



**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	Accelerating Electrification through Grid Extension and Off-Grid Electrification in Rural Areas of Uganda	
UNFCCC reference number of the PoA	10186	
Version numbers of the PoA-DD applicable to this monitoring report	9.0	
Version number of this monitoring report	6.0	
Completion date of this monitoring report	23/08/2019	
Monitoring period number	Second Monitoring Period	
Duration of this monitoring period	04/05/2017 – 31/12/2017	
Monitoring report number for this monitoring period	1	
Coordinating/managing entity	Rural Electrification Agency Uganda	
Host Parties	Host Party of the PoA	Is this the host Party of a CPA covered in this monitoring report? (yes/no)
	The Republic of Uganda	Yes
Sectoral scopes	Sectoral Scope 1 – Energy Industries (renewable- / non-renewable sources) Sectoral Scope 2 – Energy Distribution	
Applied methodologies and standardized baselines	AMS-I.L Version 3 Electrification of Rural Communities Using Renewable Energy AMS-III.AR Version 5 Substituting Fossil Fuel Based Lighting with LED/CFL Lighting Systems AMS-III.BB Version 2 Electrification of Communities Through Grid Extension or Construction of New Mini-Grids	
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 tCO ₂ e	26,536 tCO ₂ e

Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the CPA-DDs for the CPAs covered in this monitoring report

62,755 tCO₂e

PART I Monitoring of programme of activities (PoA)

SECTION A. Description of PoA

A.1. General description of PoA

Policy Measure/Stated Goal:

The micro-scale PoA will expanded access to electricity in Uganda through extensions of existing grids (AMS-III.BB Version 2), off-grid electrification (AMS-I.L Version 3), and solar powered lighting systems (AMS-III.AR Version 5). The proposed PoA combined these three methodologies to increase access to electricity within the PoA boundary. CPAs under the PoA implements AMS-I.L, AMS-III.AR, or AMS-III.BB methodologies. The proposed PoA covers sectoral scopes 1 and 2.

The Government has articulated the “Uganda Vision 2040” that lays out broad policy directives and sets out a target of increasing access to electricity to 80 per cent by 2040. The First Rural Electrification Strategy and Plan (RESP-1) set the target of electrification rate in rural area from 1% in 2001 to 10% in 2010. However, the implementation of RESP-1 has been slow-paced. The rural access to electricity as of mid 2013 is reported to be around 7%¹.

To address the challenges of low electricity access rates, a new Rural Electrification Strategy and Plan (2013-2022) (RESP II) was formulated by the Ministry of Energy and Mineral Development (MEMD) and approved by the Cabinet in July 2013 that aims to increase access to electricity in the rural areas to 26% by the year 2022. This would require 140,000 connections from solar home systems (SHS) and mini-grids and 1.3 million new grid connections.

The proposed PoA reduces greenhouse gas emissions by electrifying households and institutions in Uganda through installation of renewable energy systems, distribution of LED/CFL lighting systems, or connection to the national grid, thereby reducing the consumption of fossil fuels used in the current scenario and preventing emissions of greenhouse gases.

Framework for the Implementation of the PoA:

The PoA increases access to electricity within the PoA boundary through three types of technologies. The PoA covers grid extension, off-grid electrification, and solar powered LED lighting systems. The PoA implements these three technology types through the following methodologies:

- AMS-I.L Version 3 Electrification of Rural Communities Using Renewable Energy
- AMS-III.AR Version 5 Substituting Fossil Fuel Based Lighting with LED/CFL Lighting Systems
- AMS-III.BB Version 2 Electrification of Communities Through Grid Extension or Construction of New Mini-Grids

CPAs under the PoA implement AMS-III.BB Version 2 (Type A), AMS-III.AR Version 5 (Type B), or AMS-I.L Version 3 (Type C).

¹ Uganda Bureau of Statistics. Uganda Rural Electrification Survey 2012. December 2013. Page 20.

The implementation of the PoA is managed by the CME. The CME works with the service and technology providers to facilitate connections to the national grid (CPA Type A), distribution of LED/CFL lighting systems (CPA Type B), or electrify rural communities using renewable energy (CPA Type C). For all CPA types, the CME acts as a coordinator and operate the electronic data management system that stores information on and track all technologies under the PoA.

Under Type A CPAs, the CME acts as the CPA Implementer. Service Providers (SPs) govern grid-connections in the 13 different service territories in Uganda. Under the proposed PoA the SPs work to facilitate the connection of households and institutions/SMEs to the national grid by reducing the connection fee, providing connection materials, or supporting the connection in other ways using the revenue from CER sales. The CME/CPA Implementer coordinates the extension of the national grid in the CPA boundary and disburse the financing and materials for the grid connections. The different Type A CPAs are distinguished from one another by the region they cover. Each Type A CPA covers one or more service territories within the PoA boundary

Under Type B CPAs, the CME works with manufacturers and distributors of solar powered lighting systems to distribute solar powered efficient lights to end-users within the PoA boundary. The CME acts as the CPA Implementer. The CME/CPA Implementer will select and manage the distribution of technologies under Type B CPAs as well as oversee the data collection process for monitoring and verification. Manufacturers will produce the technologies distributed under the CPA and distributors will import and perform last mile distribution of technologies. Revenues from the sale of CERs will go to subsidize the cost of the lighting system, support the distribution of the technology, or educate end-users on the benefits of solar powered lighting systems.

Under Type C CPAs, the CME will act as the CPA Implementer, to provide electricity to off-grid rural communities. The CME/CPA Implementer will select and manage the distribution of technologies under Type C CPAs as well as oversee the data collection process for monitoring and verification. Solar vendors will import and distribute the technologies under the CPA and work with the CME/CPA Implementer to collect the required end-user information. The solar vendors will provide solar power systems under the PoA to the end-user at a lower up front or financing cost depending on the business model of the solar vendor.

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
<p>Title: Accelerating Electrification through Grid Extension and off-grid electrification in Rural Areas of Uganda CPA</p> <p>CPA Type: Generic CPA Type A</p>	9.0	2	<p>AMS-III.BB Electrification of communities through grid extension or construction of new mini-grids Version 2.0²</p> <p>AMS-I.D Grid connected renewable electricity generation Version 18.0³</p> <p>AMS-I.F Renewable electricity generation for captive use and mini-grid Version 3.0⁴</p> <p>AMS-I.L Electrification of rural communities using renewable energy Version 3.0⁵</p> <p>AM0045 Grid connection of isolated electricity systems Version 2.0⁶</p> <p>AM0104 Interconnection of electricity grids in countries with economic merit order dispatch Version 2.0⁷</p> <p>Tool to calculate the emission factor for an electricity system Version 4.0⁸</p> <p>General Guidelines for SSC CDM methodologies Version 20.0⁹</p> <p>Standard on sampling and surveys for CDM project activities and PoAs Version 2.0¹⁰</p>

² <https://cdm.unfccc.int/methodologies/DB/TI8KFU0GX1JBYZLOIJ6OMCSVYXCZUJ>

³ <https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK>

⁴ <https://cdm.unfccc.int/methodologies/DB/9KJWQ1G0WEG6LKHX21MLPS8BQR7242>

⁵ <https://cdm.unfccc.int/methodologies/DB/CCZKY3FSL1T28BNEGDRSCKS0CY0WVA>

⁶ <https://cdm.unfccc.int/methodologies/DB/0XHXSW8OSSITEWX2YMKTBIL4R05OX5>

⁷ <https://cdm.unfccc.int/methodologies/DB/OEZDV2912B4QUOOC5W7RC2JDP9BQTD>

⁸ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf>

⁹ http://cdm.unfccc.int/Reference/catalogue/document?doc_id=000003495

¹⁰ https://cdm.unfccc.int/public_inputs/2011/eb63_05/draft_standard_sampling.pdf

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Title: Accelerating Electrification through Solar Lamps in Rural Areas of Uganda CPA CPA Type: Generic CPA Type B	9.0	1	AMS-III.AR Substituting fossil fuel based lighting with LED/CFL lighting systems Version 5.0 ¹¹ AMS-I.D Grid connected renewable electricity generation Version 18.0 ¹² AMS-I.F Renewable electricity generation for captive use and min-gird Version 3.0 ¹³ General guidelines for SSC CDM methodologies Version 20.0 ¹⁴
Title: Accelerating Electrification through SHS in Rural Areas of Uganda CPA CPA Type: Generic CPA Type C	9.0	1	AMS-I.L Electrification of Rural Communities Using Renewable Energy Version 3.0 ¹⁵ AMS-I.D Grid connected renewable electricity generation Version 18.0 ¹⁶ AMS-I.F Renewable electricity generation for captive use and min-gird Version 3.0 ¹⁷ General guidelines for SSC CDM methodologies Version 20.0 ¹⁸ General guidance on leakage in biomass project activities Version 3.0 (attachment C to Appendix B) ¹⁹

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)
Accelerating Electrification through Grid Extension and off-grid electrification in Rural Areas of Uganda CPA 1	Title: Accelerating Electrification through Grid Extension and off-grid electrification in Rural Areas of Uganda CPA CPA Type: CPA Type A	9.0	Type: Fixed Duration: 28/08/2015 to 27/08/2025	Yes

¹¹ <http://cdm.unfccc.int/methodologies/DB/4K7KI9GY79UEHUKF3140PCID64IXCV>¹² <https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTFQQOFQQH4SBK>¹³ <https://cdm.unfccc.int/methodologies/DB/9KJWQ1G0WEG6LKHX21MLPS8BQR7242>¹⁴ http://cdm.unfccc.int/Reference/catalogue/document?doc_id=000003495¹⁵ <https://cdm.unfccc.int/methodologies/DB/CCZKY3FSL1T28BNEGDRSCKS0CY0WVA>¹⁶ <https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTFQQOFQQH4SBK>¹⁷ <https://cdm.unfccc.int/methodologies/DB/9KJWQ1G0WEG6LKHX21MLPS8BQR7242>¹⁸ http://cdm.unfccc.int/Reference/catalogue/document?doc_id=000003495¹⁹ https://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid04.pdf

Reference Number: 10186-0001				
Accelerating Electrification through Grid Extension and off-grid electrification in Rural Areas of Uganda CPA 2	Title: Accelerating Electrification through Grid Extension and off-grid electrification in Rural Areas of Uganda CPA	9.0	Type: Fixed Duration: 04/05/2017 to 03/05/2027	Yes
Reference Number: 10186-0002	CPA Type: CPA Type A			

A.2. Coordinating/managing entity

The Rural Electrification Agency Uganda (REA) is the CME of the PoA.

