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	Tanzania Renewable Energy Programme	
UNFCCC reference number of the PoA	9904	
Version numbers of the PoA-DD applicable to this monitoring report	Version 08 dated 23/04/2014	
Version number of this monitoring report	06	
Completion date of this monitoring report	01/11/2018	
Monitoring period number	First monitoring period	
Duration of this monitoring period	08/05/2014 to 31/12/2016 (first and last days included)	
Monitoring report number for this monitoring period	01	
Coordinating/managing entity	Rural Energy Agency (REA)	
Host Parties	Host Party of the PoA	Is this the host Party of a CPA covered in this monitoring report? (yes/no)
	United Republic of Tanzania	Yes
Sectoral scopes	01 - Energy Industries (renewable / non-renewable sources)	
Applied methodologies and standardized baselines	• AMS I.D. Grid connected renewable electricity generation, Version 17 • AMS I.F. Renewable electricity generation for captive use and mini-grid, Version 02	
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_2e	14,838 tCO_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 covered in this monitoring report	14,838 tCO_2e	

PART I Monitoring of programme of activities (PoA)

SECTION A. Description of PoA

A.1. General description of PoA

Tanzania has, over the years, strived to create an appropriate policy environment to attract private investments to the renewable energy generation sector. The National Energy Policy 2003 sets national energy objectives to ensure availability of reliable and affordable energy supplies and to promote efficient energy in order to support national development goals. The policy recognizes that, the main thrust should be private initiatives and investments for exploring the local energy sources. The policy sets an entirely new approach to modern energy in rural areas of Tanzania and the government has committed itself to develop and implement the new strategy to address modern energy needs of over 85% of Tanzanians living in rural areas.

For these reasons, the Rural Energy Board (REB), the Rural Energy Agency (REA) and the Rural Energy Fund (REF) were established and entrusted with the role of promoting, stimulating and facilitating the improved access to modern energy services in rural areas through empowering both public and private sector initiatives in rural energy.

The main objective of this programme of activities (PoA) is to increase the access to modern energy services in Tanzania by promoting both the off-grid (isolated mini-grid) and the national grid renewable energy projects within the country using photovoltaic, wind, hydro and biomass technologies for electricity generation. This programme to promote renewable energy projects is fully in line with the Government's strategy for the energy sector.

REA, under the Ministry of Energy and Minerals (MEM) of the United Republic of Tanzania, is the nodal agency to promote rural electrification projects in Tanzania. REA is responsible for implementing the PoA and acts as the coordinating and managing entity (CME).

REA, with the assistance of a World Bank project, is supporting small, rural and renewable energy initiatives in several ways. They are: (i) through an enabling policy and regulatory framework, including standardized power purchase agreements and simplified regulatory rules which reduce some of the transaction costs for small renewable power projects, (ii) through a subsidy scheme for new connections in rural areas (performance grants) and technical assistance/pre-investment support (matching grants) for the project developers; and (iii) through a line of credit (LOC) to the Tanzanian financial institutions for a long-term lending to the small renewable energy projects.

As the CME for the registered small-scale PoA, REA performs the following main activities: (i) coordinating the implementation of the PoA, (ii) screening and accepting the CPAs under the programme, (iii) supporting the effective commercialization of certified emission reductions (CERs), (iv) liaising with the project developers for maintaining the required database for verification, (v) following up any other functions that need to be performed as per the PoA rules.

The CPAs were implemented by the project developers, building on REA's existing relationship with the individual project developers. REA entered into a contractual agreement with each of the individual power projects (CPAs). The signed contracts give REA the legal rights to deal with the carbon credits that are generated from these projects and monitor the project implementation and all necessary parameters that are required for calculating the emission reductions from each CPA.

This is the first monitoring report of the PoA from 08/05/2014 to 31/12/2016 (first and last days included). The cumulative net electricity exported to grid and mini-grids by the 4 CPAs

(Mbinga, Tulila, Ngombeni and Ikondo) included in this report, during the monitoring period is 18,549 MWh. CERs generated during this monitoring period is 14,838 tCO_2e.

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
Renewable energy technology (hydro, wind, biomass or PV) connected to the national utility main grid avoiding generation from mix of fuels. Ref no: CPA category 01	Version 08 dated 23/04/2014	01 - Energy Industries (Renewable / Non-renewable sources)	AMS I.D. Grid connected renewable electricity generation, Version 17[1].
Renewable energy technology (hydro, wind, biomass or PV connected to the existing or new isolated mini-grids replacing existing dedicated diesel based power generation Ref no: CPA category 02			AMS I.F. Renewable electricity generation for captive use and mini- grid, Version 02[2].
Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both the national grid and the existing or new isolated mini-grids. Ref no: CPA category 03			AMS I.D. Grid connected renewable electricity generation, Version 17. AND AMS I.F. Renewable electricity generation for captive use and mini-grid, Version 02.

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)
Mapembasi hydro power project, Njombe district, 9904-0001	Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both national grid and existing or new isolated mini-grids. Ref no: CPA category 03	Version 08 dated 23/04/2014	Renewable (01/01/2015 - 31/12/2021)	No[3]

[1] https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

[2] https://cdm.unfccc.int/methodologies/DB/9KJWQ1G0WEG6LKHX21MLPS8BQR7242

[3] Project is delayed

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)
NextGen solar project, Kigoma region, 9904-0002	Renewable energy technology (hydro, wind, biomass or PV connected to existing or new isolated mini-grids replacing existing dedicated diesel based power generation Ref no: CPA category 02		Renewable (04/06/2014 - 03/06/2021)	No[4]
Mbinga hydroelectric Project, 9904-0003	Renewable energy technology (hydro, wind, biomass or PV connected to existing or new isolated mini-grids replacing existing dedicated diesel based power generation Ref no: CPA category 02		Renewable (01/12/2015 - 30/11/2022)	Yes
Yovi small hydro power project, 9904-0004	Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both national grid and existing or new isolated mini-grids. Ref no: CPA category 03		Renewable (01/12/2015 - 30/11/2022)	No[5]
Tulila hydro-electric plant, 9904-0005	Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both national grid and existing or new isolated mini-grids. Ref no: CPA category 03		Renewable (01/12/2015 - 30/11/2022)	Yes
Maguta small hydro power project, 9904-0006	Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both national grid and existing or new isolated mini-grids. Ref no: CPA category 03		Renewable (01/11/2016 - 31/10/2023)	No[6]
Ngombeni biomass power plant project, 9904-0007	Renewable energy technology (hydro, wind, biomass or PV connected to existing or new isolated mini-grids replacing		Renewable (01/09/2016 -	Yes

[4] Project is delayed

[5] This CPA is covered in the monitoring report number 02 for the same monitoring period

[6] Project is not yet commissioned

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)
	existing dedicated diesel based power generation Ref no: CPA category 02		31/08/2023)	
Ikondo micro hydro power plant, 9904-0008	Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both national grid and existing or new isolated mini-grids. Ref no: CPA category 03		Renewable (14/10/2016 - 13/10/2023)	Yes

A.2. Coordinating/managing entity

The coordinating/managing entity (CME) of the PoA is the “Rural Energy Agency” (REA).

SECTION B. Implementation of PoA

B.1. Description of implemented PoA

The management system is developed in accordance with the “Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities”, Version 3, EB 74.

REA is the PoA managing entity. The schematic representation of operational and management arrangements established by the REA for the implementation of the PoA is given in the figure 1.

The operational and management structure provides information and data flow channel between the CME and the CPA implementer. At the CPA level, REA ensures the actual involvement of field personnel (power plant operators/technicians) in the monitoring, data collection and record keeping activities. REA requests each CPA to designate a CPA manager at the project developer head office and an engineer in-charge of the power plant operation.

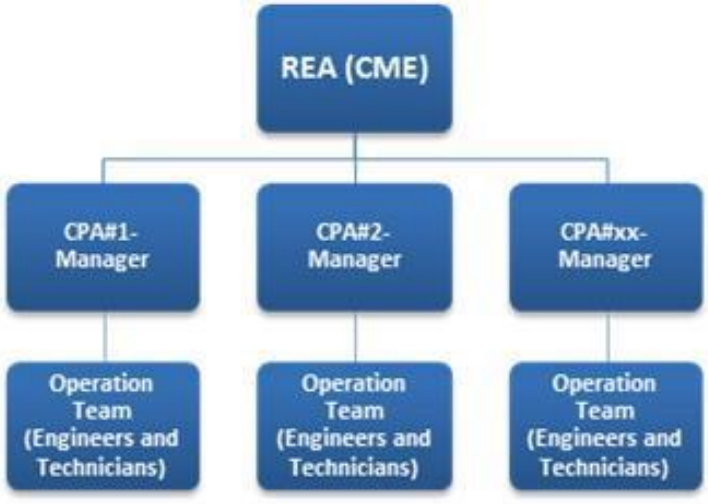

Figure 1: Implementation structure

Operation and management plan

The operation and management plan is described below.

i) A record keeping system for each CPA under the PoA

A record keeping system is established by REA, which contains the following details providing the unique identity for each SSC-CPA. The details include, but not limited to:

- Name of the CPA
- CPA number
- Name of the CPA implementer
- Contact details of the Implementing entity (Address/Contact person/Phone/e-mail/fax)
- Location of the CPA (e.g., GPS coordinates of the power house and the water intake for a hydro power plant)
- Type of renewable energy source
- Installed capacity of the CPA
- The record on technical specification of each renewable energy plant participating in the PoA
- Type and name of the grid (national grid, TANESCO mini-grid, existing isolated grid, new isolated grid) fed by the project
- Gross electricity generation
- Net electricity generation and electricity sales
- Meter calibration
- Commissioning date

Two databases are developed by REA for record keeping – one at the CPA level and the other at the PoA level.

At the CPA level, the CPA implementer is responsible for managing the records and the data associated with each SSC-CPA. They maintain a proper electronic database for these records. A hard copy backup of all these records is also made available. In case of failure in the electronic data transfer system, manually recorded project details at the site are collected and compiled, which is sent to REA. The record keeping is carried out using the field instruments, hardware and software installed in every project site and/or manual data recording in the log book. The recorded data is submitted to REA, which is responsible to archive the data as per individual CPA.

At the PoA level, REA manages and maintains a record of complete database on all CPAs and the entire PoA. REA cross-checks the data from all the CPAs to ensure completeness, accuracy and consistency. The PoA level database is obtained from the CPA level database after REA's own review work.

Paper and electronic records will be kept during the entire crediting period for each CPA and for additional two years after the crediting period.

ii) Records of arrangements for training and capacity development for personnel

REA is responsible for keeping the record on training and capacity development activities provided to the relevant personnel. The record includes:

- Date, time and venue of each training and capacity development event
- Participants record for each event
- Agenda for each training and capacity development event
- Manuals and training materials for each training and capacity development event

All relevant project staff are trained in various aspects of the CPA operation and management. Operators also pursued on-site training.

iii) Measures for continuous improvements of the PoA management system

The Project Manager of the PoA will organize a meeting with all his/her staff and CPA personnel to review the performance of the PoA management system to identify issues to be addressed, to obtain continuous improvements of the PoA management system.

