Project design document form
(Version 10.1)

BASIC INFORMATION	
Title of the project activity	Grid-connected Solar PV project in Mérina Dakhar
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	Version 1.2
Completion date of the PDD	28/03/2019
Project participants	Ten Mérina Ndakhar SA
Host Party	Senegal
Applied methodologies and standardized baselines	Methodology: ACM0002 - Grid-connected electricity generation from renewable sources - Version 17.0
Sectoral scopes linked to the applied methodologies	Sectoral Scope : 1 - Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	34,422 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The "Grid-connected Solar PV project in Mérina Dakhar" involves the construction and operation of a solar photovoltaic (PV) plant of 29.49 MW in Mérina Dakhar, department of Tivouane, region of Thiès, Senegal. The solar power plant will cover an area of 82.9 hectares, and will be equipped with 92,160 modules of 320W each. It will be connected to the national grid.

The project is developed under the sectoral Scope 1 - Energy industries (renewable - / non-renewable sources). The methodology ACM0002 (Version 17.0) is applied since its purpose is the installation of a new grid-connected renewable power plant (Greenfield). In the baseline, 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 50,636 MWh per year, resulting in emissions reductions of up to 34,422 tonnes CO_2eq per year for a renewable crediting period totalling 240,960 tonnes CO_2eq over 7 years.

The village of Mbouky, where the plant will be located, is around 145 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 2,130 kWh / m² per day[1].

In Senegal, the rural electrification rate was estimated at 40 percent in 2014[2]. In 2015, the total capacity of the interconnected system was 864 MW, of which more than 85 percent was provided by fossil fuel-based thermal power plants. Electricity demand has been growing rapidly at a rate of about 6.2 percent per annum over the last decade[3]. 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 [4].

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.

Meridiam (85%) and Eiffage (15%) created the company Ten Mérina Ndakhar SA who signed a 25 years power purchase agreement (PPA) with SENELEC, the national electricity company of Senegal, in December 2013. Ten Mérina Ndakhar SA is in the process of securing all rights, authorizations and it is the counterpart for all contracts[5] in relation with the "grid-connected project in Mérina Dakhar".

Meridiam is a developer, investor and asset manager active in Europe, North America and Africa specialized in public and community infrastructure projects developed through public-private partnerships (PPP). Méridiam manages currently more than € 3.2 billion of capital management. The company was recognized in 2013 as the Best Infrastructure Fund for the third consecutive year by Infrastructure Journal. Meridiam is

[1] Based on the ESIA
[2] Source: IEA 2016: World Energy Outlook (http://www.worldenergyoutlook.org/media/weowebsite/2015/WEO2016Electricity.xlsx
[3] Based on REEP policy database
[4] According to the Environmental and social impact assessment
[5] A Protocol of Agreement has been signed on February 2016 by the Mayor of Mérina Dakhar and the company Ten Mérina Ndakhar to authorize the construction of the "grid-connected solar plant in Mérina Dakhar". Furthermore, a deliberation extract dated from 02/03/2016 has been issued by the Sub-Prefet as well as the Mayor of Mérina Dakhar authorizing the construction of the solar plant in Mérina Dakhar.

involved in the development of another solar project in Senegal, the "grid-connected solar project in Méouane"[6].

Eiffage is an international group specialized in the construction, infrastructure and energy, with global work offers. Eiffage has a turnover of nearly 15 billion euros and manages Europe's largest motorway networks. In most of its projects, Eiffage operates as a builder and co-investor alongside the biggest international names. RMT a subsidiary of Eiffage will be in charge of EPC and the O&M will be performed by Solairedirect, a top tier French PV developer and operator.

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. Employees of the plant will be trained to solar technology. As well, a capacity building plan will be implemented to train the Regional Division of the Environment and Classified Establishments (DEEC) and the Regional Committee of Environment and Social monitoring (CRSE) to Renewable Energy in order to ensure a transfer of know-how to the host country.

In 2013, imports of Senegal were led, among others, by refined petroleum products which represented 12.1% of the total imports, making it highly vulnerable to oil price fluctuations[7]. 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

Rural community of Mérina Dakhar, Merina Dakhar Arrondissement, Tivaouane Department, Thiès Region, Senegal.

The project site's geo-coordinates are: A) 15° 9'32.62"N 16°35'48.54"W; B) 15° 9'32.83"N 16°35'18.03"W; C) 15° 9'3.20"N 16°35'17.80"W; D) 15° 9'2.98"N 16°35'48.32"W

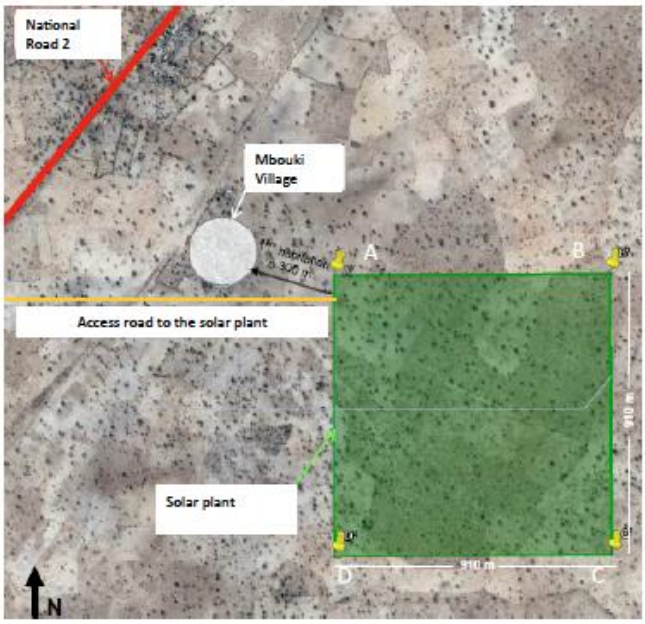


Figure 1: Zoom on the exact location of the project

[6] https://cdm.unfccc.int/Projects/Validation/DB/XLYFI1XDQXRG65HUB14S1DXERR5YGI/view.html
[7] Source : http://www.ansd.sn/ressources/ses/chapitres/18-commerce-exterieur-SESN2013.pdf

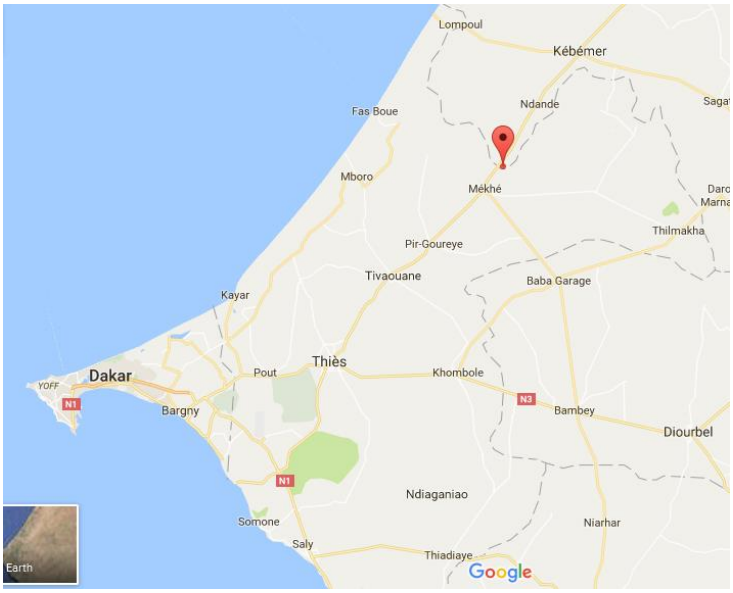


Figure 2: Project location in the Municipality of Mérina Dakhar Department Tivaouane, Senegal

A.3. Technologies/measures

The project will rely on solar power source 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 used for rain fed agricultural activities. 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 29.49 MW. The PV modules are provided by JinkoSolar manufacturer: modules JKM320PP-72 of poly silver frame solar panel.
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 6 meters).

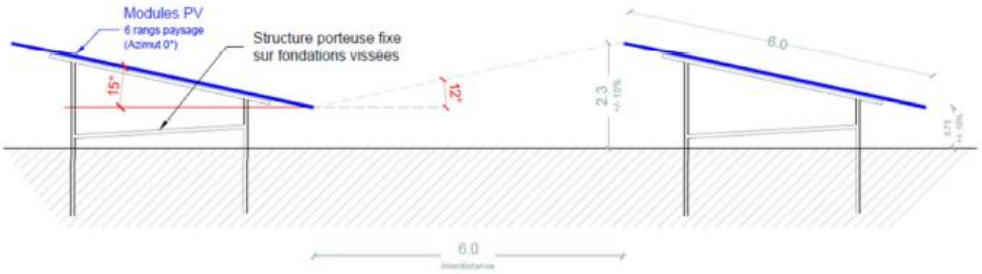


Figure 3: Installation of the panels

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 (%)	16.49
Length (mm)	1,956
Width (mm)	992
Thickness (mm)	40

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

Parameter	Unit	Description
Model		Conext Core XC 680
Maximum Input Current	A	1,280
Real 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 12 inverters

Parameter	Unit	Description
Rated capacity	kVA	1620-1890-2040
Rated voltage H/L	kV	20-22-33
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. A module lifetime is typically over 25 years.

Based on a mean annual global solar radiation potential estimated between 1,850 and 2,250 kWh/m² for the project site and the specifications of the solar PV system, annual output is expected at 50,956 MWh (P50) for the first year. The performance ratio (PR) for the first year is estimated at 78.5%. The losses can be attributed to, among others, temperature (8%), fouling (2.20%), Light Induced Degradation (2.20%). The table below describes the total losses expected. After deduction of the 22.1% of losses, and taking into account the technical availability of the project estimated at 98%, the net electricity delivered to the grid **($EG_{PJ,y}$)**, based on a seven years average, is of 50,636 MWh/yr. These figures are those provided by the EPC contractor (RMT). On this basis, the load factor is calculated as follows: 50,636 / 29,491 = 1,717 hours over 8,760 hours per year = 19.60%.