REA is a semi- autonomous agency under the Minister of Energy and Mineral Development through Uganda's Statutory Instrument 2001 no. 75, to operationalize the government's rural electrification function under a public-private partnership. It functions as the secretariat of the Rural Electrification Board which carries out the Minister's rural electrification responsibilities, as defined in the Electricity Act of 1999.

SECTION B. Implementation of PoA

B.1. Description of implemented PoA

To date, REA has worked with the Service Providers (SPs) to implement Type A CPAs, e.g. facilitating the extension of the national grid to connect end-users to the grid. The various measures used to facilitate the connection of households and institutions/SMEs to the national grid included reducing the connection fee, providing connection materials, or wholesale purchase of connection materials.

The two included CPAs included under the PoA to date cover all 13 service territories in Uganda. With CPA 1 covering 1 and CPA 2 covering the remaining 12. For this monitoring report, 4 Service Providers have provided monitoring data to determine the resulting emission reductions. The table below summarizes the respective service providers, number of connections, electricity consumed, and estimated emission reductions for the monitoring period.

Table 1 Overview of Connections under the PoA

Service Provider	Total Connections	Power Consumed (kWh)	Resulting Emission Reductions (tCO ₂ e)
UMEME	53,354	10,642	19,747
KRECS	1,588	324	578
BECS	937	122	286
KIL	4,042	1601	3,296
Total	59,921		

The SPs track the number of connections made in an electronic database. End-user information, meter number, and GPS coordinates (when available) are recorded in the system and reported to the CME.

Specific CPA Types B and C have not been included under the PoA to date.

B.2. Post-registration changes to PoA**B.2.1. Corrections**

The following PRCs were completed prior to this verification:

Reference Number: PRC-10186-001

Date of Approval: 15/07/2017

This PRC covered changes to the programme design, described under B.2.4.

Reference Number: PRC-10186-002

Date of Approval: 13/01/2019

Corrections have been made to the eligibility criterion regarding double counting and to relevant sections of the PoA and CPA Type A to correct the unique identifier to be GPS coordinates and/or meter serial numbers as an example.

Revisions have been made to various sections of the design document as the document was updated to the latest template. From Version 5.0 to Version 8.1.

Reference to the “Guidelines on the demonstration of additionality of small-scale project activities Version 9.0” has been removed from section I.1 of Generic CPA Type B and Generic CPA Type C, as additionality is shown at the PoA level and is not applied by the CPAs.

B.2.2. Inclusion of monitoring plan

Reference Number: PRC-10186-002

Date of Approval: 13/01/2019

The monitoring plan has been added to generic CPA Type A at the time of the first verification of the first CPA.

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

Reference Number: PRC-10186-002

Date of Approval: 13/01/2019

A permanent deviation of monitoring from the applied methodology was included through a PRC to follow AMS-III.BL Version 1 for determination of project emissions. The deviation is requested as AMS-III.BB Version 2 requires the grid emission factor of any country from which electricity is imported to be determined. As Uganda imports electricity from both Kenya and Rwanda, the guidelines in AMS-III.BB Version 2 would require three grid emission factors to be determined. Deviating from AMS-III.BB Version 2, to apply the guidelines to determine the project emission grid emission factor as per AMS-III.BL Version 1 is simpler and applies specifically to LDCs, which the project is implemented in.

B.2.4. Changes to programme design

Reference Number: PRC-10186-001

Date of Approval: 15/07/2017

The boundary type A CPAs was originally specified as covering a single service territory within the PoA boundary. As the restriction on CPA size limits has been revised to apply either at the CPA level or at the CPA unit level, the boundary of a type A CPA was revised to cover one or more service territories in the PoA boundary. The boundary of CPAs Type B and C were revised from 2 years to 5 years of technologies implemented since the start date.

In addition, the size limit for all CPA types under the PoA was revised to reflect Methodological Tool 19 Version 7 *Demonstration of additionality of microscale project activities* in the eligibility criteria.

PART II Monitoring of CPAs

Title: Accelerating Electrification through Grid Extension and off-grid electrification in Rural Areas of Uganda CPA 1

Reference Number: 10186-0001

SECTION C. Implementation of CPAs

C.1. Description of implemented CPAs

The CPA expanded access to electricity in the various service territories of Uganda through extensions of existing grids to increase access to electricity within the CPA boundaries.

The Government has articulated the “Uganda Vision 2040” that lays out broad policy directives and sets out a target of increasing access to electricity to 80 per cent by 2040. The First Rural Electrification Strategy and Plan (RESP-1) set the target of electrification rate in rural area from 1% in 2001 to 10% in 2010. However, the implementation of RESP-1 has been slow-paced. The rural access to electricity as of mid 2013 is reported to be around 7%²⁰.

The CPA increased access to electricity within the CPA boundary through grid extension, i.e. connecting households and institutions/SMEs to the national grid, who were not connected prior to the implementation of the project activity. The PoA implements these two technology types through the following methodologies:

- AMS-III.BB Version 2 Electrification of Communities Through Grid Extension or Construction of New Mini-Grids

The CPA covered the extension of the national grid with the goal of electrifying communities who prior to the project activity did not have access to the national grid. The first connection under the CPA was made on 27/06/2015 and the total number of connections at the end of the monitoring period under the CPA is 4,042.²¹ The CME operated the CPA under the PoA. For the CPA, the CPA Implementer and CME are the same entity. The CME has done the following under the CPA:

- Manage the extension of the national grid and connection of households and institutions to the national grid, as implemented by Service Providers governing connections to the national grid in the service territory, by setting connection targets and designating regions of focus within the geographic boundary
- Collect and aggregate the information required for monitoring of the CPA and liaise with the CDM EB during the lifetime of the CPA
- Disperse connection materials to the Service Provider in the CPA boundary in this case Kilembe Investments Limited
- Communicate with households and SMEs/Institutions connected under the project activity during the life of the project concerning monitoring of the activity

²⁰ Uganda Bureau of Statistics. Uganda Rural Electrification Survey 2012. December 2013. Page 20.

²¹ Emission Reduction Worksheet for MR 2 V2.xls

The CPA covers one service territory managed by Kilembe Investment Trust (KIL). This Service Provider has progressively engaged in commercial distribution and sale of grid electricity as a Licensee by the Electricity Regulatory Authority. The Service Provider purchases the energy from Uganda Electricity Transmission Company Limited (UETCL) and sell to the end consumer at a tariff determined by the Electricity Regulatory Authority.

The Service Provider uses the prepayment system with some under the card prepayment system and others have keypad-prepaid meters. The Service Provider records a date of connection for every customer in its database. Only customers with a connection date after the start date of the CPA will be included in the monitoring of the CPA for the purpose of determining the emissions reductions achieved.

The connection of the consumers was made possible through extension of the grid as follows:

1. Medium Voltage 33kV Power lines
188 km of three-phase 33 kV overhead power line comprising of 50/100 mm² AAAC conductors, treated wooden poles and pole hardware accessories as per BS 1320 standard as well as pole mounted transformer sub-stations.
2. Low Voltage Distribution System Network
166.35 km of 415/240V low voltage distribution lines comprising of 50 mm² AAAC conductors, treated wooden poles and hardware accessories as per BS 1320 standard.

The purpose of the CPAs is to provide access to electricity to households in the CPA boundaries through grid connection to a national/regional grid. Carbon revenues earned under the CPAs is used to:

- Finance grid connections; and
- Build capacity for the provision of the supported technologies/measures within the CPA boundary; and
- Educate consumers and increase awareness of the availability and proper use of the technologies/measures to be implemented under the CPA.

The following diagram shows the different monitoring points for the CPA.