B.2. Post-registration changes to PoA

B.2.1. Corrections

Not applicable

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

Not applicable

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

Currently 8 CPAs are included in this PoA. 3 CPAs are not yet implemented. One CPA (Yovi) is reported in the monitoring report number 02. The details of rest of the 4 CPAs considered in this report are provided in table 1.

Table 1: CPAs of the PoA considered

CPA reference no.	CPA name[7]	Registered / Included[8]	Capacity (MW)	Project Implementer
9904-0003	Mbinga hydroelectric project	06/11/2015	1.12	Andoya Hydroelectric Power Company Limited
9904-0005	Tulila hydroelectric plant	06/11/2015	7.5	Tulila Hydroelectric Plant Company Limited
9904-0007	Ngombeni biomass power plant project	11/08/2016	2.5	Ngombeni Power Limited

[7] For simplicity, in this monitoring report these CPAs are shortly referred to as Mbinga, Tulila, Ngombeni and Ikondo respectively.

[8] https://cdm.unfccc.int/ProgrammeOfActivities/poa_db/DEI4JOVUTN7A0936CP1WLMSGYB58ZF/viewCPAs

CPA reference no.	CPA name[7]	Registered / Included[8]	Capacity (MW)	Project Implementer
9904-0008	Ikondo micro hydro power plant	14/10/2016	0.430	Matembwe Village Company Limited

This report is prepared as monitoring report number 01 for the 04 CPAs (Mbinga, Tulila, Ngombeni and Ikondo) for the first monitoring period from 08/05/2014 to 31/12/2016 (first and last days included) under the registered PoA. Major milestones during the project implementation of these CPAs are furnished in table 2.

Table 2: Timeline of the CPA implementation

Description	Mbinga	Tulila	Ngombeni	Ikondo
CPA start date	22/10/12	11/10/13	31/01/12	19/12/13
CPA inclusion date	06/11/15	06/11/15	11/08/16	14/10/16
Start date of the first crediting period	01/12/15	01/12/15	01/09/16	14/10/16
Commissioning date	19/03/15[9]	12/09/15[10]	27/01/14[11]	26/01/16[12]

Technical description of the CPA

Mbinga:

This CPA supplies power to isolated and TANESCO mini-grid and comes under CPA category 02.

This CPA is a run-of-the-river hydroelectric power plant with a capacity of 1.12 MW (560 kW x 2) installed in two phases. The plant design consists of a weir, intake, desilting bay, canal, forebay, penstock pipe, power house, electromechanical machines, controls, step up transformer and transmission line to Mbinga township being the main line. A medium voltage line to Mbangamao, Lifakara and Kilimani villages will branch from the main line. The plant design also includes improvement of 12 km and 2 km new stretch. The technical specifications for Phase 2 is similar to the Phase 1 unit.

The technical specifications of installed phase 1 plant are given in table 3 and 4.

Table 3: Specification of installed power plant for phase 1

Turbine	Type	Horizontal Francis Turbine
	Rated speed	750 rpm

[9] Andoya commission report dated 29/04/2015

[10] Date as per TANESCO interconnection certificate

[11] Ngombeni-TANESCO interconnection report dated 04/02/2014

[12] Provisional acceptance certificate

	Rated capacity	550 kW
Generator	Frequency	50 Hz
	Rated voltage	400 V
	Rated capacity	700 kVA (560 kW)
	Power factor	0.8 PF

Table 4: Generation power loss estimation

Parameter	Value
Turbine speed	750 rpm
Generator efficiency	98%
Net electric power generated	495 kW at power station
Transformer efficiency	97%
Line efficiency	98%
Available power at user end	470 kW
Installed output capacity	4,117 MWh
Delivered output estimates	3,293 MWh
Operating days/year	80%
Losses in the distribution	5.43% = 179 MWh
Net saleable electricity	3,114 MWh/year

Tulila:

This CPA supplies power to national grid and isolated mini-grids and comes under the CPA category 03.

The CPA is a run-of-the-river hydroelectric power plant with an installed capacity of 7.5 MW (5 MW + 2.5 MW) in two phases. The power plant uses the natural base slope of the Ruvuma river at Tulila. It is constructed as a run-of-the-river hydroelectric power plant with earth fill dam and a weir system to divert the water to the power plant and utilize the naturally available high head. The surface area of the reservoir created by permanent impoundment is about 74,000 m^2. Water depth at the intake is 7.5 m which results in a total gross head of around 22.5 m.

The plant design consists of headworks including weirs, dams and intake, the tailworks, electromechanical machines and the powerhouse equipped with governors, transformers, medium voltage switchgear, indoor crane, drainage and dewatering system, control, monitoring and communication systems and an emergency power unit.

The whole weir system including dams and intake structure is constructed. The powerhouse will be equipped with three equisized turbines and is located at about 190 m downstream of the intake

structure. It is connected to the intake structure by three separate penstocks in staggered diameters 2.3 / 2.5 m each. Due to the short distance, a surge shaft is not necessary. The water after passing through the turbine is diverted back to the Ruvuma river by a 100 m long tailrace channel. An existing branch of the river can be used for this purpose.

In phase 1, two turbine-generator units and two penstocks were installed and the generated power was fed into the Songea mini-grid. In phase 2, third identical turbine-generator unit and a penstock will be installed and will be connected to national grid through the interconnection of Songea mini-grid to the Makambako – Songea 132 kV transmission line which is expected to be completed by the end of 2017. Following the interconnection with the main grid, generated energy from the three identical turbines will be fed into the connected national grid. The main features of the power plant are given in table 5.

Table 5: Technical specification of power plant

Parameter	Value
Turbine specifications	
Turbine type	Kaplan, axial flow with vertical axis
Rated output	2,581 kW (3 units; 2 in phase 1 and 1 in phase 2)
Rated speed	375 rpm
Rated efficiency	92%
Generator specifications	
Generator type	Synchronous
Generator capacity	3.044 MVA (3 units; 2 in phase 1 and 1 in phase 2)
Power factor	0.8
Generation voltage	6.6 kV
Efficiency	96%

Ngombeni:

This CPA supplies power to TANESCO mini-grid and comes under CPA category 02.

Ngombeni CPA is a 2.5 MW biomass power project, which covers an area of about 7,000 acres of land in Mafia Island. The area is comprised of sawmill, log yard, workshop, one office building and two staff houses nearby. The project is designed to use various biomass such as coconut palm tree wastes, different species of trees, bushes, etc. which are readily available as the main feed stock for electricity generation. The feed stock in general is derived from the discarded section of the coconut palm, trees, bushes, off-cuts, etc.

The feed stock from the chipper machine passes through the fire box in the boiler, which is burnt to generate heat. The heat generated boils the water in the boiler to produce steam at a pressure of 27– 30 bar and at 280-300 ˚C. The produced steam is then introduced into the turbine and is converted into mechanical energy through expansion in steam turbine. The mechanical energy rotates the generator, which in turn produces desired electric power.

The main features of the installed power plant are provided in table 6.

Table 6: Technical specification of power plant

Parameter	Value
Boiler capacity	10 ton/hr
Turbine capacity	2,500 kW
Generator capacity	3,125 kVA
Plant load factor	0.8
Expected electricity generation	15,023 MWh/yr

Ikondo:

This CPA supplies power to both the national grid and the isolated mini-grid and comes under the CPA category 03.

Ikondo CPA is a run-of-the-river hydroelectric power plant with an installed capacity of 430 kW (80 kW + 350 kW), where water is diverted from Kyepa River and channelled through a 300 m long concrete lined canal into the head tank which has been located at the hill which enables the water to move downwards to the 22 m penstock effortlessly. The total amount of power generated in the hydroelectric power plant depends on the height of head tank and the amount of water flowing through the penstock. The flow from the penstock is forced into the turbine and the electricity is produced in the generator. At the end of the process, the utilized water from the power plant is normally released through a tailrace channel back into the Kyepa River.

The generated electricity is directed into the step-up transformer and fed into the distribution grid of Medium Voltage (MV) Lines and then supplied to the consumers.

Only the 350 kW unit is considered for CDM purpose. It is capacity addition to the existing 80 kW unit. As per registered CPA DD, it was assumed that 350 and 80 kW units will be connected to single energy meter before power off-take. But there are synchronisation issues in connecting 350 kW and 80 kW to the same export point. 80 kW unit is still not connected to 350 kW unit energy meter. So electricity export recorded in 350 kW unit energy meter is from this unit alone. The same is used for CER estimations.

Main technical features of the installed power plant are provided in the table 7.

Table 7: Technical specification of power plant

Key design parameter	Value
Penstock material	Steel
Penstock diameter	32 inches
Turbine type	Francis
Shaft orientation	Vertical

Key design parameter	Value
Speed	500 rpm
Net head	17 m
Maximum flow rate (Q)	2.3 m^3/s
Mechanical power	350 kW
Minimum global efficiency at 80% of the flow rate	92 %
Nominal electrical power	450 kVA
Power factor	0.85
Excitation	Brushless

Net GHG emission reduction:

All the 4 CPAs included in this monitoring report operated normally during the monitoring period without any special events or situations which may impact the applicability of the methodology. Ngombeni power plant is facing some performance issues and therefore, is running at a very low utilization capacity.

The net emission reduction achieved in each CPA during this monitoring period is given in the table 8.

Table 8: Net emission reduction of each CPA

No.	CPA	Actual net emission reduction achieved (tCO_2e)
1	Mbinga	1,995
2	Tulila	12,754
3	Ngombeni	48
4	Ikondo	41

It is also confirmed here that the power plant electricity export readings for each month are metered and the meter values are supported by monthly invoices for each CPA. Hence, the double counting of power generation and emission reduction is avoided.

C.2. Location of CPAs

The location details of all the 4 CPAs covered in this monitoring report are given in the table 9.

Table 9. Location of the CPAs

Detail	Mbinga	Tulila	Ngombeni	Ikondo
Host party	United Republic of Tanzania			

Detail	Mbinga	Tulila	Ngombeni	Ikondo
Region / State / Province, etc.	Ruvuma	Ruvuma	Pwani	Njombe
City / Town / Community, etc.	Mbinga district	Mpepai-Tulila village, Mbinga / Songea district	Ngombeni, Dundani, Minaki, Chunguruma, Ras Mbisi Estates Village, Mafia district	Ikondo village, Njombe district
Latitude (°S)	11.2708	11.0947	7.6555	9.0754
Longitude (°E)	35.5875	35.2769	39.6608	35.233

The location maps of the respective CPAs are shown in Figure 2.