Horizontal Global Irradiation	**2,136 KWh/m²**	
To which we need to consider	Global level sensors gain	3.80%
	Closed shadings: loss of irradiance	-1%
	Global IAM	-2%
	Losses due to fouling	-2.20%
Effective Irradiation on sensors	**2,103 KWh/m² * 14,902 m²/sensors**	
STC efficiency		*16.50%*
Nominal energy on fields based on STC efficiency	**5,170 MWh**	
To which we need to consider	Gain/Loss due to irradiance	0.20%
	Loss due to Temperature	-8.00%
	Gain/Loss due to module quality	1.20%
	Light Induced Degradation	-2.20%
	Mismatch	-1.10%
	Ohmic losses due to cables	-0.90%
Energy field, virtual	**4,620 MWh**	
To which we need to consider	Operating inverter loss (efficiency)	-1.40%
	Over power inverter loss	-1.20%
	Loss inverter power line	0.00%
	Loss voltage inverter	0.00%
	Threshold voltage inverter	0.00%
Inverter output energy	**4,500 MWh**	
To which we need to consider	Auxiliaries losses	-0.40%
	Ohmic AC losses	-0.20%

	External transformers	-1.50%
Energy provided to the grid	**4,263 MWh**	

Table 4: Description of total losses

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

	Level of probability of exceedance 50% values will exceed
Global in-plane irradiation per year	2,130 kWh/m²
Performance Ratio the first year	78.5%
Specific Yield the first year	1,740 kWh/kW
Average yearly performance ratio over 25 years of operation	71.65%
Average yearly specific yield over 25 years of operation	1,640 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)[8]:

Year	PR (%)	P50 Yield (MWh)	P50 Rolling Average (MWh/year)
1	78,5	50,956	50,956
2	78,1	50,742	50,849
3	77,8	50,529	50,743
4	77,5	50,317	50,636
5	77,2	50,106	50,530
6	76,8	49,895	50,424
7	76,5	49,686	50,319
8	76,2	49,477	50,213
9	75,9	49,269	50,109
10	75,6	49,062	50,004
11	75,2	48,856	49,900
12	74,9	48,651	49,795
13	74,6	48,447	49,692
14	74,3	48,243	49,588
15	74,0	48,040	49,485
16	73,7	47,839	49,382
17	73,4	47,638	49,280
18	73,1	47,438	49,177
19	72,8	47,238	49,075
20	72,4	47,040	48,973
21	72,1	46,842	48,872
22	71,8	46,646	48,771
23	71,5	46,450	48,670
24	71,2	46,255	48,569
25	70,9	46,060	48,469

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

[8] EPC Yield Report

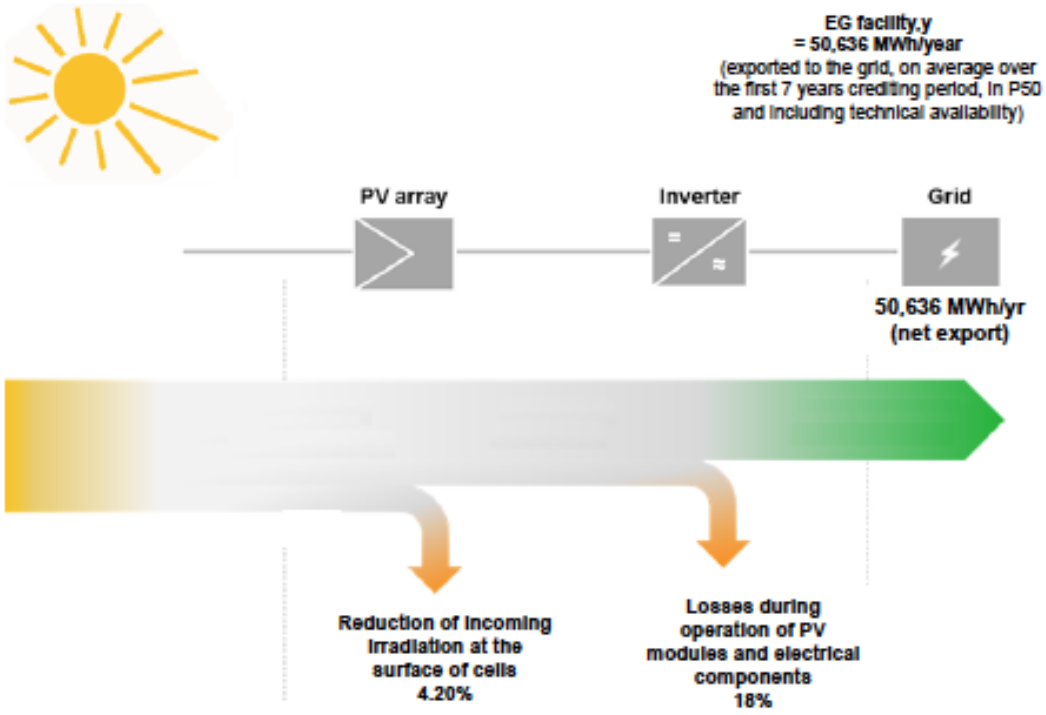


Figure 4: Energy flow with losses

The facility will be connected to the grid via the substation Mékhé (located about 2.5 km of land) via a medium voltage line of 30 kV. The connection work will be made by Ten Mérida Ndakhar and transferred to the SENELEC. A telecommunication system will be installed on the site (fiber optic, satellite or GPRS).

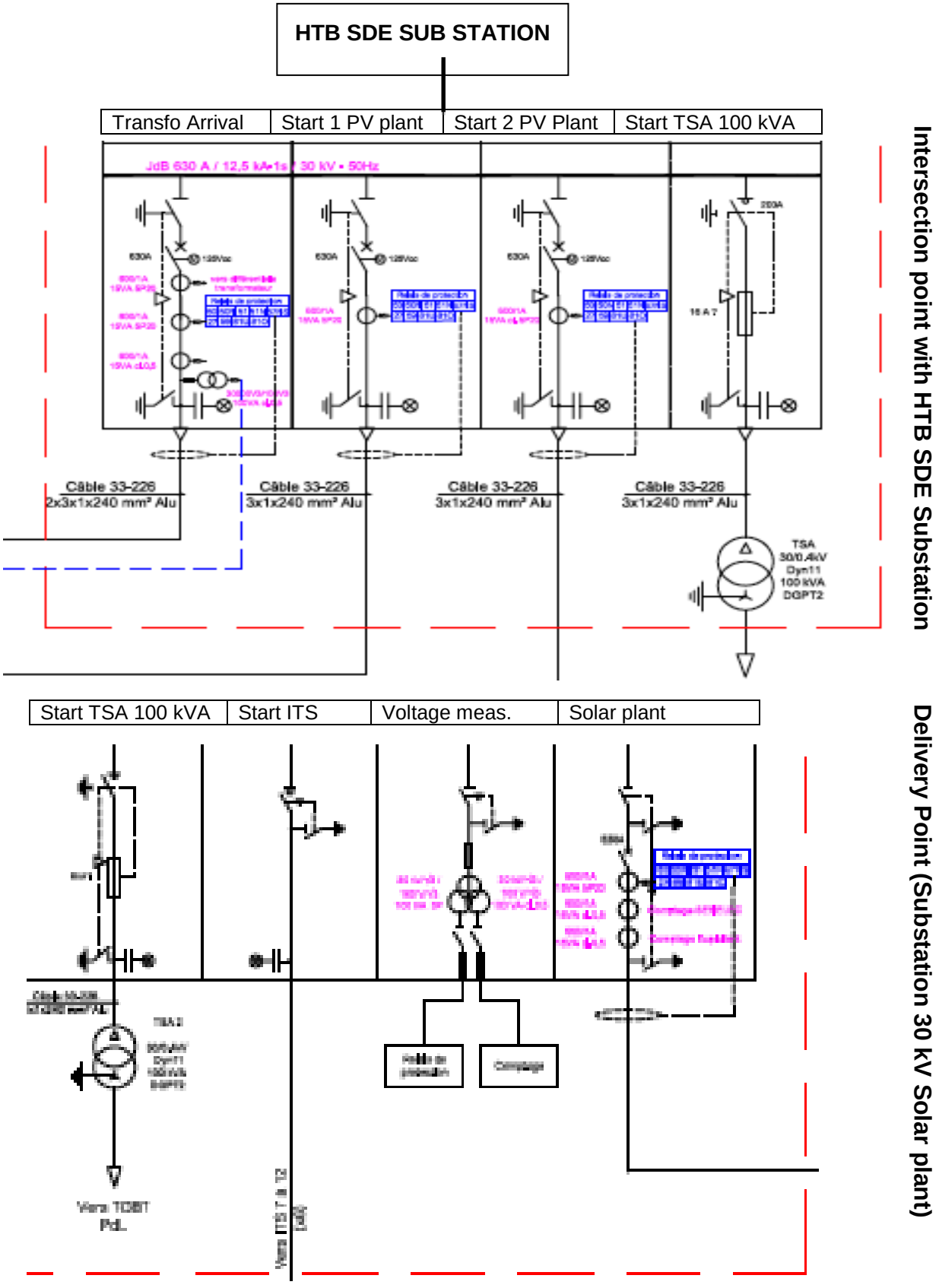
In terms of monitoring, the SCADA[9] system allows the whole PV facilities to be manually or automatically controlled and monitored:
- Locally, from the equipment and/or HMI[10] installed in Main Distribution Substation
- Remotely, from a dedicated operator console station.

