



Monitoring report form for CDM project activity
(Version 06.0)

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

MONITORING REPORT

Title of the project activity	Rwanda Electrogaz Compact Fluorescent Lamp (CFL) distribution project
UNFCCC reference number of the project activity	3404
Version number of the PDD applicable to this monitoring report	14
Version number of this monitoring report	1
Completion date of this monitoring report	08/06/2017
Monitoring period number	Third monitoring period
Duration of this monitoring period	01/04/2014 – 31/12/2015 (639 days)
Monitoring report number for this monitoring report	N/A
Project participants	<p>Rwanda: Rwanda Energy Group Ltd (REG Ltd);</p> <p>Netherlands: Netherlands' Ministry of Infrastructure and the Environment (IenM);</p> <p>Germany: BASF SE; KfW;</p> <p>Austria: Kommunalkredit Public Consulting GmbH;</p> <p>Denmark: Maersk Olie og Gas A/S; Dong Energy Salg & Service A/S; Nordjysk Elhandel A/S; Danish Ministry of Climate, Energy and Building/Danish Energy Agency; Aalborg Portland A/S;</p> <p>Sweden: Goteborg Energi AB;</p> <p>Italy: Government of Italy - Ministry for the Environment, Land and Sea;</p> <p>Belgium: Bruxelles Environnement – IBGE; Walloon Region: Walloon Air and Climate Agency;</p> <p>Spain: Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness; EDP - Energias de Portugal, S.A.; Endesa Generación, S.A.; Gas Natural SDG, S.A.; Hidroeléctrica del Cantábrico, S.A.;</p> <p>Finland: Ruukki Metals Oy;</p> <p>Norway: Statoil ASA; Statkraft Carbon Invest AS;</p>

	<p>Switzerland: Schweizerische Rückversicherungsgesellschafts AG (Swiss RE);</p> <p>Japan: Daiwa Securities Co., Ltd.; Fujifilm Corporation; Idemitsu Kosan Co., Ltd.; JX Nippon Oil & Energy Corporation; The Okinawa Electric Power Corporation, Inc.;</p> <p>Luxembourg: Ministry of Sustainable Development and Infrastructure</p> <p>Bilateral and Multilateral Funds: International Bank for Reconstruction and Development (IBRD) as Trustee of the Community Development Carbon Fund (CDCF)</p>	
Host Party	Rwanda	
Sectoral scopes	Sectoral Scope 3: Energy demand	
Applied methodologies and standardized baselines	AMS-II.J. ver. 7 - Demand-side activities for efficient lighting technologies	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0	19,763
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	20,949	

SECTION A. Description of project activity

A.1. General description of project activity

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The purpose of the Rwanda Electrogaz CFL Distribution Project is to expand the use of high-efficiency lighting technology in Rwanda's residential sector through the distribution of high-quality Compact Fluorescent Lamps.

The project activity, implemented by the national public electricity utility Rwanda Energy Group, Ltd (REG Ltd)¹, is designed with two components:

Component 1: Existing grid-connected customers have the opportunity to exchange incandescent lamps of a range of 25 to 100 watts for high-quality self-ballasted compact fluorescent lamps (CFLs) of up to 20 Watts.

Component 2: As part of the national electrification program, which aims to increase the grid-connected rate up to 36% by 2020, newly connected REG customers receive a capped number of CFLs with their new electricity meter at the time of the connection. CFLs of 15 and 20 Watts were distributed.

The CFL distribution project is implemented through 4 phases starting mid-2007. Distribution of 4 phases was completed as of December 2014, with distribution of nearly 700,000 lamps.

The total emission reductions achieved during the monitoring period from 01/04/2014 to 31/12/2015 are 19,763 tCO₂.

A.2. Location of project activity

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Location: Rwanda

Region: Country-wide

City/Town/Community etc: Country-wide, mainly in urban areas, at all REG existing or future customers

REG geographic cover is divided in 7 antennas in Kigali and 14 stations in the rest of the country:

- 7 antennas: Gikondo, Kacyiru, Kanombe, Muhima, Nyamirambo, Nyarugenge, and Remera,
- 14 stations: Gicumbi, Huye, Kabaya, Karongi, Muhanga, Musanze, Ngoma, Nyagatare, Nyamagabe, Nyanza, Rubavu, Rulindo, Rusizi, and Rwamagana.

The location of each customer, existing and new, is known from the "Customer contract number" (or ID) issued by REG. Each number is unique to a customer and provides complete information, including address and contact information.

