Project design document form for CDM project activities

(Version 08.0)

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	La Ferme – Bambous 15 MW solar power farm
Version number of the PDD	1.2
Completion date of the PDD	13/10/2016
Project participant(s)	SARAKO PVP Co. Ltd
Host Party	Mauritius
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	Methodology : ACM0002 - Grid-connected electricity generation from renewable sources - Version 16.0 ASB0019: Grid emission factor of Mauritius – Version 01.0
Sectoral scope(s) linked to the applied methodology(ies)	Sectoral Scope : 1 - Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	21,878 tCO_2e/year

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

La Ferme - Bambous Solar Photovoltaic Power Plant ("the project") consists of the construction and operation of a greenfield 15.2 MW solar photovoltaic power plant in Eau Bonne, Bambous (Mauritius). It involves the setting up of photovoltaic (PV) panels which will capture solar energy and convey such energy to the convertor station in order to produce electricity exported to the national grid. Electricity in Mauritius is mainly generated from coal and heavy fuel oil[1], which is the baseline scenario and can also be considered as the scenario prior to the implementation of the project activity leading to considerable greenhouse gas (GHG) emissions. The project activity undertaken by project promoter SARAKO PVP Co. Ltd ("SARAKO") will therefore substitute grid electricity by clean and renewable energy, and cut down GHG emissions.

La Ferme - Bambous Solar Photovoltaic Power Plant, aerial view

The project[2] is the first large-scale solar PV power plants on the island and generate approximately 21,878 tCO_2e emission reductions per year and 218,780 tCO_2e of emission reductions over the ten years crediting period.

The project promoter is SARAKO PVP Co. Ltd, which is a private Company duly incorporated in Mauritius and owned by local investors as well as Tauber Solar (Mauritius) Ltd, a subsidiary of The TAUBER-SOLAR Group based in Germany. The latter finances and operates major solar power plants on rooftops and in open spaces on a global scale.

Sustainable Development

The project participants are confident that the proposed project activity will make significant impact on Mauritius sustainable development.

Greenhouse Gas emissions reduction
The project will generate electricity from a renewable and clean energy source, thus avoiding the dispatch of the same amount of electricity produced by fossil-fuelled power plants to Mauritius grid. Besides, the SOx emissions from coal-fired power plants would also be reduced.

Development of renewable energy
The project will promote and stimulate the commercialisation of grid-connected renewable energy technologies in Mauritius, in line with the Government's renewable energy policy. Adopted in 2011, the vision of Maurice Ile Durable (MID) targets a 35% share of total energy needs to be fulfilled with renewable energies by 2025.[3]

Energy security
The project will improve energy self-sufficiency of the country which is currently heavily reliant on imported fossil fuels (above 80% according to the governmental Digest of Energy and Water statistics (Ministry of Finance and Economic Empowerment, 2013), alleviating the associated risks of price variations.

[1] Cf. Statistics Mauritius (2014): Digest of Water and Energy Statistics – 2013. Port Louis.
[2] It is confirmed that the proposed CDM project activity is not a CPA that has been excluded from a registered CDM PoA as a result of erroneous inclusion of CPAs.
[3] https://sustainabledevelopment.un.org/content/documents/4074durable.pdf

Employment opportunities
The project will contribute to the local employment throughout its building and operation phases, creating opportunities for local construction workers (300 jobs) and operation and maintenance technicians (approximately 10 jobs for 20 years).[4] It will also induce indirect employment by increasing the competitiveness of local industry from reducing the country's dependency on fossil fuels.

Therefore, Mauritius Government is supportive of the project because the development of solar PV power is in accordance with the national criteria for sustainable development and national policies relating to energy resources and the environment, which will push forward the use of renewable and clean energy across the country.

Technology transfer
This type of renewable energy project will assist building capacities in the country, through advanced technology transfer from industrialized countries. The project will introduce solar PV technology, methods and skills in Mauritius and demonstrate its applicability and efficiency, thus widening its accessibility. The technology is manufactured by Tianwei New Energy Holdings Co., Ltd. in China. The technology for large scale solar PV power generation is still at starting stage of consideration in the country. It will be the first-of-its-kind initiative within the region as:
• To date, no similar technology of this size is operated on the island (only small/micro-scale solar PV panels for a total of 2.4 MW);
• No similar solar PV farm is under construction in the country;

Duplication potential
The project will set an example and CDM reference for local stakeholders who expect to implement similar technologies on the territory and in the Indian Ocean vicinities.

A.2. Location of project activity

A.2.1. Host Party
Mauritius

A.2.2. Region/State/Province

The project is located on a 337,668 m^2 plot of land forming part of the State Land Saint Pierre and the State Land La Ferme at Eau Bonne, Bambous, Mauritius.