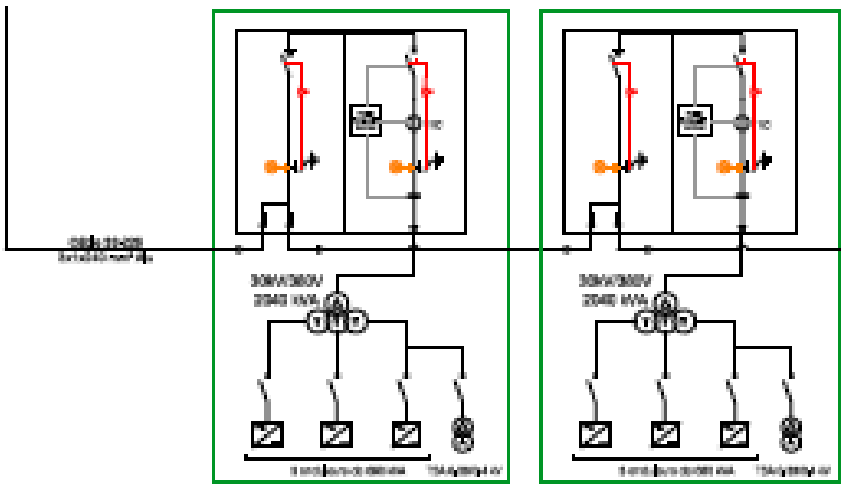
For these purposes, a fiber optic data link connection (protocol to be defined during detailed design studies) and several multi-core control cables (quantities to be defined during detailed design studies) will be routed between the HTB substation and the Main Distribution Substation.
The fiber optic 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 meters will be installed at each of the two feeder lines to the 30 kV onsite delivery point.

[9] SCADA means Supervisory Control and Data Acquisition.
[10] HMI means Human Machine Interface.

SENEGALESE POWER GRID





Mérina Dakhar solar plant

Figure 5: PV plant connection and 30 kV 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	Ten Mérina Ndakhar SA (private)	No

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 17.0.

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 17 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;	Not applicable as the proposed project activity involves a solar photovoltaic power plant.

ACM0002 version 17 applicability conditions	Project activity applicability
- - Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m^2 shall be: a.) Lower than or equal to 15 MW; and b.) Less than 10 per cent of the total installed capacity of integrated hydro power project.	
In the case of integrated hydro power projects, project proponent shall: - Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or - Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.	Not applicable as the proposed project activity involves a solar photovoltaic power plant.
The methodology is not applicable to: - Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; - Biomass fired power plants/units.	The proposed project activity neither involves - switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site, nor - biomass fired power plants/units.
In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".	The project activity does not involve capacity additions, retrofits, rehabilitations or replacements.
In addition, the applicability conditions included in the tools referred to above apply.	Applicability conditions of the applied tool 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 17.0 "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.

No	Applicability condition	Applicability to this project activity
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		GHG	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project 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 geothermal)
		CH_4	No	Minor emission source (Only for geothermal)
		N_2O	No	Minor emission source
	For binary geothermal power plants, fugitive emissions of hydrocarbons such as n-butane and isopentane (working fluid) contained in the heat exchangers	Low GWP hydrocarbon/ refrigerant	No	Main emission source (Only for geothermal)
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	No	Main emission source (Only for solar thermal power plants and geothermal power plants)
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
	For hydro power plants, emissions of CH_4 from the reservoir.	CO_2	No	Minor emission source
		CH_4	No	Main emission source (Only for hydro)
		N_2O	No	Minor emission source

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.

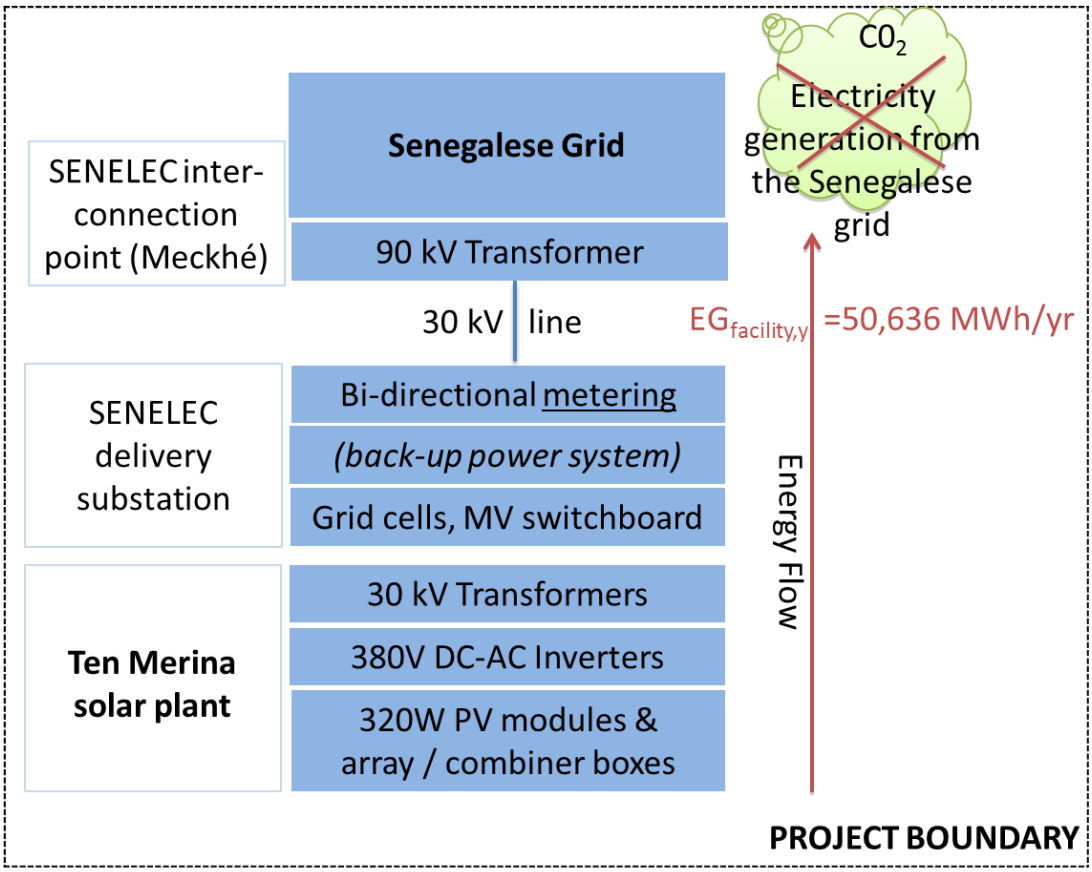


Figure 6: Diagram of the project boundary

B.4. Establishment and description of baseline scenario

According to ACM0002 Version 17.0 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 17), 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[11] and official governmental communication[12], there are only three grid connected solar PV power plants in Senegal, namely the 2 MW CICAD solar PV power plant, the grid-connected Solar PV project in Bokhol with a capacity of 20.03 MW, and the grid-connected PV Solar project in Malicounda (Mfour) with a capacity of 22 MW at time of PDD submission for registration. The government aims to reach a renewable energy penetration level of 20% by 2017. There is less than 50 MW of installed grid-connected solar PV power plant capacity 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 17.0 of ACM0002. The positive list of technologies and simplified procedures are thus valid.

The start date of the proposed project activity is defined as 06/12/2016 which is the financial closing date of the project (signature of loan agreement between Ten Mérina Ndakhar and the financing institutions PROPARCO and BIO). The Prior Consideration Form has been sent to the DNA of Senegal and published on the UNFCCC website 22 September 2016.

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 emission are calculated as follows:

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

Where:

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

[11] see Appendix 4 and ER calculations (excel sheet) provided with the PDD

[12] http://www.presidence.sn/actualites/inauguration-de-la-centrale-de-malicounda-le-jeudi-03-octobre-2016_418
http://www.presidence.sn/actualites/inauguration-de-la-centrale-solaire-de-bokhol_407

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

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \quad \text{Equation (2)}$$

Where:

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

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

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

Calculation of *$EG_{PJ,y}$*

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

$$EG_{PJ,y} = EG_{facility,y} \quad \text{Equation (3)}$$

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

Table 9: 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 restrictions 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[13]. 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 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. Therefore, the relevant electric power system is the national grid. It is managed by Senelec.

Figure 7: Project electricity system i.e. the Senegalese Power Grid [14]

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

The main transmission grid is built by a 90 kV national and a 225 kV transmission line connecting the hydro power plants of Manantali and Felou, 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)

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

[14] 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)

- 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.[15] Therefore Option II is selected for the calculation of both the operating and build margin emission factors.

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

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

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

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

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.

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

a) Senegal is classified as a least developed country.[16]
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[17]

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.

The following default values are used to determine $EG_{m,y}$ for the off-grid plants:
(a) The value of 10 per cent of the total electricity generation by grid power plants in the electricity system for the purpose of the operating margin determination;
(b) The value of 10 per cent of the electricity generation by grid power plants included in the sample group as per Step 5 for the purpose of the build margin determination.

