Monitoring report form for CDM programme of activities

(Version 02.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the PoA	Gigawatt Global Programme of Activities	
UNFCCC reference number of the PoA	10202	
Version numbers of the PoA-DD applicable to this monitoring report	Version 05	
Version number of this monitoring report	2	
Completion date of this monitoring report	31/10/2018	
Monitoring period number	M#2	
Duration of this monitoring period	01/03/2017 – 31/08/2018 (first and last days included)	
Monitoring report number for this monitoring period	01	
Coordinating/managing entity	Gigawatt Global Coöperatief U.A	
Host Parties	Host Party of the PoA	Is this the host Party of a CPA covered in this monitoring report? (yes/no)
	Rwanda	Yes
Sectoral scopes	Scope 1: Energy industries (renewable- / non-renewable sources)	
Applied methodologies and standardized baselines	Methodologies: ACM0002 Grid-connected electricity generation from renewable sources (version 16.0) and AMS-I.D Grid connected renewable electricity generation (version 18.0).	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by all CPAs covered in this monitoring report in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0 t CO_2e	13,526 t CO_2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the CPA-DDs for the CPAs	15,253 t CO_2e/yr	

covered in this monitoring report	

PART I Monitoring of programme of activities (PoA)

SECTION A. Description of PoA

A.1. General description of PoA

The purpose of the Gigawatt Global Programme of Activities (hereafter referred as the PoA) is to support the development and implementation of utility scale solar photovoltaic (PV) projects in Rwanda, thereby displacing grid-connected, fossil fuel based electricity generation, by promoting grid-connected renewable energy based electricity generation. As such, the PoA will contribute to reduction of greenhouse gas (GHG) emissions.

Despite the energy sector reforms that have taken place since the late 1990s in East Africa, renewable energy projects continue to face considerable barriers, including access to finance, inadequate tariffs and relatively high cost of capital compared to projects in established markets. Most projects have also found it difficult to benefit from the Clean Development Mechanism (CDM) because of the high transaction cost and long development times associated with the CDM registration. Gigawatt Global Cooperatief U.A. has therefore established a CDM Programme of Activities (PoA), which reduces CDM transaction costs and facilitates the route to market for Certified Emission Reductions (CERs) generated by solar PV projects in Rwanda. This will enhance projects' financial viability and ultimately result in eased access to capital.

The technology type covered by the PoA is grid-connected solar photovoltaic (PV). The programme focuses on Greenfield solar PV projects. Therefore, CO_2 is the main and only type of GHG included in the PoA due to the substitution of fossil fuel based generated electricity in the baseline scenario. Since the PoA will involve the implementation of solar PV power plants, the project activities will correspond to sectoral scope 1: Energy industries (renewable- / non-renewable sources) and will apply either the approved large-scale consolidated methodology ACM0002 Grid-connected electricity generation from renewable sources (EB 81, Annex 9, version 16.0) or the simplified baseline and monitoring small-scale methodology AMS-I.D Grid connected renewable electricity generation (EB 81, Annex 24, version 18.0).

For the large-scale CPAs under the PoA, the baseline scenario is derived from the approved large-scale consolidated methodology ACM0002 (EB 81, Annex 9, version 16.0), which states that the baseline scenario is "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." Likewise, the baseline scenario for small-scale CPAs under the programme is derived from the small-scale simplified baseline and monitoring methodology AMS-I.D (EB 81, Annex 24, version 18.0) which states that "The baseline scenario is that the 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 into the grid".

According to the utility company, Rwanda Energy Group Limited (REG), formerly known as Energy Water and Sanitation (EWSA)[1], by June 2013, the electricity generation was dominated by thermal

[1] As part of the energy sector reforms, the utility company Energy Water and Sanitation (EWSA) has been split into two separate and independent companies namely Rwanda Energy Group Limited (REG) and the Water and Sanitation Corporation Limited (WASAC) in charge of grid electricity and water resources respectively. However, since EWSA was the utility company at the time of writing the baseline, some sections of the document will maintain reference to EWSA as the utility company.

power plants accounting for about 58.7% of the total generation followed by hydropower at 41.2% and a very small fraction of 0.1% accounting for solar photovoltaic (PV)[2]. At this time, the total installed capacity reached 110 MW[3] and available capacity ranged between 80 MW and 92 MW. The government of Rwanda launched the Economic Development and Poverty Reduction Strategy II (EDPRS II), 2013-2018 with a purpose to boost economic growth. Under this policy document, the government aims to increase the installed capacity to over 563 MW by 2017/18. This target has since been further revised in the Rwanda National Energy Policy and Strategy (2011) to envision an increased generation capacity of over 1GW by 2017.[4] A large share of this capacity is anticipated to come from renewable sources.[5] However, timely implementation of these has been facing challenges. In this context, the baseline scenario is therefore the same as the scenario existing prior to the start of the implementation of individual component project activities under the PoA.

Framework for the implementation of the proposed PoA

Gigawatt Global Cooperatief U.A. hereinafter referred to as "Gigawatt Global" acts as the Coordinating/Managing Entity (CME) for the PoA. The CME is responsible for:

- Development of the PoA Design Document (CDM-PoA-DD) and CDM Component Project Activity (CPA) Design Documents (CDM-CPA-DD) for CPAs that are developed under the Programme of Activities;
- Obtaining a Letter of Approval for the implementation of the PoA from the host country;
- Obtaining a letter of Authorization of the coordination of the PoA from the host country;
- Liaise with the Designated National Authority (DNA) on matters related to the implementation of the PoA and inclusion of CPAs;
- Carry out a quality check on CPAs to be included in the Programme of Activities ensure that the CPA meets all the eligibility criteria as formulated in the PoA-DD;
- Collect and compile monitoring records from all the CPA entities;
- Coordinate monitoring activities and data management during the lifetime of the PoA;
- Contract a DOE for validation and verification purposes;
- Prepare and submit monitoring reports and facilitate the verification of the same;
- Act as the focal point with the CDM Executive Board for matters related to the PoA;
- During the lifetime of the PoA, maintenance of all monitoring reports of all CPAs in accordance with record keeping systems outlined in the CDM-PoA-DD.

CPA entities will be responsible for the implementation of individual CPAs under the PoA and will:

- Ensure that the described CPA is implemented;
- Operate and maintain the CPA for the duration of the project;
- Keep records of parameters as per the monitoring plan and provide hard and electronic records to the CME on a regular basis and provide the CME and DOE with required documents and access to sites as needed;
- Make available staff for validation and verification where applicable.

The CME will enter into contractual agreements with all CPA entities as a precedent to inclusion into the programme. The agreements will summarize roles and responsibilities regarding the implementation of the individual projects as CPAs. The agreements will ensure that the CME will

[2] Electricity data provided by EWSA for the period 2009 - 2013

[3] RURA annual report 2012/2013

[4] There are various sources indicating different electricity generation targets within this duration. However, in order to be in line with the government laws and policies, we have only referenced official government documents that are publicly available.

[5] Republic of Rwanda, Ministry of Infrastructure National Energy Policy and Strategy, p. 70-71

have control of all records and information related to the implementation of individual CPAs and will be in a position to ensure that each CPA is being implemented according to the provisions as outlined in the PoA-DD. The agreement will also put in place measures, which avoid double counting of the proposed CPA.

Confirmation that the proposed PoA is a voluntary action by the coordinating/managing entity

There are no policies, laws or mandatory requirements in Rwanda, the host country, stipulating the implementation of solar PV power plants. The proposed PoA is a voluntary action by the CME.

The PoA is expected to contribute to sustainable development in the following ways:

- The programme is expected to support projects that will provide reliable electricity to the national electricity grid. This is in line with Rwanda's Vision 2020, which places infrastructural advancement and energy generation as one of the pillars that are necessary in transforming Rwanda to a middle income earning economy.[6]
- The programme is expected to support projects that will provide local employment opportunities during the construction and operation phase.
- The programme is expected to support projects that will improve the hydrocarbon trade balance through reduction of oil imports used for electricity generation.
- The programme is expected to support projects that will result in the transfer of state-of-the art technology in utility-scale power generation from solar PV sources to the Rwandan population. The transfer of technology and know-how will be directly replicable to other future solar PV energy projects.

