KAHONE SOLAR PV PLANT

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ENERGY RESOURCES SENEGAL SA

Document Prepared By AERA Group

Project Title	*Kahone solar PV plant*
Version	*1.0*
Date of Issue	*April 25th 2017*
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Table of Contents

1 PROJECT DETAILS

1.1 Summary Description of the Project

Kahone solar PV plant ("the project") consists of the construction and operation of a greenfield 21.228 MW solar photovoltaic power plant in Kahone (Kaolack region, Senegal) by ENERGY RESOURCES SENEGAL SA. It involves the setting up of photovoltaic (PV) panels which will capture solar energy and convey such energy to the converter station in order to produce electricity exported to the national grid.

Project activity's power exports off-taken by SENELEC (National Power utility of Senegal) therefore substitute grid electricity by clean and renewable energy, and cut down GHG emissions from baseline fossil fuel intensive grid mix (heavy fuel oil and diesel oil). Apart from emission reductions, the benefits of the project comprise, among others, improvement of energy self-sufficiency of the country, as well as creation of local employment[1].

Kahone Solar Plant (final construction phase)

The project will generate approximately 20,504 tCO_2e emission reductions per year (205,040 tCO_2e of emission reductions over the ten years crediting period).

It 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 [2].

1.2 Sectoral Scope and Project Type

The sectoral scope is Scope 1 – Energy Industries (renewable sources) – ACM0002: Large-scale Consolidated Methodology: Grid-connected electricity generation from renewable sources, Version 17.0.

The project is not a grouped project.

[1] 100 workers during construction and installation, and up to 10-15 workers for the operation, maintenance, monitoring and security;

[2] cf. « Plan Sénégal Emergent (PSE) » https://www.gouv.sn/IMG/pdf/PSE.pdf (2014)

1.3 Project Proponent

Organization name	ENERGY RESOURCES SENEGAL SA
Contact person	M. Moustapha SENE
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1.4 Other Entities Involved in the Project

Organization name	AERA Group
Role in the project	Consultant
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1.5 Project Start Date

01/07/2017, which is the date on which the solar PV power plant is expected to be connected to the grid and begin generating GHG emission reductions.

1.6 Project Crediting Period

The project crediting period starts on 01/07/2017 and lasts 10 years.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	x
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
01/07/2017 - 31/12/2017	10,252
2018	20,504

2019	20,504
2020	20,504
2021	20,504
2022	20,504
2023	20,504
2024	20,504
2025	20,504
2026	20,504
01/01/2027 – 30/06/2027	10,252
Total estimated ERs	205,040
Total number of crediting years	10
Average annual ERs	20,504

1.8 Description of the Project Activity

The proposed project consists of setting-up solar PV panels with an installed capacity of 21.228 MW to produce electricity onto the 30 kV triple-phase grid of SENELEC. The national grid in consequence will have to produce less electricity from heavy fuel oil, diesel and coal, which are non-renewable sources of energy. The energy production thus implies a substantial reduction in the production of carbon and its release in the atmosphere, thereby reducing the associated greenhouse impact upon the atmosphere.

The 77,112 solar PV modules to be installed have a capacity of 260W each and are of model SOLARWATT BLUE 60P manufactured by SOLARWORLD, featuring high-efficiency poly-crystalline silicium solar cells.

Based on the expected annual global solar radiation at the project location and the specifications of the solar PV system, estimated annual output is 36.55 GWh, corresponding to a load factor of 19.65% and representing the approximate consumption of 155,000 people.[3]

The solar facility consists of 9 intelligent inverters of make Helios Systems, type APS 1950. Moreover, power transformers of 0.330/30 kV are installed before evacuation of the electricity to the 30kV network.

The monitoring equipment is composed of two Itron bi-directional meters for import/export (Model SL7000), one of which is used for back-up, located at feed-in point.

The photovoltaic modules will be mounted on supporting structures in wood or steel arranged in rows. The supporting structures will be fixed in the ground.

The installation will be connected to the grid via the Kahone substation via a medium voltage 30 kV substation at 1km distance from the power plant.

The whole solar park will be surrounded by a fence and equipped with an intrusion detection security system.