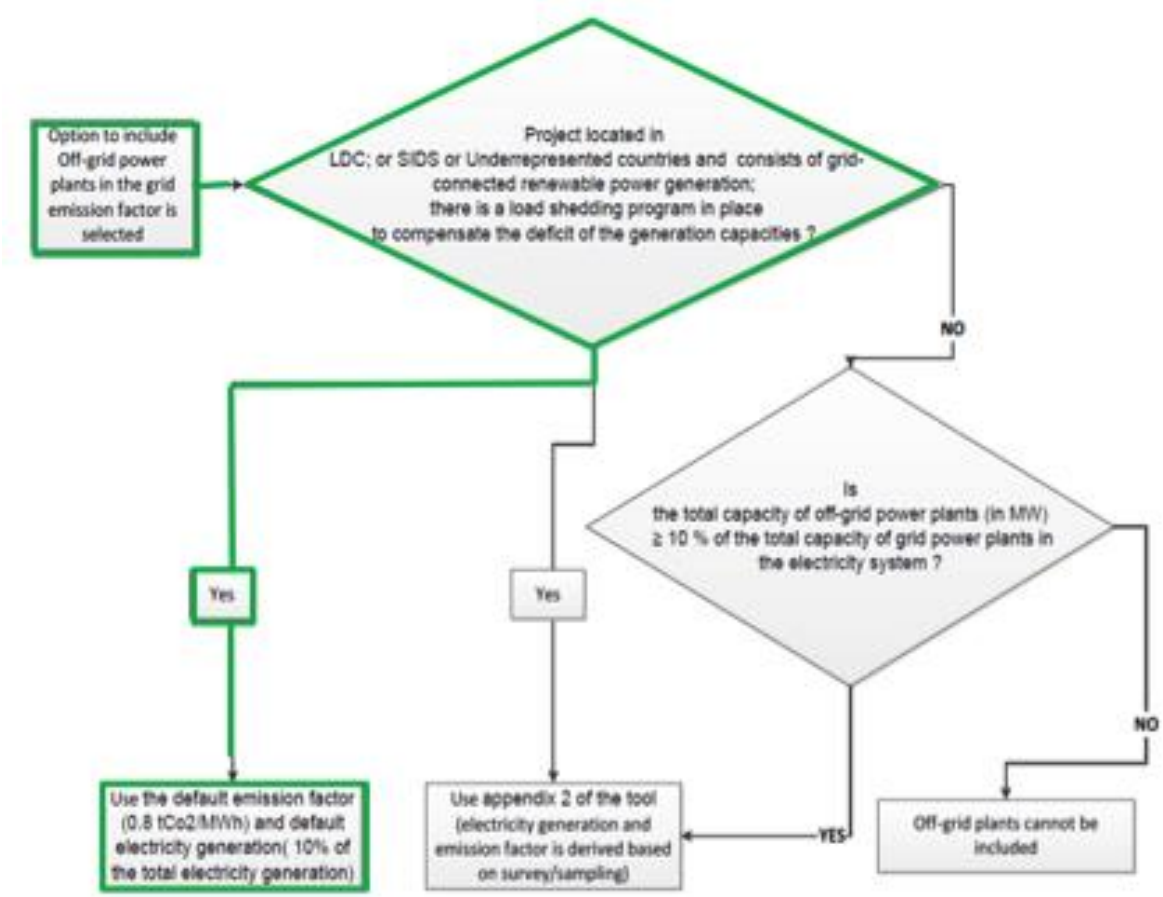


Figure 8: Inclusion of off-grid power plants in the project electricity system

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

[16] http://www.un.org/en/development/desa/policy/cdp/ldc/ldc_list.pdf
[17] http://www.senelec.sn/images/pdf/activite%20senelec%202012%20bat.pdf

(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).

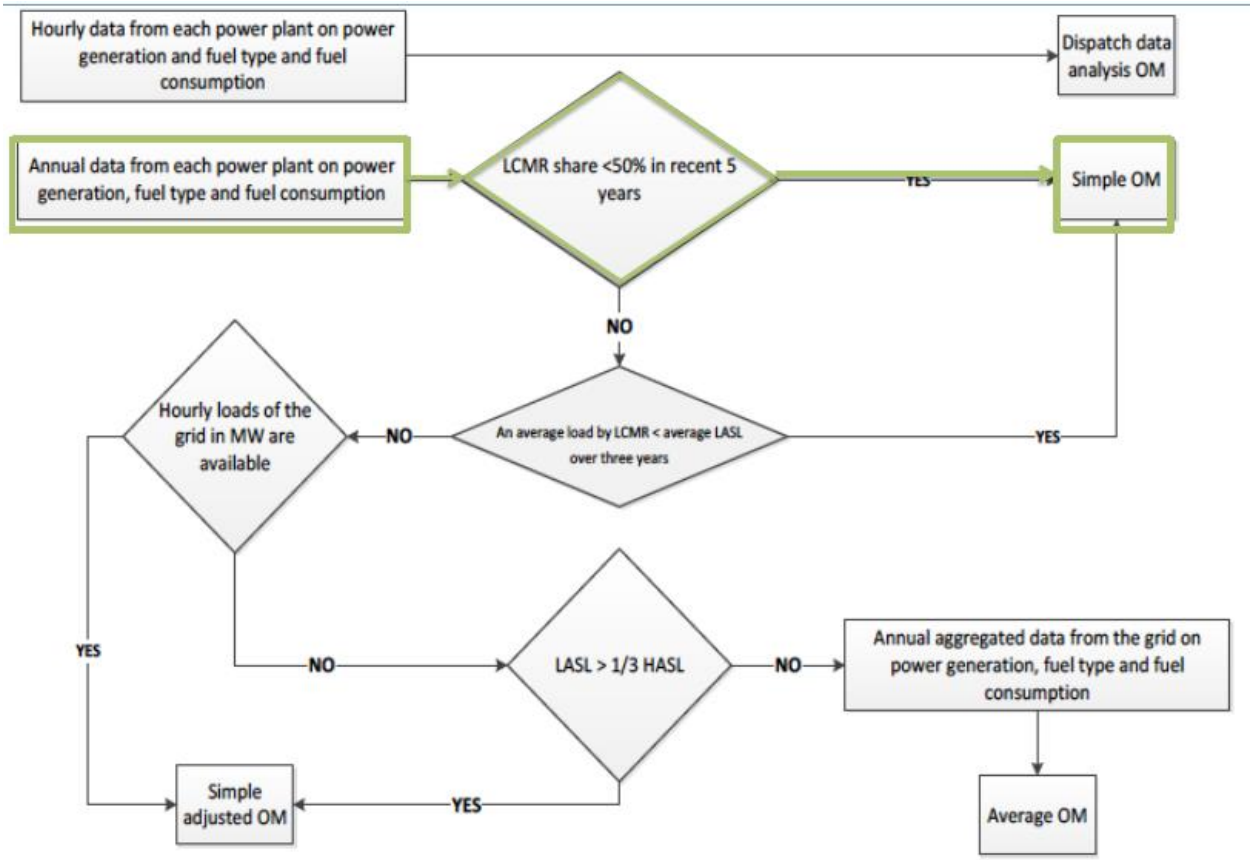


Figure 9: Overview of the application of OM methods

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

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

(i) Approach 1

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

(ii) Approach 2

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

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 $LACL_y$, $LACL_{y-1}$, $LACL_{y-2}$).

Requirement (a) and approach 1) are 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 10: Share of low cost must run source[18]

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. We have justified that the project respected this condition. Therefore, this method a) shall be used for determination of operating margin.

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.

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

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

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

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[19];;
b) Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

Option B can only be used if:
a) The necessary data for Option A is not available;
b) Only nuclear and renewable power generation are considered as low-cost/must run power sources and the quantity of electricity supplied to the grid by these sources is known;
c) Off-grid power plants are not included in the calculation (i.e. if Option I has been chosen in Step 2).

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

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

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

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

Equation (3)

Where:

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

[19] 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.

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

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

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

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

Equation (4)

Where:

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

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

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

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

Equation (5)

Where:

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

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

Option A2 is applied only to a natural gas power unit called Sococim Aggreko[20] for which data on fuel consumption were not available.

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

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.

[20] 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

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.

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

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

Determination of $EG_{m,y}$

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

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

(a) Simple OM, simple adjusted OM, average OM: Either 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); or annually during the crediting period for the relevant year, following the guidance in Step 3 above;

(b) Dispatch data OM: Hourly. Further guidance can be found in Step 3 above;

(c) BM: For the first crediting period, either once ex ante or annually ex post, following the guidance included in Step 5. For the second and third crediting period, only once ex ante at the start of the second crediting period

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 ($EF_{grid,OM\text{-}DD,y}$) 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 $EF_{grid,OM\text{-}DD,y}$.

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

Average OM

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

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

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

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

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

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

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

For the purpose of this project, option 1 is applied.
Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor.

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

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

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

Name of the power units	Starting date of operation[21]	Type	Net generation in 2015 [MWh]	Cumulated Percentage (%) based on total net electricity generation
Kounoune Power	2007	Residual fuel /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%

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

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

Table 11: Total generation in 2015 including 10% off grid power plants

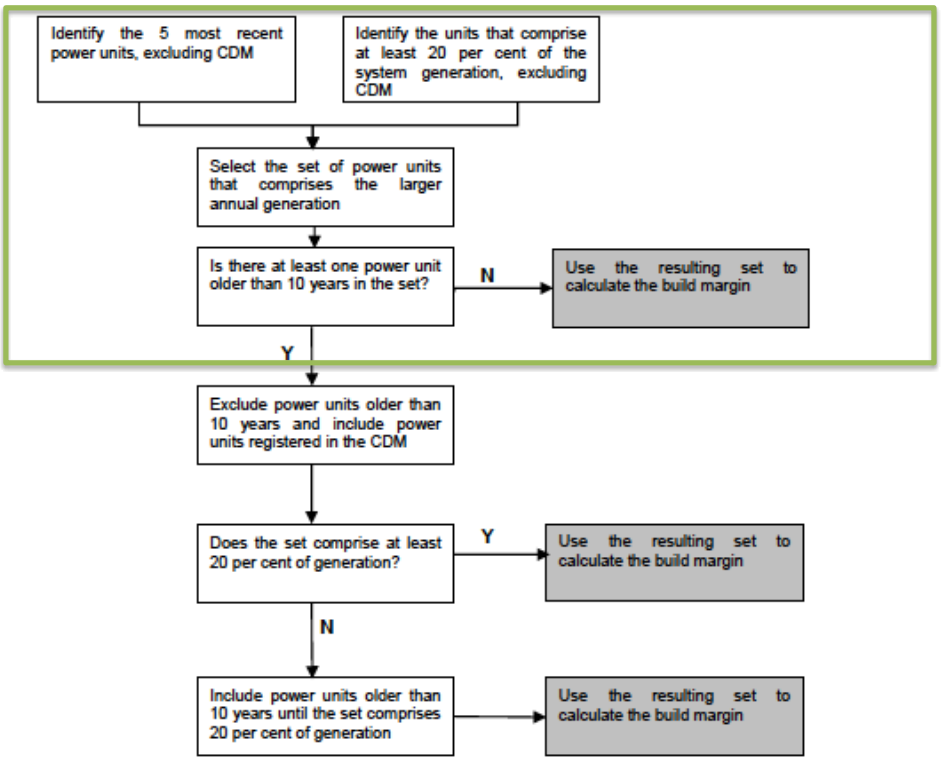
The set of five power units that have been built most recently represents a gross electricity production (in the year 2015) of 384,489 MWh. These power units are APR EDM, Aggreko CdB 2014, Aggreko CdB 2015, Aggreko Diass, and Kahone.