A.1.1. Corresponding generic component project activities (CPAs)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Greenfield small-scale solar PV power plants/units in Rwanda applying automatic additionality (version 1.0)	Version 5.0	Scope 1: Energy industries (renewable- / non-renewable sources)	AMS-I.D Small-scale methodology: *Grid connected renewable electricity generation* (EB 81, Annex 24, version 18.0) Associated methodological tools: •Tool to calculate the emission factor for an electricity system (version 04.0) •Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (version 02) •Tool to determine the remaining lifetime of equipment (version 01) •Project and leakage emissions from biomass (version 02.0) •Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (version 03.0.1)

[6] Republic of Rwanda (2000), Rwanda Vision 2020

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Greenfield large-scale solar PV power plants/units in Rwanda applying first-of-its-kind analysis (version 1.0)	Version 5.0	Scope 1: Energy industries (renewable- / non-renewable sources)	ACM0002 Large-scale consolidated methodology: *Grid-connected electricity generation from renewable sources* (EB 81, Annex 9, version 16.0) Associated methodological tools: •Tool to calculate the emission factor for an electricity system (version 04.0) •Tool for the demonstration and assessment of additionality (version 07.0.0) •Combined tool to identify the baseline scenario and demonstrate additionality (version 05.0.0) •Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (version 02) •Tool to determine the remaining lifetime of equipment (version 01.0) •Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (version 3.0.1)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Greenfield large-scale solar PV power plants/units in Rwanda applying investment analysis (version 1.0)	Version 5.0	Scope 1: Energy industries (renewable- / non-renewable sources)	ACM0002 Large-scale consolidated methodology: *Grid-connected electricity generation from renewable sources* (EB 81, Annex 9, version 16.0) Associated methodological tools: •Tool to calculate the emission factor for an electricity system (version 04.0) •Tool for the demonstration and assessment of additionality (version 07.0.0) •Combined tool to identify the baseline scenario and demonstrate additionality (version 05.0.0) •Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (version 02) •Tool to determine the remaining lifetime of equipment (version 01.0) •Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (version 3.0.1)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Greenfield large-scale solar PV power plants/units in Rwanda applying barrier analysis (version 1.0)	Version 5.0	Scope 1: Energy industries (renewable- / non-renewable sources)	ACM0002 Large-scale consolidated methodology: *Grid-connected electricity generation from renewable sources* (EB 81, Annex 9, version 16.0) Associated methodological tools: •Tool to calculate the emission factor for an electricity system (version 04.0) •Tool for the demonstration and assessment of additionality (version 07.0.0) •Combined tool to identify the baseline scenario and demonstrate additionality (version 05.0.0) •Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (version 02) •Tool to determine the remaining lifetime of equipment (version 01.0) •Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (version 3.0.1)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Greenfield large-scale solar PV power plants/units in Rwanda applying automatic additionality (version 1.0)	Version 5.0	Scope 1: Energy industries (renewable- / non-renewable sources)	ACM0002 Large-scale consolidated methodology: *Grid-connected electricity generation from renewable sources* (EB 81, Annex 9, version 16.0) Associated methodological tools: •Tool to calculate the emission factor for an electricity system (version 04.0) •Tool for the demonstration and assessment of additionality (version 07.0.0) •Combined tool to identify the baseline scenario and demonstrate additionality (version 05.0.0) •Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (version 02) •Tool to determine the remaining lifetime of equipment (version 01.0) •Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (version 3.0.1)

A.1.2. CPAs included in the PoA

Title and UNFCCC reference number of the CPA	Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Crediting period type and duration	Covered in this monitoring report? (yes/no)
ASYV 8.5MW Solar PV Project (CPA-001) 10202-0001	CPA type I: Greenfield small-scale solar PV power plants/units in Rwanda applying automatic additionality (version 1.0)	Version 5.0	Renewable 23/10/2015 – 22/10/2022	Yes

A.2. Coordinating/managing entity

CME: Gigawatt Global Coöperatief U.A.
Contact: Rietland Park 125, 1019 DT, Amsterdam, The Netherlands
Email: michael@gigawattglobal.com

SECTION B. Implementation of PoA

B.1. Description of implemented PoA

As per the CDM Project Standard for programmes of activities (CDM-EB93-A07-STAN, version 01.0), the CME shall establish, implement, and provide a description of the operational and management arrangements for the implementation of the proposed CDM PoA in accordance with requirements outlined in the Standard for demonstration of additionality, development of eligibility criteria and application of multiple technologies for programme of activities (EB 87, Annex 03, version 04.0). In accordance with validated CME manual, the following management system has been implemented by the CME:

Roles and responsibilities of personnel involved in the process of inclusion of CPAs, including a review of their competencies

The CME of Gigawatt Global PoA is Gigawatt Global Coöperatief U.A. Gigawatt Global provides the necessary managerial, technical, legal, communication and administrative functions to operate and manage the PoA in accordance with the CDM requirements, including the process of inclusion of CPAs. In the case where certain functions or tasks are to be outsourced, the ultimate responsibility for final quality control and approval still remains with Gigawatt Global as the CME.

Gigawatt Global has assigned one director-level staff member with signing authority to have overall responsibility for the management of the PoA. The director is supported by a senior level staff member (also a Director) who acts as the coordinator of the programme. Further support is provided by the project development, administrative and legal teams.

Competence requirements for personnel

At minimum, the following competencies, which are required of the following levels of staff, have been met, in order to ensure the optimal management of the PoA.

Director

- Have a good knowledge of the CDM, with particular experience in Programmes of Activities, CDM requirements and the CDM project cycle
- A good level of technical knowledge in the fields of renewable energy, grid electricity systems, power plant development and operations, economics and financial analysis and regulatory procedures
- Strong abilities in human resource management, critical thinking, problem solving, communication and project management

Programme Manager/Coordinator

Knowledge and experience in CDM and the carbon markets and in particular the specific CDM technical and methodological aspects including:

- The technical process, project design, methodology, baseline, project boundary, calculation of GHG, environmental impact and monitoring requirements, measurement techniques, calibration and uncertainty in the measurement of the applicable parameters, impact of failure of monitoring equipment on the measurement of emission reductions of a CPA, as relevant to technical areas within the sectoral scopes relevant to the project activity
- Assessment of additionality, including CDM related investment analysis as appropriate
- Quantification, monitoring and reporting of GHG emissions, including relevant technical and sector issues
- Regulatory requirements relevant to CDM sectoral scopes and project activities including the technical process, project design, methodology, baseline, project boundary, calculations of GHG, environmental impact and monitoring requirements

Legal Managers and Officers

- Knowledge of the CDM and the carbon markets and in particular with legal and commercial aspects
- Experience in contract and international law
- Knowledge of host country regulations

Administrative Managers and Officers

- Good understanding of the principles of data and information management
- Awareness of requirements regarding security and confidentiality
- Excellent organizational abilities

Records of arrangements for training and capacity development for personnel

In order to ensure that CME personnel is able to improve their skills and competencies and retain relevant knowledge given the frequent changes to the CDM rules and requirements, guidelines are put in place for the relevant CME staff to undergo internal skills assessment to identify competency levels. Based on the outcomes of the evaluation meetings, plans are put in place to schedule internal and external training sessions as necessary for the particular personnel requirements. In this way, provisions are in place to enable the CME staff to benefit and be kept abreast on the relevant information required to ensure CDM and PoA requirements are met.

Procedures for technical review of inclusion of CPAs

As part of the responsibilities of the CME, a technical review of the initial CPA (ASYV 8.5 MW Solar Project) was carried out prior to the petition for inclusion to the PoA. This process was outsourced to a carbon consultant. First, data was collected, compiled together with the supporting documentation and crosschecked for compliance with the eligibility criteria in the PoA-DD. Where necessary, the authenticity of the documents was verified by consulting with the national or local authorities. Finally, a verification exercise was carried out to confirm that the CPA has not been developed as a separate single CDM project or included into a registered CDM PoA by cross-checking projects and PoAs listed on the CDM website and any other relevant documentation such as for instance the utility's annual reports. The quality control procedures described in the CME management manual were adhered to, whereby a quality check was done by another staff from the carbon consultant that was not directly involved in the day-to-day preparation of the CDM documentation. The quality control procedure followed the Review Check list below, developed by the CME.

Based on the CPA-DD as well as documentary evidences required to proof adherence to the PoAs eligibility criteria, the carbon consultant provided a recommendation to the CME to accept the CPA inclusion. The request for inclusion was forwarded to the DOE for final assessment.

Below is a sample CDM DD Internal Review Checklist used for the inclusion criteria.

PoA TITLE	*Insert PoA title here*

Review Criteria	**Compliance?**		
	YES	**NO**	**Not applicable**
Have all eligibility criteria for inclusion in the PoA been met?			
Having procedures to avoid double counting been checked?			

Have all relevant sections in the 'Generic CPA DD been completed?			
Have emission reduction calculations been checked by the reviewer?			
If required under Section B of the CPA DD – has an environmental analysis been undertaken?			
If required under Section C of the CPA DD – has a stakeholder consultation been undertaken?			
If required under the CPA DD – has a GEF calculation been undertaken and checked by the reviewer?			
Has all supporting documentation been cited by the reviewer?			

CPA DD is: Complete and finalized / Requires further revision *(Delete appropriate option)*

Comments:

Internal Reviewer:	
Date:	
Signature:	

Procedure to avoid double counting

Double counting could occur in case a CPA is included in more than one PoA or registered as a single CDM project or in case there is an overlap between two CPAs (e.g. overlap of two phases of a solar PV project which have been developed as two separate CPAs).

In order to avoid double counting, the CME took the following measures:

The CME confirmed that the CPA has not yet been included in another CDM Programme of Activities or been registered as a single CDM project through:

- A signed confirmation letter from the CPA implementing entity that it was not yet included in another CDM Programme of Activities or has been registered or intends to be registered as a single CDM project.
- A check by the CME on the CDM website that the project has not yet been included in another Programme of Activities or has been registered as a single CDM project. The check by the CME was presented in a signed confirmation letter from the CME.

Record keeping system for each CPA under the PoA

The CME has developed and is maintaining an electronic database, which will contain essential data and information about each CPA, including:

- General information about CPA:
- CPA name
- Name and contact details of the entity implementing the CPA
- Geographical location of the CPA (GPS coordinates)
- Technology employed by the CPA and installed capacity
- Commissioning date
- Start date of the CPA
- Crediting period
- Start and end date of crediting period
- Operational lifetime
- Verification status (number of verification and associated monitoring period)
- Emission reductions monitored and issued in each monitoring period
- Supporting evidence for each eligibility criterion to demonstrate that the CPA meets all the eligibility criteria for inclusion into the PoA.
- Data and information regarding the monitoring of emission reductions achieved by the CPA in line with the monitoring plan as formulated in the PoA-DD

General information regarding the CPA as well as supporting evidence for the inclusion of the CPA has been entered into the database by the CME at the start of the implementation of the CPA. Procedures are also in place to archive data and information regarding monitoring of greenhouse gas emissions into a database at least on a quarterly basis. 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 or the last issuance of CERs, whichever occurs later.