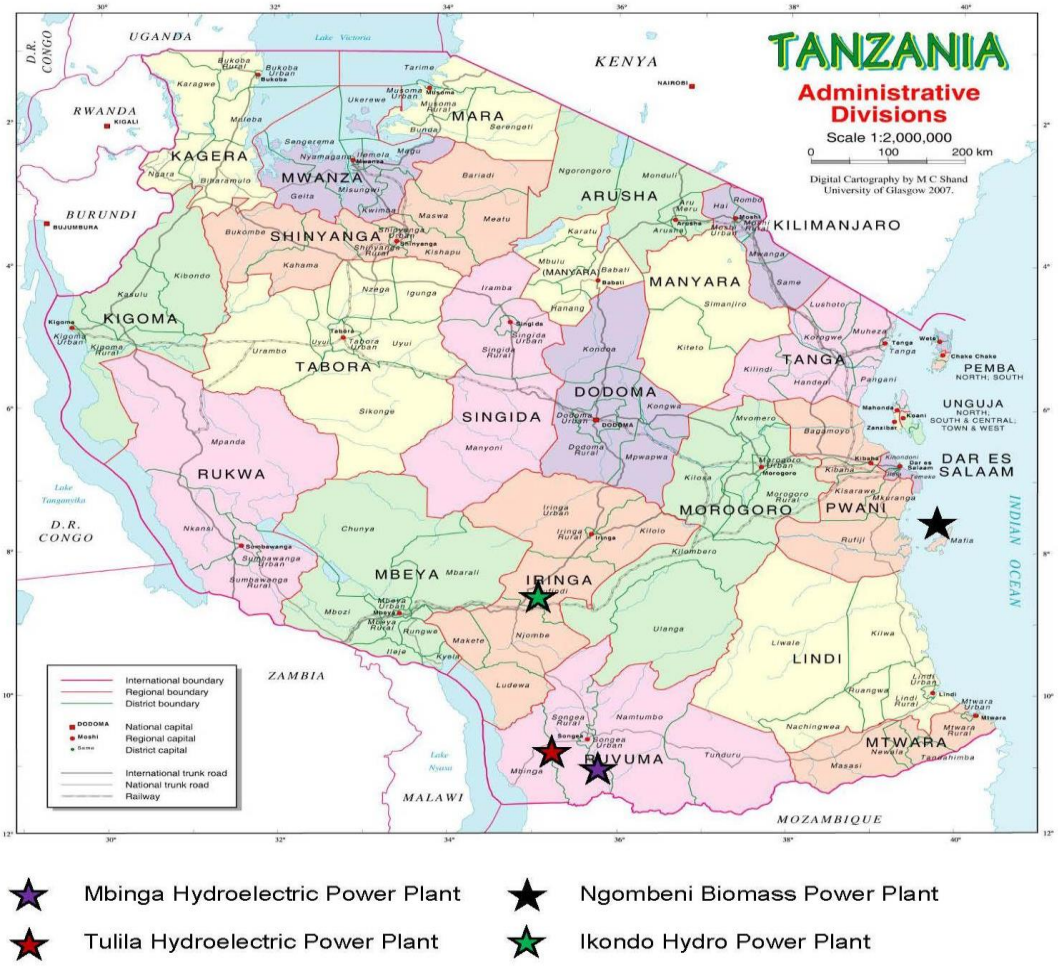

Figure 2: Location Map of CPAs

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

Not applicable

C.3.2. Corrections

Ngombeni CPA:

As per included CPA DD, the parameter "Moisture content ($MC_{biomass}$)" was fixed ex-ante. It is now made as the monitoring parameter under "section B.5.1.Data and parameters to be monitored" of the CPA. Values of different biomass fuels were provided. In cases where a lab test of sampling is not possible (due to several project barriers) for any biomass type, provision is added to use the value from standard international sources for that particular biomass type.

Similarly, the net calorific value (NCV) for different types of biomass used in the plant is provided for the parameter "$NCV_{Biomass}$" in "section B.5.1.Data and parameters to be monitored" of the CPA. In cases where a lab test of sampling is not possible (due to several project barriers) for any biomass type, provision is added to use the value from standard international sources for that particular biomass type.

The revised CPA DD, version 06 dated 14/07/2018 was approved by EB on 21/08/2018.

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

Not applicable

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

Not applicable

C.3.6. Changes to project design

Not applicable

SECTION D. Description of monitoring system of CPAs

The monitoring plan of the PoA is consistent with the methodology AMS-I.D. (version 17) and AMS-I.F (Version 02). The monitoring structure and plan for a SSC-CPA is an integrated part of the management and monitoring plan of the PoA as described in section C and section B.7.2 (Part II) of the PoA.

The management system is developed in accordance with the "Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities".

Various parameters with respect to the project category were monitored in the power plants. Various data used for the estimation of emission reduction were also monitored. The data are archived electronically and will be stored for additional 2 years after the end of the crediting period of the CPA. REA as the CME, has supervised the implementation of the monitoring plan. REA also ensured that all the relevant staff of the CPAs as well as their own personnel are trained adequately in this task.

To ensure that the data is reliable and transparent, the CME also established quality assurance and quality control (QA & QC) measures to effectively control and manage the data reading, recording, auditing as well as archiving data and all relevant documents.

Project Category

Category 1 - Power projects connected to grid
Category 2 - Power projects connected to mini-grid
Category 3 - Power projects connected to both grid and mini-grid

Monitoring data

The parameters to be monitored by each CPA are given in the table 10.

Table 10: Parameters to be monitored by each CPA

Parameter	Mbinga	Tulila	Ngombeni	Ikondo
Net electricity generation supplied to the national grid		✓		✓
Net electricity supplied to the mini-grids	✓	✓	✓	✓
Quantity of biomass consumed in a year			✓	
Net calorific value of the biomass			✓	
Moisture content of the biomass			✓	

The above parameters were monitored by the plant operators at their project site and were entered in the data sheets.

Monitoring procedure

The gross electricity generation, if possible, and the quantity of net electricity supplied to the grid were continuously measured using the energy meters with a maximum rated error of 0.5% as mandated by Energy and Water Utilities Regulatory Authority (EWURA).

Cumulative measurements were entered into an electronic database at the end of each month. Any problems occurring with the monitoring equipment were also captured. CPA implementers produced the reports containing the monthly monitoring data files and details of any equipment faults and/or loss of data. The reports were submitted to the CME and project participants for review and acceptance. All records will be retained for at least two years after the end of the crediting period.

The following measures were taken relating to the monitoring equipment owned by the CPA implementer, its installation and operation:

- All meters are designed and manufactured to the accepted standards (Regulatory standards shall be followed for each electricity meter). Each CPA shall provide all information regarding the metering devices including accuracy class and calibration frequency required, at least annually.

- All monitoring equipment should be located in secure locations free from the possibility of accidental damage.

- Routine maintenance and calibration of all monitoring equipment will be performed in accordance with the utility standards, regular standards or the manufacturer's specification, whenever applicable, to ensure that the data remains accurate.

When all the generated electricity was delivered to the national grid, then the emission reductions (ER) was calculated based on the amount of electricity measured by the buyer. The project records were used primarily for cross-checking and secondarily for ER calculation in case the Buyer could not measure the purchased electricity. In all the cases, the agreed amount of electricity used for billing purpose were the main base for ER calculation.

The technical specifications of power meters installed at each power plants are provided in table 11.

Table 11: Technical details of the power meters installed at the mini-grid export point in Mbinga

Parameter	Main meter	Check meter
Model	EDMI	EDMI
Type	Mk10E	Mk10E
Accuracy	0.5 S	0.5 S
Serial number	211108423	211108415
First calibration date	19/03/2015	19/03/2015
Second calibration date[13]	03/03/2017	03/03/2017

The validity of first calibration ended on 18/03/2016. The second calibration has been carried out by the TANESCO only on 03/03/2017. As per the second calibration testings, the error identified for the Mbinga CPA is 0.79% which is greater than the permissible limit of 0.5%. For the delay period of March to December 2016 (within the reported monitoring period of this CPA), the maximum error of 0.79% is discounted in the readings before the CER estimations as per the guideline (paragraph 351) of CDM validation and verification standard, version 01.

The metering points of the Mbinga CPA is provided in the figure 3.

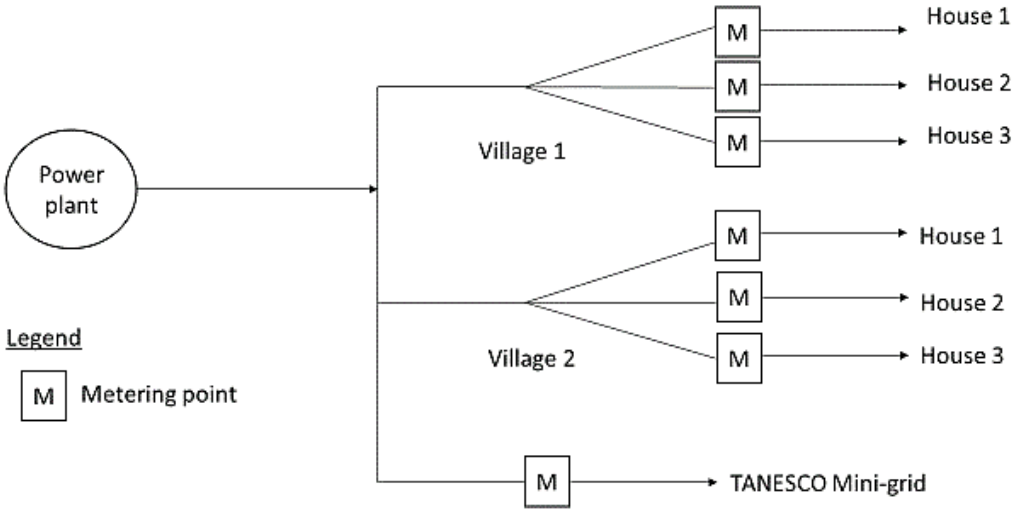

Figure 3: Metering points for Mbinga CPA

[13] As per TANESCO letter dated 03/03/2017

The technical details of Tulila power meters are provided in the table 12.

Table 12: Technical details of the power meters installed at the mini-grid export point in Tulila

Parameter	Main meter	Check meter
Model	EDMI	EDMI
Type	Mk10E	Mk10E
Accuracy	0.5 S	0.5 S
Serial number	211112553	211112571
First calibration date	12/09/2015	12/09/2015
Second calibration date[14]	03/03/2017	03/03/2017

The validity of first calibration ended on 11/09/2016. The second calibration has been carried out by the TANESCO only on 03/03/2017. As per the second calibration testings, the energy meters were still operating within the 0.5% of permissible error. For the delay period of September to December 2016 (within the reported monitoring period of this CPA), the maximum error of 0.5% is discounted in the readings before the CER estimations as per the guideline (paragraph 351) of CDM validation and verification standard, version 01.

Figure 4 depicts the metering points of the Tulila CPA.