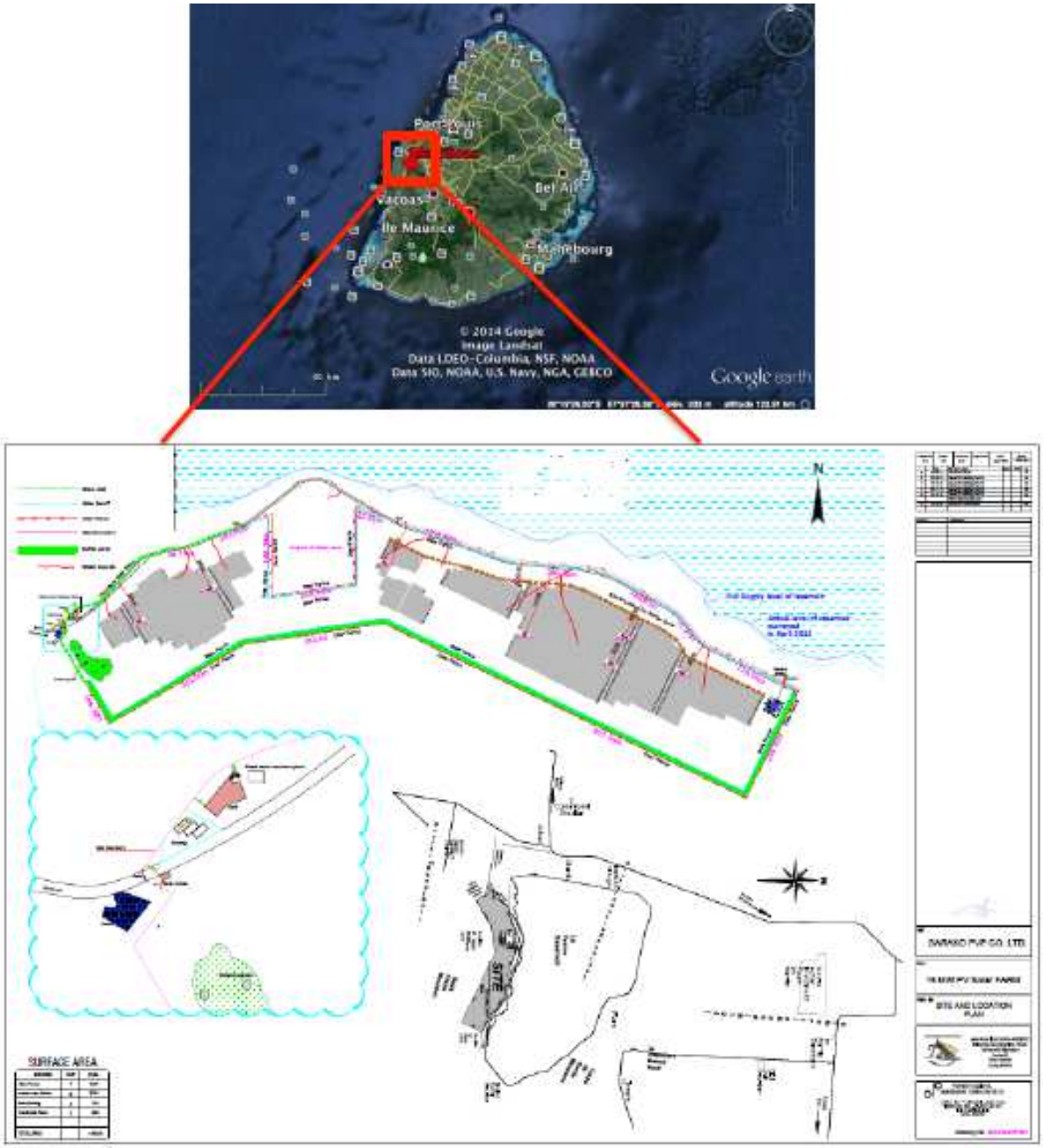
A.2.3. City/Town/Community

The site is bounded as follows:
- Towards the North: By La Ferme Reservoir
- Towards the East: By the surplus of State Land and Hydro Power Station
- Towards the South: By surplus of State Land - Saint Pierre Mountain
- Towards the West: By the village of Bambous

A.2.4. Physical/Geographical location
The project geo-coordinates are: latitude -20.3708, longitude 57.3948.

[4] 300 workers during construction, installation and operation and 20 workers for the maintenance, monitoring, security and management; cf. http://www.sarako.mu/fr/details-114/alias/solarpark-mauritius-bambous.html

Figure 1: Localisation of project site on Google earth



A.3. Technologies and/or measures

The proposed project consists of setting-up 60,800 solar PV panels with an installed capacity of 15.2 MWc to produce electricity which is exported to the grid of the Central Electricity Board (CEB). The CEB in consequence will have to produce less electricity from coal or heavy fuel oil, which are non-renewable sources of energy. The energy production strategy 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 project will transfer solar PV technology, methods and skills to Mauritius and demonstrate its applicability and efficiency, thus widening its accessibility. The technology is manufactured by Tianwei New Energy Holdings Co., Ltd. in China. The technology for large scale solar PV power generation is still at starting stage of consideration in the country.

The PV modules installed are new and of make TW250P660 from Tianwei New Energy Holdings Co., Ltd. (TWNE), an affiliate of China South Industries Group Corporation (CSGC). They are of high-efficiency, poly-crystalline silicon solar cells with high transmission and tempered glass, which results in module efficiency of

up to 15.4%. According to the manufacturer's warranty, the average annual power output degradation of the module shall not exceed 0.7% per year, ending with 83% at the end of the 25th year[5], i.e. implying a life expectancy for at least this duration.[6] For the Balance of System components, including inverters, average lifetime is estimated at 10-15 years.[7]

Based on a mean annual global solar radiation of 18.76 MJ/m^2 on West Mauritius[8] and the specifications of the solar PV system, nominal annual output is 29.0 GWh, whereas net annual output is expected at 24 GWh (minus yearly technical degradation of 0,8%, resulting in an average of 22,648 MWh/y over the 10-year crediting period) as provided to banks and/or equity financiers in the financial model, corresponding to a plant load factor of 18.26%. The difference can be attributed to, among others, inverter losses, temperature losses, shadings, cables, weak radiation, and dust. The share of electricity imported to run the solar power plant (power house, visitor centre, etc.) amounts to 4.6% of the actual annual output.

