OFF GRID SOLAR PV PROJECT AT IAMGOLD ESSAKANE SA GOLD MINE

Document Prepared by AERA group

On behalf of Essakane Solar S.A.S.

Project Title	*Off grid Solar PV project at IAMGOLD Essakane SA Gold Mine*
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

"Off-grid Solar PV project at IAMGOLD Essakane SA Gold Mine" (hereafter referred to as the "Project" or "Project Activity") is a small-scale project activity, which involves the development, construction and operation by Essakane Solar S.A.S. of a greenfield solar PV plant with a total installed capacity of 14.928 MWp at the Essakane gold mine, which is in the Sahel region of Burkina Faso about 330 km North-East from Ouagadougou.

Jointly owned by IAMGOLD Corporation (90%) and the Government of Burkina Faso (10%), IAMGOLD Essakane SA, which owns and operates the Essakane gold mine, and produced 377,000 ounces of gold in 2016.

Being owned by Essakane Solar S.A.S. (hereinafter referred to as the "Project Implementer"), a specific purpose vehicle owned by Total Eren as a majority shareholder (>90%), the main objective of the project is to deliver clean, renewable energy based electricity to IAMGOLD Essakane SA. It does so by adding capacity to the 11 existing fuel-powered engines. The Project replaces fuel consumption of the technology in use.

The latitude of the Essakane gold mine offers very favourable radiation conditions throughout the year, with an average of 2,150 - 2,250 kWh / m^2 per year. This allows an estimated electricity generation of approximately 28,868 MWh for the first full year and 24,881 MWh on a yearly average over the 7-year crediting period. The Project will result in 19,904 tCO2e of emission reductions per year or 139,329 tCO2e over a 7-year crediting period.

Implementation timeline

Date	Event
17-March-2017	Signature of the EPC contractor's contract
26-May-2017	Start of construction of power plant
01-May to 13-May-2018	Performance tests under EPC contract & power purchase agreement
01-June-2018	Effective start date of electricity production
01-June-2018 – 31-May-2019	First verification (CDM)
01-June-2019 – 31-December-2020	Joint validation and second verification (VCS)
01-January-2021 – 30-June-2022	Third monitoring period verification (VCS)

During this third monitoring period, the project reduced emissions by 28,066 tCO2e.

1.2 Sectoral Scope and Project Type

Sectoral Scope : 1 - Energy industries (renewable - / non-renewable sources)

The project is a renewable energy type and is not a grouped project.

1.3 Project Proponent

Organization name	Essakane Solar S.A.S.
Contact person	Mrs Emma KANTIONO
Title	Managing director
Address	06 BP 9302 Zogona 06 Secteur 13, Zone du bois Avenue Babanguida, Rue Kindfu
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Email	emma.kantiono@essakane-solar.com

1.4 Other Entities Involved in the Project

Organization name	AERA GROUP SAS
Role in the Project	Carbon consultant
Contact person	Alexandre Dunod
Title	Head, Certification & Deliveries
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1.5 Project Start Date

01 June 2018

The project started producing electricity at this date. It's the start date of the CDM crediting period.

1.6 Project Crediting Period

The project adopted a seven (7) years crediting period, renewable twice. The crediting period therefore is 1st June 2018 - 31st May 2025.

1.7 Project Location

The Project is located in north-eastern Burkina Faso (host party), West Africa. It straddles the boundary of the Oudalan and Seno provinces in the Sahel region of Burkina Faso and is approximately 330 km North-East of the capital, Ouagadougou. It is situated 42 km East of the nearest large town and the provincial capital of Oudalan, Gorom-Gorom.