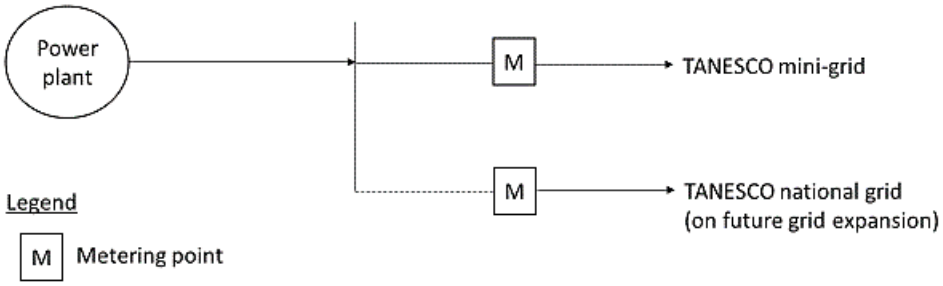

Figure 4: Metering points for Tulila CPA

The technical details of the Ngombeni power meter is given in the table 13.

Table 13: Technical details of the power meters installed at the mini-grid export point in Ngombeni

Parameter	Main meter	Check meter
Model	EDMI	EDMI

[14] As per TANESCO letter dated 03/03/2017

Parameter	Main meter	Check meter
Type	Mk10E	Mk10E
Accuracy	0.5 S	0.5 S
Serial number	211108280	211108294
First calibration date	27/01/2014	27/01/2014
Second calibration date[15]	03/03/2017	03/03/2017

The validity of first calibration ended on 26/01/2015. The second calibration has been carried out by the TANESCO only on 03/03/2017. As per the second calibration testings, the energy meters were still operating within the 0.5% of permissible error. For the delay period of September to December 2016 (within the reported monitoring period of this CPA), the maximum error of 0.5% is discounted in the readings before the CER estimations as per the guideline (paragraph 351) of CDM validation and verification standard, version 01.

Figure 5 depicts the metering points of the Ngombeni CPA.

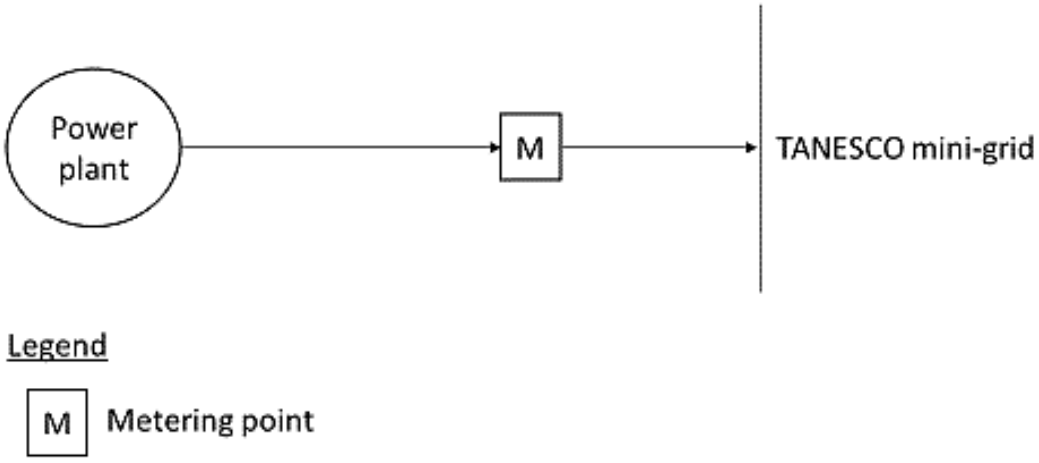

Figure 5: Metering points for Ngombeni CPA

The technical details of the Ikondo power meter connected to the national grid is given in the table 14.

Table 14: Technical details of the power meters installed at the grid export point in Ikondo

Parameter	Main meter	Check meter
Model	EDMI	EDMI
Type	Mk10E	Mk10E
Accuracy	0.5 S	0.5 S

[15] As per TANESCO letter dated 03/03/2017

Parameter	Main meter	Check meter
Serial number	212556509	212556508
First calibration date	11/11/2016	11/11/2016
Second calibration date[16]	03/03/2017	03/03/2017

The end consumers in the mini-grid were provided with the energy meters during commissioning of the plant starting from 26/01/2016. They had calibration validity until 25/01/2017[17]. For TANESCO national grid energy meters (as given in table 14), the first calibration is valid up to 10/11/2017. Therefore, the calibration validity is covered for the entire reported monitoring period for both mini-grid & grid-supply and hence, no calibration error is applied in this CPA. However, the second calibration was done for energy meters in this CPA on 03/03/2017 along with the calibration works done in other CPAs of the PoA.

The metering point for the Ikondo CPA is given in the figure 6.

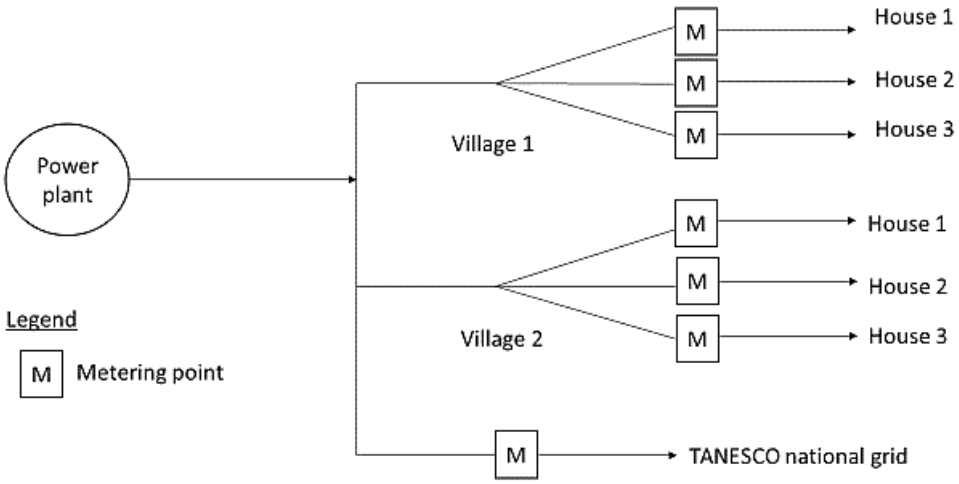

Figure 6: Metering points for Ikondo CPA

Quality assurance and quality control

QA & QC procedures for recording, maintaining and archiving data were implemented as a part of this CDM project activity. The CPA owner implemented QA & QC measures to calibrate and guarantee the accuracy of metering (for meters under his responsibility) and safety of the project operation.

Data collection, reporting, archiving and preparation for periodic verification

Data was recorded daily by the plant operator and any data outages were recorded in an operational log and reported to the plant engineer. The Plant engineer at each project site has

[16] As per TANESCO letter dated 03/03/2017

[17] After this period, the project developer started installing energy meters at key power distribution points for further monitoring and cross checking purpose, These new meter installations at distribution points in the mini-grid were started in Jan 2017 and completed by April 2017. Meters readings at these key power distribution points in the mini-grid were used for CDM monitoring.

prepared a report consisting of the above parameters in electronic format. Both, the hard copy of data as well as the electronic report, were forwarded to the CPA Manager, who manages the database for CPAs in line with the CDM requirements under the supervision of REA.

After the quality control, the CPA manager has sent the consolidated data collected to REA. Being the CME, REA is responsible for the management of records and data associated with each SSC-CPA. REA maintains the overall programme database for these records. The Project Manager of the PoA is responsible for the overall programme database and maintains the records of all the CPAs under this programme. The operation and management structure for the monitoring is shown in the figure 7. To ensure the quality of the recorded data, all the personnel were trained in accordance with this monitoring plan.

If applicable, the net electricity supplied to a grid was cross checked as gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses and electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes.

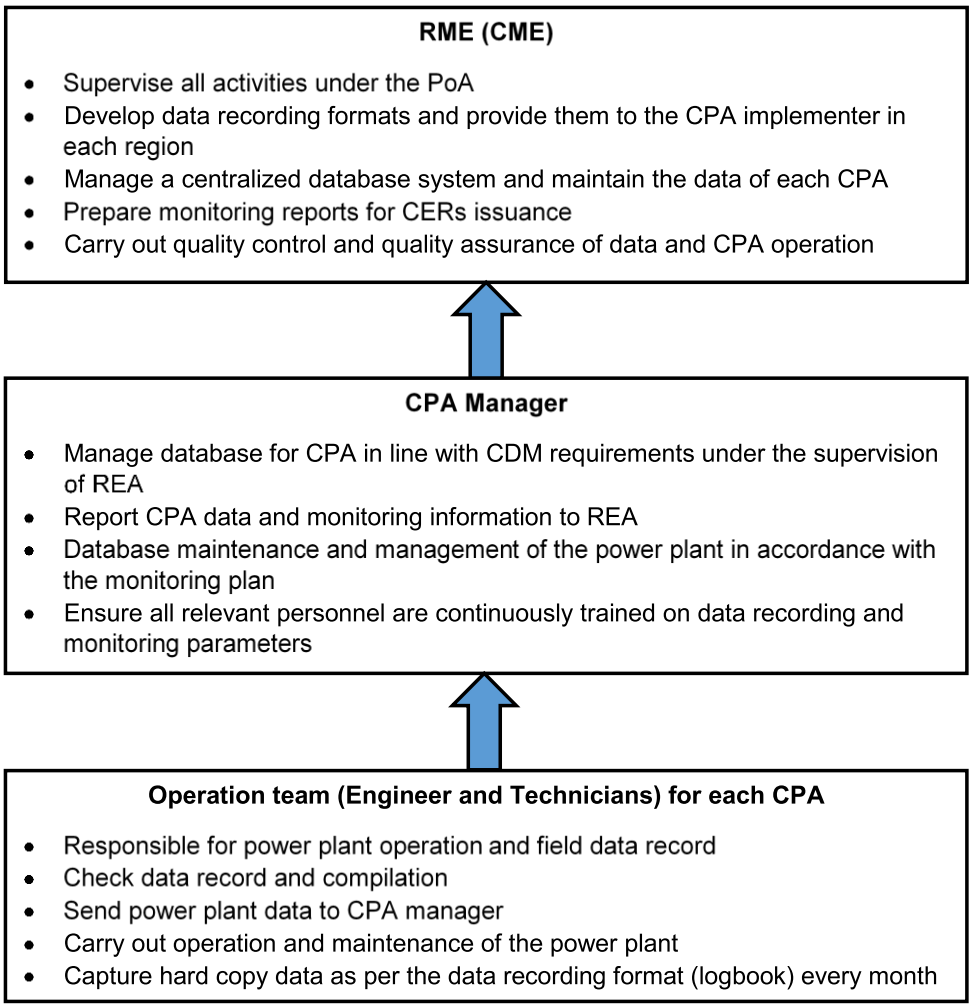

Figure 7: Operational and management structure for monitoring

Monitoring and measurements in Ngombeni CPA

Moisture content of the biomass used:

The biomass fuels obtained from the plantations during Sep – Dec 2016 included bush chips and coconut husks. As per the latest approved CPA DD version 06 dated 14/07/2018, the moisture

content of the biomass fuels must be measured once during the crediting period. Accordingly, the project developer has measured the moisture content of bush chips and coconut husks. The results of the lab reports are provided in section E.2 of this MR.