The operation of the solar park does not require hard construction (apart from the technical and administrative premises that can be prefabricated in the factory and laid on site). Thus, the main elements of the solar power plant are:

[3] According the World Bank, individual electricity consumption has been 222 kWh/year in 2014; Cf. https://is.gd/39J8ao

- The photovoltaic generator;
- the inverter / transformers;
- connection cables;
- terrestrial network;
- meters;
- The delivery station;
- Annexes: security system, telephone line, lighting, fencing and road access.

All equipment is new.

The system will have a power of 21,228 kW and will be divided into two units of 10.65 MWp of power, divided into 5 subsystems of 2.13 MW.

Each 2.13 MWp subsystem consists of approximately 7740 polycrystalline photovoltaic modules of 250 W interconnected in series in groups of 20 by forming strings grouped in zone frames. The photovoltaic generator will consist of a field of about 77,400 crystalline photovoltaic modules.

Each subsystem will be connected to 2 inverters of 1000 kWp each, housed inside a special cabin with a 30 kV LV / MV transformer and MV isolation and protection devices. The interconnection between the 5 MT cabins of each 10.65 MWp will be via a ring connection between the 20 cabins and the main delivery cabin.

The two main cabins on delivery Senelec will also contain the energy meter through which it will be possible to calculate the energy injected into the system network.It is a set of works intended to convey the electricity produced or consumed by the photovoltaic power plant from the delivery station owned by the Photovoltaic Power Plant located at the boundary of the Energy resources Senegal to the Senelec power grid via the Kahone substation located 1 km from the site.

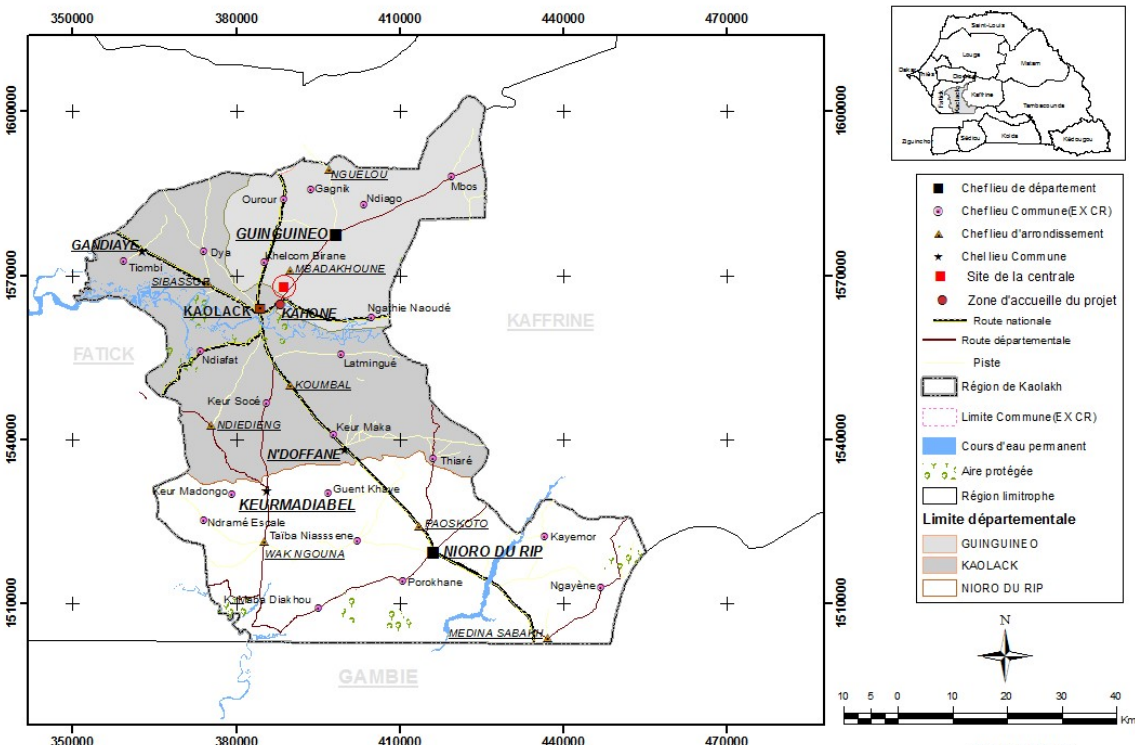
The connection will be made by two 30 kV buried electric power transmission lines.