The CME is responsible for entering, updating and maintaining data and information regarding CPAs into the electronic database with read and write access. Gigawatt Global, as the ultimate 'owner' of the system, has full ownership and access to all data and systems.

The CME record keeping and document processes also incorporate quality management procedures, which consist of:

1. Establishing and maintaining a 'Quality Manual';
2. Procedures for control of documents; and
3. Procedures for control of records.

This database and other records applicable are stored in a cloud based management system that provides the necessary infrastructure for managing document security, access and version control.

Measures for continuous improvement of the PoA management system

In the course of the PoA lifetime, it is likely that some of those procedures mentioned will result in insufficient control of the CME management system. In this case, the CME plans to keep improving its standards always taking a conservative and stricter approach with the aim of meeting the procedures described in this section. Once the crediting period is over, those new procedures in the management system will be updated.

As per standards for quality management systems, the CME has put in place a plan to monitor and improve processes to achieve the following:

- Demonstrate conformity and quality to the agreed specification
- Ensure conformity to the management system and
- Continually improve the management system

In order to achieve continual improvement, procedures are in place to collect data in areas of customer satisfaction (where the customer is the CPA implementer), process performance, and product quality (where the product is the CPA-DD development process and management of the inclusion of the CPA) and the implementation of the overall management system.

The results from this collection will be analysed and action taken to improve the effectiveness and efficiency of the system.

PoA subscription

Each CPA is expected to enter into a PoA Participation Agreement with the CME. The PoA Participation Agreement includes a confirmation that the implementing entity of the CPA is aware and agrees that the CPA is being subscribed to the PoA.

Implementation of single sampling plan(s)

The PoA and specific CPAs does not involve any sampling as they involve the generation of electricity from renewable sources.

Technologies/measures

CPAs under the PoA will use renewable energy technologies to generate electricity. The renewable energy technologies and measures to be employed by each CPA will be of solar photovoltaic (PV) type. The following five CPA types will be included in the PoA:

- Greenfield small-scale solar PV power plants/units in Rwanda applying automatic additionality
- Greenfield large-scale solar PV power plants/units in Rwanda applying first-of-its-kind analysis
- Greenfield large-scale solar PV power plants/units in Rwanda applying investment analysis
- Greenfield large-scale solar PV power plants/units in Rwanda applying barrier analysis
- Greenfield large-scale solar PV power plants/units in Rwanda applying automatic additionality

Each CPA will be given a unique name based on the location where the project will be implemented and the installed capacity of the CPA. The following standardized approach will be used:

- [name of location] [installed capacity] Solar PV Project

Upon inclusion in the PoA, each CPA will receive a unique reference number. The geographical coordinates of the CPA will be provided in section A.7 of the CPA-DD.

The following description gives more details on solar PV technology.

Solar PV technology

Solar photovoltaic cells, also known as solar cells, are used to convert solar energy into electrical energy. The solar cells are the basic elements of a solar module. When semiconductor materials are exposed to sunlight, electrons are excited from the valence band to the conduction band creating charged particles called holes. By doping the silicon, i.e. adding tiny amounts of other materials like boron or phosphorous to the crystalline structure, p- or n- type semiconductors are formed respectively. By bringing them together, a p-n junction is formed and serves for creating an electric field within the semiconductor, which is able to separate electrons and holes and which creates a direct current (DC).

Solar modules are composed of solar cells in series and parallel in order to obtain a desired final power, current, and voltage. The output current of a solar cell directly relates to the incoming irradiation: The higher the irradiation, the more electron-hole pairs are produced and therefore the current increases and more electricity is produced. There are several slightly different technologies using solar PV cells, solar crystalline modules with 36 to 72 cells being the most widely used.

The figures below give an illustration of typical solar technologies that will be implemented under the programme.

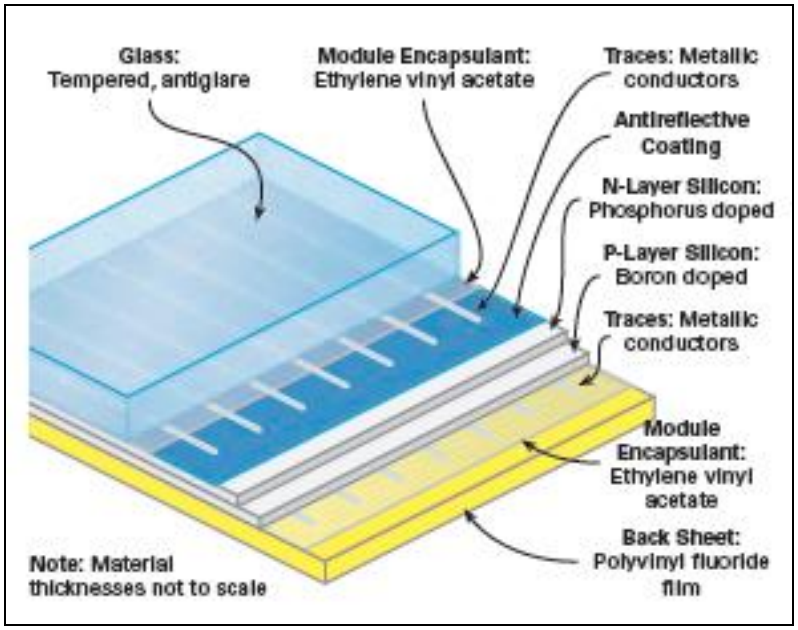

Figure 1: Solar PV analogy

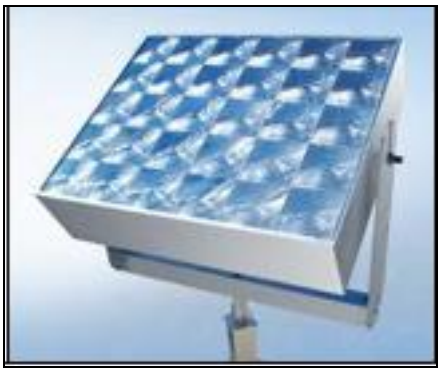

Figure 2: Concentrated Solar PV

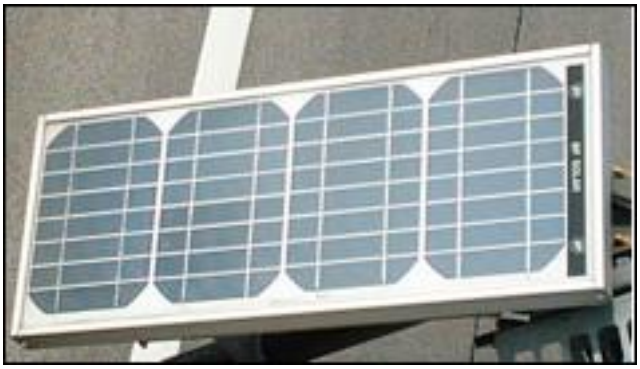

Figure 3: Solar Photovoltaic (PV)

Individual power plants may either employ fixed solar PV modules or install the PV modules with 1-axis or 2-axis sun-trackers. The sun-trackers allow the PV modules to track the direction of the sun through the day thereby maximizing the solar energy collected and electricity generated by facing the modules as perpendicular to the sunrays as possible.

In addition to the above-mentioned equipment, the CPAs will require additional equipment for the connection and transmission of the electricity generated to the electricity grid. For instance, an electrical network to collect the electricity will be installed, and where applicable, inverters and transformation boxes. Electricity will be transformed to the required voltage at the Point of Utility with the national electricity grid. In some cases, the CPA may be required to also construct a substation, but in most cases the CPA will be connected to an existing substation. The installation of a metering system is also required for both monitoring records for CDM purposes and for electricity sales.

The following diagram shows a typical equipment layout of a CPA:

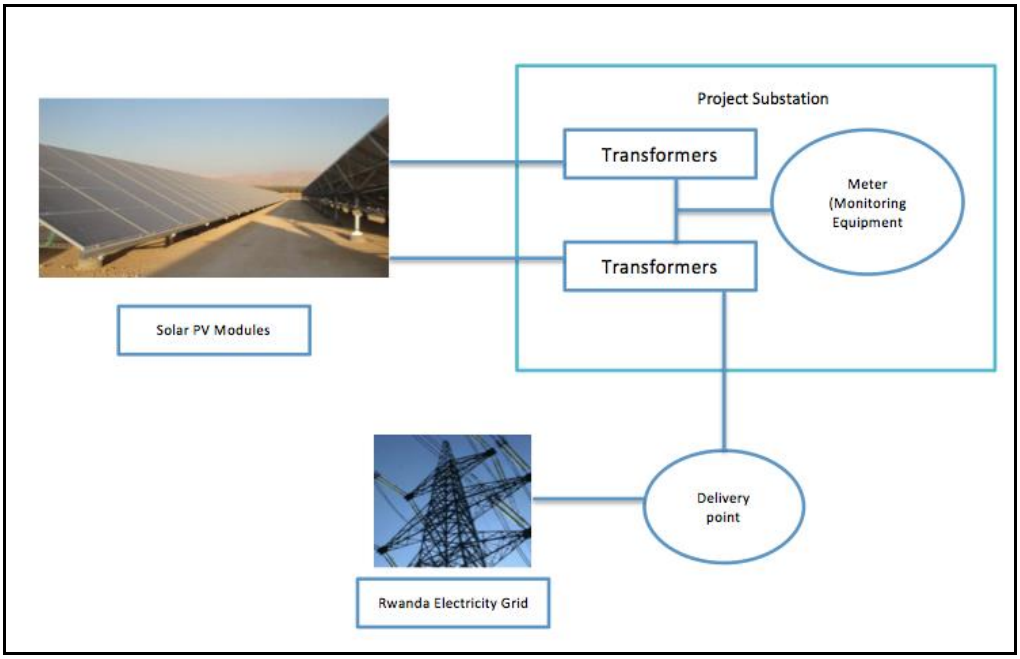

Figure 4: Equipment layout for a typical CPA

The following technical information will be provided by specific CPAs that will be included in the PoA:

- The installed capacity.
- Number and model of solar modules (solar PV) and inverters.
- Technical specifications of the equipment that will be installed and relevant industry standards.
- Lifetime of the installed equipment.
- Plant load factor, including the relevant losses, internal consumption and net electricity supply to the grid.
- Details about the electricity collection and transmission infrastructure (e.g. number of transformers).
- Details about the metering system.