(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) ($SET_{\geq 20 \text{ per cent}}$) 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[22] 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 $SET_{5\text{-units}}$ and $SET_{\geq 20 \text{ per cent}}$ 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} = $SET_{\geq 20 \text{ per cent}}$.



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

Figure 10: Procedure to determine the sample group of power units *m* used to calculate the build margin

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

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

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

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

Equation (6)

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 build 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.

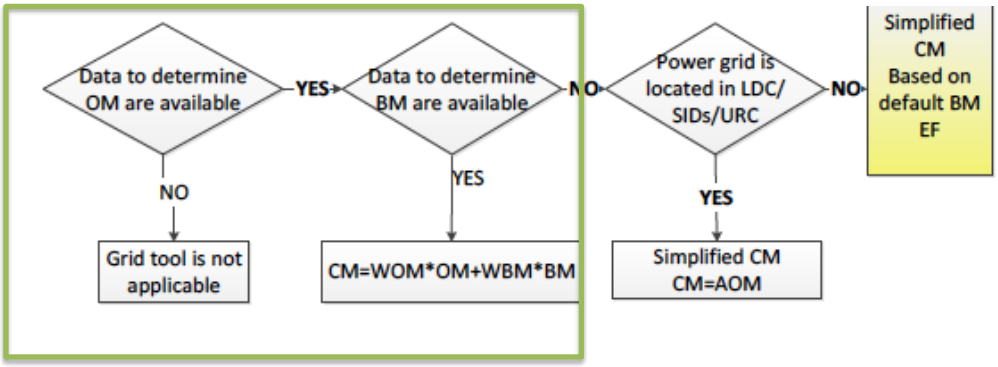


Figure 11: Determination of CM emission factor

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

(a) Weighted average CM;

$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$ Equation (7)

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 are: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods.

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

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

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 tool, 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	-

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 tool, 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	Of the 3 options below: a) Documented manufacturer's specifications (if the efficiency of the plant is not significantly increased through retrofits or rehabilitations); or b) For grid power plants: data from the utility, the dispatch center or official records if it can be deemed reliable; or c) The default values provided in the table below in appendix 1 (if available for the type of power plant) Option c) is chosen because data for option a) and b) are not available.
Value(s) applied	37.50% for natural gas steam turbine for new units (after 2000).
Choice of data or measurement methods and procedures	-
Purpose of data	Once for the crediting period
Additional comment	-

Data/Parameter	The percentage share of total installed capacity of grid-connected solar PV
Data unit	%
Description	The percentage share of total installed capacity of grid-connected solar PV in the total installed grid connected power generation capacity in the host country
Source of data	Senelec data and governmental communications
Value(s) applied	0.05%[23]
Choice of data or measurement methods and procedures	-
Purpose of data	Additionality demonstration
Additional comment	-

Data/Parameter	The total installed capacity of solar PV
Data unit	MW
Description	The total installed capacity of the grid-connected solar PV in the host country.
Source of data	Senelec data and governmental communications
Value(s) applied	44.03 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

[23] The total capacity of the Senelec grid in 2015 is equal to 897.97 MW - Source: http://www.crse.sn/upl/RevisionTarifaire-2016b.pdf (p.22)

Total installed capacity	29.49	MW	A.3 [92,160 x 320 W]
Net electricity delivered to the grid ($EG_{PJ,y}$)	50,636	MWh	A.3; B.6.1 Excel sheet [$EG_{PJ,y}=EG_{facility,y}$]
Baseline emission factor of Senegalese grid ($EF_{grid,CM,y}$)	0.6798	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)	34,422	tCO_2/y	$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$ [50,636 MWh/yr x 0.6798 tCO_2/MWh]
Project emissions (PE_y)	0	tCO_2/y	B.6.1
Emission reduction (ER_y)	34,422	tCO_2/y	$ER_y = BE_y – PE_y$

YEAR	BE_y (tCO_2)	$EG_{PJ,y}$(MWh)	$EF_{grid,CM,y}$ tCO_2/MWh
01/10/2017 -31/12/2017	8,660	12,739	0.6798
2018	34,622	50,929	0.6798
2019	34,549	50,823	0.6798
2020	34,477	50,716	0.6798
2021	34,404	50,610	0.6798
2022	34,332	50,504	0.6798
2023	34,260	50,398	0.6798
01/01/2024 -30/09/2024	25,655	37,739	0.6798
TOTAL	**240,960**	**354,457**	**/**
Average over 7 years	**34,422**	**50,636**	**/**

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

Year	Baseline emissions (t CO2e)	Project emissions (t CO2e)	Leakage (t CO2e)	Emission reductions (t CO2e)
22/10/2017 -31/12/2017	8,660	0	n/a	8,660
2018	34,622	0	n/a	34,622
2019	34,549	0	n/a	34,549
2020	34,477	0	n/a	34,477
2021	34,404	0	n/a	34,404
2022	34,332	0	n/a	34,332
2023	34,260	0	n/a	34,260
01/01/2024 -21/10/2024	25,655	0	n/a	25,655
Total	**240,960**	0	n/a	**240,960**
Total number of crediting years	7 years			
Annual average over the crediting period	**34,422**	**0**	**n/a**	**34,422**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

<table>
<tr><td>Data/Parameter</td><td>$EG_{facility,y}$</td></tr>
<tr><td>Data unit</td><td>MWh/yr</td></tr>
<tr><td>Description</td><td>Quantity of net electricity generation supplied by the project plant/unit to the grid in year y</td></tr>
<tr><td>Source of data</td><td>Measured directly with electricity meter(s) at project site’s substation.</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th>YEAR</th><th>Net electricity production fed into grid (MWh)</th></tr>
<tr><td>01/10/2017 -31/12/2017</td><td>12,739</td></tr>
<tr><td>2018</td><td>50,929</td></tr>
<tr><td>2019</td><td>50,823</td></tr>
<tr><td>2020</td><td>50,716</td></tr>
<tr><td>2021</td><td>50,610</td></tr>
<tr><td>2022</td><td>50,504</td></tr>
<tr><td>2023</td><td>50,398</td></tr>
<tr><td>01/01/2024 -30/09/2024</td><td>37,739</td></tr>
<tr><td>TOTAL</td><td>354,457</td></tr>
</table>
</td></tr>
<tr><td>Measurement methods and procedures</td><td>Two meters (1 Ten Mérina Ndakhar SA and 1 Senelec meter) will be installed at each of the two feeder lines (30 kV) to the onsite delivery point.Precision of meters: 0.2 (as per PPA metering provisions)
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.

In general, the Project Participant and Senelec ensure jointly the QA/QC of the meter measurements. Within the project participant’s monitoring organization, 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>
</table>

Purpose of data	Calculation of baseline emissions
Additional comment	-

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 17.0), 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. 17. 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 calibrated electricity meters installed at each of the two feeder lines (30 kV) to the onsite delivery point and cross-checked with sales records as follows.

Monitoring organization

The CEO of Ten Merina Ndakhar 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, well aware of CDM requirements. This team will not have any hierarchical relationships or dependence links with all entities involved to measure net electricity supplied to the grid and to assure the

correct operation and maintenance of the measuring equipment. This independence shall guarantee the integrity of the work that will be done.

Emergency and trouble-shooting procedures
In order to avoid equipment or meter breakdowns where generation data can be lost, a second counters 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 blackout, disconnection of the PVBOX from the Main Distribution Substation, etc.). Systems that may require UPS power backup are:

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

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

The start date of the proposed project activity is defined as 06/12/2016 as per the signature of a loan agreement between Ten Mérina Ndakhar and the financing institutions PROPARCO and BIO.

C.2. Expected operational lifetime of project activity

C.3. The expected operational of the project activity is 25 years (300 months) from commissioning of the plant. 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

01/10/2017

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. The project will also be in line with IFC performance standards.
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 various scenarios was performed for the following topics:

a) Absence of the project;

b) Choice of location of the plant;
c) Choice 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

The absence of the project would go against 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.
Two of these technologies have been studied. These are:
- a conventional diesel plant running on Heavy Furnace Oil (HFO);
- 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). Ten Mérida Ndakhar 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 neighboring 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	Minor
Surface water and groundwater	Quality of surface water and groundwater	Minor
Terrestrial Ecosystems	Soil Vegetation Soil exploitation Fauna and avifauna	Minor Medium (major in construction phase and minor during exploitation) * Minor Medium**
Human Environment	Socio-demographic Living environment Landscape aspect Health and security Socio-economic activities Archeologic and cultural heritage	Minor Minor Medium*** Minor Major**** Minor

Table 12: 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 Fauna and avifauna: The plant site is composed by plant species partially protected by the code of Forest of Senegal including: Acacia raddiana (Seing), Acacia Senegal (Vereck) Adansonia digitata (Baobab), Borassus aethiopium (Rônier) albida (Kadd), Tamarindus indica (Tamarind) and Ziziphus mauritiana (Sidem). The construction of the plant will require a total deforestation of the site that will be a consequent loss of forest potential on the site. Similarly, all services related to the vegetation (fuelwood, wildlife habitat, gathering activities, etc.) will be lost and fauna will be disturbed (especially the wildlife habitat). The Project proponent has agreed to compensate the populations living from the activities related to agriculture by offering a global compensation of 95 million of CFA[24] additionally to the compensation defined to be delivered to landowners.
Furthermore, the project proponent should implement a reforestation plan throughout the project lifetime and its follow-up, in collaboration with the IREF (Regional Inspectorate of Water and Forests). The definition of this plan is under discussion.