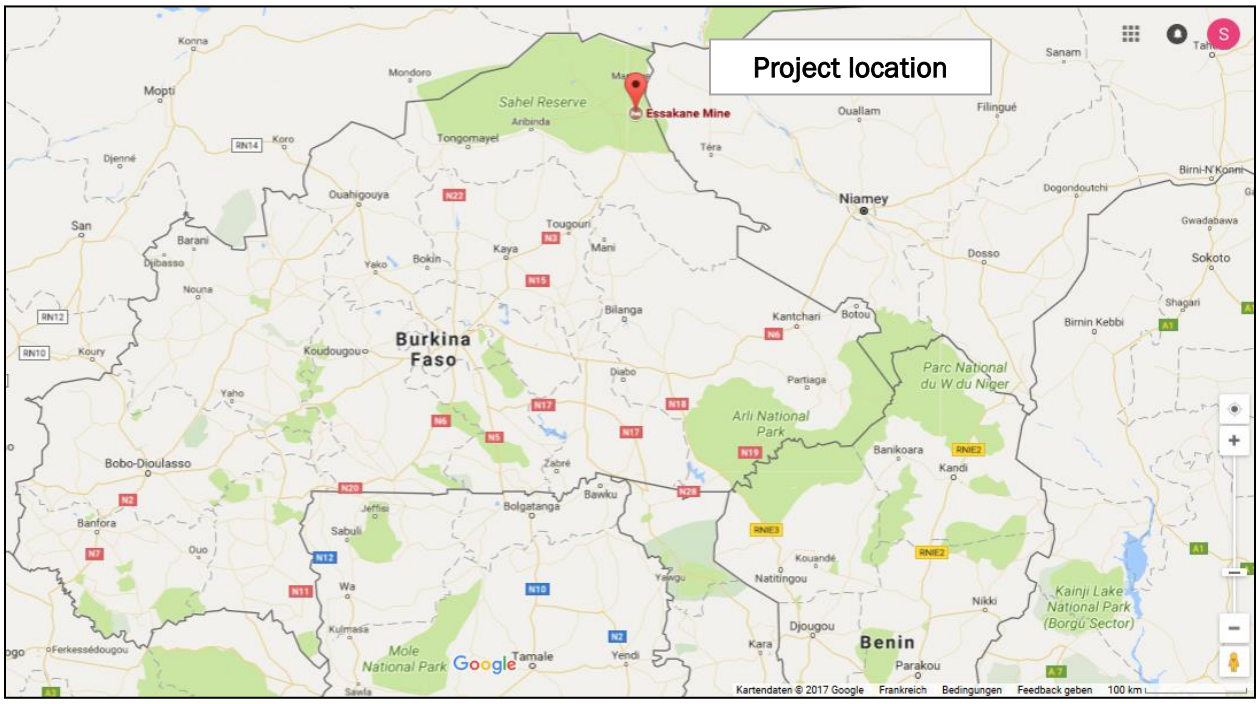
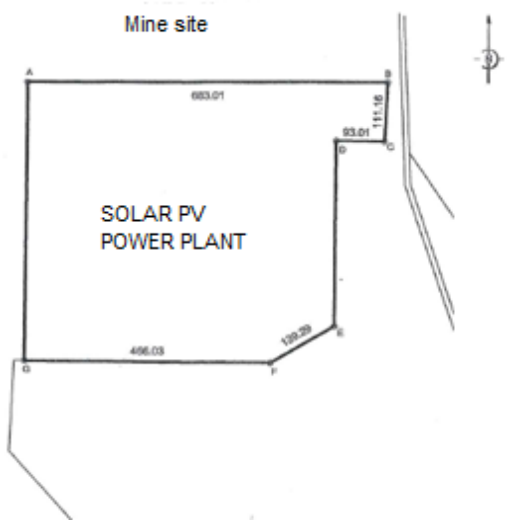


Figure 1: Project location in Burkina Faso

The six villages involved around the project site are:

- Essakane – site
- Essakane – village
- Falagountou
- Goulgountou
- Petabara – Seno
- Petabara - Oudalan

The diagram and map below reveal the exact geo-coordinates and situation of the Project site vis-a-vis the gold mine and the existing fossil fuel based power plants:



	Latitude	Longitude
A	14°21'29.3'' N	0°4'30.1'' E
B	14°21'59.5'' N	0°4'52.9'' E
C	14°21'55.9'' N	0°4'52.8'' E
D	14°21'55.9'' N	0°4'49.7'' E
E	14°21'44.5'' N	0°4'49.7'' E
F	14°21'42.2'' N	0°4'45.7'' E
G	14°21'42.2'' N	0°4'30.1'' E

Figure 2: Project borders and project location on goldmine site

1.8 Title and Reference of Methodology

AMS I.A: "Electricity generation by the user" (Version 16.0)

"General guidelines to small-scale (SSC) clean development mechanism (CDM) methodologies" (succeeded by "General guidelines for SSC CDM methodologies" Version 22.1)

Guidelines on the demonstrating of additionality of SSC project activities (succeeded by "Methodological tool Demonstration of additionality of small-scale project activities", Version 11.0)

"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 3.0)

1.9 Participation under other GHG Programs

The project is registered under the Clean Development Mechanism (Project #10398) on 05 May 2018, although its GHG emission reduction will either be claimed under the VCS programme or the CDM programme, never both.

CDM Monitoring period : 01-June-2018 – 31-May-2019, CER issued : 19,119 : https://cdm.unfccc.int/Projects/DB/KBS_Cert1502356514.63/iProcess/Applus1565174567.59/view

1.10 Other Forms of Credit

The project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

The project has neither sought nor received another form of GHG environmental credits.

1.11 Sustainable Development Contributions

The Project contributes to Burkina Faso's sustainable development policy as follows:

- Access to electricity as a production factor and resource management:

The Project reduces the country's dependency on imported fossil fuel and its price fluctuations. By making use of a local energy source, which is well suited to the local climate conditions, the project reduces fuel logistics for the largest private company in Burkina Faso located in a remote area, attracts foreign direct investment and increases national energy security/self-sufficiency. During this third monitoring period, the project produced 35,083 MWh

- Access to technologies and development of human capital (through employment and training):

The Project constitutes a significant step forward in the promotion of solar technology in Burkina Faso[1]. It provides an opportunity of knowledge transfer through training and employment of local staff during the operation and construction phases of the Project. The Project will set an example for technology diffusion and CDM reference for stakeholders who plant to implement similar technologies in the region. Up to 100 jobs were created during construction phase, while project operations employs about 40 people on the long term, most of them originating from the 6 nearby locations.

"Projects registered before 20 January 2023 shall demonstrate contributions to at least three SDGs by 20 January 2025". Thus for this monitoring period, the project participant will not demonstrate the contributions, but will by 20 January 2025.

[1] Since 2015 installed capacity of about 325 MW which consisted exclusively of thermal and hydro power plants (cf. http://sonabel.bf/index.php/nous-connaitre/metiers/production), the largest solar power plant in West Africa has been partially commissioned as CDM-CPA 10320-0003 in September 2017 (33.7 MW Zagtouli)

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
Sequential row number	*SDG Target number*	*Number and text of SDG indicator or, if no official SDG indicator is applicable, user-defined indicator*	*Indicate the project's contribution to the SDG Indicator (implemented activities to increase or decrease)*	*Brief description of the quantifiable impact of the project's activities related to the SDG indicator, during the monitoring period.*	*Brief description of the cumulative quantifiable impact of the project's activities related to the SDG indicator, over the project lifetime.*

2 SAFEGUARDS

2.1 No Net Harm

Receiver	Impacts	Environmental action	Objective of the action	Action	Actors of the action	Costs in FCFA	Follow-up Actor	Implementation schedule work	Monitoring indicators
Air	Air quality degradation due to gaseous emissions (VOC, CO, CO_2, NOx)	Providing site personnel with personal protective equipment Maintenance of site vehicles Watering of the site	Reduce the emission of CO, CO2, NOx, and dust in the atmosphere	Search for a qualified provider	ESSAKANE SOLAR	Included in the construction contract with the contractor in charge of the construction of the plant	ESSAKANE SOLAR BUNEE	During construction	Compliance of emissions with national standards, Number of complaints
Sound environment	Noise nuisance due to localized increase in noise levels	Use of less noisy equipment during work, Regular maintenance of equipment	Reduce noise pollution caused by product transport vehicles	Search for a qualified provider	ESSAKANE SOLAR	Included in the construction contract with the contractor in charge of the construction of the plant	ESSAKANE SOLAR BUNEE	During construction	Condition of construction equipment Number of complaints