1.9 Project Location

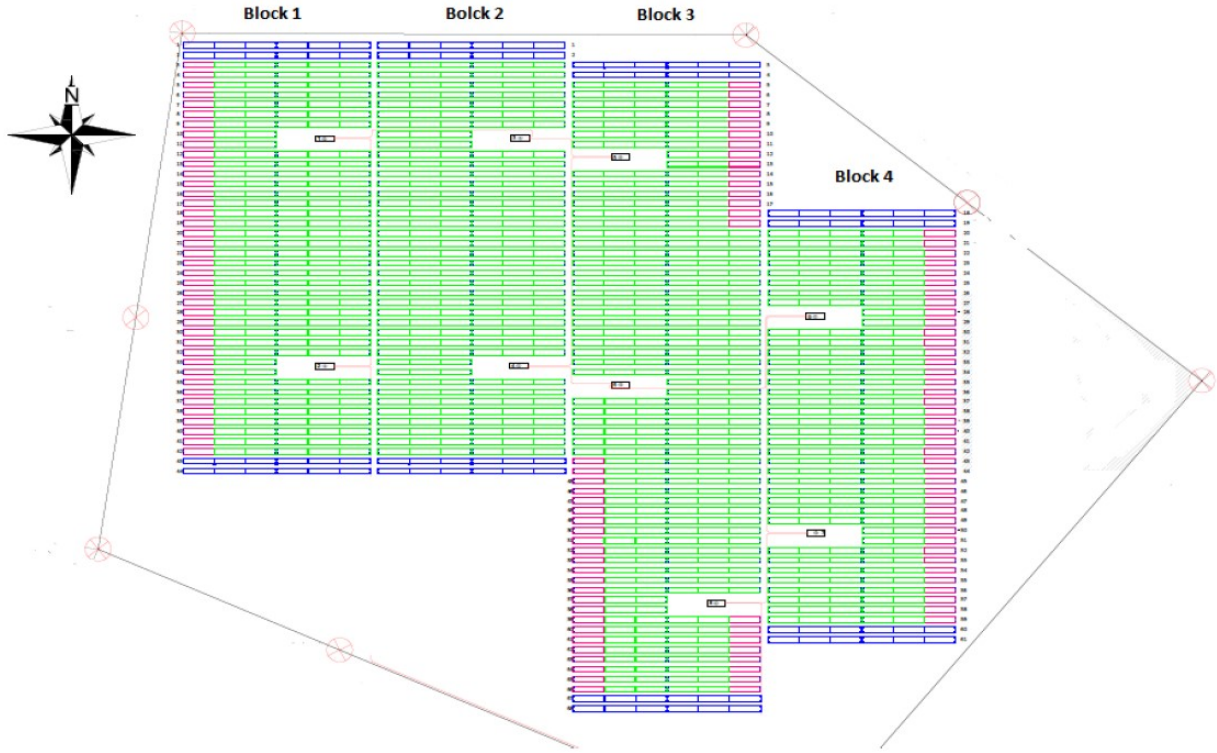
The project is located in Kahone on a 40ha plot of land about 5 km northeast of Kaolack town center, 4 km north of Mbadakhoune Commune, in the region of Kaolack, Senegal, next to the departmental road D611 linking Kahone to Guinguinéo..

Its geo-coordinates are: 14°10'43.81"N, 16°1'39.51"W

Kahone Solar Photovoltaic Power Plant, project location



Kahone Solar Photovoltaic Power Plant, project layout



1.10 Conditions Prior to Project Initiation

The project activity will generate emission reductions by avoiding CO_2 emissions from the same amount of electricity generation from the national grid, which is mainly composed of diesel and heavy fuel oil - based thermal power plants. The project activity is the installation of a new grid-connected renewable power plant. Therefore, according to ACM0002 methodology, the baseline scenario and condition prior to project initiation is the following: electricity delivered to the grid by the project activity that would have otherwise been generated by the operation of coal and fuel oil-based 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."

The project activity is generating electricity from solar energy for which GHG emission is nil. The generated electricity is supplied to the SENELEC grid thus the power generated in the project activity is actually displacing the electricity generated from the fossil fuels in the national grid. In case the project activity would not have been there, the same amount of electricity would have been generated from the power plants connected to the grid of which majority of the power plants are based on fossil fuels. Thus the project is replacing the anthropogenic emission from the fossil fuel based power plants connected to the national electricity grid.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

To date, there are no regulations and policies preventing the implementation of the project activity.