In the solar photovoltaic power plant, 25 modules are connected to form a string having an output power of 6.25 kWp. There are 2,432 strings in the facility. Up to a maximum of 21 strings are collected together to form an array and there are 114 arrays in the facility.

Table 1: Characteristics of Solar PV Modules[9]

Electrical Characteristics		**Mechanical specifications**	
Maximum Power (Pmax)	250 W	Dimensions	1,640×992×40 mm
Maximum Power Voltage (Vmp)	30.5	Weight	19.5 kg
Maximum Power Current (Imp)	8.2	Max. static load, front (snow & wind)	5,400 Pa
Open Circuit Voltage (Voc)	37.8	Max. static load, back (wind)	2,400 Pa
Short Circuit Current (Isc)	8.85	Max. hailstone impact (diameter/velocity)	25 mm / 23 m/s
Encapsulated Cell Efficiency (%)	17.3		
Module Efficiency (%)	15.4		
Power Tolerance (W)	0~5		
Maximum Series Fuse Rating (A)	15		
Maximum System Voltage (TUV)	DC 1000 V		
Normal Operating Cell Temperature (°C)	45±3		

The solar facility consists of 17 Inverter Units, 6 units of 630 kVA, 2 units of 750 kVA and 9 units of 1,000 kVA, of make ABB AG. Moreover, 13 transformers of 400/22 kV are installed in the inverter substations.

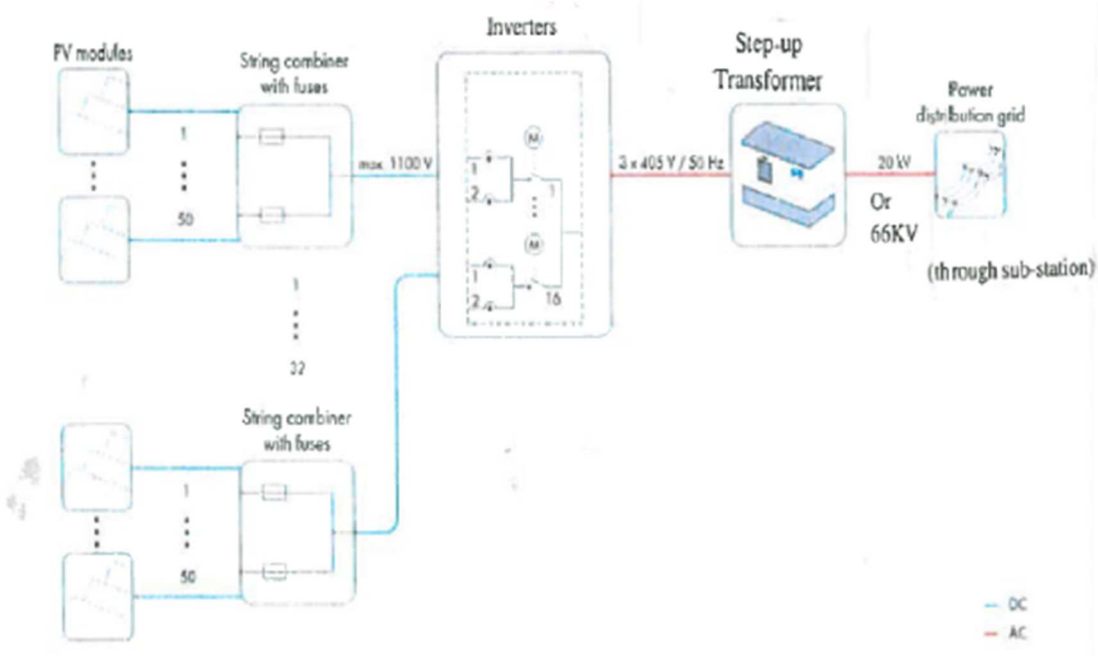
All 22 kV output from the inverter substations are connected through underground cables to the Seller's Substation whereby the power is stepped up to 66 kV through a power transformer.

The auxiliary power is supplied from the 22 kV bar at the seller's substation. The stepped power at 66 kV is then exported to CEB's La Chaumiere's Substation through approximately 4.5 km of overhead transmission line.

[5] A warranty of 10 years is provided on workmanship and material.
[6] http://www.dreamenergies.com/wp-content/uploads/2014/07/TWxxxP6601.pdf
[7] cf. Mason et al. 2006: Energy Pay-Back and Life Cycle CO_2 Emissions of the BOS in an Optimized 3.5 MW PV Installation in: Progress in Photovoltaics Research and Applications, 14:179-190.
[8] http://unfccc.int/resource/docs/natc/musnc2.pdf, Table 1.2
[9] http://www.dreamenergies.com/wp-content/uploads/2014/07/TWxxxP6601.pdf

The figure below provides an overview of full solar PV system. The engineering, procurement and construction contractor for the project was Germany's Conecon GmbH. All installed technologies, systems and equipment are new.

Figure 3: Solar PV System - From PV modules to grid connection



The monitoring equipment is composed of two EDMI kWh meters for import/export (Model MK6E)[10], one of which is used for back-up, located at CEB sub-station La Chaumiere. Both meters passed successfully accuracy and dial/register tests at the CEB's meter laboratory at Rose Hill (Mauritius) on 7 February 2014. From the results, it was concluded that the accuracy of the meters was within standard (i.e. ±0.2%). The meters were thus installed on 7 February 2014 and commissioned the day after having successfully performed an injection test.