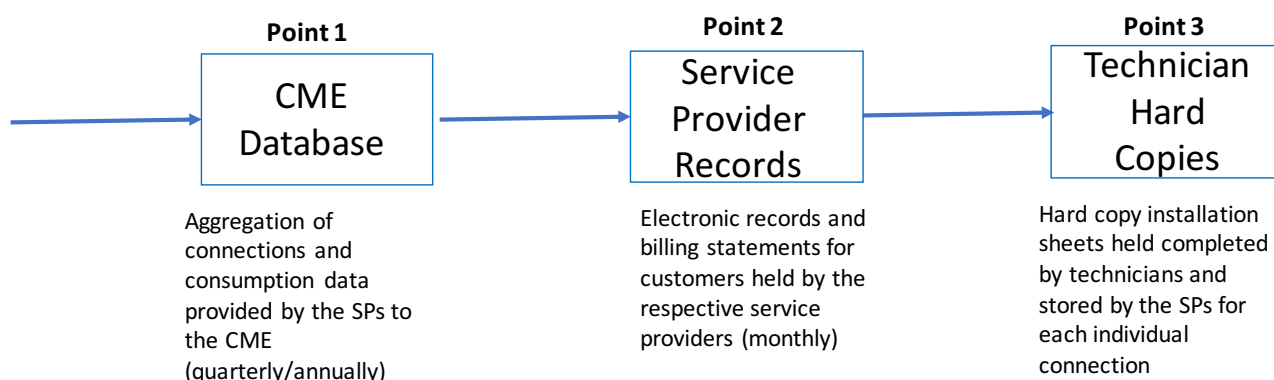
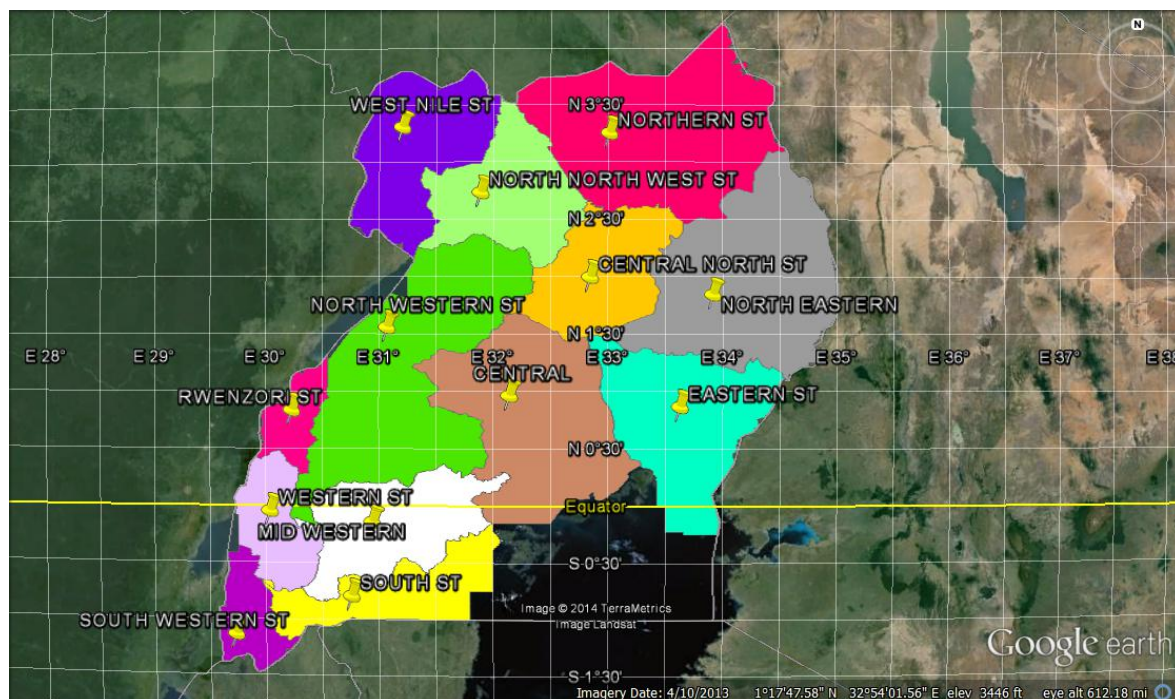


Figure 1 Monitoring Points of the CPA

The emission reduction calculations are based on the aggregated data from Monitoring Point 1. The consumption of each end-user can be validated from the billing records of the Service Provider in the Service Provider's electronic accounting system (Monitoring Point 2). The end-user information and meter numbers can in turn be validated by the technicians information, recorded at the time of installation and housed at the Service Provider.

C.2. Location of CPAs

The boundary of CPA 10186-0001 is the Western Service Territory of Uganda. The Western Service Territory is shown in the image below.



The image above shows the country of Uganda and the different service territories. The Western Service Territory is labelled in lilac.

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

There are no temporary deviations from the monitoring plans in the included CPA-DD, applied methodologies or standardized baselines during this monitoring period, the CPA covered in this monitoring report.

C.3.2. Corrections

The following PRC was completed prior to this verification:

Reference Number: PRC-10186-001

Date of Approval: 15/07/2017

This PRC covered changes to the project design, described under C.2.4.

CPA-DD Version: 7.0

Date of Completion: 15/01/2019

DOE Validation Report Date: 23/01/2019

Corrections have been made to the eligibility criterion regarding double counting and to relevant sections of the CPA to correct the unique identifier to be GPS coordinates and/or meter serial numbers as an example.

Revisions have been made to various sections of the design document as the document was updated to the latest template. From Version 4.0 to Version 8.1.

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

There are no changes to the start date of the crediting period fixed at the inclusion of the CPA covered in this monitoring report.

C.3.4. Inclusion of monitoring plan

Reference Number: PRC-10186-003

Date of Approval: 13/03/2019

Summary of Changes:

There have been post-registration changes to include a monitoring plan into the CPA-DD, for which the delayed submission of the monitoring plan was chosen by the CME at the time of inclusion of the CPA.

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

Reference Number: PRC-10186-003

Date of Approval: 13/03/2019

Summary of Changes:

A permanent deviation has been included in the CPA, to follow AMS-III.BL Version 1 for determination of project emissions. The deviation is requested as AMS-III.BB Version 2 requires the grid emission factor of any country from which electricity is imported to be determined. As Uganda imports electricity from both Kenya and Rwanda, the guidelines in AMS-III.BB Version 2 would require three grid emission factors to be determined. Deviating from AMS-III.BB Version 2, to apply the guidelines to determine the project emission grid emission factor as per AMS-III.BL Version 1 is simpler and applies specifically to LDCs, which the project is implemented in.

C.3.6. Changes to project design

Reference Number: PRC-10186-001

Date of Approval: 15/07/2017

Summary of Changes:

To date, the following changes have been made to the project design. The size limit for the CPA has been revised to reflect changes at the PoA level and references Methodological Tool 19 Version 7 *Demonstration of additionality of microscale project activities*. In addition, the boundary of a Type A CPA was revised to cover one or more service territories at the PoA level. The specific CPA only covers one service territory as at the time of registration.

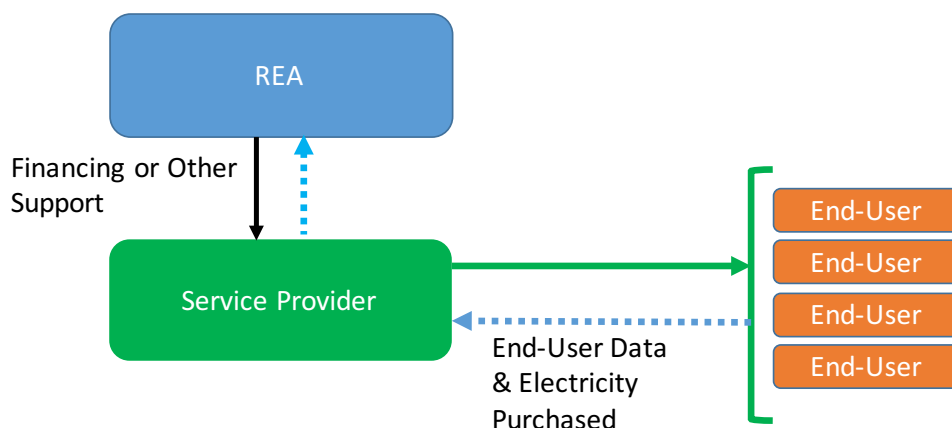
SECTION D. Description of monitoring system of CPAs

The information collected for the CPA is the following:

Information	Source	Provider	Required for
GPS Coordinates the Connected User / Meter Serial Number	Service Records	Provider	Methodology Eligibility
Connection Date	Service Records	Provider	Parameter Determination
End-User Name	Service Records	Provider	Sampling
End-User Contact Number	Service Records	Provider	Sampling
End-User Type (Household/SME)	Service Records	Provider	Methodology Eligibility

The GPS coordinates of each household or SME/institution and/or meter serial number under the CPA is recorded to ensure the connection is unique. End-users without GPS coordinates or meter numbers cannot be counted under the CPA during monitoring. In addition, the type of end-user needs to be tracked (household or SME/institution) as the methodology requires at least 75 percent of the end-users to be households.

The information flow diagram for Type A CPAs is shown below.