Soil	Soil pollution	Proper management of solid and liquid waste and hydrocarbon stocks	Avoid soil pollution by waste disposal (used batteries if used and leakage of motor oil) Avoiding contamination	Ensure the collection of waste and its deposit in approved sites Conduct regular inspections of facilities to ensure the absence of leaks	ESSAKANE SOLAR	1 000 000	ESSAKANE SOLAR BUNEE	During construction and operation	Existence of an inspection schedule for the facilities, Number of inspections performed per year Site compliance with soil pollutant discharge standards
Water resources	Risk of pollution of ecosystems' aquatic	Management of spills accidental of hydrocarbons	Minimize the risks of pollution by hydrocarbons	Formation of the staff on the management of liquid waste Training on techniques for decontamination of contaminated sites	ESSAKANE SOLAR	500 000	ESSAKANE SOLAR BUNEE	During operation	Number of training sessions number of people trained
Security	Risks accidents involving employees and those of company's surroundings	Formation of the staff on the fire hazards and the means to prevent or treat them. Equipping employees of PPE. Respect for instructions for security of the mine.	Avoiding injuries and the loss of life human	Organize sessions of training on sources potential for fires to occur in the unit and on the means of control against these fires	ESSAKANE SOLAR	Included in the construction contract with the contractor in charge of the construction of the plant	ESSAKANE SOLAR BUNEE	During construction and the operation	Number of sessions of training made Level application of the measures of security Number of accidents

Vegetation	Destruction of vegetation cover	Recovery of the upper soil horizons (arable soils) to be used for rehabilitation purposes; Carrying out the compensation plantings; Monitoring and maintaining the plants for at least three years after they are planted, Compensation loss of utility trees	Restore destroyed vegetation cover	-location identification storage of topsoil, stripping, transport and disposal Research of the reforestation site, Acquisition of plants, -cooking Planting of the seedlings	ESSAKANE SOLAR	4 455 000	ESSAKANE SOLAR BUNEE, DREEVCC / Sahel	Operation phase	Area reforested, Number of plants planted, Success rate of the plants planted -
Landscape	Landscape modification	Realization of planting of alignment and hedges on the perimeter of the institution	Improve the living and working environment	Search for a landscaping specialist	ESSAKANE SOLAR	2 000 000	ESSAKANE SOLAR BUNEE	Operating phase	Existence of landscaping
Employment	Creation of temporary and permanent jobs	Recruiting female staff where possible	Increase the social acceptability of the project	Organize the recruitment of local employees	ESSAKANE SOLAR	PM	ESSAKANE SOLAR	Before starting up the plant	Number of local jobs created, Proportion of female staff working in the plant
Agriculture and livestock	Loss of agricultural land	Compensation of the loss of the agricultural Compensations financial loss of land agricultural Compensation	Restore the means of subsistence of people impacted	Accompany PAPs in the search for agricultural land Develop the land acquired - Evaluate the cost	ESSAKANE SOLAR	19 814 400	ESSAKANE SOLAR BUNEE	During the construction phase	Compensated land area -area of developed land for PAPs Level of productivity of land acquired

		for the loss of grazing land productivity		of the loss of productivity					for the populations Number of complaints
Home	Loss of a building	Compensation financial	Allow the owner to rebuild his house	Assessing the value of the impacted building	ESSAKANE SOLAR	1 890 000	ESSAKANE SOLAR BUNEE	Before the start of work	Payment status

2.2 Local Stakeholder Consultation

No grievance was registered during this monitoring period. However, the grievance mechanism is as follows:

1. Reception: Applications are received either at the headquarters in the Zogona district of Ouagadougou or in the Ouagadougou, or at the information centers of the Health, Safety and Sustainable Development Development Department. Depending on the geographical location of the request, mail is forwarded either to the Corporate Affairs Department (requests at the national level), or to the SSDD Department (requests at the regional level)

2. Processing: once received, the requests are recorded in a follow-up table (model in annex 2) and are analyzed every week by the department concerned, especially during team meetings. Validation is done by the head of the department or his representative.