Additionnally, PowerLogic® ION8600 meters[11] are installed within Sarako solar farm premises for internal use and cross-check.

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Mauritius (host)	SARAKO PVP Co. Ltd. (private entity)	No

A.5. Public funding of project activity

No public funding is involved - according to the OECD definitions for Official Development Assistance (ODA).

[10] http://www.edmi-meters.com/Image.ashx?MltPDF=RQBEAE0ASQA4ADkARQBEAE0ASQA=
[11] http://www.chipkin.com/files/liz/PowerLogic%20ION%208600%20Gain%20Energy%20112008.pdf

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

The approved baseline and monitoring methodology selected for to the proposed project activity is: ACM0002 version 16.0 - "Large –scale Consolidated Methodology: Grid-connected electricity generation from renewable sources"

Cf. https://cdm.unfccc.int/methodologies/DB/EY2CL7RTEHRC9V6YQHLAR6MJ6VEU83

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

The applied standardized baseline is: ASB0019 "Standardized baseline: Grid emission factor of Mauritius" (Version 01.0)

B.2. Applicability of methodology and standardized baseline

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 16 applicability conditions	Project activity applicability
This methodology is applicable to grid-connected renewable energy power generation project activities that: a) Install a Greenfield power plant; (b) Involve a capacity addition to (an) existing plant(s); (c) Involve a retrofit of (an) existing operating plants/units; (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s)/unit(s).	The project activity is a greenfield solar photovoltaic power plant substituting electricity produced on the grid by renewable energy.
The project activity 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:	Not applicable as the proposed project activity involves a solar photovoltaic power plant.

(a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or (b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density calculated using equation (3) of the methodology ACM0002, is greater than 4 W/m^2; or (c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3) of the methodology ACM0002, is greater than 4 W/m^2; or (d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3) of the methodology ACM0002, is lower than or equal to 4 W/m^2, all of the following conditions shall apply: - The power density calculated using the total installed capacity of the integrated project, as per equation (4) of the methodology ACM0002, is greater than 4 W/m^2; - Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; - Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m^2 shall be: a.) Lower than or equal to 15 MW; and b.) Less than 10 per cent of the total installed capacity of integrated hydro power project.	
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	The project activity does not involve capacity additions, retrofits, rehabilitations or replacements.

implementation of the project activity and undertaking business as usual maintenance".	
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 16.0 "Grid connected electricity generation from renewable sources".

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

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).	The project activity substitutes grid electricity by supplying renewable power to grid. Hence the tool is applicable.
2	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, the tool is applicable.

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

The Clean development mechanism (CDM) project activity also meets the following applicability conditions of the Approved Standardized Baseline ASB0019 – Grid emission factor of Mauritius, which applies the "Tool to calculate the emission factor for an electricity system" (valid until January 6, 2019).

Table 4: 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	The project activity is implemented in Mauritius and is connected to the project electricity system.	As the power purchase agreement between the project participant and the CEB reveals, the project activity is implemented in Mauritius and is connected to the project electricity system.
2	The CDM approved methodology that is applied to the project activity requires the determination of CO_2 emission factor(s) through the application of the "Tool to calculate the emission factor for an electricity system"	ACM0002 Version 16.0 does require the determination of CO_2 emission factor(s) through the application of the "Tool to calculate the emission factor for an electricity system" as para. 46 of ACM0002, Version 16 states.
3	The project activity uses ex ante option for the grid emission factor as indicated in the tool i.e. no monitoring and recalculation of the emissions factor during the crediting period is required.	The project participant choses to use ex-ante option for the grid emission factor.

B.3. Project boundary

Table 5: GHG source, sinks and reservoirs in project and baseline scenarios

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

	Source	Gas	Included?	Justification/Explanation
	CO_2 emissions from 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	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 CSP)
		CH_4	No	Not applicable (Only for CSP)
		N_2O	No	Not applicable
		Other	No	Not applicable
	For hydro power plants, emissions of CH_4 from the reservoir.	CO_2	No	Not applicable
		CH_4	No	Not applicable (Only for specific hydro)
		N_2O	No	Not applicable
		Other	No	Not applicable
	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 specific geothermal)
		CH_4	No	Not applicable (Only for specific geothermal)
		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 Mauritius grid that the power plant is connected to.

Figure 3: Diagram of the project boundary

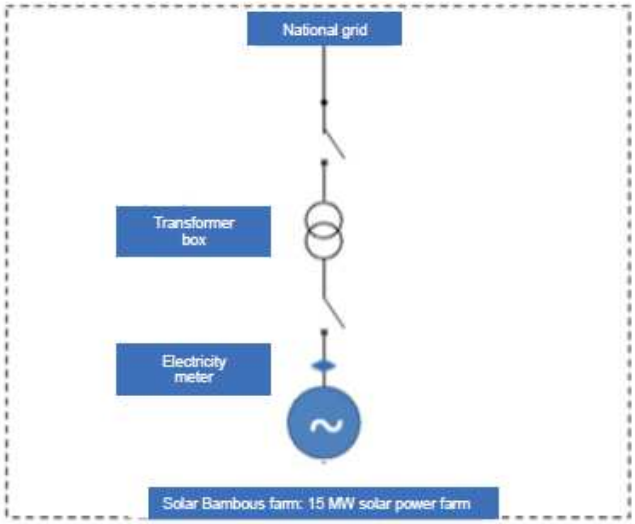


Figure 4: Physical map of the project boundary

B.4. Establishment and description of baseline scenario

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

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

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as described in section 3.1.