***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.

****Impact on socio-economic activities: The lands selected for the construction of this project are agricultural lands cultivated by the people of the villages.
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 labor will be prioritized and will be realized under the supervision of a commission set up by the Prefect of Tivouane. The developer has restored their rights through a fair and equitable compensation in accordance with the best practices of donors (Equator principles 3 June 2013 / IFC[25]), 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.
Ten Mérida Ndakhar will also allocate funds to electrify the village of Mbouky, as well as building an access road and put in place a drilling.

To summarize, the study showed that the project to build a solar power plant of 29.49 MW in Mérida Dakhar 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. The ESIA approval has been granted by ministerial decree dated December 29th, 2016.

[24] 95 million CFA equals approximately 160,000 USD in September 2016
[25] http://www.equator-principles.com/index.php/equator-principles-3

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;
- 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, six stages were necessary:

a) Initial start of the project

On March 10th, 2016, the project proponent Ten Mérina Ndakhar held a meeting to explain the project of construction and operation of a "grid-connected solar project in Mérina Dakhar". This meeting marked the start of the Environmental and Social Impact Assessment (ESIA). The Prefect of the department of Tivaouane, the Sub-Prefect, the Mayor of the municipality of Mérida Dakhar, and the chiefs of the neighbored villages were present. Preliminary information about the project was given, the geographic area was discussed and a first visit of the zone of implementation of the project was organized.

b) Meetings with administrative and municipal authorities

Between March 17th and 30th 2016, the project proponent met individually administrative and municipal authorities established in the region of Thiès and the department of Tivaouane. During these meetings, the project proponent presented the solar power plant and gathered opinions from relevant institutions.

Following these meetings, the Municipal Council of Mérina Dakhar convened an extraordinary general meeting on 30th March 2016 to facilitate the exchanges between the promoter, the cabinet in charge of the ESIA and local officials. In preparation for this consultation, a preliminary newsletter containing technical project summary was sent to all the parties involved.

During the extraordinary general meeting, explanations about the objectives of the Environmental Impact Assessment and Social were provided, as well as details about the economic, political and social rights related to the construction and exploitation of the "grid-connected solar project in Mérina Dakhar". Comments and recommendations were received from the parties involved. The importance of involving the public during the evaluation process was reminded by the local authorities.

c) Meeting to define landowners compensation

The Prefect convened a meeting on the composition and the Commission's operation. The meeting was held on March 24th,2016 with the following participants: Prefect of Tivaouane, Sub-Prefect of Mérina Dakhar, Mayor of Mérina Dakhar, representative of the Forestry Department of Tivaouane, representative of the Departmental of Planning Service of Tivaouane, representative of the Ministry of Agriculture of Tivaouane, representatives of Ten Mérina Ndakhar and partners, and the ESIA Cabinet officials.

Thereafter, the Prefect of Tivaouane, also Chairman of the Commission asked its members to conduct a site reconnaissance visit of the project and to hold the session of information on the compensation on March 30th, 2016 at 10:00. On this date, the Commission defined the compensation due by the project proponent to the landowners. The method of calculation used to define the compensation was explained to the concerned landowners. Were present on March 30th the Sub-Prefect of Mérina Dakhar and his technical team, Deputy Mayor of Mérina Dakhar and his team, a representative of the Forestry Department of Tivaouane, representative of the Departmental Service of Urbanism of Tivaouane, representative of the Ministry of Agriculture of Tivaouane, local populations of villages, representatives of Ten Mérina Ndakhar and partners, and the ESIA Cabinet officials.

d) Meeting with the national structures involved in the management of the project

Between April 10th and 20th, 2016 the project leader met with national institutions involved in the project such as ANER, SENELEC, the Industries Department, the Department of Electricity to present the proposed construction and operation of the solar plant Mérina Dakhar.

e) Meetings with concerned villages: Mbouky, Ngass, Tieumbeul, Tibo

On April 10th, 2014, 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 compare the socio-economic realities as experienced by the people themselves and the satisfaction of the people concerned by the project. Analysis of the reactions allows to state with certainty that the project has been well received by them. They welcome the project and positively enjoy the participatory approach of the firm.

f) Local Stakeholder Consultation

On October 7th, 2016, a local stakeholder consultation was held at Hotel Residence Lat Dior, in the city of Thies at 10:00 am to present the social and environmental impacts of the project. This consultation was made in order to respect the process required for the registration of the project under the CDM and Gold Standard.

E.2. Summary of comments received

a) Results of the consultations with administrative and municipal authorities

Local, regional service chiefs and local councilors have unanimously magnified this project. They agreed that the project reflects the materialization of the Emergent plan for Senegal (PSE[26]) in its energy component, and therefore, must have the support of everyone.

However, the relevance of the project did not stop to reflect a number of concerns and recommendations that were analyzed to make the project 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	Comments	Recommendations	Responses from the Developer
Prefect of the department of Tivaouane Magatte DIALLO	- Important project as related to energy production - Help reducing power dependency - Limit pollution - End of life of the project - Compensation for the landowners - Deadline for ESIA and date for public consultation	- Prioritize the local workforce during recruitment - Remain attentive to the concerns of the population	- The recruitment of local labor will be a priority. - Concerns of the population has been and will continue to be taken into account.
Sub Prefect of Mérina Dhakar Ndiaty BAKHOUM	- Important project for the town; - Help reducing power dependency - Project aligned with national development policy; - Compensation for the landowners need to be defined	- Provide support to the people with the installation of boreholes; - Supporting health and education facilities	- The Commission has been requested to assess the compensation amounts to be delivered to the landowners. The project proponent compensated the landowners accordingly. He also agreed to compensate the people that lived from the exploitation of the land required for the project implementation. - A Corporate Social Responsibility (CSR) policy developed in consultation with the population has been

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

Administrative and local authorities	Comments	Recommendations	Responses from the Developer
			organized in order to define the most important actions they would like to see put in place. It was agreed that the project proponent should build access roads, implement a drilling system and will ensure the electrification of the Mbouky village.
City Council Mérina Dakhar Biame Liliayo	- Relevant project - Attraction for tourists - Lot of land required - Loss of land, forest and livelihoods for populations and heritage for future generations - Implication of the populations - Access to electricity to the villages - Support to the landowners that have a weak instruction level - High unemployment for the young - Lifetime of the project - Economic repercussions need to be reflected in the town - Price defined by Senelec once the electricity will be produced - Need to implement similar projects everywhere to reduce energy dependency - Final destination of the solar panel at the end of the project lifetime - Retraining workers after central dismantling	- Prioritize the local workforce during recruitment - Develop infrastructure - Create roads - Develop intensive agriculture on the remaining lands in compensation for lands taken - Undertake a replacement of plant species slaughtered by other more productive species and generate income such as fruit trees; - Support the protection of the four existing classified forests in the municipality; - Support the education and environment in the CSR policy - Make landowners become stakeholders of the project - Help landowners in developing sustainable and profitable projects - Build boreholes for intensive agriculture - Electrification via solar kits - Register the company in the municipality to pay taxes locally - Create a protected area and make it a touristic attraction	- Priority recruitment of local labor has been agreed and will be ensured through a collaboration with the departmental commission for recruitment; - A Corporate Social Responsibility (CSR) policy developed in consultation with the population has been organized in order to define the most important actions they would like to see put in place. It was agreed that the project proponent should build access roads, implement a drilling system and will ensure the electrification of the Mbouky village. - The developer has approached 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 project proponent may not give shares of the project to the landowners but landowners were compensated based on the commission´s evaluation.
Regional Inspectorate for Water and Forests of the region of Thies (IREF)	- The area is not rich in wildlife resources and the site is not in a classified area - Forest mainly composed by kadd, soump and baobabs - No existing management plans	- Have "a clearing permit" before starting the construction work - Provide floristic compensation after deforestation - Improve living conditions of populations	- Project proponent will respect the legislation and wait to receive all requested permits before starting the construction /exploitation work. - The developer has approached the services of the IREF (Regional Inspectorate of Water and Forests) to develop a reforestation program to

Administrative and local authorities	Comments	Recommendations	Responses from the Developer
	for the zone - Compensation to landowners - Distance to the first houses of Mbouky are below the 500m required	- Educate and inform people about the project; - As part of CSR carry out actions such as the drilling, the establishment of community areas for gardening and nursery etc.; - Implement a participatory approach by ensuring the training of villagers and their involvement in actions to lead; - Take electrical hazards into account	compensate the losses incurred by deforestation during construction; - Landowners have been compensated in accordance with the Commission conclusions. As well the project proponent has agreed to compensate families living from breeding and external activities previously delivered by the required lands. - A capacity building plan has been agreed to train the DEEC and the CRSE to Renewable Energy for a total value of 8 million of CFA[27] - As part of the CSR, the project proponent has agreed to electrify the town of Mbouky, to build an access road and to create a drill. - Population has been involved since the early stage of the project to ensure that their concerns are taken into account.
Regional Development Agency (ARD) Mr. FAYE	- Fair and equitable compensation for landowners as well as people who lives from picking and forest activities; - Project in line with the national energy policy - Very large land space required - Recycling process of end of life equipment - Battery required - The baobab perimeter should not be destroyed	- Take into account the importance of the loss of land (83ha); - Ensure a good recycling process of end of life equipment - Help in commune in keep the Baobab perimeter in protected area	- The landowners have been compensated in respect with the results of the Commission - Dismantling the plant will be in accordance with local regulations. The site will be returned in the state it was before the plant (own to agriculture). - The baobab perimeter will be protected.
Regional Service of Water Mr. Baba DIENG Deputy Head of Service	- The project won't have impact on water resources - Access to polarized water for neighboring villages - Neighboring villages should benefit from the electrification - Tariffs applied by the SDE high in comparison with	- Analyze the water access of neighboring villages - Develop a water supply system - Respect local regulation	- The plant has no water requirement - Regulation will be respected