The emission reductions under CPA is determined through the following equations.

$$ER_y = BE_y - PE_y - LE_y$$

Where

ER_y Emission reductions in year y (tCO₂e/y)

BE_y Baseline emission in year y (tCO₂e/y)

PE_y Project emissions in year y (tCO₂e/y)

LE_y Leakage emissions in year y (tCO₂e/y)

Under the CPAs both project emissions are baseline emissions are determined. Leakage emissions are considered zero. Baseline emissions are calculated as per the equations below.

$$BE_y = BE_{55,y} + BE_{250,y} + BE_{250 \text{ plus},y}$$

Where

BE_y	Baseline emissions in the year y ; tCO ₂
$BE_{55,y}$	Aggregate baseline emissions for facilities that consumed equal to or less than 55 kWh of electricity from project electricity systems in year y ; tCO ₂
$BE_{250,y}$	Aggregate baseline emissions for facilities that consumed more than 55 kWh but equal to or less than 250 kWh of electricity from project electricity systems in year y ; tCO ₂
$BE_{250 \text{ plus},y}$	Aggregate baseline emissions for facilities that consumed greater than 250 kWh of electricity from project electricity systems in year y ; tCO ₂

As in the equation above, there are different tiers of energy consumption under the methodology ranging from 0 – 55 kWh, 55 – 250 kWh, and greater than 250 kWh. Each tier has an emission factor. The emission factors are 6.8, 1.3, and 1.0 (t CO₂e per MWh), respectively.

The total electricity purchased during the monitoring period is used to determine the tier within which the end-user. The electricity recorded through the pre-paid meters by each end-user the monitoring period is taken from the accounts of the service provider, which shows the total units purchased during the monitoring period. Electricity consumption for each consumer is the summation of the pre-paid electricity purchased during the monitoring period, excluding the last purchase during the monitoring period but including the last purchase of the previous monitoring period.

The emission reductions for each tier are calculated as follows:

$$BE_{55,y} = \sum_x EG_{x,y} * EF_{CO_2,55}$$

Where

$EG_{x,y}$	Electricity delivered by project electricity system to facility x , where the electricity delivered to that facility is equal to or less than 55 kWh in year y ; MWh
$EF_{CO_2,55}$	6.8 tCO ₂ /MWh

$$BE_{250,y} = \sum_z ((EG_{z,y} - 0.055) * EF_{CO_2,250} + C)$$

Where

$EG_{z,y}$	Electricity delivered by project electricity system to facility z in year y , where the electricity delivered to the facility is more than 55 kWh but equal to or less than 250 kWh in year y ; MWh
$EF_{CO_2,250}$	1.3 tCO ₂ /MWh
x	Facility supplied with electricity from operating project electricity systems consuming more than 55 kWh but equal to or less than 250 kWh in year y
C	0.374 (tCO ₂), a constant calculated as (0.055 MWh x 6.8 tCO ₂ /MWh)

$$BE_{250 \text{ plus},y} = \sum_w ((EG_{w,y} - 0.250) * EF_{CO_2,250 \text{ plus}} + D)$$

Where

$EG_{w,y}$	Electricity delivered by project electricity system to facility w in year y such that the electricity delivered to the facility is more than 250 kWh in year y ; MWh
$EF_{CO_2,250 \text{ plus}}$	1.0 tCO ₂ /MWh

<i>w</i>	Facility supplied with electricity from operating project electricity systems consuming more than 250 kWh in year <i>y</i>
<i>D</i>	0.6275 (tCO ₂), a constant calculated as (0.055 MWh x 6.8 tCO ₂ /MWh + 0.195 MWh x 1.3 tCO ₂ /MWh)

The purchase of electricity through the prepaid meter is deemed evidence of functionality of the connection. Connections without a purchase of electricity in the past six months are deemed inactive and not included in monitoring.

Project emissions are calculated as the total electricity consumed by all end-users under the CPA, multiplied by the grid emission factor for the national grid of Uganda. The number is adjusted to account for transmission and distribution losses. The emission factor for the national grid is 0.513 tCO₂ per MWh. The transmission and distribution losses are equal to 10 per cent, as per the methodology.

$$PE_y = (ED_{tot,y} * EF_{grid,CO2,y}) \div (1 - TL_{grid})$$

Where

<i>ED_{tot,y}</i>	Total electricity delivered to all new and existing consumers (MWh)
<i>EF_{grid,CO2,y}</i>	Emission factor of the project electricity system in year <i>y</i> (tCO ₂ /MWh)
<i>TL_{grid}</i>	Transmission and distribution losses in the project activity electricity system supplying the project activity (%)

SECTION E. Data and parameters

E.1. Data and parameters fixed ex ante

(This section is intentionally blank.)

Data / Parameter:	
Data unit:	
Description:	
Source of data:	
Value(s) applied:	
Choice of data or Measurement methods and procedures:	
Purpose of data	
Additional comment:	

E.2. Data and parameters monitored

Data/Parameter	EC _{T1M,j,y}
Unit	MWh/y
Description	Electricity metered at Type I consumers

Measured/calculated/default	Measurement of electricity through purchase records of pre-paid vouchers by consumer <i>j</i> .
Source of data	AMS-III.BB Version 2
Value(s) of monitored parameter	Consumption values for the monitoring period are shown in the emission reduction calculation worksheet. ²² Values for consumption for Type I and Type II consumers are shown in the following columns of the worksheet: "KIL Consumption Data" – Column Y
Monitoring equipment	Electricity Meters and electronic billing system
Measuring/reading/recording frequency	Monthly
Calculation method (if applicable)	Summation of purchases in a 12-month period in the monitoring period. Note that the 12 month period does not necessarily cover exactly a calendar year as the monitoring period starts on 04/05/2017. In addition, the monitoring period does not cover a single or multiple 12-month periods. Therefore, the 12-month consumption is used to determine the appropriate baseline emission factor, however only electricity consumed during the monitoring period is counted to determine the baseline emissions.
QA/QC procedures	
Purpose of data/parameter	Determination of baseline emissions
Additional comments	

Data/Parameter	EC _{T2,i,y}
Unit	MWh/y
Description	Electricity metered at Type II consumers
Measured/calculated/default	Measurements are undertaken using electricity meters at each of the Type II facilities
Source of data	AMS-III.BB Version 2
Value(s) of monitored parameter	Consumption values for the monitoring period are shown in the emission reduction calculation worksheet. ²³ Values for consumption for Type I and Type II consumers are shown in the following columns of the worksheet: "KIL Consumption Data" – Column Y
Monitoring equipment	Electricity Meters and electronic billing system
Measuring/reading/recording frequency	Continuous monitoring, hourly measurement and at least monthly recording
Calculation method (if applicable)	Summation of purchases in a 12-month period in the monitoring period. Note that the 12 month period does not necessarily cover exactly a calendar year as the monitoring period starts on 04/05/2017. In addition, the monitoring period does not cover a single or multiple 12-month periods. Therefore, the 12-month consumption is used to determine the appropriate baseline emission factor, however only electricity consumed during the monitoring period is counted to determine the baseline emissions.
QA/QC procedures	
Purpose of data/parameter	Determination of baseline emissions
Additional comments	

Data/Parameter	EF _{grid,CO2,y}
Unit	tCO ₂ /MWh

²² Emission Reduction Worksheet for MR 2 V2.xls

²³ Emission Reduction Worksheet for MR 2 V2.xls

Description	Emission factor of the project electricity system in year y
Measured/calculated/default	Calculated
Source of data	Power production records in Uganda in year y ²⁴
Value(s) of monitored parameter	0.00
Monitoring equipment	Electricity Meters
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	<p>As per paragraph 46 of AMS-III.BL Version 1, the emission factor for the project electricity system in year y is determined through Option 3, as the project is implemented in an LDC. Under Option 3, there are sub-options (i) and (ii). The default emission factor used is either 0.00 if the share of renewable energy mix is greater than 95% based on immediate three years average historical data, or the value from Table 6 of the methodology depending on the fuel mix of the grid.</p> <p>As shown in the calculation of the percentage of renewable energy mix in the grid for the previous 3 years (2015, 2016, and 2017), the percentage of renewable energy is 95.67 %. It follows that emission factor is 0.00 tCO₂/MWh.²⁵ Imported electricity has been treated as non-renewable.</p>
QA/QC procedures	Transparent data analysis and reporting
Purpose of data/parameter	Determination of project emissions
Additional comments	

Data/Parameter	f_{HH}
Unit	Fraction
Description	The fraction of end-users (by number) under the CPA that are households
Measured/calculated/default	Calculated
Source of data	Electronic database maintained by CME
Value(s) of monitored parameter	0.98
Monitoring equipment	N/A
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	The designation of the end user is determined at the time of installation of the solar power system. Each end-user is designated as either a household or a SME/Institution as shown in the monitoring plan. The total number of end users designated as households divided by the total number of end users gives the value of the parameter
QA/QC procedures	
Purpose of data/parameter	Eligibility
Additional comments	

²⁴ <https://www.era.or.ug/index.php/stats/generation-statistics/energy-generated>

²⁵ Uganda Grid Emission Factor V3.xlsx

Data/Parameter	Proportion of N _y and M _y having access to the grid
Unit	-
Description	Check for continued access to electricity
Measured/calculated/default	Measured
Source of data	-
Value(s) of monitored parameter	1.00
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Billing records are used in place of on-site checks. Any purchases within the a given year serve as evidence that the connection is active. As billing records are available for all connections under the CPA this parameter is not sampled.
QA/QC procedures	Transparent data analysis and reporting
Purpose of data/parameter	Determination of baseline emissions
Additional comments	

Data/Parameter	A _{def}
Unit	Hectares
Description	Area of land deforested in the construction of the interconnection lines
Measured/calculated/default	Measured
Source of data	Records from SPs and CME data
Value(s) of monitored parameter	0.0
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	The CME and the CPA Implementer do not construct any interconnection, transmission, or distribution lines under the CPA. Therefore the total hectares deforested is zero. Only the connection from the existing line to the household, wiring or the household, and installation of the meter is covered by the CPA.
QA/QC procedures	Transparent data analysis and reporting
Purpose of data/parameter	Determination of Leakage
Additional comments	

Data/Parameter	L _c
Unit	tCO ₂ /hectare
Description	Carbon stock per area (above ground, below ground, soil carbon, litter and dead biomass)
Measured/calculated/default	Measured
Source of data	Literature and/or studies
Value(s) of monitored parameter	59
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Not applicable

QA/QC procedures	Transparent data analysis and reporting
Purpose of data/parameter	Determination of Leakage
Additional comments	

E.3. Implementation of sampling plan

No parameters were determined using sampling.