B.5. Demonstration of additionality

Specify the methodology or standardized baseline that establish automatic additionality for the proposed project activity (including the version number and the specific paragraph, if applicable).	According to ACM0002 Version 16 §30, the simplified procedure to demonstrate additionality is applicable to five grid connected electricity generation technologies (positive list[12]), including solar photovoltaic technologies.
Describe how the proposed project activity meets the criteria for automatic additionality in the relevant methodology or standardized baselines.	A specific technology in the positive list is defined as automatically additional if at the time of PDD submission[13] 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 "Energy and Water Statistics of Mauritius - 2013", total installed Mauritian power capacity amounted to 778.2 MW in 2013[14]. Two per cent of total installed power capacity thus equals to 15.56 MW. Installed capacity of solar PV in Mauritius as of 2013 should not exceed 50 MW so that at least condition (b) is fulfilled and the project activity qualifies for the simplified procedure. As the aforementioned Energy and Water Statistics reveal, total installed solar PV capacity in the country amounted to 2.71 MW in 2013 (electricity generated was 6.30 GWh)[15], which is - even under consideration of potential capacity additions in 2014[16] - far below the 50 MW threshold. Therefore, additionality of the project is demonstrated.

In order to comply with the simplified procedure of the ACM002 Version 16, the project shall provide information on actual capital cost of the project activity at the time of the first verification.

Early consideration of the CDM

Prior Consideration of the CDM was notified on 28/11/2013 to the UNFCCC and the CDM-DNA of Mauritius, shortly after the Building and Land Use Permit was delivered on 15/11/2013.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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

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

[12] Valid until 27 November 2017.
[13] For registration of the project activity.
[14] Cf. Statistics Mauritius (2014): Digest of Energy and Water Statistics - 2013, p. 44;
[15] Cf. Statistics Mauritius (2014): Digest of Energy and Water Statistics - 2013, p. 45 and 46;
[16] http://ceb.intnet.mu/CorporateInfo/IEP2013/Chapter5_Power Generation Plan.pdf

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)

LE_y = Leakage emissions in year *y* (tCO2e)

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.[17] 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.

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:

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

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)

[17] A 10 kVA diesel genset (to backup power the servers and security lighting) will likely result in negligible emissions.

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 $\mathbf{EF_{grid,CM,y}}$

The grid emission factor ($\mathrm{EF}_{\mathrm{grid,CM,y}}$) is determined ex-ante. As per the "Tool to calculate the emission factor for an electricity-system" (Version 05.0.0), the emission factor is not monitored during the crediting period of each project activity but shall be updated at the renewal of the crediting period of the project activity.

This methodological tool further 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 following parameters:

Table 6: Main parameters in "Tool to calculate the emission factor for an electricity system"

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

The tool indicates six steps for the calculation of the combined margin (CM) emission factor. As a standardized baseline on the Grid emission factor in Mauritius has been approved at the UNFCCC level (ASB0019: Grid emission factor of Mauritius Version 01.0), no further calculation is required and the approved standardized combined margin (CM) emission factor can be adopted and applied to the emission reduction calculation of this project activity.

Based on ASB0019, the combined margin emission factor and **grid emission factor value** used to calculate the emission reductions of the La Ferme – Bambous Solar Photovoltaic power plant project is **0.966 tCO_2/MWh**.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$EF_{grid,CM,y}$
Unit	tCO_2/MWh

Description	Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data	As per ASB0019 Version 01.0
Value(s) applied	0.966
Choice of data or Measurement methods and procedures	As per ASB0019 Version 01.0
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{grid,OM,y}$
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	As per ASB0019 Version 01.0
Value(s) applied	1.017
Choice of data or Measurement methods and procedures	As per ASB0019 Version 01.0
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	Build Margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data	As per ASB0019 Version 01.0
Value(s) applied	0.813
Choice of data or Measurement methods and procedures	As per ASB0019 Version 01.0
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	The percentage share of total installed capacity of solar PV
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	Statistics Mauritius (2014): Digest of Water and Energy Statistics - 2013, Port Louis.
Value(s) applied	0.3
Choice of data or Measurement methods and procedures	-
Purpose of data	Additionality demonstration

Additional comment	-

Data / Parameter	The total installed capacity of solar PV
Unit	MW
Description	The total installed capacity of the solar PV in the host country.
Source of data	Statistics Mauritius (2014): Digest of Water and Energy Statistics - 2013, Port Louis.
Value(s) applied	2.46
Choice of data or Measurement methods and procedures	-
Purpose of data	Additionality demonstration
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

	Value/Result	Source/reference
Total installed capacity	15.2 MW	Project documents
Net electricity delivered to the grid ($EG_{PJ,y}$)	22,648 MWh/yr[18]	Project documents $[EG_{PJ,y} = EG_{facility,y}]$
Baseline emission factor of Mauritius grid ($EF_{grid,CM,y}$)	0.966 tCO_2e/MWh	Section B.6
Baseline emissions (BE_y)	21,878 tCO_2e	Section B.6 $BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}$
Project emissions (PE_y)	0 tCO_2e	Section B.6
Emission reductions (ER_y)	21,878 tCO_2e	$ER_y = BE_y - PE_y$

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

Year	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage (tCO_2e)	Emission reductions (tCO_2e)
01/10/2016-31/12/2016	5 703	0	0	5 703
01/01/2017-31/12/2017	22 632	0	0	22 632
01/01/2018-31/12/2018	22 450	0	0	22 450
01/01/2019-31/12/2019	22 271	0	0	22 271