CPAs will involve transfer of environmentally safe and sound technology through the introduction of state-of-the-art technology in solar PV systems. Transfer of know-how will take place through the training of local engineers and other technical staff by the operations and maintenance contractor with the support of the equipment manufacturer. The equipment manufacturer, as well as assuring performance standards for the projects, will also provide oversight of the maintenance and operation of the equipment during the lifetime of a typical CPA.

Detailed information about the exact technology and measures applied by the individual CPAs will be provided in the relevant section of the specific CPA-DD. The section will also include a description of how environmentally safe and sound technology and know-how is being applied by the specific CPA *inter alia* technology transfer to the host party for application in the CPA.

B.2. Post-registration changes to PoA

B.2.1. Corrections

No corrections

B.2.2. Inclusion of monitoring plan

Not applicable

B.2.3. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

No permanent changes

B.2.4. Changes to programme design

Not applicable

PART II Monitoring of CPAs

SECTION C. Implementation of CPAs

C.1. Description of implemented CPAs

Only one specific case CPA has been implemented and included in this monitoring period. The CPA falls under generic CPA type I: Greenfield small-scale solar PV power plants/units in Rwanda applying automatic additionality (version 1.0)

(a) *Purpose of the specific-case CPA(s) and the measures taken for GHG emission reductions or net GHG removals by sinks;*

The ASYV 8.5MW Solar PV project (CPA-001) forms part of the Gigawatt Global Programme of Activities, which seeks to promote grid connected renewable energy projects in Rwanda. The CPA falls under CPA type I "Greenfield small-scale solar PV power plants/units in Rwanda applying automatic additionality", which is one of the five CPA types eligible for inclusion under the PoA.

The CPA has installed a new renewable energy power plant at a site where none existed prior to the implementation of the project activity (Greenfield plant). The CPA is located in Rwamagana District, Rubona Sector, Karambi cell at the Agahozo-Shalom Youth Village (ASYV), approximately nine kilometres from the main Kigali-Kagitumba highway. The site is about 50 km from Kigali, Rwanda's capital.

The CPA uses solar photovoltaic (PV) modules with a single axis tracking system. The CPA has a peak output capacity of 8.5 MWp consisting of 28,360 solar PV modules and covering 16 hectares.[7]

For the second monitoring period (01 March 2017 to 31 August 2018) the net electricity generation amounted to 20,495 MWh corresponding to emission reductions of 13,526 tCO_2e. Electricity generated was evacuated to the Rwandan national electricity grid via the utility company owned transmission lines. The CPA therefore achieves CO_2 emission reductions by displacing electricity that would have been generated by fossil fuel powered plants connected to the national electricity grid.

In addition to emission reduction benefits outlined above, the CPA as part of the Gigawatt Global Programme of Activities is perceived to have contributed to sustainable development benefits in the following ways:

[7] Feasibility Study for Solar PV power plant in Rwanda (2012)

- The project is providing clean and reliable electricity to the national electricity grid. This is in line with Rwanda's Vision 2020, which places infrastructural advancement and energy generation as one of the pillars that are necessary in transforming Rwanda to a middle income earning economy.[8]
- The project provided employment to the local population during the construction stage and continues to do so at the operation phase.
- The project is improving the hydrocarbon trade balance through reduction of oil imports used for thermal electricity generation.
- The project is resulting in the transfer of state-of-the art technology in utility scale power generation from solar PV sources to the Rwandan population. The transfer of technology and know-how will be directly replicable to other future solar PV energy projects.
- The project is contributing to Rwanda's fiscal revenues through payment of taxes

b) Description of the technology employed and installed equipment and/or infrastructure, including information requested by the eligibility criteria;

An overview of the energy and mass flows and balances of the systems and equipment included in the CPA can be introduced with the conversion of radiation from the sun into electrical energy in direct current (DC) form, by the solar modules. The electricity is then collected via the DC distribution network comprising of an interconnection of solar modules in series and parallel strings. Inverters convert the collected DC to an alternating current (AC) before being stepped-up by transformers to the required voltage for evacuation to the Rwandan National Grid. Measurement of electricity supplied to the grid is done using electricity meters located at the interconnection point, which are remotely monitored continuously by the utility company through a supervisory control and data acquisition (SCADA) system.

Solar PV technology

The solar photovoltaic cells, also known as the solar cells, are used to convert solar irradiation into electrical energy. The solar cells, which are the basic elements of a solar module, are made of a special class of materials called semiconductors. The number of solar cells in crystalline modules varies typically between 36 and 72 cells. The output current of a solar cell directly relates to the incoming irradiation: The higher the irradiation, the more electron-hole pairs are produced and therefore the current increases and more electricity is produced. These cell connections comprise of positive and negative wiring terminals allowing for the electricity generated to be channelled to an electrical load. As long as sunlight is available, the electrons will keep flowing and can deliver electrical energy to a load that's connected to the circuit. Solar PV modules are typically composed of solar cells connected in series, parallel or a combination of series and parallel strings, in order to obtain a desired final power, current, and voltage.

Technical specifications of the main equipment

According to the Energy Yield Assessment report, the CPA will comprise of polycrystalline silicon PV modules, of the BYD 300P6C-36 type, rated 300 Wp at STC[9] conditions. 28,360 of such modules will be connected in series consisting of 20 PV modules to form 1,418 strings of parallel connections and produce a nominal capacity of 8.5 MWp.[10] The single axis tracking system design is used to minimize the angle of incidence between the incoming sunlight and a photovoltaic panel thereby optimizing the amount of electricity that can be generated. During the second monitoring

[8] Republic of Rwanda (2000), Rwanda Vision 2020

[9] STC: Standard Test Conditions

[10] In the context of this CPA, nominal capacity is determined in accordance with the nameplate manufacturer specifications (DC). The capacity therefore excludes any related losses related to conversion of the power to AC.

period net electricity generation amounts to 20,495 MWh, which translates to a plant load factor of 18.35%.

The table below highlights the solar PV module characteristics:

Table 1. Solar PV module specifications

Parameter	Value
PV Module type	Si-Poly
PV Model	BYD 300P6C-36 series
Manufacturer	BYD
Rated Nominal Capacity	300Wp
Umpp	35.97 V
Impp	8.34 A
Umax	1000 V
Max fuse Current rating	15 A
Tolerance	+3%
Number of modules	28,360
Operating Voltage	600-850 V
Array Efficiency (STC)	15.47%
Array Nominal Capacity	8.5 MWp
Array operating characteristics	646 V, 11812 A
Lifetime	25 years

Source: Energy Yield Assessment Report and Single Line Diagram

Direct solar radiation constitutes the major source of solar energy that can be captured by solar photovoltaic modules. Since the sun keeps changing its relative position during the day, the angle by which the direct sun rays hit the solar panels also keeps changing resulting in energy losses especially in the morning and evenings. Rotating the panels by use of solar trackers help to minimize the angle of incidence between the incoming sunlight and a photovoltaic panel thereby increasing the amount of energy produced from a fixed amount of installed power generating capacity. A single axis tracker system, rotating from East to West depending on the position of the sun has been used for this CPA.

The table below highlights the characteristics of the tracking system:

Table 2. Tracking system specifications

Tracking plane, tilted Axis	Axis tilt 0°	Axis azimuth 0°
Minimum limitations	Minimum Phi: -45°	Maximum Phi: -45°
Backtracking strategy	Tracker Spacing: 950 m	Collector width: 3.92m
Inactive band	Left: 0.10 m	Right: 0.10 m

Source: Energy Yield Assessment Report

The figure below depicts a visual impression of the project's implementation:

Figure 5: Visual Impression of the CPA implementation

Apart from the module technology, the other vital component of the power plant is the DC distribution system. The DC distribution system is comprised of cabling, connectors, fuses, switches, over voltage and lightning protection, current sensing devices and enclosures. The distribution system is critical since it determines the final electrical output from the PV modules. The CPA DC distribution system has been designed to keep losses arising from cabling to a maximum of 1.5% at Standard Test Conditions. This is reached by using proven design topography for cable routing and box design.