NCV value of biomass used:

The biomass fuels obtained from the plantations during Sep – Dec 2016 included bush chips and coconut husks. As per the latest approved CPA DD version 06 dated 14/07/2018, the NCV value of the biomass fuels must be measured once during the crediting period. Accordingly, the project developer has measured the NCV value of bush chips and coconut husks. The results of the lab reports are provided in section E.2 of this MR.

Measurement of biomass consumption for the plant:

As per the monitoring plan of the registered CPA, the biomass consumption in the power plant must be measured continuously or in batches. In actual practice, the biomass is obtained from the own plantations of the project developer. Therefore, there are no invoice/payment bills for biomass procurement. The biomass (mulch, bush chips and coconut husk) are taken in the small carts from the plantations to the power plant site. Before taken to the storage area, the biomass loads are weighed using the weigh bridge and the quantity is recorded in log books. This data is consolidated on monthly basis and is made available for verification. The biomass quantity brought to the power plant during the months of 2016 is provided in table 15.

Table 15. Monthly biomass quantity for 2016[18]

Month	Quantity of Biomass (tons)		
	Mulch	Bush chips	Coconut husks
January	25.47	161.99	0
February	700.82	176.52	0
March	241.18	325.26	0
April	115.55	529.36	0
May	156.14	632.98	0
June	228.54	974.00	292.00
July	0.00	1,233.83	261.00
August	0.00	657.00	82.00
September	0.00	402.00	213.00
October	0.00	263.00	73.00
November	0.00	274.00	32.00

[18] As per the monthly monitoring data reported to REA by the project developer

Month	Quantity of Biomass (tons)		
	Mulch	Bush chips	Coconut husks
December	0.00	411.00	0.00
Total	**1,467.69**	**6,040.92**	**953.00**

Measuring the biomass every time before loading into the boiler is practically very difficult in Ngombeni power plant. There is no separate weighing machine to do that. It is expensive in terms of investment for equipment as well as labour especially, for a small power plant like this. In reality, the power plant is not even receiving appropriate payments from TANESCO on time. This itself is a biggest barrier for very small power producers.

However, the project developer ensured that each cart of biomass quantity brought into power plant yard for feeding the boiler is measured and monitored in batches. The total quantity of biomass brought into the power plant during one year period is considered as the total biomass consumption of the boiler for that one year period. Therefore, it is justified that the monitoring frequency of the biomass consumption is in line with the registered monitoring plan, i.e., as batch process.

Energy balance for the power plant:

The QA & QC process in the parameter table of Biomass consumption in section D.7.1 of registered CPA DD states that: *"Cross-check the measurements with an annual energy balance that is based on purchased quantities (e.g., with sales/receipts) and stock changes. The consistency of measurements ex post will be checked with annual data on energy generation, biomass used and the efficiency of energy generation as determined ex ante."*

According to above requirement, initially, the efficiency of energy generation ex-ante is estimated in table 16.

Table 16. Efficiency of plant as per the registered CPA DD (ex-ante)

No.	Parameter	Unit	Value
1	Net power generation	MWh/year	15,023
2	Net biomass consumption	Tons/year	19,530
3	NCV of biomass used	MJ/kg	16.3
4	Net input energy (a)	MJ	318,339,000
5	Net energy output (b)	MJ	54,083,000
6	Net ex-ante efficiency of plant (c) = b / a	%	17

From table 16, it is inferred that the power plant is expected to operate at an ex ante power generation efficiency of 17%.

The power generation efficiency during the implementation period (ex post) is estimated in table 17. For this analysis, the total power generation from the whole year of 2016 is taken against the total biomass consumption during the same period.

Table 17. Operating efficiency of power plant in 2016 (ex-post)

No.	Parameter	Unit	Value
1	Net power generation	MWh	513.730
2	Net coconut husk consumption	Tons	953
3	NCV of coconut husk used	MJ/kg	7.63
4	Net bush chips consumption	Tons	6,040.92
5	NCV of bush chips used	MJ/kg	12.28
6	Net mulch consumption	Tons	1,467.69
7	NCV of mulch used	MJ/kg	9.81
8	Net input energy (a)	MJ	95,489,471
9	Net energy output (b)	MJ	1,849,428
10	Net ex-post efficiency of plant (c) = b / a	%	1.93

As per QA & QC requirements, the cross check of parameters is done in table 18.

Table 18. Comparison of plant parameters

No.	Parameter	Unit	Ex-ante	Ex-post
1	Power generation	MWh	15,023	513.730
2	Biomass consumption	Tons	19,530	8,461.61
3	Efficiency of energy generation	%	17	1.93

Inferences from table 18 are as follows:

- There is no increased efficiency of power generation or increased power generation in the power plant (ex-post) than the estimated ex-ante values.
- The overall power generation efficiency of the plant is very low. This was due to the technical issues with the boiler as stated by the project developer

Based on the above analysis, it can be justified that the cross checking of the power plant performance is carried out using the energy balance and the results do not indicate any non-compliance with the registered monitoring plan of Ngombeni CPA DD.

For information, there is no coal or any such fossil fuel in the island or nearby area for usage in the power plant. The power plant developer has a large plantation catering to more than enough for the power plant. That is the reason, though the power plant is running on the low efficiency, the project developer is able to manage the required biomass.

Considering the above conditions and practical reasons in the powerplant located in a very remote island of Least Developed Countries (LDC), the deviations from the plan stated in the CPA DD may kindly be justified.

SECTION E. Data and parameters

E.1. Data and parameters fixed ex ante

CPA Category 1 : CPAs supplying the national grid (AMS I.D. Grid connected renewable electricity generation)

Data/Parameter	**$EF_{CO2,grid,y}$**
Unit	tCO_2e/MWh
Description	CO_2 emission factor of the grid in year y
Source of data	Calculated as described in D.6.3. Details of Tanzania national grid obtained from TANESCO.
Value(s) applied	0.530
Choice of data or measurement methods and procedures	The grid emission factor is calculated using the latest version of the "Tool to calculate the emission factor for an electricity system". The power generation data of Tanzania national grid for years 2012-14 is used. Details of calculation are provided in Section D.6.3.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	The value is fixed ex-ante for the first crediting period.

Data/Parameter	**$EF_{CO2,m,i,y}$**
Unit	tCO_2e/GJ
Description	CO_2 emissions factor of fossil fuel type i used in power unit m in year y
Source of data	IPCC default values at the lower limit of 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	Gas Oil/Diesel Oil - 0.0726 tCO_2e/GJ Natural Gas - 0.0543 tCO_2e/GJ
Choice of data or measurement methods and procedures	No data for the fuels used in Tanzania is available. Hence IPCC defaults are used. For the calculation of the Simple Adjusted OM these figures shall be updated once, at the start of each crediting period in accordance with the applicable IPCC data at that time. For the BM, these figures shall be updated once, at the start of each crediting period with the applicable IPCC data at the time.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Not applicable

Data/Parameter	**$EF_{EL,m,y}$**
Unit	tCO_2e/MWh
Description	CO_2 emissions factor of power unit m considered in grid emission factor calculation in year
Source of data	TANESCO

Value(s) applied	<table><tr><th>Plants</th><th>Emission Factor $EF_{EL,m,y}$ (tCO_2e/MWh)</th></tr><tr><td>Zuzu</td><td>0.69</td></tr><tr><td>Tegeta Gas Plant (TGP)</td><td>0.46</td></tr><tr><td>Ubungo Gas Plant (UGP)</td><td>0.45</td></tr><tr><td>SONGAS UGT 1 & 2</td><td>0.57</td></tr><tr><td>SONGAS UGT 3, 4, 5 & 6</td><td>0.54</td></tr><tr><td>IPTL</td><td>0.70</td></tr><tr><td>NYAKATO</td><td>0.69</td></tr><tr><td>AGR (TG)</td><td>0.66</td></tr><tr><td>AGR (UB)</td><td>0.66</td></tr><tr><td>UGP 2</td><td>0.53</td></tr><tr><td>SYMB UB GP</td><td>0.49</td></tr><tr><td>SYMB UB JET A</td><td>0.66</td></tr><tr><td>SYMB (AR)</td><td>0.66</td></tr><tr><td>SYMB (DD)</td><td>0.66</td></tr></table>
Choice of data or measurement methods and procedures	Calculated based on the approach provided under Option A of the OM method, using annual electricity generation, fuel type and efficiency for each power unit, m.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	This data will be used if available from TANESCO. Otherwise, it should be calculated.

Data/Parameter	**$EG_{m,y}$**
Unit	MWh
Description	Net quantity of electricity generated and delivered to the grid by power unit m in year y
Source of data	TANESCO
Value(s) applied	See grid emission factor calculation spreadsheet
Choice of data or measurement methods and procedures	As per “Tool to calculate the emission factor for an electricity system” method for Simple OM.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Not applicable

Data/Parameter	**$EG_{k,y.}$**
Unit	MWh
Description	Net quantity of electricity generated and delivered to the grid by power unit k in year y (by low cost/must run power plants).
Source of data	TANESCO.
Value(s) applied	See grid emission factor calculation spreadsheet
Choice of data or measurement methods and procedures	As per “Tool to calculate the emission factor for an electricity system” method for simple OM.
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	Not applicable

Data/Parameter	**$\eta_{m,y}$**
Unit	-
Description	Average net energy conversion efficiency of power unit m in year y
Source of data	TANESCO and default values as per Appendix 1 of “Tool to calculate the

	emission factor for an electricity system", version 04.0.0
Value(s) applied	<table><tr><th>Plants</th><th>Type of fuel</th><th>Technology used</th><th>Efficiency (%)</th></tr><tr><td>Zuzu</td><td>Diesel & Industrial oil</td><td>Open cycle</td><td>37.8%</td></tr><tr><td>Tegeta Gas Plant (TGP)</td><td>Natural Gas</td><td>Open cycle</td><td>42.4%</td></tr><tr><td>Ubungo Gas Plant (UGP)</td><td>Natural Gas</td><td>Open cycle</td><td>43.0%</td></tr><tr><td>SONGAS UGT1&2</td><td>Natural Gas</td><td>Open cycle</td><td>34.1%</td></tr><tr><td>SONGAS UGT3,4,5&6</td><td>Natural Gas</td><td>Open cycle</td><td>36.4%</td></tr><tr><td>IPTL</td><td>HFO</td><td>Open cycle</td><td>39.0%</td></tr><tr><td>NYAKATO</td><td>Diesel & Industrial oil</td><td>Open cycle</td><td>38.0%</td></tr><tr><td>AGR (TG)</td><td>Diesel & Industrial oil</td><td>Open cycle</td><td>39.5%</td></tr><tr><td>AGR (UB)</td><td>Diesel & Industrial oil</td><td>Open cycle</td><td>39.5%</td></tr><tr><td>UGP 2</td><td>Natural Gas</td><td>Open cycle</td><td>37.0%</td></tr><tr><td>SYMB UB GP</td><td>Natural Gas</td><td>Open cycle</td><td>39.5%</td></tr><tr><td>SYMB UB JET A</td><td>Diesel & Industrial oil</td><td>Open cycle</td><td>39.5%</td></tr><tr><td>SYMB (AR)</td><td>Diesel & Industrial oil</td><td>Open cycle</td><td>39.5%</td></tr><tr><td>SYMB (DD)</td><td>Diesel & Industrial oil</td><td>Open cycle</td><td>39.5%</td></tr></table> Efficiency factor of AGR and SYMB plants are taken from Appendix 1 of the "Tool to calculate the emission factor for an electricity system" for plant built after 2000.
Choice of data or measurement methods and procedures	Data from the Tanzania grid company are used as available. Default values are used for the plants where data are not available.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Not applicable