¹ The name of this entity is REG (Rwanda Energy Group) according to Law no 87/03 of 16/08/2014. Prior to this data the name was EWSA (Energy, Water and Sanitation Authority). Prior to 07/12/2010 the name was RECO RWASCO. Prior to 08/2009, RECO - RWASCO was officially named Electrogaz. The change does not impact project legal terms and implementation. For coherence in this document, only REG is used in the MR to refer to the project entity, unless there is a historical or legal reason to use an earlier name.

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Rwanda (host)	Rwanda Energy Group (REG)	No
Netherlands	Netherlands' Ministry of Infrastructure and the Environment (IenM)	Yes
Germany	BASF SE; KfW	No
Austria	Kommunalkredit Public Consulting GmbH	No
Denmark	Maersk Olie og Gas A/S; Dong Energy Salg & Service A/S; Nordjysk Elhandel A/S; Danish Ministry of Climate, Energy and Building/Danish Energy Agency; Aalborg Portland A/S	Yes
Sweden	Goteborg Energi AB	No
Italy	Government of Italy - Ministry for the Environment, Land and Sea	Yes
Belgium	Bruxelles Environnement – IBGE; Walloon Region: Walloon Air and Climate Agency	Yes
Spain	Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness; EDP - Energias de Portugal, S.A.; Endesa Generación, S.A.; Gas Natural SDG, S.A.; Hidroeléctrica del Cantábrico, S.A.	Yes
Finland	Ruukki Metals Oy	No
Norway	Statoil ASA; Statkraft Carbon Invest AS	No
Switzerland	Schweizerische Rückversicherungsgesellschaft AG (Swiss RE)	No
Japan	Daiwa Securities Co., Ltd.; Fujifilm Corporation; Idemitsu Kosan Co., Ltd.; JX Nippon Oil & Energy Corporation; The Okinawa Electric Power Corporation, Inc.	No
Luxembourg	Ministry of Sustainable Development and Infrastructure	Yes
Netherlands, Belgium, Spain, Luxembourg, Austria, Finland	International Bank for Reconstruction and Development (IBRD) as Trustee of the Community Development Carbon Fund (CDCF)	Yes

A.4. Reference to applied methodologies and standardized baselines

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AMS-II.J. “Demand-side activities for efficient lighting technologies” (Version 7) - <http://cdm.unfccc.int/methodologies/DB/GIIF3094709KR4YEEJXX72UY39L6Y4>

“Tool to calculate the emission factor for an electricity system” (Version 2) - <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf>

A.5. Crediting period type and duration

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Fixed crediting period

Start Date: 30/05/2010

Length: 10 years 0 months

SECTION B. Implementation of project activity**B.1. Description of implemented project activity**

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The project is implemented in 4 phases, all of them completed as of the completion of this monitoring report.

The table below provides the number of CFLs distributed under each phase, as accounted for and double-checked as per the PDD requirements.

Table 1: CFL distribution project status

Phase	Procured/Estimated Number of CFLs	Actual Distributed CFL ²	Distribution Timeline in the registered PDD	Actual End date of distribution
Phase1	50,000	43,119	August - September 2007	December 2007
Phase2	150,000	132,351	September 2008 - March 2009	June 2009
Phase3	200,000	185,453	Mid 2009	December 2010
Phase4	400,000	322,243	Mid 2010 to early 2011 (monthly recorded)	Dec 2014

The deviation between the number of CFLs procured and the number of CFLs distributed is due to the following:

- Some lamps were found faulty during the distribution,
- Others were broken, and
- Some losses were noted during the lamps distribution.

The overall timeline of the project was lengthened compared to the projection in the PDD due to two major factors, as follows:

- The distribution pace for existing customers (Component 1: Phase 1, Phase 2 and partly Phase 3) slowed down at the second half of Phase 2 and during Phase 3 as the coverage of existing customers increased, reducing the target population.
- Each phase is associated with a specific lamp purchase contract. The procurement process and the contract implementation (up to the lamp delivery) for the 3rd phase took about 6 more months than expected, mainly due to procurement delays. The planned supply of phase 4 of 400,000 CFLs in mid-2010 was delivered in December 2011 and the majority of the distribution was not complete until May 2014.