SECTION F. Calculation of emission reductions or net anthropogenic removals

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

The monitoring period covers from 04/05/2017 through 31/12/2017. As the baseline emission factor for each end-user is based on their annual consumption level, the baseline emissions are determined for each end-user for each 12-month period, as shown in the emission reduction calculation worksheet.

Baseline emissions are calculated as follows:

$$BE_y = BE_{T1NM,y} + BE_{T1M,y} + BE_{T2,y} + BE_{exist,y}$$

Where

$BE_{T1NM,y}$ Baseline emissions for Type I-NM consumers in year y (tCO₂)

$BE_{T1M,y}$ Baseline emissions for Type I-M consumers in year y (tCO₂)

$BE_{T2,y}$ Baseline emission for Type II consumers in year y (tCO₂)

$BE_{exist,y}$ Baseline emissions of existing consumers i.e. baseline emissions from displacement of electricity from an existing mini-grid (tCO₂)

For the CPA, Option 2 under paragraph 14 of the methodology is used to determine baseline emissions.

Under the CPA, all end-users will be metered. It follows $BE_{T1NM,y}$ is equal to zero.

All end-users under the project activity will be metered through prepaid devices. As such there is no electricity consumption recorded from existing consumers sharing the same metering point under the project activity. It follows that $BE_{exist,y}$ is equal to zero.

Baseline emissions for Type I consumers are calculated as follows:

$$BE_{T1M,y} = \sum_{j=1}^{M_y} EC_{T1M,j,y} \times EF_{CO2,T1M}$$

Where

$EC_{T1M,y}$ Annual electricity consumption for all Type I-M consumers j in year y (MWh)

M_y Number of Type I-M consumers in year y

j	Type I-M consumer ($j = 1, 2, 3, \dots$)
$EF_{CO_2,T1M}$	<p>Emission factor for Type I-M consumers:</p> <ul style="list-style-type: none"> ○ If the electricity consumed during year y is equal to or less than 0.055MWh/y, then use a default value of 6.8 ○ If the electricity consumed during year y is less than or equal to 0.25 MWh/y but greater than 0.055 MWh/y then for the portion up to and including 0.055 MWh/y, use a default value of 6.8 and for the portion greater than 0.055 MWh/y, use a default value of 1.3. ○ If the electricity consumed during year y is greater than 0.25 MWh/y but less than 0.500 MWh/y then for the portion up to and including 0.055 MWh/y, use a default value of 6.8, for the portion greater than 0.055 MWh/y and less than 0.25 MWh/y use a default value of 1.3, and for the portion greater than 0.25 MWh/y use a default value of 1.0. ○ If the electricity consumed is greater than 0.500 MWh/y then use a default value of 1.0 for the entire portion.

Baseline emissions for Type II consumers are calculated as follows:

$$BE_{T2,y} = \sum_{i=1}^{N_y} EC_{T2,i,y} * EF_{CO_2,T2}$$

Where

$EC_{T2,i,y}$	Metered annual electricity consumption of Type II consumer i in year y (MWh)
$EF_{CO_2,T2}$	1.0 (tCO ₂ /MWh)
N_y	Type II consumer ($i = 1, 2, 3, \dots$)

Total baseline emissions for the 4,042 end-users under the CPA are determined for each end-user through summation of the annual usage through billing records and then multiplied by the corresponding emission factor. The summation is shown in the emission reduction worksheet.²⁶

$$BE_y = 1,609 \text{ tCO}_2\text{e}$$

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

Project emissions under a generic CPA are calculated as follows:

$$PE_y = (ED_{tot,y} * EF_{grid,CO_2,y}) \div (1 - TL_{grid})$$

Where

$ED_{tot,y}$	Total electricity delivered to all new and existing consumers (MWh)
$EF_{grid,CO_2,y}$	Emission factor of the project electricity system in year y (tCO ₂ /MWh)
TL_{grid}	Transmission and distribution losses in the project activity electricity system supplying the project activity (%)

²⁶ Emission Reduction Worksheet for MR 2 V2.xls

Project emissions are the summation of the consumption for each end-user multiplied by the national grid emission factor of Uganda.

$$PE_y = (808 \text{ MWh} * 0.00 \text{ tCO}_2\text{e/MWh}) / (1-0.1)$$

$$PE_y = 0.0 \text{ tCO}_2\text{e}$$

F.3. Calculation of leakage emissions

Leakage is assessed following baseline and monitoring methodology AM0045 "Grid connection of isolated electricity systems" where leakage is defined as follows:

$$LE_y = A_{def} * L_c$$

Where

A_{def} is the area of land deforested in hectares.

L_c is the carbon stock per unit area in tonnes of CO₂ per hectare.

The CPA Implementer of a generic CPA under the PoA will track leakage emissions arising due to transmission lines construction. All transmission lines constructed during the monitoring period in question within the CPA boundary will be reported to estimate the leakage emissions from this source in conjunction with credible literature on the carbon stock in the region.

Under this CPA no interconnection, transmission, or distribution lines are constructed. Therefore the total hectares deforested is zero. Only the connection from the existing line to the household, wiring or the household, and installation of the meter is covered by this CPA.

As A_{def} is zero, the parameter LE_y is zero as well.

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

CPA UNFCCC reference number	Baseline GHG emissions or baseline net GHG removals (t CO ₂ e)	Project GHG emissions or actual net GHG removals (t CO ₂ e)	Leakage GHG emissions (t CO ₂ e)	GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e)		
				Before 01/01/2013	From 01/01/2013	Total amount
10186-0001	1,609	0	0	0	1,609	1,609
Total	1,609	0	0	0	1,609	1,609

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

CPA UNFCCC reference number	Amount achieved during this monitoring period (t CO ₂ e)	Amount estimated ex ante (t CO ₂ e)
10186-0001	1,609	8,027
Total	1,609	8,027

F.6. Remarks on increase in achieved emission reductions

The monitoring period covers from 04/05/2017 through 31/12/2017. The ex-ante emissions for the CPA were estimated as follows:

2017 – 13,761 tCO₂e

Multiplying the respective year by the fraction of the year covered by the monitoring period yields the following:

2017: 13,761 tCO₂e * (7/12) = 8,027 tCO₂e

The amount achieved during the monitoring period is 1,609 tCO₂e. The discrepancy is due to the lower amount of connections active during the time period than previously expected. The ex-ante estimate assumed 16,000 connections in 2017. While the monitoring period only covers 4,042 connections under the CPA, which covers connections installed from the start of the CPA on 03/03/2015 through the end of the monitoring period on 31/12/2017.

PART III Monitoring of CPAs

Title: Accelerating Electrification through Grid Extension and off-grid electrification in Rural Areas of Uganda CPA 2

Reference Number: 10186-0002

SECTION C. Implementation of CPAs

C.1. Description of implemented CPAs

The CPA expanded access to electricity in the various service territories of Uganda through extensions of existing grids to increase access to electricity within the CPA boundaries.

The Government has articulated the “Uganda Vision 2040” that lays out broad policy directives and sets out a target of increasing access to electricity to 80 per cent by 2040. The First Rural Electrification Strategy and Plan (RESP-1) set the target of electrification rate in rural area from 1% in 2001 to 10% in 2010. However, the implementation of RESP-1 has been slow-paced. The rural access to electricity as of mid 2013 is reported to be around 7%²⁷.

The CPA increased access to electricity within the CPA boundary through grid extension, i.e. connecting households and institutions/SMEs to the national grid, who were not connected prior to the implementation of the project activity. The PoA implements these two technology types through the following methodologies:

- AMS-III.BB Version 2 Electrification of Communities Through Grid Extension or Construction of New Mini-Grids

The CPA covered the extension of the national grid with the goal of electrifying communities who prior to the project activity did not have access to the national grid. The first connection under the CPA was made on 01/08/2015 the total number of connections from the start of the CPA on 03/11/2014 through the end of the monitoring period on 31/12/2017 is 55,879.²⁸ The CME operated the CPA under the PoA. For the CPA, the CPA Implementer and CME are the same entity. The CME has done the following under the CPA:

- Manage the extension of the national grid and connection of households and institutions to the national grid, as implemented by Service Providers governing connections to the national

²⁷ Uganda Bureau of Statistics. Uganda Rural Electrification Survey 2012. December 2013. Page 20.