[27] 8 million of CGA is equivalent to 13,616 Euros

Administrative and local authorities	Comments	Recommendations	Responses from the Developer
	local revenues		
General Directorate of Rural Development of Thiés (DRDR) Mr. SIDIBE	- Project must be realistic and take into consideration the local context - Lands are over exploited and poor. - Enumerate the agricultural problems	- Integrate concerns of the people and communities - Highlight the human and organizational aspects for - Better awareness among populations - Develop a water supply program - Support agro and pastoral activities to increase revenues of the population - Make some statistics of the region	- Landowners have been compensated in accordance with the Commission conclusions. As well the project proponent has agreed to compensate families living from breeding and external activities previously delivered by the required lands. - A Corporate Social Responsibility (CSR) policy developed in consultation with the population has been organized in order to define the most important actions they would like to see put in place. It was agreed that the project proponent should build access roads, implement a drilling system and will ensure the electrification of the Mbouky village.
Regional Service of Territory Planning Head of Service M. SISSOKO	- Important project, contributes to the diversification of energy sources. - Respect the Act III that encourages communes to develop renewable energy based on their resources - The project will be implemented in a zone were lands have been over exploited and would not be used in the future - Ensure a transfer of knowledge and trainings - Some concerns with regards to the deforestation of species that remain (kadd and soump) - Delocalization of breeding activities	- Put in place a reforestation program - Prioritize local employment - Train local youth people to the maintenance work - Work on the land statutes	- 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; - Priority recruitment of local labor has been agreed and will be ensured through a collaboration with the departmental commission for recruitment Employees will be trained by the project proponent. As well the project proponent has agreed to create a capacity building program to train the DEEC and the CRSE to the renewable energy. - The project will be developed in accordance with all the rules and regulations.
National Agency of Statistics and Demography (ANSD) Ms. Oumou Laye, Head of Service	- Economic repercussions for landowners - Impact on breeding and agriculture - Availability of data on the region of Tivouane	- The project can be built on the Moroccan model that has good expertise in solar - Make sure populations affected by the project will be considered.	- Landowners have been compensated in accordance with the Commission conclusions. As well the project proponent has agreed to compensate families living from breeding and external activities delivered by the lands.
Regional	- The project is	- Gain experience and	- Populations have been

Administrative and local authorities	Comments	Recommendations	Responses from the Developer
Division of the Environment and Classified Establishments (DEEC of Thies) Moussa GUEYE	sustainable - Treatment of end of life equipment - It is the third solar plant in the region. There is a lack of specialized workers which is noted to ensure maintenance and repairing work - Senegalese regulation doesn't reflect these type of projects - Existence or not of a magnetic field under which perimeter could it be perceptible	apply what would be learnt from the previous solar plants developed in the region - Put in place mechanisms that would enable the population to feel connected to the project - Consider field characteristics - Train youth people to solar requirements - Prioritize local force at least during construction phase - Implement a capacity building program for environmental monitoring - Identify risks related to the installation of the plant (don´t underestimate them)	concerted since the early stage of the project. Their concerns were listened and taken into account. - Priority recruitment of local labor has been agreed and will be ensured through a collaboration with the departmental commission for recruitment - An extended Environment and Social Assessment was made which describe the characteristics of the area of the projects. This ESIA included a risks analysis and a describe measures that should be implemented in order to limit the impact on the environment. - The project proponent will train the workers to the solar technology. As well the project proponent has agreed to put in place a capacity building process for the DEEC and CRSE on renewable energy.
Fire Brigade of Mekhe	- Dangers are limited during exploitation phase but they still exist - Workers are not trained to emergency situation	- Identify all existing risks related to solar plants - Make a complete risk assessment - Put a lightning rod	- An extended Environment and Social Assessment was made which describe the characteristics of the area of the projects. This ESIA included a risks analysis and a describe measures that should be implemented in order to limit the impact on the environment. - A lightning rod will be installed.
Senegalese Water Agency (SDE of Thies)	- Water requirements need to be clearly defined - Possibility of impact of the local network	- Check availability of existing report in the commune - Contact the person in charge of the Mekhe´s suppressor	- As justified in the ESIA the demand of water will be limited. However, the project proponent will make sure to read existing reports and to contact the person in charge of Mekhe´s suppressor.
Thies Cadastre	- Encroachment of the project area on the commune of Ndande which is part of the region of Louga - Pending opinion of the referral domains - Frequency of problems associated with delineation between land; - Baobab field could remain - Site serve as a buffer zone.	- Problem on the encroachment with the commune of Ldande should be solved	- The project proponent is working along with the relevant institutions in order to clarify the problem of the encroachment of the land on the commune of Ldande.

Administrative and local authorities	Comments	Recommendations	Responses from the Developer
Planning Regional Service	- The project is in the remote and driest area of the region - It is in line with national strategy - If the site is a transit area for livestock define measures of compensation - Respects compensation agreed with landowners	- Analyze the impacts the project will have on populations and compensate them accordingly - Support population´s interests - Respect recycling agreement for end of life equipment - Prioritize local employment - Ensure capacity building - Intend that neighboring villages be electrified - Put in place a community program	- Landowners have been compensated in accordance with the Commission conclusions. As well the project proponent has agreed to compensate families living from breeding and external activities delivered by the lands. - A Corporate Social Responsibility (CSR) policy developed in consultation with the population has been organized in order to define the most important actions they would like to see put in place. It was agreed that the project proponent should build access roads, implement a drilling system and will ensure the electrification of the Mbouky village. - Priority recruitment of local labor has been agreed and will be ensured through a collaboration with the departmental commission for recruitment - End of life equipment will be managed based on the national regulations - The project proponent will train the workers to the solar technology. As well the project proponent has agreed to put in place a capacity building process for the DEEC and CRSE on renewable energy.
Regional Sanitation Service Mr. Landing SONKO	- Sustainable project in respect with national policy - The localization of the project in rural area represent an opportunity of development for the region - The area is not connected to the public network - Compensation offered to landowners - Important risk of pollution during the construction phase for the population - CSR policy should respect national regulation - Risk of percussion of the solar panels by	- Establish an autonomous sanitation network - Prioritize local employment - During construction provide mobile toilets and sign a protocol with a provider for regular emptying and management of water withdrawn; - Implement an effective management plan for solid waste and non-biodegradable; - Take into account the micro fauna and microflora; - Set up a device that avoid percussion panels by the birds; - Build toilets for population	- Priority recruitment of local labor has been agreed and will be ensured through a collaboration with the departmental commission for recruitment - During construction mobile toilets will be installed and regularly emptied. - All waste will be managed based on regulations. - Microfuge and micro fauna will be considered as per the advice delivered by the ESIA report. - A Corporate Social Responsibility (CSR) policy developed in consultation with the population has been organized in order to define the most important actions they would like to see put in place. It was agreed that the project proponent should build access roads, implement a drilling system and will ensure the

Administrative and local authorities	Comments	Recommendations	Responses from the Developer
	the livestock - Measures taken of end of life equipments.		electrification of the Mbouky village.

Table 13: Results of the consultations with administrative and municipal authorities.

b) Results of the consultations with national structures involved in the management of the project

This consultation was made with national institutions and structures involved at different levels of implementation of the project including the construction as well as the operation of the solar plant.

National structures	Comments	Recommendations	Responses from the Developer
ANER Dr Gora Niang	- The project helps to reduce the energy deficit in the country - It supports the objective to reach 30% of the energy produced by clean energy by 2017 - Compensation to the population - The land required will be a loss for the landowners - Deforestation is a loss for the ecosystem - Respect of the engagement - Trainings on Renewable Energy are made available by the ANER - Establishment of a monitoring committee	- Being a CDM project, look at the possibilities offered by the purchase /sales of carbon credits - Offer a reasonable compensation to respective landowners - Consider existing flora and fauna - Define end of life equipment process - Prioritize local employment - Under the CSR policy, equip schools and medical centers - Give solar kits to schools and medical centers as well as population if possible - Empowering women - Minimize the impacts on the environment during the construction phase	- The sales/purchase of carbon credits will be managed by the consulting company AREA Group, also in charge of validating and registering the carbon project - Landowners have been compensated in accordance with the Commission conclusions. As well the project proponent has agreed to compensate families living from breeding and external activities delivered by the lands. - Flora and fauna as well as impact due to the construction have been considered under the ESIA and measures recommended will be respected. - End of life equipment will be managed according to regulations - Priority recruitment of local labor has been agreed and will be ensured through a collaboration with the departmental commission for recruitment - A Corporate Social Responsibility (CSR) policy developed in consultation with the population has been organized in order to define the most important actions they would like to see put in place. It was agreed that the project proponent should build access roads, implement a drilling system and will ensure the electrification of the Mbouky village.

SENELEC Pape Macodou SALL and Mohamed Abdoulaye SALL	- One of the 10 Green project having obtained a PPA since end of 2013 - Delay in the start of the construction phase - Energy produced depend on weather - Solar energy is more expensive than other fossil fuel energy resources - Land required is large in an area that received lot of projects - Having an underground line of connection is too expensive - The project area could be used by livestock - Rural electrification is more under the responsibility of the ASER	- Identify the concerns of the population and try to find suitable solution in order for the population to accept the project - Provide reasonable compensation to landowners - Send a letter in writing to competent authorities for an extension of electrical network to these not electrified towns - Prioritize local employment - Develop a reforestation plan to compensation deforestation	- Population have been involved at early stage of the project. Their concerns have been taken into account. - Landowners have been compensated in accordance with the Commission conclusions. As well the project proponent has agreed to compensate families living from breeding and external activities delivered by the lands. - Priority recruitment of local labor has been agreed and will be ensured through a collaboration with the departmental commission for recruitment - 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; - A Corporate Social Responsibility (CSR) policy developed in consultation with the population has been organized in order to define the most important actions they would like to see put in place. It was agreed that the project proponent should build access roads, implement a drilling system and will ensure the electrification of the Mbouky village.
Direction of Industries	- Land required is consequent - End of life equipment - Low number of employment created - The constituent materials of the solar panels can be a source of pollution; - The high number of solar panels can cause visual pollution	- Ensure that lands are protected - Organize meeting with the populations to listen and take their concerns into account - Refer to the existing solar project for the definition of the compensation and CSR strategy - Define process for end of life equipment	- End of life equipment will be managed based on the national regulations - An extended Environment and Social Assessment was made which describe the characteristics of the area of the projects. This ESIA included a risks analysis and a describe measures that should be implemented in order to limit the impact on the environment. - Population have been involved at early stage of the project. Their concerns have been taken into account.