3. Result: once the request has been processed, the results of the analysis are communicated to the applicant

2.3 AFOLU-Specific Safeguards

Not applicable as not an AFOLU project.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

During this third monitoring period, the project operated normally and no changes occurred. The Project consists in the installation of a greenfield renewable power plant. The Project relies on solar power source through photovoltaic conversion technology to produce electricity, which is delivered to IAMGOLD Essakane SA.

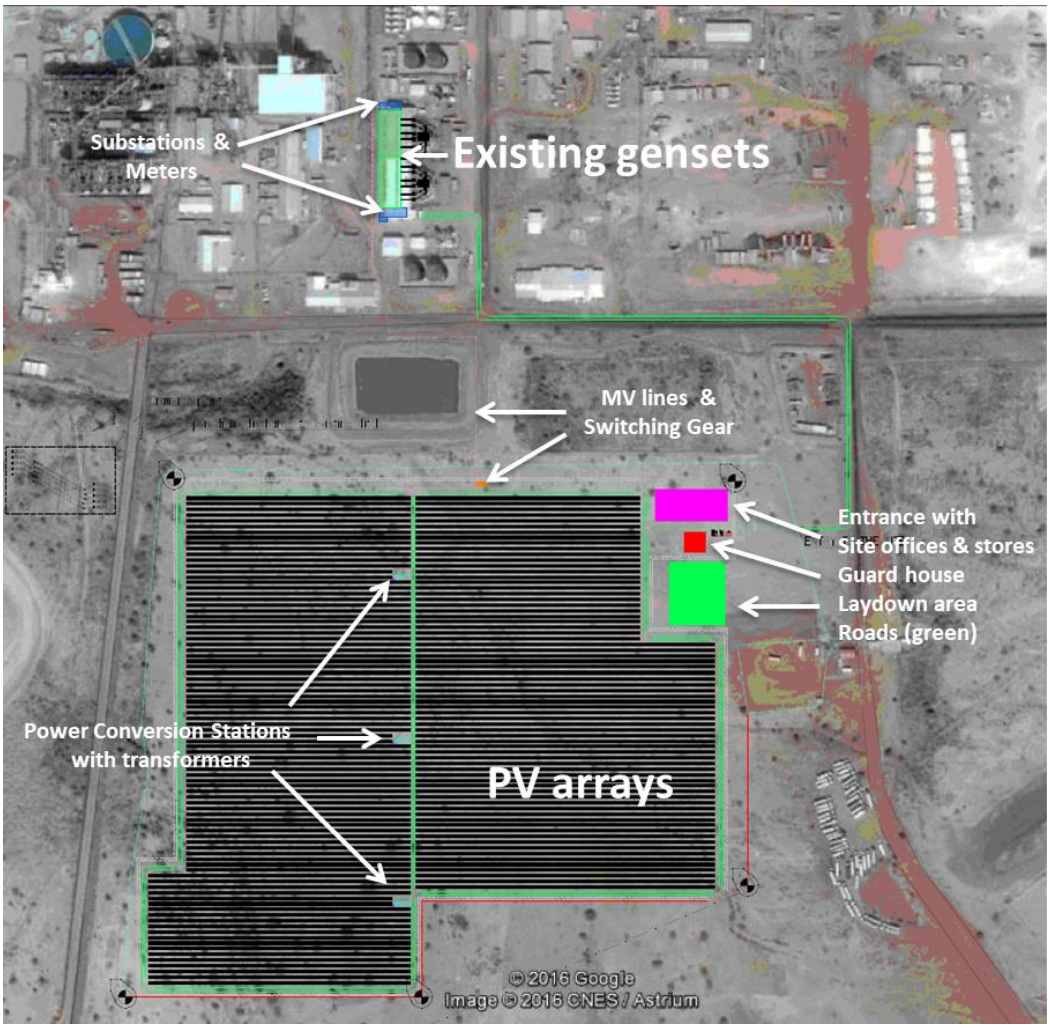
The PV array consists of 128,880 thin film (CdTe) photovoltaic modules, including 42,840 of 117.5 W (FS-4117-3 of First Solar Series 4™) and 86,040 of 115 W (FS-4115-3) for a total installed capacity of 14.928 MW provided by First Solar manufacturer through Wärtsilä EPC services.