In exchange for each CFL distributed in Component 1, the customers provide an incandescent lamp (ICL). All the incandescent lamps were shipped to the central warehouse in Kigali for storage before destruction. Prior to the destruction of the incandescent lamps, an Environmental study needs to be conducted to provide guidance on the proper way to dispose of the lamps (as required by Rwanda Environmental Management Authority - REMA). The Rwanda National University has

² The number of lamps used for ER calculation is taken conservatively by comparing the number of CFLs distributed with the number of ICLs collected.

prepared the study. The report has been sent to the Rwanda Development Board (RDB) which is entitled to approve EIAs in Rwanda, and the project participants are awaiting the response from RDB, prior to implementing the recommendation of the report on ICL disposal.

Table 2: Quantity and Rated power of the collected ICLs, ex-post monitored³

ICL Group (W)	Power rate	Number of ICL in Component 1		
		Phase 1	Phase 2	Phase 3
25		953	0	0
40		12,330	1,068	22,059
60		11,961	51,266	34,667
75		15,084	79,708	33,970
Total		40,328	132,042	90,696

For Component 1, the number of distributed CFLs and received ICL should be equal; however, losses of ICLs occurred during the shifting of lamps from the branches to the central storage location in Kigali. The lamp numbers presented in the table above represent those that have been verified physically in the central storage location. Also, broken ICLs were not accounted for.

The number of lamps distributed per household was restricted in each Phase of the distribution. Phase 1 distribution was limited to two (2) per household. Phase 2 was limited to five (5) per household. Phase 3 and Phase 4 were limited to four (4) per household. The number of lamps distributed per household was always fewer than six (6).

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

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N/A

B.2.2. Corrections

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A request for corrections was submitted via a request for post-registration change on 27/09/2016 and approved as of 02/12/2016. In the approved revised PDD dated 27/10/2016 (version 14), the following corrections were included:

- The name of the project participant was changed to REG Ltd. from Electrogaz throughout (This change was notified to the UNFCCC on 30 April 2015).
- The list of project participants was corrected in line with the list on the UNFCCC webpage
- The parameter fixed ex ante "Percentage of lamps of type i operating at the rated lifetime (Ri)" was included as it was not listed in the original registered PDD. It is a default value provided by applied methodology AMS.II.J version 07.
- The list of parameters fixed ex ante and parameters to be monitored were updated as some of the parameters were included in the wrong sections.

(Details are available at <http://cdm.unfccc.int/PRCContainer/DB/prcp447598078/view>)

B.2.3. Changes to the start date of the crediting period

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N/A

³ Refer to project databases. The number of lamps used for ER calculation is taken conservatively by comparing the number of CFLs distributed with the number of ICLs collected.

B.2.4. Inclusion of monitoring plan

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N/A

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

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A request for permanent change from the registered monitoring plan and applied methodology was submitted via a request for post-registration change on 27/09/2016 and approved as of 02/12/2016. In the approved revised PDD dated 27/10/2016 (version 14), the following permanent changes were made:

- All the requirements of methodology AMS-II.J version 07 were adopted to Component 1 and Component 2 as it was recommended by the UNFCCC Small Scale Working Group (SSCWG) during its 50th meeting;
- A description of the sampling plan according to the Standard: Sampling and surveys for CDM project activities and programme of activities" version 05.0 was included

B.2.6. Changes to project design

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N/A

SECTION C. Description of monitoring system

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Data Collection Procedures

Data collection procedures applicable for both Component 1 and Component 2 (AMS-II.J, Version 07)

Recording of lamp distribution data

Data	Date of CFL distribution Customer identification (REG customer ID, which allows for unambiguous identification of the recipient of the equipment). Number of CFLs provided and wattage. Number of ICLs exchanged for each type (for Component 1 only).
Data generation	Customer provides unique identification to REG employee (e.g. REG bill, prepaid purchase or voucher). Component 1 only: Customer provides ICL(s) to REG employee. REG provides CFL(s) to customer.
Responsible	REG employees
Location	REG Antennas and Stations
Data recording	Phase 1: Data entered in a handwritten register and then entered into an Excel database. Phase 2 - 4: Data entered in an Excel database and in an in-house software. The Excel database serves as the reference for data recording.
Data aggregation	Phase 1: Data from handwritten registers aggregated in the Excel database Phase 2 - 4: Data aggregated Excel database and in the in-house software. The Excel database serves as the reference for data recording.
Archiving	All electronic data are stored until two years after the end of the crediting period

Data collection procedures applicable for Component 1 (AMS-II.J, Version 07)

Ex post monitoring surveys carried out within the first year after installation and once for every 30% of the elapsed rated lifetime (or every 3 years) to confirm installation and operation of the CFLs

The CFLs distributed in Phases 1 to 3 have a rated lifetime of 6,000 hours or 4.7 years, considering a daily use of 3.5 hours. Based upon this, and the requirement that the first survey be carried out within the first year after installation, the following schedule of the ex-post monitoring surveys has been implemented.