²⁸ Emission Reduction Worksheet for MR 2.xls

grid in the service territory, by setting connection targets and designating regions of focus within the geographic boundary

- Collect and aggregate the information required for monitoring of the CPA and liaise with the CDM EB during the lifetime of the CPA
- Disperse connection materials to the Service Provider in the CPA boundary in this case Kilembe Investments Limited
- Communicate with households and SMEs/Institutions connected under the project activity during the life of the project concerning monitoring of the activity

In the 12 territories covered by the CPA, Service Providers have progressively engaged in commercial distribution and sale of grid electricity as a Licensee by the Electricity Regulatory Authority. The Service Providers purchase the energy from Uganda Electricity Transmission Company Limited (UETCL) and sell to the end consumer at a tariff determined by the Electricity Regulatory Authority.

The Service Providers use the prepayment system with some under the card prepayment system and others have keypad-prepaid meters. The Service Providers record a date of connection for every customer in its database. Only customers with a connection date after the start date of the CPA will be included in the monitoring of the CPA for the purpose of determining the emissions reductions achieved.

The connection of the consumers was made possible through extension of the grid as follows:

3. Medium Voltage 33kV Power lines
188 km of three-phase 33 kV overhead power line comprising of 50/100 mm² AAAC conductors, treated wooden poles and pole hardware accessories as per BS 1320 standard as well as pole mounted transformer sub-stations.
4. Low Voltage Distribution System Network
166.35 km of 415/240V low voltage distribution lines comprising of 50 mm² AAAC conductors, treated wooden poles and hardware accessories as per BS 1320 standard.

The purpose of the CPAs is to provide access to electricity to households in the CPA boundaries through grid connection to a national/regional grid. Carbon revenues earned under the CPAs is used to:

- Finance grid connections; and
- Build capacity for the provision of the supported technologies/measures within the CPA boundary; and
- Educate consumers and increase awareness of the availability and proper use of the technologies/measures to be implemented under the CPA.

The following diagram shows the different monitoring points for the CPA.

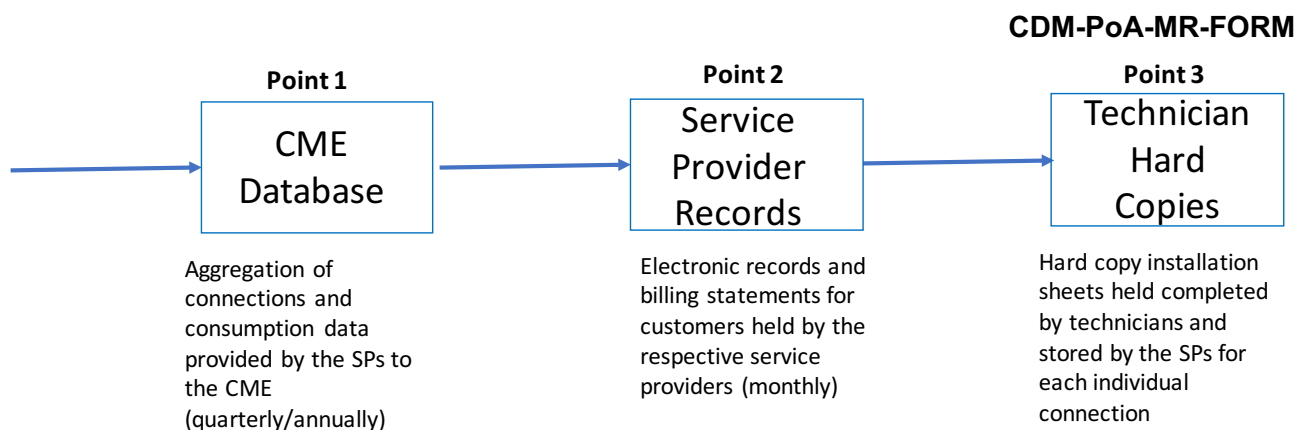


Figure 3 Monitoring Points of the CPA

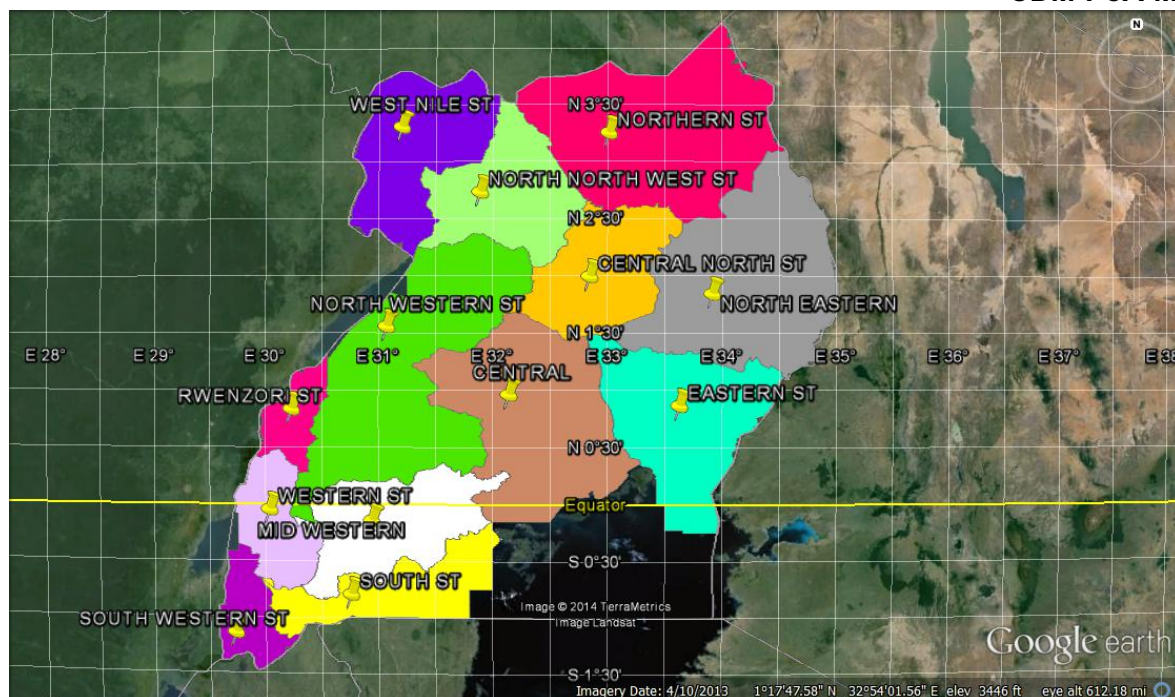
The emission reduction calculations are based on the aggregated data from Monitoring Point 1. The consumption of each end-user can be validated from the billing records of the SPs in the SPs electronic accounting system (Monitoring Point 2). The end-user information and meter numbers can in turn be validated by the technicians information, recorded at the time of installation and housed at the SPs.

C.2. Location of CPAs

The boundary of CPA 10186-0002 is the following Service Territories:

1. Rwenzori
2. Mid Western
3. South
4. South Western
5. North Western
6. Central
7. Eastern
8. North Eastern
9. Central North
10. North North West
11. Northern
12. West Nile

A map of the Service Territories is shown below. The CPA covers all the Service Territories in Uganda except for the Western Service Territory.



The image above shows the country of Uganda and the different service territories.

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

There are no temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies or standardized baselines during this monitoring period, for any CPAs covered in this monitoring report.

C.3.2. Corrections

Reference Number: PRC-10186-004

Date of Approval: 23/04/2019

Summary of Changes:

Corrections have been made to the eligibility criterion regarding double counting and to relevant sections of the CPA to correct the unique identifier to be GPS coordinates and/or meter serial numbers as an example.

Revisions have been made to various sections of the design document as the document was updated to the latest template. From Version 5.0 to Version 8.1.

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

There are no changes to the start date of the crediting period fixed at the inclusion of any of the CPAs covered in this monitoring report.

C.3.4. Inclusion of monitoring plan

Reference Number: PRC-10186-004

Date of Approval: 23/04/2019

There have been post-registration changes to include a monitoring plan into the CPA-DD, for which the delayed submission of the monitoring plan was chosen by the CME at the time of inclusion of the CPA.

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

Reference Number: PRC-10186-004

Date of Approval: 23/04/2019

A permanent deviation has been included in the CPA, to follow AMS-III.BL Version 1 for determination of project emissions. The deviation is requested as AMS-III.BB Version 2 requires the grid emission factor of any country from which electricity is imported to be determined. As Uganda imports electricity from both Kenya and Rwanda, the guidelines in AMS-III.BB Version 2 would require three grid emission factors to be determined. Deviating from AMS-III.BB Version 2, to apply the guidelines to determine the project emission grid emission factor as per AMS-III.BL Version 1 is simpler and applies specifically to LDCs, which the project is implemented in.

C.3.6. Changes to project design

There are no changes to the project design of the CPA included in this monitoring report.