The photovoltaic panels are arranged in line and fixed on galvanized steel support structures that are nailed into the ground minimizing the occurrence of shadows or a variation in their orientation and inclination (15°).

The Project also includes 6 inverters and 3 transformers located in powerhouses wired to the modules through buried cables. Two medium voltage overhead MV lines (6.6 kV) then connect the project to the offtaker's busbar, which is connected to two existing fuel oil based electrical generator sets in the baseline scenario of a total capacity of 58.24 MW. They consist of a total of 11 electrical generator

units (5 x 5,256 kW and 6 x 5,327.2 kW) of which 2 spare units (1 for maintenance, 1 for emergency spare).

A hybrid automation system (Wärtsilä Supervisory Control and Data Acquisition (SCADA) system, real-time controllers and photovoltaic combining switchgear) synchronizes the project plant with the existing fossil fuel-based power plant and allows the whole PV facilities to be manually or automatically controlled and monitored.



The technical characteristics of the modules, inverters and transformers installed are those in the tables below:

Table 1: Electrical and mechanical characteristics of the modules (Standard Test Conditions)

Peak Power (W)	115 W	117.5 W
Type of cells	Thin-film CdTe semiconductor	
Rated voltage (V_{mpp}) (V)	69.3	70.1

Rated current (I_{mpp}) (A)	1.66	1.68
Efficiency (%)	16.0	16.3
Length (mm)	1,200	
Width (mm)	600	
Thickness (mm)	6.8	

Table 2: Technical data of the inverters

Parameter	Unit	Description
Manufacturer		ABB
Model		PVS980, -1909kVA-J
Maximum DC input power ($P_{PV,max}$)	kWp	3,055
Nominal AC output power (SN(AC))	kVA	1,909
Maximum AC output power (Smax (AC))	kVA	2,100
Output frequency range	Hz	50/60
Nominal output voltage	V	630
Maximum efficiency	%	98.8
Own consumption in operation	W	2,500
Own consumption in standby	W	225

Table 3: Technical data of transformers

Parameter	Unit	Description
Manufacturer	-	ABB
Rated power	kVA	3818
High voltage	V	6600
Low voltage (no load)	V	630 (630)
Rated frequency	Hz	50

Relevant implementation dates during operation are described in the table below.

Table 4: Relevant implementation dates

Date	Event
17/03/2017	Signature of the EPC contractor's contract

26/05/2017	Start of construction of power plant
01/05/2018 – 13/05/2018	Performance tests under EPC contract & power purchase agreement
01/06/2018	Effective start date of electricity production
01/06/2018 – 31/05/2019	First monitoring period, CDM
01/06/2019 - 31/12/2020	Second monitoring period, VCS (and VCS registration)
01/01/2021 – 30/06/2022	Third monitoring period, VCS

3.2 Deviations

2.1.1 Methodology Deviations

No methodology deviation has occurred during this monitoring period nor previous one.

2.1.2 Project Description Deviations

No project description deviation has occurred during this monitoring period nor previous one.