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 Senegal, the procedure for evaluating impact assessments is governed by Articles L 48 to L 54 of Chapter 5 of Law 2001 - 01 of 15 January 2001 on the Environment Code.

1.12 Ownership and Other Programs

1.12.1 Project Ownership

ENERGY RESOURCES SENEGAL SA

1.12.2 Emissions Trading Programs and Other Binding Limits

The project activity is not included in any emissions trading program or any other mechanism that includes GHG allowance trading.

1.12.3 Other Forms of Environmental Credit

The project has not sought or received another form of GHG-related environmental credits including renewable energy certificates.

1.12.4 Participation under Other GHG Programs

The project neither has nor intended to generate any other form of GHG related environmental credit for the GHG emission reduction or removal claimed under the VCS programme. Only once the project becomes registered under the CDM, its subsequent emission reductions will be verified and issued exclusively as either CERs or VERs.

1.12.5 Projects Rejected by Other GHG Programs

Not Applicable.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

The project activity is not a grouped project. Hence no eligibility criterion is applicable.

Leakage Management

As per approved methodology ACM0002 (Version 17.0), para. 60, no leakage is considered for the proposed project.

Commercially Sensitive Information

There is no information deemed as commercially sensitive for this project activity.

Sustainable Development

Besides emission reductions impacts and fuel cost savings, economic and social benefits to the local population include 105 jobs created since construction, among which 25 permanent positions for the operations and maintenance of the plant.

The project is directly aligned with the pillars of the national sustainable development strategy of Senegal:

- Lettre de Politique de Développement du Secteur de l'Energie
- Stratégie Nationale de Mise en Oeuvre de la CCNUCC et Rapport de Contribution Prévue Déterminée au Niveau National (CPDN)

Thanks to the support and adherence of all stakeholders, side projects such as 20ha cultivation will also be set up and open indirect jobs together with local infrastructures enhancement.

Further Information

The project participants obtained all necessary clearances; hence no legislative, economic, sectoral, social, environmental, geographic, site-specific risks are anticipated which may have impact on the eligibility of the project activity and the net GHG emission reductions.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

The approved baseline and monitoring methodology selected for to the proposed project activity is: ACM0002 version 17.0 - “Grid-connected electricity generation from renewable sources”

The methodology also refers to the latest approved versions of the following tools, which are applied by the project:

- “Tool to calculate the emission factor for an electricity system” (Version 5.0)
- “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period”

2.2 Applicability of Methodology

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

Table 2: Compliance of the project activity project activity regarding ACM0002 applicability conditions

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
The project activity is the construction and operation, capacity addition, rehabilitation (or refurbishment), retrofit or replacement of a 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, solar power 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	Not applicable as the proposed project activity involves a solar photovoltaic power plant

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

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”.

Table 3: Compliance of the project activity project activity regarding applicability conditions of "Tool to calculate the emission factor for an electricity system"

No	Applicability condition	Applicability to this project activity
1	This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	As part of ACM0002, "operating margin" (OM), "build margin" (BM) and "combined margin" (CM) need to be estimated to calculate baseline emissions of the project activity that substitutes electricity in the Senegalese grid. Hence the tool is applicable.
2	Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off - grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in "Appendix 2: Procedures related to off-grid power generation" should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	The emission factor for the project electricity system is calculated for grid power plants and off-grid power plants. Option IIb is applied, i.e. the tool is applicable.
3	In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	Since the project electricity system is not located partially or totally in an Annex I country - it is located in the Republic of Senegal - the tool is applicable.
4	Under this tool, the value applied to the CO_2 emission factor of biofuels is zero.	There are no biofuels used in the project activity, i.e. the tool is applicable.

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

2.3 Project Boundary

Table 4: GHG source, sinks and reservoirs in project and baseline scenarios

Source		Gas	Included?	Justification/Explanation
	CO_2 emissions from	CO_2	Yes	Main emission source