Phase	Time Elapsed from Equipment Installation				Dates of ex-post surveys		
	30% of rated life	60% of Rated Life	90% of Rated Life	100% of rated life	First	Second	Third
Phase 1	5/28/2009	10/24/2010	3/21/2012	9/9/2012	Apr-08	Oct-09	Jun-11
Phase 2	11/26/2010	4/23/2012	9/19/2013	3/10/2014	Oct-09	Jun-11	Sep-13
Phase 3	5/28/2012	10/24/2013	3/22/2015	9/10/2015	Jun-11	Sep-13	NA

Data	<p>Check whether each CFL distributed under the project activity is installed (based on records on the type/number of efficient lamps distributed to each individual household)</p> <p>Record whether CFLs distributed under the project activity are operational</p> <p>Determine whether defective CFLs were replaced by the end-user and, if so, with what type/wattage of lamp.</p> <p><i>General Information:</i></p> <p><i>Interviewer</i></p> <p><i>Date of interview</i></p> <p><i>Name and Address (or description of location of dwelling)</i></p> <p><i>Ownership status (owner/tenant/other).</i></p>
Data generation	Door-to-door surveys of a sample of CFLs, with a sample size no less than 100 or 0.1% of the population.
Responsible	REG
Location	Installation locations of distributed CFLs
Data recording	Data are recorded in a central database, or in a spread sheet and then in the database
Data aggregation	The data analysis results are provided in the survey report
Archiving	The survey report is stored until two years after the end of the crediting period

Organizational Structure

REG, the implementer of this project activity, conducts monitoring of the lamp distribution data through its antennas and stations or through private retailers; and collection, storage and destruction of ICLs.

REG supervises the monitoring surveys, which are undertaken by external consultants.

Roles and Responsibilities:

- REG CFL Distribution Staff: Distribute CFLs among REG customers and recording of customer ID, number of CFLs distributed, date and wattage.
- REG Antenna/Station Managers: Ensure the accuracy of the data collected by the distribution staff and enter the information in the in-house software.
- REG CFL Project Coordinator: Revise the information provided by the Antenna/Station Managers through the software, ensure data traceability and reliability, and calculation of the emission reductions achieved by the project.

Initially, the project activity was partially included in REG's Urgent Electricity Rehabilitation Project (UERP), which was closed in 2010. For the three first phases of the CDM project, the UERP implementation unit was responsible for the CFL purchase, including the procurement process. For the 4th Phase, REG was directly in charge of the procurement.

Training has been arranged for the relevant participants in the project monitoring:

- The REG CFL distribution staff was trained on the benefits of CFLs at the beginning of the project.
- The REG CFL distribution staff was also trained on the procedures for distribution and data recording in accordance with the requirements of the methodologies and the registered PDD.
- Staff using the in-house software for lamp distribution data collection was trained by the IT staff on use of the program.

Quality Control and Emergency Procedures*Recording of lamp distribution data*

The REG station/antenna manager receives a specified number of CFLs, and the station/antenna manager acts as, or designates, a "storekeeper". The storekeeper releases a fixed number of CFLs to the lamps distributor. The distributor operates the computer, where data is entered on customer name/number, ICLs received and CFLs provided and their Wattage.

For component 1, the cashier and the customer test the ICLs and CFLs before the exchange. The storekeeper receives a specified number of ICLs from the cashier. ICLs are shipped to REG warehouse in Kigali where they are stored before destruction. At the end of each phase, an independent party certifies the collection of incandescent lamps through a random sampling of the lamps in storage – the number, rating and operational condition of the ICLs, as per REG records. The independent certifier prepares a report, including witnessing the destruction/crushing of the ICLs in the safe disposal area.