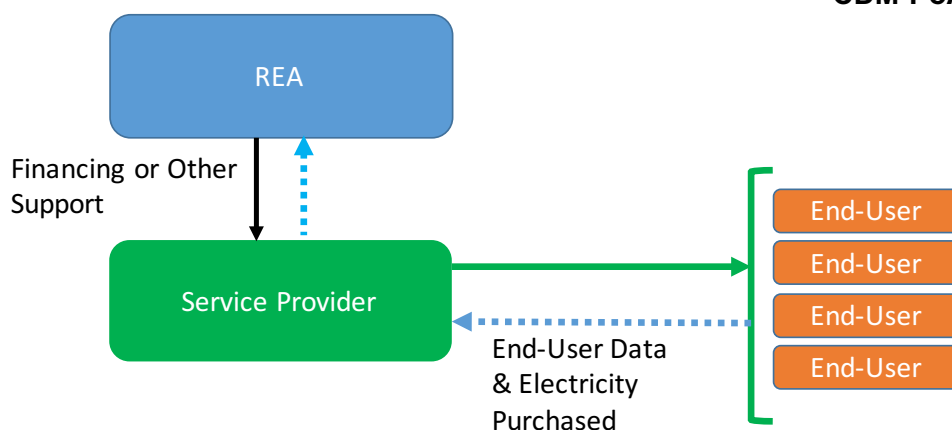
SECTION D. Description of monitoring system of CPAs

The information collected for the CPAs is the following:

Information	Source	Required for
GPS Coordinates the Connected User / Meter Serial Number	Service Provider Records	Methodology Eligibility
Connection Date	Service Provider Records	Parameter Determination
End-User Name	Service Provider Records	Sampling
End-User Contact Number	Service Provider Records	Sampling
End-User Type (Household/SME)	Service Provider Records	Methodology Eligibility

The GPS coordinates of each household or SME/institution and/or meter serial number under the CPA is recorded to ensure the connection is unique. End-users without GPS coordinates or a meter number cannot be counted under the CPA during monitoring. In addition, the type of end-user needs to be tracked (household or SME/institution) as the methodology requires at least 75 percent of the end-users to be households.

The information flow diagram for Type A CPAs is shown below.



The emission reductions under CPAs are determined through the following equations.

$$ER_y = BE_y - PE_y - LE_y$$

Where

ER_y Emission reductions in year y (tCO₂e/y)

BE_y Baseline emission in year y (tCO₂e/y)

PE_y Project emissions in year y (tCO₂e/y)

LE_y Leakage emissions in year y (tCO₂e/y)

Under the CPAs both project emissions and baseline emissions are determined. Leakage emissions are considered zero. Baseline emissions are calculated as per the equations below.

$$BE_y = BE_{55,y} + BE_{250,y} + BE_{250 plus,y}$$

Where

BE_y Baseline emissions in the year y ; tCO₂

$BE_{55,y}$ Aggregate baseline emissions for facilities that consumed equal to or less than 55 kWh of electricity from project electricity systems in year y ; tCO₂

$BE_{250,y}$ Aggregate baseline emissions for facilities that consumed more than 55 kWh but equal to or less than 250 kWh of electricity from project electricity systems in year y ; tCO₂

$BE_{250 plus,y}$ Aggregate baseline emissions for facilities that consumed greater than 250 kWh of electricity from project electricity systems in year y ; tCO₂

As in the equation above, there are different tiers of energy consumption under the methodology ranging from 0 – 55 kWh, 55 – 250 kWh, and greater than 250 kWh. Each tier has an emission factor. The emission factors are 6.8, 1.3, and 1.0 (t CO₂e per MWh), respectively.

The total electricity purchased during the monitoring period is used to determine the tier within which the end-user. The electricity recorded through the pre-paid meters by each end-user during the monitoring period is taken from the accounts of the service provider, which shows the total units purchased during the monitoring period. Electricity consumption for each consumer is the summation of the pre-paid electricity purchased during the monitoring period, excluding the last purchase during the monitoring period but including the last purchase of the previous monitoring period.

The emission reductions for each tier are calculated as follows:

$$BE_{55,y} = \sum_x EG_{x,y} * EF_{CO2,55}$$

Where

$EG_{x,y}$ Electricity delivered by project electricity system to facility x, where the electricity delivered to that facility is equal to or less than 55 kWh in year y; MWh

$EF_{CO2,55}$ 6.8 tCO₂/MWh

$$BE_{250,y} = \sum_z ((EG_{z,y} - 0.055) * EF_{CO2,250} + C)$$

Where

$EG_{z,y}$ Electricity delivered by project electricity system to facility z in year y, where the electricity delivered to the facility is more than 55 kWh but equal to or less than 250 kWh in year y; MWh

$EF_{CO2,250}$ 1.3 tCO₂/MWh

x Facility supplied with electricity from operating project electricity systems consuming more than 55 kWh but equal to or less than 250 kWh in year y

C 0.374 (tCO₂), a constant calculated as (0.055 MWh x 6.8 tCO₂/MWh)

$$BE_{250 plus,y} = \sum_w ((EG_{w,y} - 0.250) * EF_{CO2,250 plus} + D)$$

Where

$EG_{w,y}$ Electricity delivered by project electricity system to facility w in year y such that the electricity delivered to the facility is more than 250 kWh in year y; MWh

$EF_{CO2,250 plus}$ 1.0 tCO₂/MWh

w Facility supplied with electricity from operating project electricity systems consuming more than 250 kWh in year y

D 0.6275 (tCO₂), a constant calculated as (0.055 MWh x 6.8 tCO₂/MWh + 0.195 MWh x 1.3 tCO₂/MWh)

The purchase of electricity through the prepaid meter is deemed evidence of functionality of the connection. Connections without a purchase of electricity in the past six months are deemed inactive and not included in monitoring.

Project emissions are calculated as the total electricity consumed by all end-users under the CPA, multiplied by the grid emission factor for the national grid of Uganda. The number is adjusted to account for transmission and distribution losses. The emission factor for the national grid is 0.513 tCO₂ per MWh. The transmission and distribution losses are equal to 10 per cent, as per the methodology.

$$PE_y = (ED_{tot,y} * EF_{grid,CO2,y}) \div (1 - TL_{grid})$$

Where

$ED_{tot,y}$ Total electricity delivered to all new and existing consumers (MWh)

$EF_{grid,CO2,y}$ Emission factor of the project electricity system in year y (tCO₂/MWh)

TL_{grid}

Transmission and distribution losses in the project activity electricity system supplying the project activity (%)

SECTION E. Data and parameters

E.1. Data and parameters fixed ex ante

(This section is intentionally blank.)

Data / Parameter:	
Data unit:	
Description:	
Source of data:	
Value(s) applied:	
Choice of data or Measurement methods and procedures:	
Purpose of data	
Additional comment:	

E.2. Data and parameters monitored

Data/Parameter	$EC_{T1M,j,y}$
Unit	MWh/y
Description	Electricity metered at Type I consumers
Measured/calculated/default	Measurement of electricity through purchase records of pre-paid vouchers by consumer j .
Source of data	AMS-III.BB Version 2
Value(s) of monitored parameter	Consumption values for the monitoring period are shown in the emission reduction calculation worksheet. ²⁹ Values for consumption for Type I and Type II consumers are shown in the following columns of the worksheet: "Krecs Consumption Data" – Column Z "BECS Consumption Data" – Column AA "UMEME Consumption Data" – Column X
Monitoring equipment	Electricity Meters and electronic billing system
Measuring/reading/recording frequency	Monthly
Calculation method (if applicable)	Summation of purchases in a 12-month period in the monitoring period. Note that the 12 month period does not necessarily cover exactly a calendar year as the monitoring period starts on 04/05/2017. In addition, the monitoring period does not cover a single or multiple 12-month periods. Therefore, the 12-month consumption is used to determine the appropriate baseline emission factor, however only electricity consumed during the monitoring period is counted to determine the baseline emissions.
QA/QC procedures	

²⁹ Emission Reduction Worksheet for MR 2 V2.xls

Purpose of data/parameter	Determination of baseline emissions
Additional comments	

Data/Parameter	EC _{T2,i,y}
Unit	MWh/y
Description	Electricity metered at Type II consumers
Measured/calculated/default	Measurements are undertaken using electricity meters at each of the Type II facilities
Source of data	AMS-III.BB Version 2
Value(s) of monitored parameter	Consumption values for the monitoring period are shown in the emission reduction calculation worksheet. ³⁰ Values for consumption for Type I and Type II consumers are shown in the following columns of the worksheet: "Krecs Consumption Data" – Column Z "BECS Consumption Data" – Column AA "UMEME Consumption Data" – Column X
Monitoring equipment	Electricity Meters and electronic billing system
Measuring/reading/recording frequency	Continuous monitoring, hourly measurement and at least monthly recording
Calculation method (if applicable)	Summation of purchases in a 12-month period in the monitoring period. Note that the 12 month period does not necessarily cover exactly a calendar year as the monitoring period starts on 04/05/2017. In addition, the monitoring period does not cover a single or multiple 12-month periods. Therefore, the 12-month consumption is used to determine the appropriate baseline emission factor, however only electricity consumed during the monitoring period is counted to determine the baseline emissions.
QA/QC procedures	
Purpose of data/parameter	Determination of baseline emissions
Additional comments	

Data/Parameter	EF _{grid,CO₂,y}
Unit	tCO ₂ /MWh
Description	Emission factor of the project electricity system in year y
Measured/calculated/default	Calculated
Source of data	Power production records in Uganda in year y ³¹
Value(s) of monitored parameter	0.00
Monitoring equipment	Electricity Meters
Measuring/reading/recording frequency	Annually

³⁰ Emission Reduction Worksheet for MR 2 V2.xls

³¹ <https://www.era.or.ug/index.php/stats/generation-statistics/energy-generated>