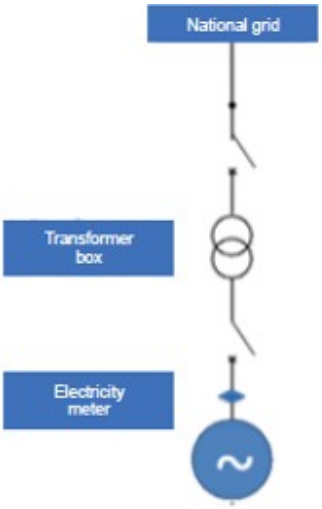
Source		Gas	Included?	Justification/Explanation
	electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CH_4	No	Minor emission source
		N_2O	No	Minor emission source
		Other	No	Minor emission source
Project	For geothermal power plants, (fugitive) emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam	CO_2	No	Not applicable (Only for geothermal)
		CH_4	No	Not applicable (Only for geothermal)
		N_2O	No	Not applicable
		Other	No	Not applicable
	For binary geothermal power plants, fugitive emissions of hydrocarbons such as n-butane and isopentane (working fluid) contained in the heat exchangers	Low GWP hydro-carbon/ refrigerant	No	Not applicable (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	Not applicable (Only for solar thermal power plants and geothermal power plants)
		CH_4	No	Not applicable
		N_2O	No	Not applicable
		Other	No	Not applicable
	For hydro power plants, emissions of CH4 from the reservoir.	CO_2	No	Not applicable (Only for hydro)
		CH_4	No	Not applicable
		N_2O	No	Not applicable
		Other	No	Not applicable

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 3: Diagram of the project boundary



2.4 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 3.1.

2.5 Additionality

According to ACM0002 Version 17, the simplified procedure to demonstrate additionality is applicable to five grid connected electricity generation technologies (positive list[4]), including solar photovoltaic technologies. A specific technology in the positive list is defined as automatically additional if at the time of PD submission[5] any of the following conditions is met:

(a) The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country is equal to or less than two per cent;

or

(b) The total installed capacity of the technology in the host country is less than or equal to 50 MW.

According to Senelec data and official governmental communication, there are only two grid connected solar PV power plants in Senegal, namely the 2 MW CICAD solar PV power plant and

[4] Valid until 27 November 2017.
[5] For registration of the project activity.

the grid-connected Solar PV project in Bokhol with a capacity of 20.03 MW. Consequently, there is less than 50 MW of installed grid-connected solar PV power plant capacity in Senegal. Thus, the project thus meets the conditions for automatic additionality.

2.6 Methodology Deviations

Not applicable.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 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:

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

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 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" (t CO_2/MWh)

Calculation of $EG_{PJ,y}$

Since the project activity consists of the installation of new grid-connected renewable power plant at a site where no renewable power plant was operated prior to the implementation of the project activity, the project activity is the installation of a greenfield renewable energy power plant, so that:

$$EG_{PJ,y} = EG_{facility,y}$$

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 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)

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

Based on Standardized Baseline ASB0034 Grid emission factor for West African Power v1.0, the applicable grid emission factor value to calculate the emission reductions of the PV power plant project is 0.561 tCO_2/MWh.

3.2 Project Emissions

Project emissions are calculated as follows:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

Where:

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

$PE_{FF,y}$, $PE_{GP,y}$ and $PE_{HP,y}$ are equal to 0 as the project is an installation of a solar power plant with no auxiliary fossil fuel consumption. In particular, ACM0002 §37 stipulates that for all renewable energy power generation project activities, emissions due to the use of fossil fuels for the backup generator can be neglected.

3.3 Leakage

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.

3.4 Net GHG Emission Reductions and Removals

According to the approved methodology ACM0002 ver.17.0, emission reductions are calculated as follows:

$$\mathbf{ER_y = BE_y - PE_y}$$

Where:

$\mathbf{ER_y}$	= Emission reductions in year y (t CO_2e)
$\mathbf{BE_y}$	= Baseline emissions in year y (t CO_2)
$\mathbf{PE_y}$	= Project emissions in year y (t CO_2e)

Table 8: Calculation of emission reductions

	Value/Result	Source/reference

Total installed capacity	21.228 MW	Project documents[6]
Net electricity delivered to the grid ($EG_{PJ,y}$)	36,550 MWh/yr	Project documents (nominal average) $[EG_{PJ,y} = EG_{facility,y}]$
Grid emission factor ($EF_{grid,CM,y}$)	0.561 tCO_2e/MWh	ASB0034 Standardized baseline
Baseline emissions (BE_y)	20,504 tCO_2e	Section 3.1 $BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}$
Project emissions (PE_y)	0 tCO_2e	Section 3.2
Emission reductions (ER_y)	20,504 tCO_2e	$ER_y = BE_y – PE_y$