[18] From base year net power generation of 24 GWh/yr (2014) subject to a yearly technical degradation of 0.8%, resulting in an average of 22,648 MWh/y over the 10-year crediting period)

01/01/2020-31/12/2020	22 093	0	0	22 093
01/01/2021-31/12/2021	21 916	0	0	21 916
01/01/2022-31/12/2022	21 741	0	0	21 741
01/01/2023-31/12/2023	21 567	0	0	21 567
01/01/2024-31/12/2024	21 394	0	0	21 394
01/01/2025-31/12/2025	21 223	0	0	21 223
01/01/2026-30/09/2026	15 790	0	0	15 790
Total	**218 780**	0	0	218,780
Total number of crediting years	**10**			
Annual average over the crediting period	**21,878**	**0**	**0**	**21,878**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{facility,y}$
Unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Measured directly with electricity meter(s) at CEB sub-station.
Value(s) applied	22,648
Measurement methods and procedures	Electricity outputs will be electronically recorded, stored and invoiced monthly to Sarako by CEB, after reconciliation with Sarako's internal meters which readings are recorded on a record sheet by the Technical/Engineering/Maintenance Department under the Plant Manager's authority Three-phase electronic electricity meters at CEB substation. The CEB Meters measure the net electrical energy delivered to CEB by SARAKO PVP Co. Ltd with the following specifications: Make: EDMI Model: MK6E V= 3x57-259V I: 1(6)A (50/60Hz) Accuracy class: 0.2S (±0.02%) LED Impulse: 0.1 imp/kWh Country of origin: Singapore SN: # 14502802 (main) & # 14502803 (back-up) CT ratio: 200/1 PT ratio: 66kV/110V
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	Cross check of measurement results with records for sold electricity. Meter Laboratory (ML) of CEB is solely responsible for the selection, installation, calibration, servicing, testing and repairing of all energy meters.

	As per PPA §12.1.4, *CEB shall inspect each CEB Meter upon installation and at least once every year thereafter. CEB shall check the certification of CEB Meters through an accuracy test at least once every 4 (four) years thereafter or at any time the readings of Net Energy from the CEB Meter and Seller Back-up Meter differ by an amount greater than 0.5%.* Sarako's internal meter is a Schneider Electric PowerLogic® ION8600, accuracy class 0.2S (SN: MT-1309A052-01). ION meters are digital and do not require calibration, only verification of their accuracy, as per manufacturer's specifications.
Purpose of data	Calculation of baseline emissions
Additional comment	Base year net generation is 24 GWh (2014) subject to a yearly technical degradation of 0.8%, resulting in an average of 22,648 MWh/y over the 10-year crediting period)

B.7.2. Sampling plan

n/a

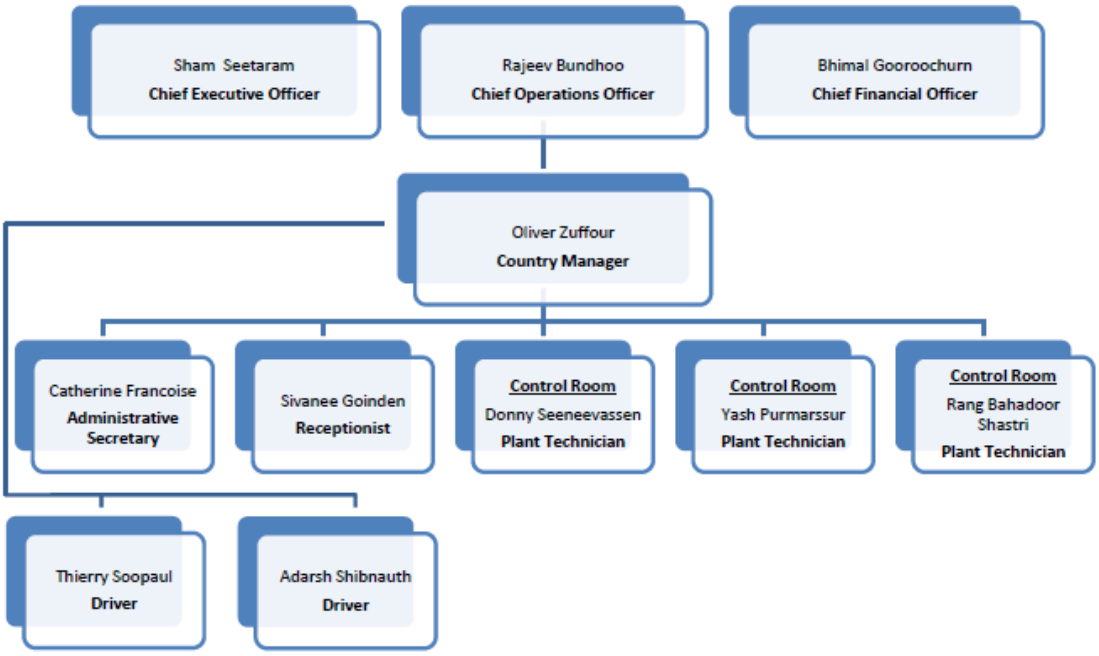
B.7.3. Other elements of monitoring plan

The proposed project activity monitoring plan complies with the methodology ACM0002 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources (Version 16.0), whereby it is stated that:

As per ACM002 provisions for record handling, all data collected as part of monitoring is archived electronically and kept at least for 2 years after the end of the last crediting period.