Calculation method (if applicable)	<p>As per paragraph 46 of AMS-III.BL Version 1, the emission factor for the project electricity system in year y is determined through Option 3, as the project is implemented in an LDC. Under Option 3, there are sub-options (i) and (ii). The default emission factor used is either 0.00 if the share of renewable energy mix is greater than 95% based on immediate three years average historical data, or the value from Table 6 of the methodology depending on the fuel mix of the grid.</p> <p>As shown in the calculation of the percentage of renewable energy mix in the grid for the previous 3 years (2015, 2016, and 2017), the percentage of renewable energy is 95.67 %. It follows that emission factor is 0.00 tCO₂/MWh.³² Imported electricity has been treated as non-renewable.</p>
QA/QC procedures	Transparent data analysis and reporting
Purpose of data/parameter	Determination of project emissions
Additional comments	

Data/Parameter	f_{HH}
Unit	Fraction
Description	The fraction of end-users (by number) under the CPA that are households
Measured/calculated/default	Calculated
Source of data	Electronic database maintained by CME
Value(s) of monitored parameter	0.99
Monitoring equipment	N/A
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	The designation of the end user is determined at the time of installation of the solar power system. Each end-user is designated as either a household or a SME/Institution as shown in the monitoring plan. The total number of end users designated as households divided by the total number of end users gives the value of the parameter
QA/QC procedures	
Purpose of data/parameter	Eligibility
Additional comments	

³² Uganda Grid Emission Factor V3.xlsx

Data/Parameter	Proportion of N _y and M _y having access to the grid
Unit	-
Description	Check for continued access to electricity
Measured/calculated/default	Measured
Source of data	-
Value(s) of monitored parameter	1.00
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Billing records are used in place of on-site checks. Any purchases within the a given year serve as evidence that the connection is active. As billing records are available for all connections under the CPA this parameter is not sampled.
QA/QC procedures	Transparent data analysis and reporting
Purpose of data/parameter	Determination of baseline emissions
Additional comments	

Data/Parameter	A _{def}
Unit	Hectares
Description	Area of land deforested in the construction of the interconnection lines
Measured/calculated/default	Measured
Source of data	Records from SPs and CME data
Value(s) of monitored parameter	0.0
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	The CME and the CPA Implementer do not construct any interconnection, transmission, or distribution lines under the CPA. Therefore the total hectares deforested is zero. Only the connection from the existing line to the household, wiring or the household, and installation of the meter is covered by the CPA.
QA/QC procedures	Transparent data analysis and reporting
Purpose of data/parameter	Determination of Leakage
Additional comments	

Data/Parameter	L _c
Unit	tCO ₂ /hectare
Description	Carbon stock per area (above ground, below ground, soil carbon, litter and dead biomass)
Measured/calculated/default	Measured
Source of data	Literature and/or studies
Value(s) of monitored parameter	59
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Not applicable

QA/QC procedures	Transparent data analysis and reporting
Purpose of data/parameter	Determination of Leakage
Additional comments	

E.3. Implementation of sampling plan

No parameters were determined using sampling.

SECTION F. Calculation of emission reductions or net anthropogenic removals

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

The monitoring period covers from 04/05/2017 through 31/12/2017. As the baseline emission factor for each end-user is based on their annual consumption level, the consumption from 01/01/2017 through 31/12/2017 was used to determine for the consumption level and corresponding emission factor for each connection

Baseline emissions are calculated as follows:

$$BE_y = BE_{T1NM,y} + BE_{T1M,y} + BE_{T2,y} + BE_{exist,y}$$

Where

$BE_{T1NM,y}$ Baseline emissions for Type I-NM consumers in year y (tCO₂)

$BE_{T1M,y}$ Baseline emissions for Type I-M consumers in year y (tCO₂)

$BE_{T2,y}$ Baseline emission for Type II consumers in year y (tCO₂)

$BE_{exist,y}$ Baseline emissions of existing consumers i.e. baseline emissions from displacement of electricity from an existing mini-grid (tCO₂)

For the CPA, Option 2 under paragraph 14 of the methodology is used to determine baseline emissions.

Under the CPA, all end-users will be metered. It follows $BE_{T1NM,y}$ is equal to zero.

All end-users under the project activity will be metered through prepaid devices. As such there are no existing users metered under the project activity. It follows that $BE_{exist,y}$ is equal to zero.

Baseline emissions for Type I consumers are calculated as follows:

$$BE_{T1M,y} = \sum_{j=1}^{M_y} EC_{T1M,j,y} \times EF_{CO2,T1M}$$

Where

$EC_{T1M,y}$ Annual electricity consumption for all Type I-M consumers j in year y (MWh)

M_y Number of Type I-M consumers in year y

j Type I-M consumer ($j = 1, 2, 3, \dots$)

- $EF_{CO_2, T1M}$ Emission factor for Type I-M consumers:
- If the electricity consumed during year y is equal to or less than 0.055 MWh/y, then use a default value of 6.8
 - If the electricity consumed during year y is less than or equal to 0.25 MWh/y but greater than 0.055 MWh/y then for the portion up to and including 0.055 MWh/y, use a default value of 6.8 and for the portion greater than 0.055 MWh/y, use a default value of 1.3.
 - If the electricity consumed during year y is greater than 0.25 MWh/y but less than 0.500 MWh/y then for the portion up to and including 0.055 MWh/y, use a default value of 6.8, for the portion greater than 0.055 MWh/y and less than 0.25 MWh/y use a default value of 1.3, and for the portion greater than 0.25 MWh/y use a default value of 1.0.
 - If the electricity consumed is greater than 0.500 MWh/y then use a default value of 1.0 for the entire portion.

Baseline emissions for Type II consumers are calculated as follows:

$$BE_{T2,y} = \sum_{i=1}^{N_y} EC_{T2,i,y} * EF_{CO_2, T2}$$

Where

$EC_{T2,i,y}$ Metered annual electricity consumption of Type II consumer i in year y (MWh)

$EF_{CO_2, T2}$ 1.0 (tCO₂/MWh)

N_y Type II consumer ($i = 1, 2, 3, \dots$)

Total baseline emissions for the 55,879 end-users under the CPA are determined for each end-user through summation of the annual usage through billing records and then multiplied by the corresponding emission factor. The summation is shown in the emission reduction worksheet.³³

$$BE_y = 24,927 \text{ tCO}_2\text{e}$$

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

Project emissions under a generic CPA are calculated as follows:

$$PE_y = (ED_{tot,y} * EF_{grid, CO_2, y}) \div (1 - TL_{grid})$$

Where

$ED_{tot,y}$ Total electricity delivered to all new and existing consumers (MWh)

$EF_{grid, CO_2, y}$ Emission factor of the project electricity system in year y (tCO₂/MWh)

TL_{grid} Transmission and distribution losses in the project activity electricity system supplying the project activity (%)

³³ Emission Reduction Worksheet for MR 2 V2.xls

Project emissions are the summation of the consumption for each end-user multiplied by the national grid emission factor of Uganda.

$$PE_y = (14,451 \text{ MWh} * 0.0 \text{ tCO}_2\text{e/MWh}) / (1-0.1)$$

$$PE_y = 0.0 \text{ tCO}_2\text{e}$$

F.3. Calculation of leakage emissions

Leakage is assessed following baseline and monitoring methodology AM0045 "Grid connection of isolated electricity systems" where leakage is defined as follows:

$$LE_y = A_{def} * L_c$$

Where

A_{def} is the area of land deforested in hectares.

L_c is the carbon stock per unit area in tonnes of CO₂ per hectare.

The CPA Implementer of a generic CPA under the PoA will track leakage emissions arising due to transmission/distribution lines construction. All transmission lines constructed during the monitoring period in question within the CPA boundary will be reported to estimate the leakage emissions from this source in conjunction with credible literature on the carbon stock in the region.

Under this CPA no interconnection, transmission, or distribution lines are constructed. Therefore the total hectares deforested is zero. Only the connection from the existing line to the household, wiring or the household, and installation of the meter is covered by this CPA.

As A_{def} is zero, the parameter LE_y is zero as well.

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

CPA UNFCCC reference number	Baseline GHG emissions or baseline net GHG removals (t CO ₂ e)	Project GHG emissions or actual net GHG removals (t CO ₂ e)	Leakage GHG emissions (t CO ₂ e)	GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e)		
				Before 01/01/2013	From 01/01/2013	Total amount
10186-0002	24,927	0	0	0	24,927	24,927
Total	24,927	0	0	0	24,927	24,927

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

CPA UNFCCC reference number	Amount achieved during this monitoring period (t CO ₂ e)	Amount estimated ex ante (t CO ₂ e)
10186-0002	24,927	54,728
Total	24,927	54,728

F.6. Remarks on increase in achieved emission reductions

The monitoring period covers the 6-month period from 04/05/2017 through 31/12/2017. The ex-ante emissions for the CPA were estimated as follows:

2017 – 131,346 tCO₂e

Multiplying the respective years by the fraction of the year covered by the monitoring period yields the following:

2017: $131,346 \text{ tCO}_2\text{e} * (5/12) = 54,728 \text{ tCO}_2\text{e}$

The amount achieved during the monitoring period is 24,927 tCO₂e. The discrepancy is due to the lower amount of connections active during the time period than previously expected. The ex-ante estimate assumed a cumulative 169,345 connections from the start of the CPA through 2017. While the monitoring period only covers 55,879.

Document information

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02.0	7 June 2017	Revision to: <ul style="list-style-type: none">• Ensure consistency with version 01.0 of the “CDM project standard for programmes of activities (CDM-EB93-A07-STAN);• Make editorial improvements.
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