Table 9: Summary of emission reductions

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
01/07/2017 - 31/12/2017	10,252	-	-	10,252
2018	20,504	-	-	20,504
2019	20,504	-	-	20,504
2020	20,504	-	-	20,504
2021	20,504	-	-	20,504
2022	20,504	-	-	20,504
2023	20,504	-	-	20,504
2024	20,504	-	-	20,504
2025	20,504	-	-	20,504
2026	20,504	-	-	20,504
01/01/2027 – 30/06/2027	10,252	-	-	10,252
Total	205,040	-	-	205,040

[6] Provisions are being made for a capacity extension of the same site up to 44MW or 66MW in the future.

4 MONITORING

4.1 Data and Parameters Available at Validation

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	ASB0034 Standardized baseline
Value applied:	0.561
Justification of choice of data or description of measurement methods and procedures applied	As per the "Tool to calculate the emission factor for an electricity system"
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$EF_{grid,OM,y}$
Data unit	tCO2/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	ASB0034 Standardized baseline
Value applied:	0.559
Justification of choice of data or description of measurement methods and procedures applied	As per the "Tool to calculate the emission factor for an electricity system"
Purpose of Data	Calculation of baseline emissions
Comments	-

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 applied:	0.565
Justification of choice of data or description of	As per the "Tool to calculate the emission factor for an electricity system"

measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions
Comments	-

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 the solar PV in the total installed grid connected power generation capacity in the host country.
Source of data	Senelec data and governmental communications
Value applied:	0.05%[7]
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Additionality demonstration
Comments	-

Data / Parameter	The total installed capacity of solar PV
Data unit	MW
Description	The total installed capacity of the solar PV in the host country.
Source of data	Senelec data and governmental communications
Value applied:	44.03 MW (at the time of PDD submission for registration)
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Additionality demonstration
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$
Data unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant/unit to

[7] 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)

	the grid in year y
Source of data	Measured directly with electricity meter(s) at project site.
Description of measurement methods and procedures to be applied	Electricity outputs will be electronically stored and invoiced monthly to Senelec by Project implementer, after reconciliation with internal meter which readings are recorded on a record sheet by the Technical/Engineering/ Maintenance Department under the Plant Manager's authority
Frequency of monitoring/recordin g	Continuous measurement and at least monthly recording
Value applied:	36,550
Monitoring equipment	Bi-directional electronic electricity meters measuring the net electrical energy delivered to Senelec with the following specifications: Make: Itron Model: SL7000 Accuracy class: 0.2S (±0.02%) Country of origin: France SN: #
QA/QC procedures to be applied	Cross check of measurement results with records for sold electricity. Calibration of the meters will be carried out after each deviation of more than +- 0.5% but at least annually, as per manufacturer & PPA specifications.
Purpose of data	Calculation of baseline emissions
Calculation method	Electronic recording
Comments	-

4.3 Monitoring Plan

The proposed project activity 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 calibrated electricity meters and cross-checked with sales records as per internal monitoring practices.

Monitoring team and training

Data collection, consolidation and results analysis will be undertaken by a dedicated team adequately trained, well aware of VCS 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.

5 SAFEGUARDS

5.1 No Net Harm

The development of the project will inevitably result in environmental and social impacts, both positive and negative. The ESIA concludes that "the project will have a major positive impact on national electricity generation. Likewise, the communities will feel the economic benefits through the payment of taxes and the use of local labour." A "group for the phase of operation" under the leadership of the Governor of the Kaolack Region will assess any losses due to negative project impact, reconcile interests between the project and local people as well as ensure the fulfilment of the commitments made in a Memorandum of Understanding. An Environmental and Social Management Plan, will take account of the envisaged mitigation and compensation measures and require the involvement of all stakeholders.[8]

The project received an environmental approval ("certificat d'autorisation ») on xxx.

The following table presents a summary of the negative impact of the project and corresponding mitigation measures/recommendations, as identified in the Environmental and Social Impact Assessment (ESIA) carried out by the local company EES.

