of the impact assessment study.

Administrative and local authorities	Observations, threats	Recommendations	Responses from the Developer
	species present in the site	proceed to the payment of taxes; - To revitalize the area by improving the afforestation rate: reforestation in schools, nurseries creations emphasizing the "Kaad" (a typical tree of the Senegalese flora); - Integrate the landscape aspect.	
Regional Development Agency (ARD) Mr FAYE	- Significant losses of farmers cropland; - Fair and equitable compensation; - Recruitment Policy.	- Take into account the importance of the loss of land (64ha); - Provide alternative sites for the PAPs; - Priority to local workforce in recruitment; - Supporting the community in the identification and implementation of priority needs.	- For the local workforce, the promoter will comply with the standards, and in particular with the Méouane departmental commission recruitment requirements; - CSR policy adapted to the needs of the local population.
Regional Service of Water Mr Baba DIENG Deputy Head of Service	- No available local water resources for the plant construction - The water table is between 80 and 90 m depth. The access rate in the area is more than 90%.	- Develop an independent water supply system - Available to read the report before it was published to give its views on the part that concerns him.	- The plant has no water requirement - Discussions are ongoing for the realization of a drill (Memorandum of Understanding).
Inspector of Labour and Social Security (IRTSS) of Thiès Hammadou BALDE	- Number of workers in all phases of the project - Number of laborers during the construction phase, in operational phase	- Proceed with the site opening statement before the start of work; - Establish contracts for all types of workers (specific contracts for daily); - Contact the IRTTS before recruiting to identify the types of contract.	- The consultants recommend that the promoter contacts the labor inspector for all necessary information to comply with current regulations.
General Directorate of Rural Development of Thiés (DRDR) Mr SIDIBE	- Welcomes the promoter approach - Losses of major cropland; Losses corridor passage for livestock.	- Fair and equitable compensation for farmers affected by the construction of the plant; - Improve soil fertility as part of CSR policy; - Support the renewal of agricultural equipment; - Develop a water management master program in the area; - Support the electrification of the area;	- The promoter is working with the departmental commission to define a compensation mechanism - A Corporate Social Responsibility (CSR) policy developed in consultation with the population is about to be implemented to enable them to restore their livelihoods.
Regional Service of Territory Planning	- Important project, contributes to the diversification of energy sources.	- Integrate safety and security aspects;	- The ESIA includes a hazard study to take into account the security and safety aspects

Administrative and local authorities	Observations, threats	Recommendations	Responses from the Developer
Head of Service M. SISSOKO	- Site planting area, the Niayes;	- Establish a security perimeter in the long poles carrying power; - Install an appropriate signage; - Proceed to the fair and equitable payment of disbursements; - Participate in local development efforts (schools, health posts, etc.).	- -The promoter is in contact with the departmental commission to define a compensation system; - A CSR policy developed in consultation with the population is about to be implemented to enable them to restore their livelihoods.
National Agency of Statistics and Demography (ANSD) Mme Oumou Laye, Head of Service	-Private project that has an impact on investment in the region and in the country.	- Allow the electrification of surrounding villages - Emphasize the security perimeter; - Develop a proper rehabilitation program; - Foster a reforestation program in compensation and also in orderfo to fight against wind erosion; - Implement an Independent Electrical Contractors (IEC) program on safety and operation of the plant.	- The developer will approach the services of the IREF (Regional Inspectorate of Water and Forests) to develop a reforestation program to compensate the losses incurred by deforestation during construction; - The electrification of surrounding villages is not within the prerogatives of the promoter. However, he will develop a CSR policy in line with the needs of local populations; - The ESIA includes a hazard study that take into account the security and safety aspect
Regional Directorate of Mines and Geology of Thies Mme CARLOS	- Overlap with other promoters in possession of a license; - Stripping of the site; - Sampling in quarries.	- Check if there is no duplication of project with other promoters; - Send the site UTM coordinates for verification; - Highlight the sand removal techniques used during construction; - Highlight the economic and social impacts of the project; - Ensure the quality of the report.	- The site in question is a purely agricultural area, not a career, - No overlap on the site with other promoters.

Table 15: Results of the consultations with administrative and municipal authorities.

b) Results of the consultations with local villages and populations

COMMUNE	VILLAGES
Méouane	Santhiou Mékhé
	Sine Kane
	Mékhé Village
	Ngakham

Table 16: List of concerted villages.

Results of the consultations with local villages are presented below:

Observations, threats	Recommendations	Responses
• Use of local experts during all the phases of the project; • Electrification of neighbored villages ; • Compensation of owners of the lands concerned • What are the negative effects of the project ; • Lack of follow up of the negatives impacts on similar projects; • Loss of agricultural land ; • Qualification of local population ; • Absence of communication from the commission regarding the land in some villages ; • Long absence from the initial developer on site	- Priority to local population for employment - Information required on negative effects of the project; - Replace the land required for the project by other land with the help of the developer - Train youth generation to the specialization required on the solar farm - Electrify neighbored villages with the solar park - Compensation of families affected by the project - Implication of all people affected by the project - Respect of the engagement agreed by the developer - Electrification of the villages of the Commune of Méouane; - Support from the local small enterprises for the development of the project ;	- Recruitment of local labor will be guaranteed by the Commission established by the sub prefect of Méouane - Apart from the use of agricultural lands, negatives effects of the project are insignificant - In order to compensate the loss of the land, the developer will put in place different measures to compensate the farmers concerned - The developer will support the local population in the getting electricity in defined areas. - An environmental committee will be created to make sure recommendations defined in the ESIA are applied. - Further from paying the usual taxes to the Commune for the construction of the solar farm, the developer will help the populations in the development of basic social services.