CPA Category 2: CPAs supplying to a mini-grid (AMS I.F. Renewable electricity generation for captive use and mini-grid)

Data/Parameter	**$EF_{CO2,y}$**
Unit	tCO_2e/MWh
Description	CO_2 emission factor for displacement of electricity in the grid, the mini-grid and/or the captive power plant.
Source of data	Table I.F.1. of AMS-I.F.
Value(s) applied	0.8
Choice of data or measurement methods and procedures	The portion of electricity supplied to mini-grids replaces electricity production through diesel generators that would have been used in the absence of the project activity. As per AMS-I.F, for a mini-grid system where all the generators use exclusively fuel oil and/or diesel fuel, an emission factor for a modern diesel generating unit of the relevant capacity operating at optimal load as given in Table I.F.1 can be used. The installed capacity is larger than 200 kW. Thus, the value of 0.8 tCO_2e/MWh is used. This is the emission factor for a modern diesel generating unit of capacity larger than 200 kW.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Not applicable

CPA Category 3: CPAs using both AMS I.D. and AMS I.F.

All parameters mentioned above for the category 1 and 2 are also applicable for the category 3.

In addition to the parameters of category 3, the following parameters are applicable to Ikondo CPA.

Data/Parameter	**$EG_{BL,existing,y,grid}$**
Unit	MWh
Description	Estimated net electrical energy that would have been produced and supplied to grid by the existing units
Source of data	Ikondo 80kW power plant records for years 2010-2015
Value(s) applied	69
Choice of data or measurement methods and procedures	The annual average actual power produced from 80 kW unit was calculated from the historic data from 2010-2015. Similarly, the estimated electricity generation from the 80 kW unit was calculated using standard operating hours and plant load factor. The design factor (that only 28.5% of electricity generated would be exported to grid) is applied. As per methodology, the maximum of the two values, i.e., $EG_{estimated,y}$ is considered for $EG_{BL,existing,y,grid}$.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Not applicable

Data/Parameter	**$EG_{BL,existing,y,MG}$**
Unit	MWh
Description	Estimated net electrical energy that would have been produced and supplied to a mini-grid by the existing units
Source of data	Ikondo 80kW power plant records for years 2010-2015
Value(s) applied	175
Choice of data or measurement methods and procedures	The annual average actual power produced from the 80 kW unit was calculated from the historic data from 2010-2015. Similarly, the estimated electricity generation from the 80 kW unit was calculated using standard operating hours and plant load factor. The design factor that only 71.5% of electricity generated would be exported to the mini-grid is applied. As per methodology, the maximum of the two values, i.e., $EG_{estimated,y}$ is considered for $EG_{BL,existing,y,MG}$.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Not applicable

E.2. Data and parameters monitored

CPA Category 2: CPAs supplying to a mini-grid alone (AMS-I.F. Renewable electricity generation for captive use and mini-grid)

Data/Parameter	$EG_{BL,y}$
Unit	MWh/year
Description	Quantity of net electricity displaced in year y
Measured/calculated/ default	Measured
Source of data	Measured by energy meters.

<table>
<tr><td>Value(s) of monitored parameter</td><td><u>To TANESCO mini-grid</u>

<table>
<tr><th rowspan="2">CPA</th><th colspan="3">Power supplied to the mini grid (MWh/year)</th></tr>
<tr><th>2014</th><th>2015</th><th>2016</th></tr>
<tr><td>Mbinga</td><td>NA</td><td>41.298</td><td>2,433.169</td></tr>
<tr><td>Ngombeni</td><td>NA</td><td>NA</td><td>60</td></tr>
</table>

<u>To Isolated mini-grid</u>

<table>
<tr><th rowspan="2">CPA</th><th colspan="3">Power supplied to the mini grid (MWh/year)</th></tr>
<tr><th>2014</th><th>2015</th><th>2016</th></tr>
<tr><td>Mbinga</td><td>NA</td><td>1.969</td><td>35.376</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Energy meter</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Continuous monitoring, hourly measurement and at least monthly recording.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>Measurements were taken using energy meters. In the case of electricity sold to a third party, measurement results are cross-checked with records of sold / purchased electricity (e.g., invoices/receipts). The net electricity displaced is the gross energy generation by the project activity power plant minus the auxiliary/station electricity consumption.</td></tr>
<tr><td>QA/QC procedures</td><td>The device was calibrated and tested by CPA implementer as per the EWURA’s standard.

There was strict compliance with the maintenance schedule recommended by the technology provider and EWURA. The quality control was ensured by EWURA’s SPPA that mandates monthly readings, with rated error no greater than 0.5%.

Quality control and assurance was achieved through a monthly check of the monitoring log sheet, which was signed by plant staff to acknowledge that the parameters are correct</td></tr>
<tr><td>Purpose of data/parameter</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comments</td><td>The data will be archived for two years after the crediting period.</td></tr>
</table>

For Ngombeni CPA, the parameters mentioned below were additionally monitored

<table>
<tr><td>Data/Parameter</td><td>Biomass Consumption</td></tr>
<tr><td>Unit</td><td>Tonnes/year</td></tr>
<tr><td>Description</td><td>Quantity of biomass consumed in year y</td></tr>
<tr><td>Measured/calculated/ default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>The fuel consumed by the power plant will be measured at the fuel delivery system or taken from the plant records and log books.</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>The biomass consumed during the monitoring period of Sep – Dec 2016:

<table>
<tr><th>Biomass type</th><th>Quantity (tons)</th></tr>
<tr><td>Bush chips</td><td>1,350</td></tr>
<tr><td>Coconut husk</td><td>318</td></tr>
<tr><td>Total</td><td>1,668</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Weigh Bridge</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>The quantity of biomass was measured in batches.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>Use mass or volume based measurements. If more than one type of biomass fuel was consumed, each was monitored separately.</td></tr>
</table>

QA/QC procedures	Quality control and assurance was achieved through a daily check of the monitoring log sheet, which was signed by plant staff to acknowledge that the parameters are correct. The weigh bridge was calibrated on 11/02/2017 and the accuracy was assured to be 0.05%.
Purpose of data/parameter	Cross-check of the measurements with an annual energy balance was done based on purchased quantities (e.g., with sales/receipts) and stock changes. The consistency of measurements ex post was checked with annual data on energy generation, biomass used and the efficiency of energy generation as determined ex ante. Here the amount of biomass brought into the power plant area is considered to be consumed for the power generation. Refer subsection "Monitoring and measurements in Ngombeni CPA" under section D of this report. The cross checking showed that energy generated was not more than energy made available from biomass consumption reported during same period.
Additional comments	Parameter listed as per methodology and PoA DD. This parameter is not used in the emission calculation.

Data/Parameter	$NCV_{Biomass}$
Unit	MJ/kg
Description	Net calorific value of biomass type k
Measured/calculated/ default	Measured
Source of data	Lab reports or standard sources such as IPCC
Value(s) of monitored parameter	<table><tr><th>No.</th><th>Type</th><th>MJ/kg</th><th>Source</th></tr><tr><td>1</td><td>Bush chips</td><td>12.28</td><td>Lab tested sample by the EPC contractor</td></tr><tr><td>2</td><td>Coconut husk</td><td>7.63</td><td>Lab tested sample by project developer (10 MJ/kg) and standard source (Understanding coconut as a biomass fuel, DP CleanTech – 7.63 MJ/kg)[19]. The conservative value is considered here.</td></tr></table>
Monitoring equipment	Measurement in the laboratories according to relevant national/international standards. NCV was measured based on wet biomass basis
Measuring/reading/recording frequency	Determined once in the first year or when a new biomass type is used and the value can be used for the rest of the crediting period.
Calculation method (if applicable)	Not applicable. NCV value is lab tested or referred from relevant national/international standards.
QA/QC procedures	Consistency of the measurements were checked by comparing the measurement results with relevant data sources (e.g., values in the literature, values used in the national GHG inventory, etc.) and default values by the IPCC.
Purpose of data/parameter	Parameter listed as per methodology and PoA DD. This parameter is not used in the emission calculations
Additional comments	The data will be archived for two years after the crediting period.

[19] As per IPCC table 1-13, for coconut husk and shells the moisture content is 40% and NCV is 9.8 MJ/kg. From public sources (Understanding coconut as a biomass fuel, DP CleanTech), a more conservative value of 50% moisture and 7.63 MJ/kg was found. The same is used in CPA DD.

Data / Parameter	$MC_{Biomass}$
Unit	% of water
Description	Moisture content of the biomass (wet basis)
Measured/calculated/ default	Measured
Source of data	Lab reports or standard sources such as IPCC
Value(s) applied	

No.	Type	Moisture content (%)	Source
1	Bush chips	44	Lab tested sample by the EPC contractor (30%) and referred from standard sources (39-44%)[20]. The value considered here is the conservative of the two sources.
2	Coconut husk	39	Lab tested sample by project developer

Monitoring equipment	Measurement in the laboratories according to relevant national/international standards or through conservative reference from standard international sources such as IPCC.
Measuring/reading/recording frequency	Determined once in the first year and the value can be used for the rest of the crediting period.
Calculation method (if applicable)	Not applicable. NCV value is lab tested or referred from relevant national/international standards.
QA/QC procedures	Consistency of the measurements were checked by comparing the measurement results with, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC.
Purpose of data	Parameter listed as per methodology and PoA DD. This parameter is not used in emission calculations
Additional comment	The data will be archived for two years after the crediting period.

CPA Category 3 : CPAs supplying to both the national grid and the mini-grid (TANESCO/ Isolated)

Data/Parameter	$EG_{actual,y}/EG_{BL,y(Category1)}$
Unit	MWh/year
Description	Quantity of net electricity supplied to the national grid in year y.
Measured/calculated/ default	Measured
Source of data	Measured by energy meters.
Value(s) of monitored parameter	

CPA	Power supplied to the grid (MWh/year)		
	2014	2015	2016
Tulila[21]	NA	0	0
Ikondo	NA	NA	2

Monitoring equipment	Energy meters

[20] https://www.ecn.nl/phyllis2/Browse/Standard/NTA-8003##846 (samples - #900, #903, #906, #909)

[21] Currently, Tulila CPA supplying power only to Sonega mini-grid and national grid is expected to establish by end of 2017. Therefore, during this monitoring period there is no power supplied to national grid.