3.3 Grouped Projects

N/A as not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	**$EF_{CO2,\ default}$**
Data unit	kg CO_2/kWh
Description	CO_2 emission factor
Source of data	AMS-I.A, Version 16
Value applied	0.8
Justification of choice of data or description of measurement methods and procedures applied	Default emission factor, derived from diesel generation units.
Purpose of Data	Baseline emissions
Comments	-

Data / Parameter	l
Data unit	-
Description	Average technical distribution losses
Source of data	AMS-I.A, Version 16
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	Reasonable default value if very few distribution losses on low voltage distribution grid are expected.
Purpose of Data	Baseline emissions
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	EG_y
Data unit	MWh/monitoring period
Description	Annual net output of the solar photovoltaic power plant
Source of data	Electricity meters
Description of measurement methods and procedures to be applied	Measured continuously by electricity meters and recorded at least once per day. Auxiliary consumption deducted through bi-directional metering.
Frequency of monitoring/recording	Continuously, aggregated at least annually
Value monitored	2021: *24,043* 2022: *11,041*
Monitoring equipment	The PowerLogic PM8420 digital meters installed at IAMGOLD power station's feed-in points (Wärtsilä 1 & Wärtsilä 2) have an accuracy of class 0.2S (active energy) and class 0.5S (reactive energy) at the two delivery points. ID of the meters : BA0904 Meter 1 : ME-1706B040-02 (Iamgold, buyer : main) Meter 2: ME1706B060-02 (Essakane Solar, seller : check) BA0911 Meter 1 : ME1706B032-02 (Essakane Solar) Meter 2: ME/1706B257-02 (IamGold)
QA/QC procedures to be applied	As per PowerLogic PM8000 Series manual, "all meters are tested and verified at the factory in accordance with International

	Electrotechnical Commission (IEC) and American National Standards Institute (ANSI) standards. [These] digital power meters typically do not require re-calibration". Besides the installation of a main & back-up meter at each feed-in point, reconciliation of measurement results between Essakane Solar and IAMGOLD will occur monthly before electricity invoicing takes place. Furthermore, Essakane Solar has installed its own meters at the transformer's point for transmission losses assessment.
Purpose of the data	*Baseline emissions*
Calculation method	*N/A*
Comments	Invoices to the mine serve as a cross-check basis

4.3 Monitoring Plan

The net electricity generated by the project activity is monitored continuously by at least two electronic electricity meters at the solar PV plant installed by the project implementer and IAMGOLD ESSAKANE S.A. Measurements are carried out on the project implementer's meter.

The metered PV Energy is calculated as the sum of net active energy deliveries by the project plant to IAMGOLD ESSAKANE S.A., less the metered auxiliary energy calculated as the sum of net active energy deliveries from IAMGOLD ESSAKANE S.A. to the project plant measured in kWh at the Wärtsilä 1 & Wärtsilä 2 feed-in pointsmeters.

In practice, it is the technical officer of the Solar PV plants who reports to a Project Monitoring Officer. The project monitoring officer then compiles the recorded data into monthly and annual report. He further keeps a log of the meter readings in the electronic data monitoring panel WISE and in the project implementer's offices at the PV Power Plant during the crediting period and two years after the end of the last crediting period. The monitoring officer will then report this data to electricity off-taker and the CDM Project Manager who will compile the CDM monitoring report.