Table 1: Summary of negative project impact and envisaged mitigation/compensation measures[9]

		Negative impact	Mitigation/compensation measure
ENVIRONMENT	*Construction phase*	Surface water: Risks of water erosion and degradation of runoff from rainwater.	• carry out rigorous geotechnical and hydro geological studies; • manage construction waste rationally; • repair any drainage networks damaged; • preserve the natural flow of surface water in the ground works; • install pipes for runoff;
		Underground water: Accidental pollution	• carry out rigorous geotechnical and hydro geological studies; • manage construction waste rationally; • limit spills/leaks with the provision of anti-pollution kits and respective training
		Risk of water shortage for local population due to demand by workers	• use good water tanks to prevent water leakage; • rational watering of runways; • raise worker awareness of rational water use;
		Negative impact on fauna due to land-clearing and excavation work, including loss of habitats, mortality, wildlife disturbance, and fragmentation of environmental spheres;	• delineate constructions site; • develop green corridors; • reduce noisy work; • limit speeds on newly built access roads; • conduct off-site inspections and maintenance at an appropriate location.
		Vegetation loss due to land clearing	• establish an application for land- clearing; • close site with fast-growing species; • revegetate soils with shredded vegetation. • establish buffer zones between project and adjacent

[8] P. 248, ESIA (free and unofficial translation from French).

[9] Only negative impact of "medium" or "high" significance mentioned

			agricultural areas; • implement compensation measures
	Operation phase	Accidental pollution of soils and underground water	• contain power transformer; • raise awareness among staff about measures to be taken in the event of accidental pollution; • place oil absorbents next to transformers; • avoid maintenance work during rainy season; • limit spills and accidental leaks • inform and train workers in implementation of waste management programs;
		Accidental pollution and disturbance of surface water runoff	• avoid maintenance work during rainy season; • inform and train workers in the implementation of waste management programs; • provide anti-pollution kits during maintenance.
		Negative impact on fauna and flora due to invading exogenous species, noise, wildlife disturbance, barrier effect;	• maintain vegetation by full clearing or regular mowing; • minimize light sources and light reflection; • combat invasion of exotic species to site; • reduce engine noise through regular technical maintenance and visits.
SOCIAL	*Construction phase*	Land loss for owners of project land	• compensate fairly affected land owners; • comply with the Memorandum of Understanding/Protocol • promote positive discrimination of affected people (e.g. in recruitment)
		Loss of grasslands due to land clearing	• put in place anti-erosion measures; • develop reforestation plan; • establish bypasses for the livestock;
		Noise and waste	• minimize noisy night work; • use equipment and tools with low noise level; • carry out timely maintenance of tools etc; • limit use of very noisy equipment; • do not dispose waste or sewage in nature; • collect, sort, transport waste to official landfills; • raise awareness about waste management; • empty regularly septic tanks by accredited body and monitor disposal;
		Alteration of landscape	• level surfaces; • establish green shields; • dismantle and transfer off-site all unnecessary equipment and materials;
		Road traffic and disturbance of adjacent communities	• coordinate with authorities prior to start of activities; • plan arrival of heavy equipment; • inform stakeholders about risks; • limit speed to 30km/h on roads to the site.
	Operation phase	Alteration of landscape and waste	• do not dispose waste or sewage in nature; • collect, sort, transport waste to official landfills; • raise awareness about waste management; • empty regularly septic tanks by accredited body and monitor disposal;
		Hygiene/Health/Security: • optical effects/reflection; • electric and magnetic fields;	• set up hedges around the site • install electrical equipment in technical premises with thick walls;

		• noise pollution; • soil pollution through hydrocarbons and panel wash water.	• ground all equipment; • install mufflers in ventilation ducts; • establish effective on-site hydrocarbon management procedures; • provisions for access of emergency services; • establish on-site water reserves (for the control of possible fires.

5.2 Environmental Impact

The above-mentioned ESIA, edited in January 2017, consists of eight main chapters: Apart from providing a general project description (chapter 2), its political, legal and institutional framework (chapter 3), description of the environmental-social situation before project implementation (chapter 4) and stakeholder consultation process (chapter 5), as well as an analysis of project alternatives (chapter 6), the ESIA identifies the positive and negative project impacts on the biophysical and human environment and proposes measures to mitigate the potential negative effects and maximize positive ones (chapter 7). The chapter is followed by a danger analysis, which evaluates the risks in case of accidents and potential security measures (chapter 8) as well as an Environmental and Social Management Plan (ESMP) (chapter 9), which aims at the correct and timely realization of all measures to mitigate negative impacts and to maximize positive impacts.