SECTION D. Data and parameters**D.1. Data and parameters fixed ex ante**

Data / Parameter	EF_{CO2,ELEC,y} or EF_{grid}
Unit	kg CO2e/kWh
Description	Emission factor for the national electricity grid for 2007
Source of data	See PDD annex for EF grid calculation
Value(s) applied	0.6540

Choice of data or Measurement methods and procedures	Calculated as per Combined Margin approach from the “Tool to calculate the emission factor for an electricity system” (version 2), mentioned in ACM0002 and AMS I.D, using data from 2003 to 2008 provided by the electricity company REG Ltd. The calculation is detailed in section B.6.3. All references are included in the annex.
Purpose of data	Baseline emissions and project emissions calculation
Additional comment	

Data / Parameter	TD_y
Unit	None
Description	Average annual technical grid losses in year y
Source of data	Methodology default value
Value(s) applied	10%
Choice of data or Measurement methods and procedures	No recent data is available.
Purpose of data	Baseline and project emissions calculation
Additional comment	-

Data / Parameter	NTG
Unit	None
Description	Net-to-gross adjustment factor
Source of data	Methodology default value
Value(s) applied	0.95
Choice of data or Measurement methods and procedures	No recent data is available.
Purpose of data	Baseline and project emissions calculation
Additional comment	-

Data / Parameter	O_i
Unit	Hours
Description	Average daily operating hours of the lighting devices replaced by the group of “i” lighting devices
Source of data	Methodology default value
Value(s) applied	3.5
Choice of data or Measurement methods and procedures	As stipulated by methodology: 3.5 hours per 24 hrs period.
Purpose of data	Baseline and project emissions calculation
Additional comment	-

Data / Parameter	L_i
Unit	Hours
Description	Equipment lifetime
Source of data	Provided by REG Ltd, technical specification set in the tender
Value(s) applied	At least 6000 hours
Choice of data or Measurement methods and procedures	Stipulated by the methodology: ‘Rated lifetime’ or ‘rated average life’ or ‘rated life to 50% failures’ is the expected time at which 50% of the total number of lamps reach the end of their individual life.

Purpose of data	Baseline and project emissions calculation
Additional comment	The number is checked through the monitoring of the failure rate

Data / Parameter	X_i
Unit	hours
Description	Number of operating hours per year for equipment type <i>i</i>
Source of data	Methodology default value
Value(s) applied	1277.5
Choice of data or Measurement methods and procedures	Stipulated by methodology, the lower value of 3.5 hours per 24 hrs period is considered for this project activity over 365 days per year.
Purpose of data	Baseline and project emissions calculated
Additional comment	-

Data / Parameter	R_i
Unit	%
Description	Percentage of lamps of type <i>i</i> operating at the rated lifetime
Source of data	Methodology default value
Value(s) applied	50
Choice of data or Measurement methods and procedures	No project specific data is available.
Purpose of data	Baseline and project emissions calculation
Additional comment	This figure is applied for ex ante calculations or in the case there is not a value from an ex post survey according to paragraph 30 of AMS-II.J version 07.

Data / Parameter	$P_{I,BL}$
Unit	Watt
Description	Power of the incandescent lamps in the baseline scenario
Source of data	Baseline survey conducted in April 2008
Value(s) applied	83.3
Choice of data or Measurement methods and procedures	The power of the baseline light bulb has been calculated on a pro rata basis of the ICL breakdown provided by the baseline survey.
Purpose of data	Baseline emissions calculation
Additional comment	-

D.2. Data and parameters monitored

Data and parameters applicable for Component 1 and Component 2 (AMS-II.J, Version 7)

Data/parameter:	Customer information
Unit	-
Description	Customer Identification Number (unique – as per REG records) Name of head of household Address or description of location of household
Measured/calculated/default	Measured
Source of data	Information provided by utility customers at the distribution points upon presentation of a bill or a cash power receipt.

Value(s) of monitored parameter	Recorded information is available to the DOE; personal information not publicly released
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Once at bulb distribution
Calculation method (if applicable):	N/A
QA/QC procedures:	Identity of heads of households and customer ID to be cross-checked with utility records by REG Ltd to avoid several purchase with the same ID
Purpose of data:	This is the basic identification parameter that is used for existing and new customers and forms the foundation of the monitoring of both component 1 and 2 of the project.
Additional comments:	-

Data/parameter:	Distribution date
Unit	Date
Description	Date of the CFL distribution uniquely recorded for each customer participant
Measured/calculated/default	Measured
Source of data	Recorded by REG at distribution points
Value(s) of monitored parameter	Available to the DOE in the project distribution database
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Once at distribution (check in the database at each verification)
Calculation method (if applicable):	N/A
QA/QC procedures:	Quality check of data sent by REG Ltd branches and antennas at central local in Kigali. Reports from branches
Purpose of data:	Baseline and project emissions calculation
Additional comments:	Components 1 and 2 Dates are reported monthly for the purpose of the ER calculations