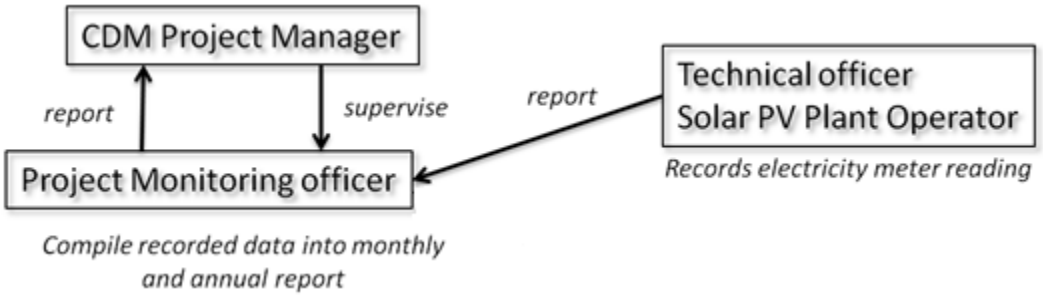


Figure 3 : Monitoring Organisation

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The baseline is described by Paragraph 8 of AMS-I.A., Version 16 as "…the fuel consumption of the technology in use or that would have been used in the absence of the project activity to generate the equivalent quantity of energy…", estimated using one of three possible options.

For the project activity, Option 2 is applied, such that the energy baseline is calculated based on annual electricity generation from project renewable energy technologies as per the below:

$E_{BL,y} = \sum_i EG_{i,y} / (1 - l)$

Where:

$E_{BL,y}$	Annual energy baseline; kWh
$\sum_i$	The sum over the group of *i* renewable energy technologies (e.g. renewable energy technologies for solar home systems, solar pumps) implemented as part of the project activity.
$EG_{i,y}$	The estimated annual output of the renewable energy technologies of the group of *i* renewable energy technologies installed; kWh
l	Average technical and distribution losses that would have been observed in diesel powered minigrids installed by public programmes or distribution companies in isolated areas, expressed as a fraction.

The emission baseline is the energy baseline calculated in accordance with Paragraph 8(b) of AMS-I.A. times a default emission factor:

$BE_{CO2,y} = E_{BL,y} * EF_{CO2}$

Where:

$BE_{CO2,y}$	Emissions in the baseline in year, *y*; tCO_2
$E_{BL,y}$	Annual energy baseline in year, *y*; kWh
EF_{CO2}	CO_2 emission factor; tCO_2/kWh

For EF_{CO2}, default value of 0.8 t CO_2-e/MWh, which is derived from diesel generation units, is used.

Month	BE_y	$E_{BL,y}$	EF_{CO2}
	t CO_2	MWh	tCO_2/MWh
January 21	1,848	2,310	0.8000

February 21	1,621	2,027	0.8000
March 21	1,701	2,126	0.8000
April 21	1,718	2,148	0.8000
May 21	1,412	1,765	0.8000
June 21	1,433	1,791	0.8000
July 21	1,450	1,813	0.8000
August 21	1,485	1,856	0.8000
September 21	1,622	2,028	0.8000
October 21	1,691	2,113	0.8000
November 21	1,654	2,067	0.8000
December 21	1,599	1,998	0.8000
January 22	1,739	2,174	0.8000
February 22	1,533	1,917	0.8000
March 22	1,482	1,853	0.8000
April 22	1,504	1,880	0.8000
May 22	1,232	1,540	0.8000
June 22	1,342	1,678	0.8000
TOTAL	**28,066**	35,083	

Thus, $BE_{CO2,y}$ = 35,083 kWh * 0.8 tCO_2/MWh = **28,066** tCO2.

5.2 Project Emissions

The project activity is a solar PV project and auxiliary consumption is taken account in the net electricity off-taken by the mine. Therefore, as per the applied methodology AMS-I.A., the GHG emission from the project activity is considered as zero

5.3 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.

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2021	*19,234*	*0*	*0*	*19,234*
2022	*8,832*	*0*	*0*	*8,832*
Total	*28,066*	*0*	*0*	*28,066*

Emissions reductions are calculated as the product of energy produced and the emission factor for diesel : $BE_{CO2,y} = E_{BL,y} * EF_{CO2}$

Ex ante emission reduction planned for 2021 are 20,234 and for 2022 19,223tCO2e.

Thus, ex ante emissions for this monitoring period are 2021 + 0.5*2022 = 20,234 + 0.5*19,223 = 29,845.5 tCO2e.

The emissions reductions are a little lower than expected, 94% was achieved as ex ante emission reductions are a theoretical calculation.