Legal basis of ESIA

In Senegal, the procedure for evaluating environmental impacts is governed by Articles L 48-L 54 of Chapter 5 of Law 2001-01 of 15 January 2001 relating to the Environmental Code.[10] The objective of the ESIA is to comply with these regulations and ensure that environmental and social aspects are taken into account in decisions concerning the project. After submission of the ESIA to the Senegalese Environmental Ministry, it has issued an approval ("certificat d'autorisation ») as per Article L 49 of the law.

Methodology of ESIA

The methodology for assessing the potential impacts of the project was carried out by a group of local environmental and social assessment specialists.

The approach used to conduct the ESIA was basically guided by the requirements of the Senegal Environmental Code. It also took into account the regulatory requirements expressed in sectoral codes. Where necessary, databases and recommendations from the World Bank and IFC were used.

The ESIA consists of four steps: launch of study- workshop, on-site visit, edition of preliminary report, final report.

Identification and evaluation of environmental and social impact

Please see section 5.1 for a summary of environmental impact.

Environmental and Social Management Plan

[10] http://www.droit-afrique.com/upload/doc/senegal/Senegal-Code-2001-environnement.pdf

The Environmental and Social Management Plan (ESMP) is composed of the recommendations and measures to reduce or optimize the impacts, as partly outlined in section 5.1. The ESMP includes a budget and responsibilities for monitoring and implementing measures proposed by the ESIA.

Conclusion

The ESIA concludes that "the project will have a major positive impact on national electricity generation. Likewise, the communities will feel the economic benefits through the payment of taxes and the use of local labour." A "group for the phase of operation" under the leadership of the Governor of the Kaolack Region will assess any losses due to negative project impact, reconcile interests between the project and local people as well as ensure the fulfilment of the commitments made in a Memorandum of Understanding. Implementation of an Environmental and Social Management Plan is part of the negative impact mitigation and will require the involvement of all stakeholders. Finally, it is the development project is considered be "in line with Senegal's energy policy, which relies on the energy mix through the promotion of renewable energies such as solar energy."[11]

5.3 Local Stakeholder Consultation

The local stakeholder consultation took place on 07/03/2017 in the context of the ESIA process. The objective of the consultation as part of the ESIA is specified in article 1 of ministerial order no. 9468MJEHP-DECC of 28 November 2001 regulating public participation in the Environmental Impact Assessment. According to the order, the consultation shall ensure social acceptability of the project by all stakeholders. It can be also considered a relevant tool for measuring social impact of the project.

Method of engagement

The methodology of stakeholder consultation is based on meeting with local populations, families affected, administrative authorities, public technical services and local representatives of the populations. In general, the engagement of all stakeholders involved two phases, namely identification of actors concerned (including characteristics and sensitivities) and transmission of the agenda and programme of consultations with shareholders at least one week prior to consultations as well as short a project information note one week or ten days prior to consultation.

To better inform and sensitize people about the project, public meetings were held in all the districts of Kahone.


Meeting with population in Kanda Fodé bayo 1 et 2 (left) and Kahone city council (right)

[11] P. 248, ESIA (free and unofficial translation from French).

Outcomes
The questions discussed during the meetings revolved around the following issues:
- Loss of rainfed crop land;
- Use of local labor;
- Transparency in job offers;
- Involvement of administrative authorities in all project activities;
- Damage to crops in case of construction work during winter times;
- Proximity of the site to the subdivisions of the Cité (Senelec, SDE and SONATEL), West African Oil tanks and USSEIN site, including future subdivision areas;
- Loss of flora and fauna;
- Loss of pasture land;
- Compliance with regulatory safety distance, knowing that the WAO oil mill is located within 100m of the site;
- Low level of knowledge of solar technology in the region.

To solve the above issues, stakeholders made the following recommendations:
- Prioritize affected families in recruitment;
- Provide solar kits to affected people;
- Respect all commitments made to the town administration;
- Use local workforce with equal competence
- Sensitize and inform the local people on project issues
- Compensate affected people for crops damage;
- Take local people concerns into account in the ESMP;
- Install surge arresters on site;
- Develop traffic plan and make fire hydrant available;
- Develop a Internal Operation Plan;
- Compensate of affected people in a fair and equitable manner;
- Plant hedgerows with high thorny species;
- Compensate lost vegetation.

5.4 Public Comments

Public commenting phase under VCS has been from ... to.. and no comments have been received.