All measurements are conducted with calibrated measurement equipment according to relevant industry standards. Indeed, the quantity of net electricity generation supplied by the project plant to the grid is reliably monitored through calibrated electricity meters and cross-checked with sales records as part of quality assurance/quality control measures on top of CEB diligence.

Monitoring organization



The Country Manager of SARAKO PVP Co. Ltd 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 Country Manager 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.

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.

The Meter Laboratory (ML) of CEB is solely responsible for the selection, installation, calibration, servicing, testing and repairing of all energy meters. As per PPA §12.1.4, CEB shall inspect each CEB Meter upon installation and at least once every year thereafter. CEB shall check the certification of CEB Meters through an accuracy test at least once every 4 (four) years thereafter or at any time the readings of Net Energy from the CEB Meter and Seller Back-up Meter differ by an amount greater than 0.5%. The ML has recently acquired a sophisticated test bench to enable testing of electronic meters which have been put in service for registering the electricity consumption of maximum demand customers. Moreover, the SARAKO PVP Co. Ltd's back up meters shall be sealed by CEB in the presence of both parties and break only by CEB when required.

Monitoring team training and emergency preparedness
Data collection, consolidation and results analysis is undertaken by a dedicated team adequately trained, well aware of CDM requirements.
State-of-the-art training programs successfully undertaken by the staff include:

- Tauber Solar ServiceZentrum 'operational control of photovoltaic system' (1-month), featuring:
  - Basics of photovoltaic,
  - System monitoring,
  - Practical training on measurements, error detection etc.
  - Practical assignments in daily operations (inverter swap, module replacement, maintenance & troubleshooting)
- Central Electricity Board CFPP 'Safety and Health' (3-days), including:
  - Clearances to be observed with CEB power lines & live installations,
  - Precautions when carrying out works on Low & High Voltage Systems,
  - Duties & Responsibilities of CEB & Contractors under the OSHA 2005,
  - Proper use of personal protective equipment & tools,
  - Pole Top Rescue Operations,
  - Risk assessment,
  - Practical demonstration on switching, isolating, testing & earthing voltage lines
- Skytron 'Remote PV Plant Supervision using the PVGuard SCADA Platform' (1-day)

O&M workflow manual enforced on-site further includes all updated procedures in case of mistake/break-downs, emergency disconnections and cyclone warnings

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

The application of the methodology to the project activity study was completed on 28/08/2015 by:

ecosur afrique
9th Floor, Raffles Tower,

19 Cybercity, Ebene, Mauritius
Tel. +230 404 6060
Fax. +230 468 1616
www.ecosurafrique.com

Alexandre Dunod – Regional Manager
a.dunod@ecosurafrique.com

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

05/07/2013

The starting date has been determined as the date on which the EPC contract was signed, as the earliest date when the real action on the project begins, as per Glossary definition of "implementation or construction or real action of a CDM project activity".[19]

Table 7: Project implementation milestones

Milestones	Date
Measurements and planning	Mar-Apr. 2013
Local stakeholders consultations	Apr-Jun. 2013
EPC contract signature	05/07/2013 **>> start date**
Site preparation (civil works)	August 2013
EIA license	19/08/2013
Building and Land Use Permit	15/11/2013
Drilling and mounting of the panels	Nov-Dec. 2013
Commissioning Date	18/02/2014

According to EB41 clarifications, minor pre-project expenses, e.g. the contracting of services /payment of fees for feasibility studies or preliminary surveys, should not be considered in the determination of the start date as they do not necessarily indicate the commencement of implementation of the project.

C.1.2. Expected operational lifetime of project activity

The expected operational of the project activity is in excess of 20 years.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

The project crediting period is 10 years, fixed.

C.2.2. Start date of crediting period

The project crediting period starts on 01/10/2016 or at registration, whichever occurs later.

C.2.3. Length of crediting period

10 years (i.e. 120 months)

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

As per the amended Environmental Protection Act (EPA, 2008), an Environment Impact Assessment (EIA) is required for "Power Generating Plants". SARAKO PVP Co. Ltd (the implementer) has contracted the services

[19] http://www.sarako.mu/fr/chronique.html

of Scene-Ries Consult Ltd (EIA Consultant) to carry out an Environmental Impact Assessment and to produce an EIA Report for their proposed project[20]. This EIA aims to maximize positive impacts and minimize negative impacts that the project under consideration could have on the environment. The stipulations of the EPA 2008 have been closely monitored during the conduct of the study in view of achieving total compliance to all environmental requirements prescribed by regulations in force in the Republic of Mauritius.

D.2. Environmental impact assessment

As outlined in the EIA report, the site does not encompass any sensitive flora or fauna given that it is for most of its extent bare land with mainly bushes and shrubs. However, the project area has been dully surveyed by a floral and faunal expert and a terrestrial biodiversity report duly produced. The survey has established that the project site does not harbour any endemic or indigenous floral or faunal species. Besides, the site is devoid of any hydrological features such as river, spring or wetland.

From evidence compiled above, it has been assessed that the environmental impacts associated with the installation and operation of the proposed solar PV power plants will be minimal. Moreover, the proposed mitigating measures will comply with industry standards and applicable regulations. Consequently, an EIA Licence has been granted by the Department of Environment on August 19, 2013.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

For the purpose of initiating and developing this project, the implementer, either directly or through his team of professionals, has undertaken the following consultations:

- Liaison and discussion with the Ministry of Housing and Lands, the Ministry of Renewable Energy and Public Utilities;
- Discussion with the CWA (central water authority) for planning of water supply to the site
- Discussion with the CEB (central electricity board) for supply of electricity to the site
- Discussion with Orange for the planning of telecommunication services to the site.
- Discussions with the Black River district council for presentation of the project
- Discussions with the Bambous Village Council through meetings for awareness creation about the project and its benefits (the minutes of this solicitation are detailed below).