Table 17: Results of the public consultations with local populations.

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 encountered during public consultations.

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 12: Public consultation in villages of Santhiou Mékhé and Sine Kane.

Figure 13: Public consultation in villages of Mékhé Village.

Figure 14: Public consultation in villages of Ngakham.

SECTION F. Approval and authorization

The host country Letter of Approval (LoA) has been issued on April 11th 2016.

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Appendix 1. Contact information of project participants

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Senergy PV SA
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State/Region	
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Project participant and/or responsible person/ entity	☐ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
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Appendix 2. Affirmation regarding public funding

N/A

Appendix 3. Applicability of methodology and standardized baselines

N/A

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

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	8,432	47,884	80,971	0	0	0	0	0	0
SENELEC	C4	0	0	0	112,122	112,054	109,467	60	0	0	536	964	795
SENELEC	TAG2	0	0	0	0	0	0	1,682	0	0	3,939	9,893	5,333
SENELEC	TAG4	0	0	0	0	0	0	9,639	0	0	14,067	21,835	14,117
Wartsila	C6	0	0	0	112,063	123,540	131,207	0	0	0	117	93	30
Wartsila	C7	0	0	0	129,422	127,846	123,202	0	0	0	238	10	114
	KAHONE	-	-	-	-	-	4,534	-	-	0		-	732
Mitsubishi	Kounoune Power	0	0	0	82,994	73,757	86,905	0	0	0	1,121	6,847	455
MEGS	GTI	0	0	0	0	0	0	0	0	0	3,391	0	0
APR Energy	Location APR	0	0	0	0	0	0	0	0	0	64,940	51,452	30,146
	APR EDM	0	0	0	0	0	0	0	0	0	18,603	27,822	31,825
Aggreko	Sococim	na	na		0	0	0	0	0	0	0	0	0
	AGG. CDB	-	-	-	-	7,314	17,853	-	0	0	-	18,198	28,230
	Aggreko Diass 22 MW	0	0	0	0	0	0	0	0	0	0	0	5,141
	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		**$EG_{m,y}$ [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		**1,659,355**	**1,721,592**	**2,637,447**	**2,835,751**	**2,942,301**
	Off-grid	**165,935**	**172,159**	**263,745**	**283,575**	**294,230**
Total EGy + off-grid		1,825,290	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
$EG_{2013,2014,2015\ without\ import\ with\ off\text{-}grid}$	MWh	9,257,049		
$EF_{grid,OMsimple,2013,2014,2015\ without\ import\ with\ off\text{-}grid}$	(t CO_2/MWh)	0.6795		

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
EF_{CM}	0.6801	tCO_2/MWh	For other 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

Correction of sections A.3 and B.7.1 with regard to situation of meters to be coherent with figures 6 and 7 of the same section and correction of section B.7.1 with regard to number of meters to be coherent section A.3. Correction of section B.7.3 with regard to situation of meters to be coherent with figures 6 and 7 and with regard to number of meters to be coherent with section A.3.

Reasons: The incoherence with regard to location of meters in the registered PDD is due to the ambiguous use of “sub-station” in internal communication both for the Senelec grid substation and the main distribution substation located at the project site at stage of project registration. At the same time, figures 6 and 7 of the revised PDD clearly indicate the metering points.
The incoherence with regard to number of meters in the registered PDD is due to the installation of two Senelec - owned meters and two Senergy PV SA - owned meters. Section B.7.1 and section B.7.3 mentioned only two meters, as there was uncertainty about the necessity and possibility of monitoring of the Senelec meters at stage of project validation/registration.

All corrections are in line with ACM0002, V. 16 (Data / Parameter table 14), which does not state any requirements with respect to location and number of meters, the actual situation (including the PPA) as well as para. 232 of the Project Standard V.2. All parameter values of the registered monitoring plan remain unchanged.

Permanent changes to the registered monitoring plan

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. These 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.

No.	Changes	Impact	Sections of PDD revised
1	Update calibration, maintenance and testing requirements of MV electricity meters	- Applicability of the applied methodologies: Project continues to comply with all applicability criteria and all other provisions of the methodology. - Impact on accuracy and completeness of monitoring[26]: 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. Finally, the power purchase agreement continues to entail provisions, which allow for detection of inaccuracy and implementation of corrective action in case measurements of a pair of two meters deviates more than +- 0.5%. Cross check of measurement	Sections A.3, B 7.1, B.7.3

[26] As per “CDM validation and verification standard”, para. 329 (c), a materiality threshold for verification of "2 per cent of the emission reductions or removals for large-scale project activities achieving a total emission reduction or removal of 300,000 tonnes of carbon dioxide equivalent per year or less" applies, i.e. 33,992 tCO2e/year*0.02 = 679 tCO_2e/year.

No.	Changes	Impact	Sections of PDD revised
		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.	

As per para. 230 of the Project 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*
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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