Measuring/reading/recording frequency	Continuous monitoring, hourly measurement and at least monthly recording. The data will be archived for two years after the crediting period.
Calculation method (if applicable)	Measurements were taken using energy meters. Bidirectional energy meters were installed so that any eventual electricity supplied by the grid to the project or to the communities is not included in the ER calculation. Measurement results are cross checked with records for sold/purchased electricity (e.g., invoices/receipts). The net electricity exported/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import. The net electricity supplied to a grid are cross checked with the gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses and electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes. For Ikondo: As per registered CPA DD, it was assumed that 350 and 80 kW units will be connected to single energy meter before power off-take. But there are synchronisation issues in connecting 350 kW and 80 kW to the same export point. 80 kW unit is still not connected to 350 kW unit energy meter. So electricity export recorded in 350 kW unit energy meter is from this unit alone. The same is used for CER estimations.
QA/QC procedures	The device was calibrated and/or tested as per the instructions (schedules, procedures) for QA of the technology provider and/or EWURA's standard. There was compliance with the maintenance schedule recommended by the technology provider and/or EWURA. The quality control was ensured by EWURA's SSPA that mandates monthly readings, with rated error no greater than 0.5%. Quality control and assurance was achieved through a monthly check of the monitoring log sheet, which was signed by plant staff to acknowledge that the parameters were correct.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Not applicable.

Data/Parameter	$EG_{BL,y}$
Unit	MWh/year
Description	Quantity of net electricity supplied to the mini-grid in year y.
Measured/calculated/ default	Measured
Source of data	Measured by energy meters.
Value(s) of monitored parameter	**To TANESCO mini-grid** **CPA** / **Power supplied to the mini grid (MWh/year)** **2014** / **2015** / **2016** Tulila / NA / 508 / 15,448.49 **To Isolated mini-grid** **CPA** / **Power supplied to the mini grid (MWh/year)** **2014** / **2015** / **2016** Ikondo / NA / 0 / 50
Monitoring equipment	Energy meters
Measuring/reading/recording frequency	Continuous monitoring, hourly measurement and at least monthly recording.

Calculation method (if applicable)	Measurements were taken using energy meters. In the case of electricity sold to a third party, measurement results were cross-checked with records of sold/purchased electricity (e.g., invoices/receipts). The net electricity displaced was the gross energy generation by the project activity power plant minus the auxiliary/station electricity consumption. For Ikondo: As per registered CPA DD, it was assumed that 350 and 80 kW units will be connected to single energy meter before power off-take. But there are synchronisation issues in connecting 350 kW and 80 kW to the same export point. 80 kW unit is still not connected to 350 kW unit energy meter. So electricity export recorded in 350 kW unit energy meter is from this unit alone. The same is used for CER estimations.
QA/QC procedures	The device was calibrated and tested by the CPA implementer as per the instructions (schedules, procedures) for QA of the technology provider and/or EWURA's standard. There were compliance with the maintenance schedule recommended by the technology provider and/or EWURA. The quality control was ensured by EWURA's SPPA that mandates monthly readings, with rated error no greater than 0.5%. Quality control and assurance were achieved through a monthly check of the monitoring log sheet, which was signed by the plant staff to acknowledge that the parameters are correct.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	The data will be archived for two years after the crediting period.

E.3. Implementation of sampling plan

Not applicable

SECTION F. Calculation of emission reductions or net anthropogenic removals

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

CPA Category 2: For the CPAs supplying to a mini-grid (AMS-I.F. Renewable electricity generation for captive use and mini-grid)

For the electricity fed into the isolated/TANESCO mini-grids, the CPA should use the methodology, AMS-I.F. (Version 02) and the relevant equations. Moreover, all the CPAs under this PoA are new power plants (greenfield projects).

Baseline emissions

For new power plants at the site where there was no renewable energy power plant operating prior to the implementation of the project activity (greenfield plant):

$$BE_{y(Category2)} = EG_{BL,y(Category2)} \times EF_{CO2,y}$$

Where:

$BE_{y(Category2)}$ = Baseline emissions in year *y* (tCO_2e) for mini-grids

$EG_{BL,y(Category2)}$ = Quantity of net electricity supplied to the mini-grid as a result of the implementation of the CDM project activity in year y (MWh)

$EF_{CO2,y}$ = CO_2 emission factor (tCO_2e/MWh)

For the mini-grids, the emission factor is as of a modern diesel generating unit of the relevant capacity operating at optimal load as given in Table I.F.1. of AMS-I.F.

Mbinga:

Mbinga CPA is a greenfield power plant and supplies power to both TANESCO mini grid and isolated mini grid (villages).

The details of net power supplied to TANESCO mini grid is given in table 19.

Table 19 : Net electricity exported to mini-grid from Mbinga

Time period		Electricity supplied to TANESCO mini-grid	Electricity supplied to isolated mini grid (MWh)	Electricity imported from TANESCO mini-grid	Net electricity supplied $EG_{facility,y}$	Net electricity after calibration error (MWh)
From	To	(MWh) A	(MWh) B	(MWh) C	(MWh) D=A+B-C	
01/12/2015	31/12/2015	41.298	1.969	0.000	43.267	43.267
01/01/2016	31/01/2016	9.540	1.826	0.000	11.366	11.366
01/02/2016	29/02/2016	214.581	2.347	0.000	216.928	216.928
01/03/2016	31/03/2016	213.158	2.463	0.000	215.621	213.918
01/04/2016	30/04/2016	267.223	2.665	0.000	269.888	267.756
01/05/2016	31/05/2016	275.988	2.637	0.000	278.625	276.424
01/06/2016	30/06/2016	271.107	2.944	0.000	274.051	271.886
01/07/2016	31/07/2016	276.532	3.407	0.000	279.939	277.728
01/08/2016	31/08/2016	276.098	3.134	0.000	279.232	277.026
01/09/2016	30/09/2016	223.490	3.353	0.000	226.843	225.050
01/10/2016	31/10/2016	158.029	4.063	0.000	162.092	160.811
01/11/2016	30/11/2016	109.975	3.435	0.000	113.410	112.514
01/12/2016	31/12/2016	137.448	3.102	0.000	140.550	139.440
Total		**2,474.467**	**37.345**	**0.000**	**2,511.000**	**2,494.000**

Ngombeni:

Ngombeni CPA is a greenfield biomass power plant and supplies power to the TANESCO mini grid. The details of net power supplied to TANESCO mini grid is given in table 20.

Table 20: Net electricity exported to mini-grid from Ngombeni

Time period		Electricity supplied to TANESCO mini- grid	Electricity imported from TANESCO mini-grid	Net electricity supplied $EG_{facility,y}$	Net electricity after calibration error (MWh)
From	To	(MWh) A	(MWh) B	(MWh) C=A-B	
01/09/2016	30/09/2016	54.090	12.480	41.610	41.402
01/10/2016	31/10/2016	26.040	8.600	17.440	17.353
01/11/2016	30/11/2016	16.580	8.310	8.270	8.229
01/12/2016	31/12/2016	0.000	6.950	-6.950	-6.915
Total		**96.710**	**36.340**	**60.000**	**60.000**

CPA Category 3: For CPAs supplying to both the national grid and the mini-grid (AMS-I.D. and AMS-I.F.)

All the procedures for baseline estimations of Category 1 and 2 (greenfield projects) are also applicable to Category 3.

Tulila:

Tulila hydroelectric power plant is a green field project and supplies power to the national grid as well as to the mini-grid. Currently, Tulila power plant is supplying power only to the mini-grid and it is expected to connect to the national grid by end of 2017[22] when the national grid extends to that location. The details of the net electricity supplied to TANESCO mini grid is given in the table 21.

Table 21: Net electricity exported to the mini-grid from Tulila

Time period		Electricity supplied to TANESCO mini-grid	Electricity imported from TANESCO mini-grid	Net electricity supplied $EG_{facility,y}$	Net electricity after calibration error (MWh)
From	To	(MWh)	(MWh)	(MWh)	
		A	B	C=A-B	
01/12/2015	31/12/2015	508.000	0.000	508.000	508.000
01/01/2016	31/01/2016	1,181.570	0.000	1,181.570	1,181.570
01/02/2016	28/02/2016	1,206.580	0.000	1,206.580	1,206.580
01/03/2016	31/03/2016	1,944.840	0.000	1,944.840	1,944.840
01/04/2016	30/04/2016	1,869.330	0.000	1,869.330	1,869.330

[22] Tulila CPA-DD, Version 2 dated 26/10/2015

Time period		Electricity supplied to TANESCO mini-grid	Electricity imported from TANESCO mini-grid	Net electricity supplied EGfacility,y	Net electricity after calibration error (MWh)
From	To	(MWh)	(MWh)	(MWh)	
		A	B	C=A-B	
01/05/2016	31/05/2016	2,064.070	0.000	2,064.070	2,064.070
01/06/2016	30/06/2016	1,938.450	0.000	1,938.450	1,938.450
01/07/2016	31/07/2016	1,365.960	0.000	1,365.960	1,365.960
01/08/2016	31/08/2016	1,262.690	0.000	1,262.690	1,262.690
01/09/2016	30/09/2016	928.010	0.000	928.010	923.370
01/10/2016	31/10/2016	601.750	0.000	601.750	598.741
01/11/2016	30/11/2016	266.890	0.000	266.890	265.556
01/12/2016	31/12/2016	818.350	0.000	818.350	814.258
Total		**15,956.490**	**0.000**	**15,956.000**	**15,943.000**

Ikondo:

Ikondo micro hydro power plant is a capacity addition project to the existing 80kW micro hydro power plant and supplies power to the national grid as well as to the mini-grid.

As the CPA is a renewable energy based capacity addition to an existing renewable energy power plant, the baseline emissions are calculated as per "*For capacity addition with renewable energy units other than photovoltaic, wind plants"* approach provided in the registered PoA DD, version 08 page 42.

a) For power supplied to the TANESCO grid:

The baseline emissions from the electricity supply to the grid are calculated as,

$$BE_{Add,co2,y,grid}=(EG_{PJ,add,y,grid} - EG_{BL,exiting,y,grid}) * EF_{co2}$$

Where,

$EG_{PJ,add,y,grid}$ = The total net electrical energy supplied to a grid in year y by all units, existing and new project units; (MWh)

$EG_{BL,exiting,y,grid}$ = The estimated net electrical energy that would have been produced and supplied to a grid by existing units (installed before the project activity) in year y in the absence of the project activity; (MWh)

Where,

$$EG_{BL,existing,y,grid} = MAX\ (EG_{actual,y}\ or\ EG_{estimated,y})\ until\ DATE_{baselinecapacityaddition}$$

and

$EG_{BL,existing,y,grid}$ *is 0 on/after* $DATE_{baselinecapacityaddition}$

Where,

$EG_{actual,y}$ = The actual, measured net electrical energy produced and supplied to the grid by the existing units in year y (MWh)

$EG_{estimated,y}$ = The estimated net electrical energy produced and supplied to the grid by the existing units in year y (MWh)

The annual average actual power produced from the 80 kW unit was calculated using the historic data from 2010-2015. Similarly, the estimated electricity generation from the 80 kW unit was calculated using the standard operating hours and the plant load factor. The values of power supply considering the grid export is given in the table 22.