Table 8: Minutes of proceedings of the meeting of Bambous Village Council

Minutes of proceedings of the meeting of the above Village Council on Monday 31 May 2013 at 2.00 p.m. under the Chairmanship of Mr B. Bhugmon	
Members Present	Messrs:- D. J.C. Anseline, J.E. Bauda B. Jeetun J. Melisse A. Mungra Mrs:- M.P.0 Aimee, T. Davedoss, M.D. Jonjon
Members Absent	Nil
In Attendance	Mr A.K. Dusoye - Assistant Chief Executive (Secretary)
Confirmation of Minutes	The motion to confirm the minutes of proceedings of Village Council meeting of 29 April 2013 was proposed by Mr B. Bhugmon and seconded by Mrs T. Davedoss.
Implementation	The Secretary was requested by the Council to take immediate action on all the above decisions. The meeting rose at 15.10 hrs. Confirmed this 31th day of May 2013.

As for the inauguration of the project activity on 18/02/2014, invitations were sent out widely including representatives of the CEB, Deputy Ministers, and representatives from institutions such as the road development authority, waste water management authority, or insurance company.

Inauguration of La Ferme - Bambous Solar Photovoltaic Power Plant

[20] EIA report provided to DOE.

Mechanisms for ongoing communication with stakeholders of the project activity include:

- Direct communication at the solar farm's visitor center,
- Electronic communication via the project owner's website or telephone number,
- Indirect communication through local and national government authorities and CEB.

E.2. Summary of comments received

The following comments were received:

1) Councilor Bauda highlighted that the minutes of 24 April 2013 include the fact that the Vice Chairperson, Mrs Aimee, who made the Chairman's welcome address in replacement of the Chairman Mr Bhugmon who was running late. It was suggested that a joint site visit with the Head of Departments of the District Council should take place on 13 June 2013 at 11.00 am preceded by a joint meeting with the National Development Unit at 9.30 am to discuss on forthcoming projects in the villages.

2) Councillors Ansaline and Melissedrew drew the attention of the Council of the proposal of SARAKO PVP Co LTD following a meeting with its chief Executive officer, Mr Shyam Seetaram. The saidcompany shall be shortly coming up with a project of creating a "Photovoltaic Power plant" whereby some 62,000 photovoltaic panels will be fixed at a place commonly referred to as Montagne St Pierre, near La Ferme.

E.3. Report on consideration of comments received

The comments received were considered as follows:

Comment 1) A joint site took place on 13 June 2013 at 11am preceded by a joint meeting with the National Development Unit at 9.30 am to discuss on forthcoming projects in the villages.
Comment 2) It was decided to take immediate action on the implementation of the project. In addition, the manifold benefits to Bambous village were explained to the Council, such as:
- Creation of direct and indirect employment
- Corporate Social Responsibilities of SARAKO PVP Co. Ltd towards the local community of Bambous
- The immediate upgrading of avenue Centrale, together with the provision of roadside drains.
- Creation of a buffer zone of an approximate dimension of 50 metres and green belt as well.
- The site would become an attractive and interesting venue for students and tourists.
- The village of Bambous could become more visible as this project is the first of its kind in Mauritius.
- The existing access to La Ferme would not be restricted.

After taking stock of the whole array of the above advantages entailed by the project of SARAKO PVP Co.Ltd, the Council unanimously approved its implementation.

No further comments or complaints of any sort were received.

SECTION F. Approval and authorization

Mauritius DNA letter of approval has been issued on August 1st, 2016.

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Appendix 1. Contact information of project participants and responsible persons/ entities

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	SARAKO PVP Co. Ltd.
Street/P.O. Box	-
Building	BPML Cyber Tower 1 Ground Floor
City	Ebene
State/Region	-
Postcode	72201
Country	Mauritius
Telephone	+230 4681401
Fax	+230 4677914
E-mail	info@sarako.mu
Website	www.sarako.mu
Contact person	Mr Rajeev Bundhoo
Title	COO
Salutation	Mr
Last name	Bundhoo
Middle name	-
First name	Rajeev
Department	-
Mobile	+230 54681401
Direct fax	+230 4677914
Direct tel.	+230 4681401
Personal e-mail	rajeev.bundhoo@sarako.mu

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	ecosur afrique
Street/P.O. Box	Cybercity 19
Building	Raffles Tower 9th floor
City	Ebene
State/Region	-
Postcode	72201
Country	Mauritius
Telephone	+203 4046060
Fax	+230 4681616
E-mail	info@ecosurafrique.com
Website	www.ecosurafrique.com
Contact person	Mr Alexandre Dunod
Title	Regional manager
Salutation	Mr
Last name	Dunod
Middle name	-

First name	Alexandre
Department	-
Mobile	+230 59845649
Direct fax	+230 4681616
Direct tel.	+203 4046060
Personal e-mail	a.dunod@ecosurafrique.com

Appendix 2. Affirmation regarding public funding

No public funding is involved - according to the OECD definitions for Official Development Assistance (ODA).

Appendix 3. Applicability of methodology and standardized baseline

n/a

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

n/a

Appendix 5. Further background information on monitoring plan

n/a

Appendix 6. Summary of post registration changes

n/a

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