The inverter receives the direct current (DC) from the DC distribution and converts it to alternating current (AC) utility grade electricity and feeds it to the grid. The inverter model to be used in the CPA is the Sunny Central 900CP XT_25degree type with characteristics as shown in the table below:

Table 3. Inverter specifications

Parameter	**Value**
Inverter Model	Sunny Central 900CP XT_25degree
Manufacturer	SMA
Operating voltage	600-850 V
Number of inverters	8
Unit nominal capacity	990 kW AC
Total nominal capacity	7,920 kW AC

Source: Energy Yield Assessment Report

Transmission system

The transmission system comprises of all the transmission lines and infrastructure, which aids in the connection of the project site to the Rwandan National Grid. The project was previously designed to be connected to the existing utility owned 15 kV Karenge transmission line which connects to the Musha substation which thereafter connects to the Rwandan National Grid via a 70kV transmission line. However, in order to minimize losses due to transmission inefficiencies, the utility company has since built a new 15 kV dedicated transmission line connecting Musha substation to the project. The project has been integrated into the existing supervisory control and

data acquisition (SCADA) system allowing for continuous monitoring from the utility end and enhance communication with the utility through a cellular modem.

Figure 6 below shows the schematic diagram of the power plant.

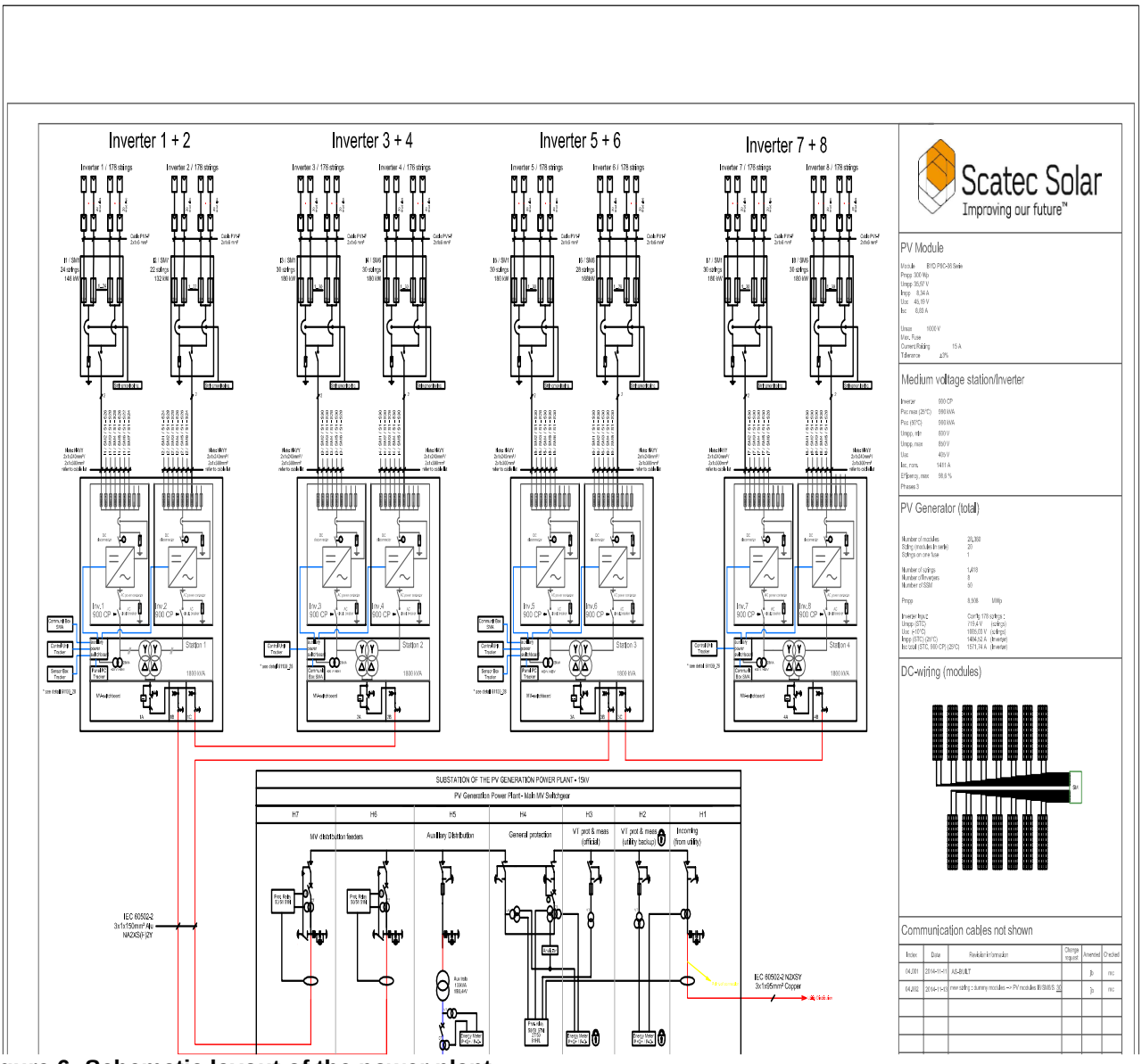

Figure 6: Schematic layout of the power plant

Metering system

The metering equipment installed at the CPA site can be distinguished in two systems:

1) The system that is responsible for metering the power exported to the grid and the power imported from the grid is implemented and operated in line with the provisions of the Power Purchase Agreement. The metering installation has been put in place at the Interconnection Point, at a voltage of 15 kV. The system includes a main- and a back-up meter which can be remotely interrogated and which is having an electronic communication link connected to the metering database of the Transmission Metering Admin+kistrator (TMA) or Distribution Metering Administration (DMA).

2) An auxiliary sub-meter that meters the electricity consumed by some loads at the ASYV 8.5MW Solar PV project e.g. the site facility building and lighting. Since the meter is a sub-meter (see

Figure 6), the energy consumed and measured by the auxiliary meter is already captured by the main meter and back-up meter. This meter is thus considered an “internal meter”, that is not used for any billing purposes.

The metering system responsible for metering the power exported to the grid and power imported from the grid is used for billing purposes as well as for calculation of emission reduction generated by this CPA.

Technology Transfer

Transfer of environmentally safe and sound technology continues to take place through the introduction of state-of-the-art solar tracking technology and applicable inverters from Germany, to Rwanda. Transfer of know-how will take place through the training of local engineers and other technical staff by the EPC contractor and the Operations and Maintenance contractor.

c) Relevant dates for the specific-case CPA(s) (e.g. construction, commissioning, continued operation periods, etc.);

The major milestones achieved during the implementation of the project activity are summarized in the table below.

Table 4: Project major milestones

Milestone	Date	Documentary Evidence
Agreement reached between the Government of Rwanda and Gigawatt Global Rwanda Ltd.	5 November 2012	MoU with the Government of Rwanda
Conclusion of the Environmental Impact Assessment	November 2012	Environmental Impact Assessment Report
Feasibility Studies for the project is finalized	28 December 2012	Feasibility Studies Report.
Approval of the Environmental Impact Assessment	9 January 2013	EIA Licence from Rwanda Development Board
Financial close (CDM Start Date)	14 February 2014	Financial close documents
Project construction is commenced	February 2014	Public media[11]
Commissioning Date	18 September 2014	Letter from the utility

d) Total GHG emission reductions or net GHG removals by sinks achieved in this monitoring period for the specific-case CPA(s), including information on how double counting is avoided.

Emission reductions in the monitoring period

The emissions sources and greenhouse gases involved include CO_2 emissions from electricity generation by fossil fuel fired power plants that is displaced due to the project activity. During the monitoring period in question i.e. (01 March 2017 to 31 August 2018) the ASYV 8.5MW solar PV project has delivered 20,495 MWh of renewable electricity to the Rwandan national grid. In accordance with the simplified baseline and monitoring methodology AMS-I.D (EB 81, Annex 24, version 18.0) *Grid connected renewable electricity generation*, the baseline scenario is “the 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 into the grid”. In line with the above guidance, the project has therefore displaced 20,495 MWh within this monitoring period corresponding to 13,526 tCO_2e being achieved.

[11] https://energiyaglobal.com/rwanda-field-reaches-financial-close-begins-construction/

A comprehensive description of the amount of electricity generation and the calculation of resulting emission reductions are provided in section G and section H of this report.

Avoidance of double counting

The project is the only MW-scale operational grid connected solar PV power plant in Rwanda and the CME has confirmed that it has not been registered as a standalone CDM project or included in any other PoA. This has been confirmed by consulting the CDM database for registered standalone CDM project activities and CPAs in Rwanda. Therefore, it can be confirmed that double counting of emission reductions will not occur.

C.2. Location of CPAs

The project is located in Rwamagana District, Rubona Sector, Karambi cell at the Agahozo-Shalom Youth Village (ASYV), approximately nine kilometres from the main Kigali-Kagitumba highway and about 50 km from Kigali.

The table and diagram below shows the geo-coordinates and location of the project site respectively.

Table 5: Project location coordinates

Latitude	Longitude
- 2.024050°	30.377978°
- 2.027697°	30.379181°
- 2.028694°	30.375042°
- 2.026692°	30.374444°

Figure7: Location of the CPA

C.3. Post-registration changes to CPAs

C.3.1. Temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies or standardized baselines

No deviations from the registered monitoring plan, applied methodology or applied standardized baseline.

C.3.2. Corrections

For the CPA 10202-0001 a post-registration change notification with a correction on the number of modules was submitted during the last issuance request and successfully approved. The monitoring in the current issuance request has been done in accordance with the approved post-registration changes.