Direction of Electricity	- Clean project that enables an improvement in the energetic mix - In respect to the national strategy - PPA signed since December 2013 - The license production and sales is issued by the Department of Energy that is willing to support the promoter in all administrative procedures	- Make sure to start the operation of the plant on the shortest delays	- It is in the interest of all parties involved to initiate the project on the shortest delays possible

Table 14:Results of the consultations with national structures

c) Results of the consultations with local villages and populations

COMMUNE	VILLAGES
Merina Dakhar	Mbouky
	Ngass
	Tieumbeul
	Tibo

Table 15: List of concerted villages.

Results of the consultations with local villages are presented below:

Comments	Recommendations	Responses
- Compensation of owners of the lands concerned - What are the negative effects of the project? - Loss of agricultural land - Qualification of local population - Absence of communication from the commission regarding the land in some villages - Fear that compensation will only go to the land owners without considering the women who live from the picking of the wood forests and medicinal plants. - Respect of the environment - Local development impulse through the project - Mobility of the persons, goods, and people	- Priority to local population for employment - Support local development by promoting the access to water, education, health and electrification via solar kits - Create significant and sustainable agro-pastoral and forestry activities to restore incomes by the introduction of pilot farms, the improvement of poultry and forage - Support women empowerment by funding embroidery, pottery, basketry, agricultural and processing activities - Ensure capacity building through thematic workshops - Roads for the mobility of goods and persons. - Ensure permanent communication with the population of the villages - The CSR strategy might be realistic in order for the villages to benefit from its repercussion.	- Recruitment of local labor will be prioritized - A Corporate Social Responsibility (CSR) policy developed in consultation with the population has been organized in order to define the most important actions they would like to see put in place. It was agreed that the project proponent should build access roads, implement a drilling system and will ensure the electrification of the Mbouky village. - 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 project proponent will train the workers to the solar technology. As well the project proponent has agreed to put in place a capacity building process for the DEEC and CRSE on renewable energy. - Population have been involved at early stage of the project. Their concerns have been taken into account.

Table 16: 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.

Some parameters have enabled the project proponent to measure the "acceptability of the project. They are:

- The strong presence of populations including youth and women.
  The percentage of the presence of women is over 58%;
- The words used by people for interventions "the project is good; we want the project; the project will help etc.";
- The feeling of desolation populations whose fields are excluded from the area project. Some landowners have already proposed to have their field incorporated in the project area if the site was being extended.

On this basis we can conclude that the project was accepted and raises high hopes on the part of the different actors encountered during public consultations.

d) Local Stakeholder Consultation

On October 7th, 2016, a local stakeholder consultation was held at Hotel Residence Lat Dior, in the city of Thies at 10:00 am to present the social and environmental impacts of the project. This consultation was made in order to respect the process required for the registration of the project under the CDM and Gold Standard.

Organisation (if relevant)	Name of invitee	Questions	Responses
Head of Mbouky´s village	Mor Diakhaté	When would the cemetery be closed?	The closure of the cemeteries (Mbouky and Tibo) will begin with the start of the works of the plant.
Head of Ngass´s village	Abdou Seye	Magnifies the project. Ensure that the availability of Ngass youth is taken into account and integrate CSR activities with the village of Ngass	The project company will make its best to ensure that the CSR activities benefit the impacted people
Tieumbeul´s Village	Abdoulaye Ndiaye	Satisfied to have associated the village of Thieumbeul in the discussions. Village quite close to the site. Ensure that the impacts of the plant on the village are taken into account, even though the Thieumbeul populations have not lost land under this project. Associate the village of Thieumbeul in the activities of the plant. Take into account the passage of the connection line and identify the people that have been affected.	Once the route is established, the persons affected will be granted. This activity will be carried out by Senelec with the support of Ten Merina
Young of Tibo´s village	Moussa Wade	When is the start of CSR activities planned? (Cemetery fencing, electrification, road, etc.)	The start of these activities is imminent. Some activities will start with the construction phase of the plant. Others will be carried out throughout the lifetime of the plant.
Iman of Ngass	Abo Seye	Village quite close to the site. Ensure that the impacts of the plant on the village are taken into account, even if the Ngass populations have not lost land under this project. Associate the village of Ngass in the activities of the plant.	The project company will associate the village of Ngass with the activities planned under the project
Vice Mayor of Mérina Dakhar	Goumba Diop	Ensure that local labour is taken into account	Local employment will be promoted as stipulated in the Memorandum of Understanding. A prefectural commission will identify all candidates in a transparent manner.

Direction of Hydro	Baba Dieng	Contact the Hydraulics Division to discuss the hydro-geological aspects and also consider the realization of water supply.	This action is planned by the project proponent.
Prefet of Merina Dakhar	Ndiaty Bakhoum	Why is the meeting taking place in Thiès?	The meeting is organized in Thiès mainly for logistical reasons.
Mamour Sylla	Assistant to the Mayor	Project full of hope. Ensure compliance with the Memorandum of Understanding signed with the Mayor.	Compliance with the MOU is a priority for the project company.
Regional Development Agency (ARD)	Abdou Karim Sow	Congratulates the Mayor on the negotiations with the proponent. Many questions / contributions have been taken into account in the ESMP No major impact identified The impact on human rights can be considered void. Build a borehole AND support all-season farming process Negotiating to set up the headquarters of the company in the municipality of Merina Dakhar	The construction of a drilling and development of agricultural parcels for the development of intensive agriculture in all seasons is foreseen within the framework of the memorandum of understanding. Negotiating to set up the headquarters of the company in the municipality of Merina Dakhar this facility will be studied and validated for enforcement during the exploitation phase.
Cheikh Wagne	President of the Commission of Merina Dakhar	Congratulates the process. Does the project expect carbon credit financing to start work? What is the share of revenues from Carbon credits used locally? Do you plan a reforestation in the area of Merina Dakhar? Is there an annual spin-off for the local community? (Taxes and Patents) Is a market for Merina Dakhar still under discussion? Will the cemeteries next to the site be fenced? What are the planned activities for education at the local level?	 No, the financial closure is under process and will be provided by development banks. Revenues from carbon credits will be mainly given to the Senelec A reforestation program of the impacted area is under preparation with the forest service of Tivaouane. The project proponent will consider the possibility of implementing the company's head office in the community in order to benefit from local taxes and licenses. The contribution to the construction of the market of Mérina Ndakhar is one of the activities planned by the Project company. The fencing of the cemeteries (Mbouki and Tibo) is foreseen in the accompanying plan of the project company. It is planned to: - awarding merit scholarships - distributing school supplies - building classrooms
DRDR Thies	Daouda	What are the mitigation measures	The loss of agricultural land is

	Hann	planned for the loss of agricultural land? It is only compensation to be paid or is it provided for a livelihood restoration plan?	compensated for by a dual mechanism of compensating the impacted persons and restoring livelihoods.
Work Inspector	Alioune Fall	Welcomes the participatory approach. What type and number of jobs will be created (day laborer, worker, etc.)? In construction phase? In operating phase? Will the project comply with the regulations on the social care of workers?	The number will be defined later. Jobs, reserved primarily for the surrounding villages, will be created during construction and operation. Strict performance standards (labour regulations) will be imposed on society when it comes to working conditions

E.3. Consideration of comments received

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

SECTION F. Approval and authorization

The request for host country Letter of Approval (LoA) has been delivered on February 24th 2017.

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	TEN MÉRINA NDAKHAR SA
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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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Department	-
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Personal e-mail	a.lepage@area-group.fr

Appendix 2. Affirmation regarding public funding

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Appendix 3. Applicability of methodology and standardized baselines

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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 [m^3]			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		**1,657,917**	**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		1,823,709	1,893,752	2,901,192	3,119,326	3,236,531
Import [MWh]		257,243	290,317	308,492	318,070	435,498

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

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

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

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

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Appendix 6. Summary report of comments received from local stakeholders

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Appendix 7. Summary of post-registration changes

Permanent changes to the registered monitoring plan

- Update of situation, number, maintenance and testing and calibration frequency of MV electricity meters. The move of two electricity meters from the sub-station to the onsite 30-kV delivery point is due to a request of Senelec, the grid operator, to be in conformity with the power purchase agreement.
  Furthermore, the frequency of verification & calibration of the electronic meters indicated in the PDD is brought in line with the ACM0002, V.17, 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, which is the equivalent to "verification" in the national regulations, with "calibration") at stage of project validation.

No.	Changes	Impact	Sections of PDD revised
1	Update of situation, number, maintenance and testing and calibration 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[28]: i) the update only involves a change of the situation of the meter (towards the onsite delivery point) ii) the calibration requirements are revised as per ACM0002 V.17, and remain in accordance with requirements set by the meter supplier iii) the electricity meter will be subject to regular maintenance and testing as per ACM0002 V.17 and remain in accordance with national requirements. 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	Sections A.3, B 7.1, B.7.3

[28] 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. 20,768 tCO2e/223*365*0.02=679 tCO_2e.

No.	Changes	Impact	Sections of PDD revised
		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).
03.0	26 July 2006	EB 25, Annex 15

Version	*Date*	*Description*
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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