Table 22: The value of power supply considering export to the grid

Parameter	Total estimated (MWh)	Percentage supply to grid	Value to be considered (MWh)
$EG_{actual,y}$	79	28.5	22
$EG_{estimated,y}$	245		69

As per methodology, the maximum of the two values, i.e., $EG_{estimated,y}$ is considered for $EG_{BL,existing,y,grid}$= 69 MWh.

The existing 80 kW unit was installed in 2005. Considering the standard operating life of 25 years for hydro power plants, the $DATE_{baselinecapacityaddition}$ for existing 80 kW plant is 31/12/2024.

During the monitoring period, a separate energy meter was not installed to measure the power generation from the 80 kW unit. So as conservative measure, the estimated power supply from 80 kW unit to the grid, i.e., 69 MWh as per CPA DD is considered. Net electricity export to grid from Ikondo is given in table 23.

Table 23: Net electricity exported to grid from Ikondo

Time period		Electricity supplied to TANESCO mini- grid	Electricity imported from TANESCO mini grid	Net electricity supplied $EG_{facility,y}$
From	To	(MWh)	(MWh)	(MWh)
		A	B	C=A-B
01/11/2016	30/11/2016	6.610	5.750[23]	0.860
01/12/2016	31/12/2016	7.750	5.750	2.000
Total		**14.360**	**11.500**	**2.000**

b) For power supplied to the mini-grid

The baseline emissions from the electricity supplied to mini-grid are calculated as,

[23] 69 MWh for 12 months. For one month = 69/12 = 5.75 MWh

$$BE_{Add,co2,y,MG} = \left(EG_{PJ,add,y,MG} - EG_{BL,exiting,y,MG}\right) * EF_{co2}$$

Where,

$EG_{PJ,add,y,MG}$ = The total net electrical energy supplied to a mini-grid in year *y* by all units, existing and new project units; (MWh)

$EG_{BL,exiting,y,MG}$ = The estimated net electrical energy that would have been produced and supplied to a mini-grid by existing units (installed before the project activity) in year *y* in the absence of the project activity; (MWh)

Where,

$$EG_{BL,existing,y,MG} = MAX\left(EG_{actual,y} \text{ or } EG_{estimated,y}\right) until\ DATE_{baselinecapacityaddition}$$

and

$EG_{BL,existing,y,MG}$ is 0 on/after $DATE_{baselinecapacityaddition}$

Where,

$EG_{actual,y}$ = The actual, measured net electrical energy produced and supplied to the mini-grid by the existing units in year *y* (MWh)

$EG_{estimated,y}$ = The estimated net electrical energy produced and supplied to the mini-grid by the existing units in year *y* (MWh)

The annual average actual power produced from 80 kW unit was calculated from the historic data from 2010-2015. Similarly, the estimated electricity generation from the 80 kW unit was calculated using standard operating hours and plant load factor. The values of power supply considering mini- grid export are given in the table 24.

Table 24: The value of power supply considering export to the grid.

Parameter	Total estimated (MWh)	Percentage supply to mini-grid	Value be considered (MWh)
$EG_{actual,y}$	79	71.50	57
$EG_{estimated,y}$	245		175

As per methodology, the maximum of the two values, i.e., $EG_{estimated,y}$ is considered for $EG_{BL,existing,y,MG}$ = 175 MWh.

During the monitoring period, a separate energy meter was not installed to measure the power generation from the 80 kW unit. So as conservative measure, the estimated power supply from 80 kW unit to mini-grid i.e., 175 MWh as per CPA DD is considered.

The details of net electricity exported to mini-grid is given in the table 25.

Table 25: Net electricity exported to mini-grid from Ikondo

Time period		Electricity exported to mini-grid	Electricity generation from 80 kW unit	Net electricity generation $EG_{facility,y}$
From	To	(MWh) A	(MWh) H	(MWh) C=A - H
14/10/2016	31/10/2016	24.845	7.292	17.553
01/11/2016	30/11/2016	32.949	14.583	18.366
01/12/2016	31/12/2016	28.841	14.583	14.257
Total		86.635	36.458	50.000

The baseline emissions for each of the CPA based on the supply to grid or mini-grid is summarised as in table 26.

Table 26. Baseline Emissions

Time period		Net electricity generation[24] $EG_{facility,y}$	Grid emission factor	Baseline Emission BE_y
From	To	(MWh)	(tCO_2/MWh)	(tCO_2)
		C	D	E = C*D
Mbinga				
01/12/2015	31/12/2016	2,494	0.8	1,995
Tulila				
01/12/2015	31/12/2016	15,943	0.8	12,754
Ngombeni				
01/09/2016	31/12/2016	60	0.8	48
Ikondo				
14/10/2016	31/12/2016	2	0.53	1
14/10/2016	31/12/2016	50	0.8	40
Total baseline emissions				**14,838**

[24] After applying appropriate calibration errors for delay in calibration.

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

All the CPAs generating power from hydro sources are run-of-the-river type power projects. Hence, the project emission is considered as zero.

$PE_{y(Category1)} = 0$

There is no project emissions ($PE_{y(Category2)}$) from the operation of Ngombeni biomass power project. Hence, it is considered as zero.

$PE_{y(Category2)} = 0$

F.3. Calculation of leakage emissions

(i) CPA Category 2: For CPAs supplying a mini-grid (AMS-I.F. Renewable electricity generation for captive use and mini-grid)

As per AMS-I.F., leakage has to be considered if there is any energy generating equipment transfer from another activity. The Mbinga CPA under this PoA did not involve any transfer of equipment from another project activity. Hence, the leakage emission was not considered for the CPAs under this PoA.

For Ngombeni biomass power project:

African industries face several challenges including poor access to funding, capital, credit, technical capabilities, etc. For start-up industries, buying new equipment may be a choice but it is just not a practical reality in Africa. To minimize the financial risks and increase the cash flow, industries are forced to purchase used equipment, which is readily available than the new ones. This is the most common practice prevailing among the African countries[25].

The power plant equipment for this project was purchased from salvaged unit in Mauritius[26]. This did not affect the operation of any existing plant. It is justified that there was no transfer of equipment from other ongoing activity. Hence, no leakage is considered.

$LE_{y(Category2)} = 0$

(ii) CPA Category 3: For CPAs supplying both national grid and mini-grid (AMS-I.D. and AMS- I.F.)

As per AMS-I.D. and AMS-I.F., leakage has to be considered, if there is any energy generating equipment transfer from another activity. The CPAs (Mapembasi, Tulila, Maguta and Ikondo) under this PoA were not involved any transfer of equipment from another activity. All systems have comprised only newly procured equipment. Hence, the leakage emission due to equipment transfer was not considered for the CPAs under this PoA.

$LE_{y(Category3)} = 0$

(iii) Leakage due to biomass fuel usage

[25] http://constructionreviewonline.com/2016/07/new-or-used-equipment/

[26] Omnicane Milling Operations Limited: Closure of Union St-Aubin Sugar Mill - Environmental Impact Assessment (June 2011)

As per "Definition of renewable biomass", EB 23, Annex 18, the biomass fuel used in this project are "biomass residues" as the fuels used are coconut tree wastes that have outlived their economic life like Coconut husk and other biomass residues like Mulch, Bush chips etc..

Methodological tool: leakage in biomass small-scale project activities, version 04, EB 83 states only one emission source for biomass residues usage which is the "competing use of biomass". It states that "*The project participant shall evaluate ex ante if there is a surplus of the biomass in the region of the project activity, which is not utilised. If it is demonstrated (e.g., using published literature, official reports, surveys, etc.) at the beginning of each crediting period that the quantity of available biomass in the region (e.g., 50 km radius), is at least 25% larger than the quantity of biomass that is utilised including the project activity, then this source of leakage can be neglected otherwise this leakage shall be estimated and deducted from the emission reductions.*"

The availability of biomass in Mafia Island is calculated based on the data provided in Section 6. Sustainable biomass of report "Power for Mafia Island - An IPP proposal utilising Renewable Energy". The details are listed in table 27.

Table 27. Estimation of biomass availability

Parameter	Value	Unit	Source
A. Annual biomass requirement			
Annual power generation	15,023	MWh	ER calculation
Biomass required per kWh generation	1.3	kg of biomass	Weblink[27]
Annual biomass required	19,530,420	kg of biomass	
B. Biomass availability in Mafia island			
Total coconut trees	150,000	Nos	Power plant proposal
Average weight of tree (air dried)	1,640	kg	Power plant proposal
Total available biomass	246,000,000	kg	
Biomass availability for power generation	12.60	years	
C. Biomass required for 4 years of operation alone (before yield from energy plantations)			
Biomass requirement	78,121,680	kg	
Percentage of excess biomass available	215	%	

The above estimation shows that there is sufficient biomass available in the Mafia Island to run the Ngombeni power plant for 12.6 years. However, it is also to be noted that the project participant plans to go for energy plantations in the areas where the biomass is cut. The energy plantation will start yielding after 4 years. He has already established a nursery with the view to go for energy plantation in the available spaces. With such a scenario, it can be clearly seen that the excess

[27] http://www.bioenergyindia.in/attachment/rura-energy-from-biomass.pdf

biomass available in Mafia Island is around 215%, which is clearly above the 25%, the quantity required by CDM. Hence, there is no leakage calculated.

When the project starts utilising the biomass from the energy plantations, then the project emission and leakages shall be calculated as per the methodological tool for "Project and leakage emissions from biomass", as applicable to project conditions.

F.4. Calculation of emission reductions 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
9904-0003	1,995	0	0	0	1,995	1,995
9904-0005	12,754	0	0	0	12,754	12,754
9904-0007	48	0	0	0	48	48
9904-0008	41	0	0	0	41	41
Total	**14,838**	**0**	**0**	**0**	**14,838**	**14,838**

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_2e)	Amount estimated ex ante (t CO_2e)
9904-0003	1,995	5,190
9904-0005	12,754	25,686
9904-0007	48	4,006
9904-0008	41	354
Total	**14,838**	**35,236**

F.6. Remarks on increase in achieved emission reductions

The overall CER generated during the reported monitoring period is 58% less than the estimated CERs from the registered CPAs.

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Document information

Version	*Date*	*Description*
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