As per the submitted CDM-CPA-PRC-FORM the notification date of the post registration date was 16/11/2017. The approval date being the date of issuance 3/01/2018. The post-registration change documentation can be found on the PoA issuance page on the UNFCCC website http://cdm.unfccc.int/PoAIssuance/iss_db/poaiss385618334/view.

C.3.3. Changes to the start date of the crediting period

For the CPA 10202-0001 a post-registration change notification with a change on the start date of the crediting period was submitted during the last issuance request and successfully approved. The monitoring in the current issuance request has been done in accordance with the approved post-registration changes.

As per the submitted CDM-CPA-PRC-FORM the notification date of the post registration date was 16/11/2017. The approval date being the date of issuance 3/01/2018. The post-registration change documentation can be found on the PoA issuance page on the UNFCCC website http://cdm.unfccc.int/PoAIssuance/iss_db/poaiss385618334/view.

C.3.4. Inclusion of monitoring plan

Not applicable.

C.3.5. Permanent changes to the included monitoring plans, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

For the CPA 10202-0001 a post-registration change notification on meter installation and accuracy of the main and back-up meters was submitted during the last issuance request and successfully approved. The monitoring in the current issuance request has been done in accordance with the approved post-registration changes.

As per the submitted CDM-CPA-PRC-FORM the notification date of the post registration date was 16/11/2017. The approval date being the date of issuance 3/01/2018. The post-registration change documentation can be found on the PoA issuance page on the UNFCCC website http://cdm.unfccc.int/PoAIssuance/iss_db/poaiss385618334/view.

C.3.6. Changes to project design

Not applicable

SECTION D. Description of monitoring system of CPAs

Overall authority and responsibility for monitoring rests with the CME, which is also responsible for managing the emission reduction monitoring and verification process. In order to enable verification of emission reductions each CPA must maintain credible, transparent and adequate data measurement, collection, estimation and tracking systems. The following monitoring procedures and responsibilities apply:

Roles and Responsibilities of the CPA implementing entity

Each CPA implementing entity under the PoA is responsible for the technical aspects related to on-site monitoring such as:

- Employment and training of personnel responsible for gathering and recording monitoring data
- Continuous measurement of electricity generated by the project activity
- Collecting metering information
- Storage of monitoring data
- Calibration and maintenance of main metering equipment according to the standards described in the PPA
- Submission of monitoring data to the CME

The CPA implementing entity for the CPA 0001 has appointed the managing director with the overall responsibility for the CPA, assisted by the asset manager, site manager and associate officers.

The table/diagram below shows an overview of the organizational structure for the operation and data monitoring of the CPA.

Title	Reports to	Roles and Responsibilities
Managing Director	Board of Directors	• Overall guidance and management • Receive information of decisions by the managers. • Provide final quality control of documents and contracts • Sign off final approval on documents and contracts • Be accountable for results, omissions, errors, etc. • Lead the management system improvement process • Supervise manager-level staff
Asset Manager	Managing Director	• Overall guidance on operations and maintenance of the power plant/CPA for the duration of the project • Overall guidance on record keeping of electricity generation and provide quality control. • Overall guidance on employment and training of personnel responsible for gathering and recording monitoring data • Overall guidance on the continuous measurement of electricity generated by the CPA • Overall guidance on the collection of metering information • Overall guidance on the calibration and maintenance of main metering equipment, according to appropriate standards or manufacturer specifications. • Provide supervision to the site manager
Site Manager	Asset Manager	• Responsible for operations and maintenance of the power plant/CPA for the duration of the project • Employment and training of personnel responsible for

		gathering and recording monitoring data • Provide supervision on the continuous measurement of electricity generated by the CPA • Provide supervision on the collection of metering information • Provide supervision on the calibration and maintenance of main metering equipment, according to appropriate standards or manufacturer specifications. • Maintenance of all equipment and machinery during the lifetime of the power plant • Ensure compliance with day-to-day tasks of the power plant e.g. inspections • Ensure adherence with the HSE regulations • Ensure adherence with the onsite emergency an evacuation procedure • Address any concerns from the local community in consultation with the local government and the project manager. • Provide supervision to the technical officers
Monitoring and Technical Officers	Site Manager	•Under supervision of the site manager, ensure the maintenance of the all equipment and machinery during the lifetime of the power plant. •Collection of metering information •Calibration and maintenance of main metering equipment, according to appropriate standards or manufacturer specifications •Under supervision of the site manager, ensure adherence to the HSE procedures.

The following parameters are being monitored by the CPA implementing entity:

Parameter	Description
$EG_{PJ,facility,y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y*

The CPA implementing entity of CPA 001 continuously monitors and keeps records of the quantity of net electricity supplied to the grid ($EG_{PJ,facility,y}$).

The CPA implementing entity is responsible for preparing invoices for the sales of electricity to the electricity off-taker, Rwanda Energy Group (REG). At the same time, the CPA implementing entity receives monthly invoices from Rwanda Energy Group (REG) for the consumption of electricity imported from the grid.

The quantity of electricity supplied to the grid as well as the electricity consumed from the grid are currently being reported to the CME on a quarterly basis for the previous three months and are accompanied by supporting evidence such as outgoing and incoming invoices for cross-checking purposes. Based on this, the CME is carrying out a calculation of net electricity supplied to the grid, utilised for calculation of emission reductions. The CPA has also set up an electronic system capable of storing CDM related data, at least until two years after the end of the last crediting period or the last issuance of CER, whichever will occur later.

The metering equipment installed at the CPA site can be distinguished in two systems:

1) The system that is responsible for metering both, the electricity exported to the grid as well as the power imported from the grid. The system has been implemented and is operated in line with

the provisions of the Power Purchase Agreement. The metering installation has been put in place at the Interconnection Point, at a voltage of 15 kV. The system includes a main- and a back-up meter which can be remotely interrogated and which is having an electronic communication link connected to the metering database of the Transmission Metering Administrator (TMA) or Distribution Metering Administration (DMA).

2) An auxiliary meter that meters the electricity consumed by some loads at the ASYV 8.5MW Solar PV project e.g. the site facility building and lighting. Since the meter is a sub-meter, the electricity consumed and measured by the auxiliary meter is also captured by the main meter and back-up meter. This meter is thus considered an “internal meter” that is not used for any billing purposes and is thus irrelevant for calculating the emission reductions generated by this CPA.

The CPA implementing entity is responsible for operation and maintenance of the main meter that measures the electricity exported to and imported from the grid. This includes:

- Calibration and maintenance of equipment
- Physical reading and day-to-day handling
- Quality Control and Quality assurance measures

The utility REG is responsible for operation and maintenance of the back-up meter.

Measuring of electricity exports to and imports from the grid, by the main and backup meters, is being conducted with calibrated measurement equipment in accordance with the relevant industry standards and specified in the Power Purchase Agreement.

Calibration of both the main and back-up meter is done in accordance with the PPA. Accordingly, an accuracy class for the meters of 0.2S for active power and 0.5 for reactive power applies. The CPA implementing entity is expected to test and calibrate the main metering system while testing and calibration of the backup meter remains the responsibility of the utility. Testing and calibration occurs at intervals of not less than ninety (90) days.

A single-line diagram of the power plant inclusive of the metering system is provided in the figure below:

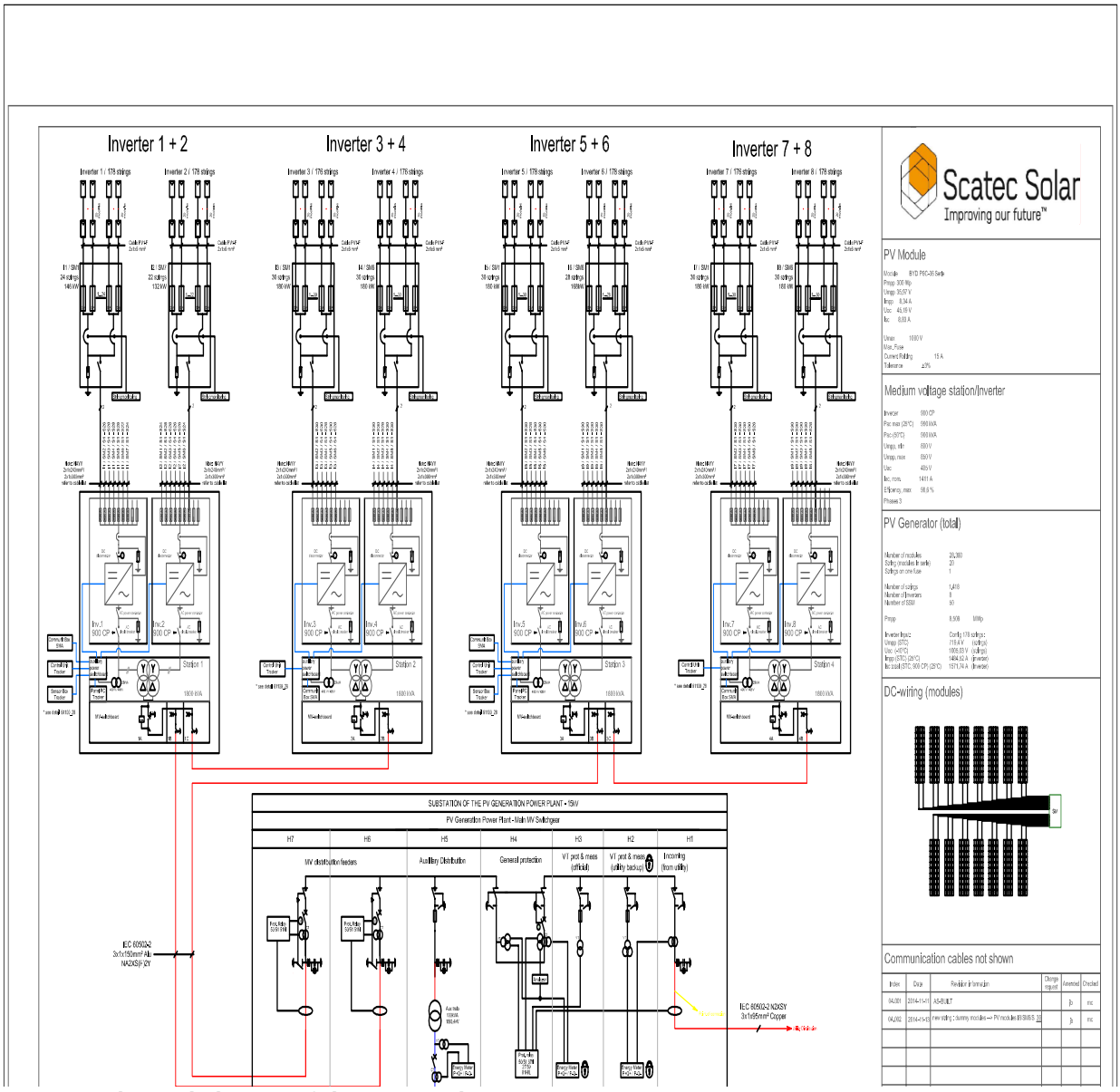

Figure 8: Schematic layout of the power plant

The meter(s) readings are readily accessible for the Designated Operational Entity (DOE) carrying out the verification of monitoring data.

Emergency procedures

For main and back-up meter measuring electricity exported to the grid:

The CPA implementer is responsible for reading the main metering system and the backup metering system on the last day of each month for the purpose of measuring the net energy output and shall give the utility prior notice before taking the reading. The CPA implementing entity will take a record of such readings together with photographic records and maintain a log of all such readings. In the event that the metering system is not in service as a result of maintenance, repairs, or testing or when the metering system is found to be inaccurate pursuant to the accuracy levels further outlined below, then assuming that the backup metering system is within the allowed limits of accuracy, the readings taken from the backup metering system shall be used during the period that the metering system is not in service.

When as a result of any test of the metering system is found to be inaccurate by more than two tenths (0.2%) or is otherwise functioning improperly, then the correct amount of electricity delivered to the purchaser for the actual period which inaccurate measurements were made, if any, shall be determined as follows:

a) First, the readings of the backup metering system, if any, shall be utilized to calculate the correct amount of electricity, unless a test of such backup metering system, as required by either party, reveals that the backup metering system is inaccurate by more than two tenths (0.2%) or is otherwise functioning improperly;
b) If the backup metering system is not within the acceptable limits of accuracy or is otherwise functioning improperly, then the project developer and the utility shall prepare an estimate of the correct reading on the basis of all available information including deliveries of electricity during periods of similar operating conditions when the metering system was registering accurately;
c) In the event that parties cannot agree on the actual period during which inaccurate measurements were made, the period during which measurements are to be adjusted shall be the shorter of i) One half of the period from the last previous test of the metering system, or ii) thirty (30) days immediately preceding the test which found the metering system to be inaccurate and
d) The difference between the previous payments by the utility for the period of inaccuracy or improper functioning and the recalculated amount shall be offset against or added to the next payment to the CPA implementer as appropriate

In the event that the utility and the project developer fail to agree upon an estimate following the steps outlined above, then the matter may be referred by either party for determination by an expert.

For main and back-up meter measuring electricity imported from the grid:

The main meter (owned by the CPA implementer) and the back-up meter (owned by the utility Rwanda Energy Group) have the capability of measuring both electricity exported by the project to the grid and electricity imported by the project from the grid, occurring during periods of either low generation or no generation (e.g. during the night). The CPA implementing entity is supplied with monthly invoices by the utility showing the meter readings and culminating to the total electricity imported from the grid for the given month.

In case no readings are available for a certain month, the CPA will carry out the following to estimate electricity consumption from the grid:

a) If actual electricity consumption data for the billing period subsequent to the billing period of which readings are missing is known, estimate power consumption for missing billing period as the difference of meter readings at the end of the previous billing period and end of subsequent billing period and subtract consumption during subsequent billing period.
b) If actual electricity consumption data for billing period subsequent to the billing period of which readings are missing, estimate power consumption for missing billing period as an average for the billing period in between the last two most recent meter readings.

A further quality check on invoices provided by the utility is carried out through comparison with minimum and maximum consumption during the last 12 months. In case a reading exceeds or is below the maximum or minimum consumption, the reading will be confirmed by dividing the amount billed by the applicable energy tariff. If such are not available or lead to a similar reading not within the applicable range, confirmation shall be sought with the utility.

Gigawatt Global Coöperatief U.A. - Coordinating/managing entity

The CME is responsible for the following:

- Training of CPA implementer on CDM monitoring requirements;

- Receiving monitored data from the CPA implementer;
- Storage of data for at least two years after the end of the last crediting period or the last issuance of CERs, whichever occurs later;
- Crosscheck of monitored electricity generation data with a copy of invoices and the proof of payment of those invoices;
- Confirm that the CPA implementer has operated the metering system in line with relevant regulations
- Preparation of monitoring report;

Provisions are in place for the CME to carry out quality control on the data upon receipt, calculate net electricity supplied to the grid and calculate resulting emission reductions before archiving into an electronic database. Subsequent to this, the CME is responsible for preparing monitoring reports for submission to the DOE for verification on a need-to basis. The CME has also made provisions for electronic data storage in a centralized database that is capable of storing data for at least two years following the end of the last crediting period or the last issuance of CERs, whichever will come later. The electricity data is stored together with copies of evidence to crosscheck for quality control. Such evidence includes but not limited to records of invoices to and from the utility or proof of payment of the invoices.

The database contains the following information:

- Name of the CPA
- CPA implementing entity and contacts
- GPS coordinates
- Technical description
- Installed capacity
- Number of verifications and associated monitoring periods
- Monitored data/parameters and relevant evidence
- Emission reductions monitored

Training

Provisions were put in place for the training and guidance for CPA 001 staff prior to the start of the crediting period. Undertaken as part of the mock monitoring exercise, the training and guidance session included:

- CDM project cycle and the significance of monitoring
- Management structure and work scope
- Components of the monitoring plan
- QA/QC procedures
- Monitoring parameters
- Preparation for verification
- Questions and answers

SECTION E. Data and parameters

E.1. Data and parameters fixed ex ante

Data/parameter	$NCV_{i,y}$
Unit	GJ/kg
Description	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

Value(s) applied	Fuel Type: NCV Heavy Fuel Oil[12]: 0.0398 Diesel Oil: 0.0414
Choice of data or measurement methods and procedures	IPCC default values are used, as there is no specific data from the fuel suppliers of the power plants and also not regional default values.
Purpose of data	Calculation of baseline emissions
Additional comments	Applicable only to grid emission factor calculations

Data/parameter	$EF_{CO2,i,y}$ / $EF_{CO2,m,i,y}$
Unit	tCO_2/GJ
Description	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	Fuel Type: Effective CO_2 Emission factor Heavy Fuel Oil[13]: 0.0755 Diesel Oil: 0.0726
Choice of data or measurement methods and procedures	IPCC default values are used, as there is no specific data from the fuel suppliers of the power plants and also not regional default values.
Purpose of data	Calculation of baseline emissions
Additional comments	Applicable only to grid emission factor calculations

Data/parameter	$EG_{m,y}$
Unit	MWh
Description	Net electricity generated by power plant/unit *m*in year *y*
Source of data	Rwanda Energy Group (REG)
Value(s) applied	See emission reduction spread sheet.
Choice of data or measurement methods and procedures	Data on electricity generation has been obtained from EWSA, the utility company in Rwanda and owner of the power plants.
Purpose of data	Calculation of baseline emissions
Additional comments	Applicable only to grid emission factor calculations The utility company has since been renamed from Energy Water and Sanitation Authority (EWSA) to Rwanda Energy Group (REG).

Data/parameter	FCi,m,y
Unit	Kg/year
Description	Amount of fossil fuel type i consumed by power plant / unit m in year y
Source of data	Rwanda Energy Group (REG)
Value(s) applied	See emission reductions spread sheet.

[12] The description of Residual Fuel Oil in the IPCC guidelines has been considered to closely match the description of Heavy Fuel Oil. Therefore, the NCV value for Residual Fuel Oil has been considered to be the same as that of Heavy Fuel Oil.

[13] The description of Residual Fuel Oil in the IPCC guidelines has been considered to closely match the description of Heavy Fuel Oil. Therefore, the CO_2 emission factor for Residual Fuel Oil has been considered to be the same as that of Heavy Fuel Oil.

Choice of data or measurement methods and procedures	Data on fuel consumption for electricity generation has been obtained from EWSA, the utility company in Rwanda and owner of the power plants.
Purpose of data	Calculation of baseline emissions
Additional comments	Applicable only to grid emission factor calculations The utility company has since been renamed from Energy Water and Sanitation Authority (EWSA) to Rwanda Energy Group (REG).

Data/parameter	$\eta_{m,y}$
Unit	Percentage
Description	Average net energy conversion efficiency of power unit *m* in year *y (ratio)*
Source of data	Defaults from the tool for average net energy of combined cycle engines.
Value(s) applied	60%
Choice of data or measurement methods and procedures	Publicly available sources suggest that the Methane Gaz power plant comprises gas engines of the otto cycle technology and therefore a combined cycle technology is applied. (http://www.wartsila.com/en/references/lake-kivu)
Purpose of data	Calculation of baseline emissions
Additional comments	Applicable only to grid emission factor calculations For the Methane Gaz power plant, only data on electricity generation and fuel type used was available from the utility company. Therefore, In accordance with the Tool to calculate the emission factor of an electricity System version 4, if only data on electricity generation and fuel types is available, then option A2 can be used to calculate the emission factor of an electricity system (EFel,m,y.). This parameter is part of the equation applied in these calculations.

E.2. Data and parameters monitored

Data/parameter	$EG_{PJ,facility,y}$
Unit	MWh/year
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y*
Measured/calculated/ default	Measured
Source of data	Electricity meters (main and backup)

Value(s) of monitored parameter

Start Date	End Date	Quantity of net electricity generation supplied to the grid (MWh)
1st March 2017	31st March 2017	1179
1st April 2017	30th April 2017	1168
1st May 2017	31st May 2017	1192
1st June 2017	30th June 2017	1236
1st July 2017	31st July 2017	1149
1st August 2017	31st August 2017	1102
1st September 2017	30th September 2017	1115
1st October 2017	31st October 2017	1119
1st November 2017	30th November 2017	1093
1st December 2017	31st December 2017	1145
1st January 2018	31st January 2018	1040
1st February 2018	28th February 2018	1047
1st March 2018	31st March 2018	1040
1st April 2018	30th April 2018	944
1st May 2018	31st May 2018	1125
1st June 2018	30th June 2018	1323
1st July 2018	31st July 2018	1356
1st August 2018	31st August 2018	1125
Total		**20495**

Monitoring equipment

The metering equipment installed to measure electricity exports to as well as imports from the grid in line with the provisions of the Power Purchase Agreement (PPA).

The metering installation consists of a Metering System (operated and maintained by the Project Implementer) and a Backup Metering System (operated and maintained by the Purchaser) (together, the "Metering Installation"). The Metering Installation has been installed at the Interconnection Point, at a voltage of 15 kV, and has a main electronic meter that can be remotely interrogated, which has an electronic communication link and which is connected to the metering database of the Transmission Metering Administrator (TMA) or Distribution Metering Administration (DMA). The Metering Installation measures the amount and direction of Active Power/Energy and Reactive Power/Energy.

The main and back-up meters also measure energy imported from the grid during periods of low generation or no generation (e.g. during the night).

Testing and inspection of both the Metering System and Backup Metering System is done at intervals of not less than 90 days. The Projects Implementer is responsible for the testing and inspection of the Metering System and the Purchaser takes responsibility for the Backup Metering System. The Project Implementer is required to give a seven (7) days' notice to the Purchaser before the Metering System testing is done and the Purchaser is supposed to have a representative present during testing.

Information on the type, accuracy class, serial number, calibration date, testing and inspection frequency is shown below.

Meter	Manufacturer	Model /Type	Serial number	Accuracy	Calibration date	Testing and Inspections
Metering System (main meter)	Landis+ Gyr	650E ZMD 402CT44	3507510704209	P: 0.2S Q: 0.5S	11/10/2016	24/07/2017 18/10/2017 24/01/2018 03/05/2018 14/08/2018
Backup Metering System (backup meter)	Landis+ Gyr	650E ZMD 402CT44.0457S3	3507510704191	P: 0.2S Q: 0.5S	14/07/2015	24/07/2017 18/10/2017 24/01/2018 03/05/2018 14/08/2018
Electricity meter secondary	Landis+ Gyr	650E ZMD 402CT44	3507510704217	P: 0.5S Q: 2	11/10/2016	

Measuring/reading/ recording frequency

The quantity of electricity supplied to and imported from the grid is monitored continuously, measured hourly and recorded at least monthly.

Calculation method (if applicable)

The net electricity exported/supplied to the Rwandan grid is then calculated as the difference between the measured quantities of the grid electricity supplied to the grid and delivered from the grid to the project.

QA/QC procedures	Records from the main meter of the quantity of electricity supplied by the project plant/unit to the grid will be crosschecked against billing records of electricity to the utility company (Rwanda Energy Group). If necessary, records can also be crossed checked with those of the backup meter. As per the PPA, main and back-up meter have to comply with an accuracy class of 0.2S for active power and 0.5S for reactive power. Calibration of the meters is carried out in accordance with the PPA and relevant industry standards. The CPA implementing entity is expected to test and inspect the main metering system while testing and inspection of the backup meter remains the responsibility of the utility. Following the initial installation and calibration, subsequent testing and inspection is expected to occur at intervals of not less than ninety (90) days. Electricity consumed at the plant is derived from the metering system which reads both ways and therefore able to record both imported and exported electricity. Records of electricity consumed by the project plant/unit are also sent to the CPA implementing entity from the utility company as electricity bills. A quality check on such data is carried out through comparison with minimum and maximum consumption during the last 12 months. In case a reading exceeds or is below the maximum or minimum consumption, the reading will be confirmed by dividing the amount billed by the applicable energy tariff. If such are not available or lead to a similar reading not within the applicable range, confirmation shall be sought with the utility.
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

E.3. Implementation of sampling plan

The project does not involve any sampling.

SECTION F. Calculation of emission reductions or net anthropogenic removals

F.1. Calculation of baseline emissions or baseline net removals

Baseline emissions
The baseline emissions for small-scale solar PV CPAs are the product of electrical energy baseline $EG_{PJ,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

The baseline emissions (BE_y) are calculated using **equation (1)** of AMS-I.D (version 18.0):

$$BE_y = EG_{PJ,y} * EF_{grid,y}$$

As per AMS-I.D (version 18.0):

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

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

Parameter	Value	Unit	Source
$EG_{PJ,facility,y}$	**Year** / **MWh** **01/03/2017 to 31/12/2017** 11,496 **01/01/2018 to 31/08/2018** 8,999 **Total** 20,495	MWh	Owner of the power plant collaborated by invoices to an from REG, the utility company in Rwanda

Calculation of $EF_{grid,y}$

The emission factor is calculated in a transparent and conservative manner using option (a), the combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures described in the *Tool to calculate the emission factor for an electricity system* (version 04.0). Therefore:

$$EF_{grid,y} = EF_{grid,CM,y}$$

Values to determine $EF_{grid,CM,y}$ for this solar PV CPA:

Parameter	Value	Unit	Source
$EF_{grid,BM,y}$	0.45	tCO_2/MWh	GEF calculations
w_{BM}	0.25		Default value
$EF_{grid,OM-DD,y}$	0.73	tCO_2/MWh	GEF calculations
w_{OM}	0.75		Default value
$EF_{grid,CM,y}$	0.66	tCO_2/MWh	GEF calculations

Therefore, for this monitoring period, the following values apply:

$EF_{grid,y}$ = 0.66 tCO_2/MWh

BE_y = 20,495 * 0.66 = 13,526 tCO_2/year

F.2. Calculation of project emissions or actual net removals

In accordance with paragraph 39 of the simplified baseline and monitoring methodology AMS-I.D (version 18.0), most renewable energy projects except for hydro and geothermal technology types, PE_y = 0. Since the CPA is of solar PV type, PE_y = 0.

F.3. Calculation of leakage emissions

No leakage emissions are considered since the CPA is not a biomass project activity.

F.4. Calculation of emission redutions or net anthropogenic removals

CPA UNFCCC reference number	Baseline GHG emissions or baseline net GHG removals (t CO_2e)	Project GHG emissions or actual net GHG removals (t CO_2e)	Leakage GHG emissions (t CO_2e)	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
10202-0001	13,526	0	0	0	13,526	13,526

Total	13,526	0	0	0	13,526	13,526

F.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the included CPA-DDs

<table>
<tr><th>CPA UNFCCC reference number</th><th>Amount achieved during this monitoring period (t CO2e)</th><th>Amount estimated ex ante (t CO2e)</th></tr>
<tr><td>10202-0001</td><td><table><tr><th>Year</th><th>Emission reductions (tCO_2e)</th></tr><tr><td>01/03/2017 – 31/08/2018</td><td>13,526</td></tr></table></td><td><table><tr><th>From</th><th>To</th><th>Emission reductions (tCO_2e)</th></tr><tr><td>01/03/ 2017</td><td>31/08/20 18</td><td>15,253</td></tr></table></td></tr>
<tr><td>Total</td><td>13,526</td><td>15,253</td></tr>
</table>

F.6. Remarks on increase in achieved emission reductions

The actual GHG emission reductions achieved for this monitoring period are not greater than the amount based on ex ante estimation in the registered PDD for the period covered in this monitoring report

This monitoring period runs from 1st March 2017 to 31st August 2018, which is also the period used to make the ex-ante estimations. As opposed to the ex-ante estimates of emission reduction which are based on electricity generation forecasts within the monitoring period, the actual amount achieved during the monitoring period selected is based on actual electricity generation amounts as read from the meters. Actual emission reductions are slightly lower compared to ex-ante forecasts due to lower irradiation levels as initially anticipated.