Data/parameter:	$Q_{PJ,i}$
Unit	-
Description	Number (quantity) of pieces of CFLs of type i distributed under the project,
Measured/calculated/default	Measured
Source of data	Recorded by REG (Lamps distribution databases)
Value(s) of monitored parameter	Component 2 Only <ul style="list-style-type: none"> For distributed CFL, $i = 15\text{ W}$ 130,353 For distributed CFL, $i = 20\text{ W}$ 190,902
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Once at distribution
Calculation method (if applicable):	N/A
QA/QC procedures:	Quality check of data sent by REG Ltd branches and antennas at central local in Kigali. Comparison of allotted and distributed lamps with procured lamps
Purpose of data:	Baseline and project emissions calculation
Additional comments:	N/A

Data/parameter:	P_{i,PJ}
Unit	Watts
Description	Rated power of the project CFLs of the group of “ <i>i</i> ” lighting devices, <i>i</i>
Measured/calculated/default	Default
Source of data	Technical specifications set in the tender
Value(s) of monitored parameter	15 W and 20 W
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Recorded once at distribution (check in the database at each verification)
Calculation method (if applicable):	N/A
QA/QC procedures:	Specification at procurement and reading during distribution
Purpose of data:	Calculation of project emissions
Additional comments:	The number will also be monitored once ex post at distribution

Data/parameter:	Q_{BL,I}
Unit	-
Description	Number (quantity) of pieces of incandescent lamps (ICLs) of type <i>i</i> exchanged under the project
Measured/calculated/default	Measured
Source of data	Recorded by REG (Lamps distribution databases)
Value(s) of monitored parameter	Not applicable given only component 2 is considered for this monitoring period.
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Once at CFL distribution
Calculation method (if applicable):	N/A
QA/QC procedures:	A third party was engaged to certify the number of ICLs collected. The report is available for Phases 1, 2 and 3. The sampling methodology is based on the Standard ISO 2859-1: 1999. The report was prepared by an independent consultant using a sampling approach based on the Guidelines for sampling and surveys for CDM project activities and programme of activities, version 04.0.
Purpose of data:	Baseline and project emissions calculation
Additional comments:	-

Data/parameter:	N_{sample,s}
Unit	-
Description	Number of sampled CFLs during the post installation survey <i>s</i>
Measured/calculated/default	Measured
Source of data	Survey reports
Value(s) of monitored parameter	120 (based on ex-post monitoring survey in September 2013)

Monitoring equipment	N/A
Measuring/reading/recording frequency:	Four ex-post monitoring surveys have been conducted as shown below based on the requirement of the frequency in AMS-II.J (version 3) 1 st ex-post monitoring survey: April, 2008 2 nd ex-post monitoring survey: October, 2009 3 rd ex-post monitoring survey: June, 2011 4 th ex-post monitoring survey: September 2013
Calculation method (if applicable):	N/A
QA/QC procedures:	<p>As per AMS-II.J, version 07, the sampling size is determined by minimum 90% confidence interval and the 10% maximum error margin; the size of the sample shall be no less than 100. Using the calculation method for a normal distribution, the sample size would be 68, which is lower than the minimum size allowed by the methodology. Hence, the minimum size of the sample is 100 for each population (or phase).</p> <p>At the PDD registration, and in the absence of detailed guidelines from the UNFCCC on formula to calculate sample sizes, the project participant confirmed the minimum sample size for the Lamp Failure Rate parameter using the procedures outlined in Cochran (1977)⁴ and described by Bartlett et al (2001)⁵:</p> $n_o = \frac{(t)^2 \times (p \times q)}{(d)^2}$ <p>Where: t = value for the standard normal distribution value, with an infinite number of readings, and for the desired confidence level. For confidence level of 90%, t = 1.645 (pxq) = estimate of variance value = 0.25, meaning standard deviation (variability) of 50% is assumed as no historical data were available. d = acceptable margin of error (precision) for proportion being estimated 10%</p> $n_o = \frac{(1.645)^2 \times (0.25)}{(0.1)^2} = 68$
Purpose of data:	Calculation of baseline emissions
Additional comments:	The ex-post surveys were conducted well before the approval of the post-registration change. The procedures defined in AMS-II. J version 03 were followed at the time of the survey instead of AMS-II. J version 7 which results in a temporary deviation from the methodology.

Data/parameter:	N_{OK,s}
Unit	-
Description	Number of sampled CFLs which are functional during the post installation surveys
Measured/calculated/default	Measured
Source of data	Survey reports
Value(s) of monitored parameter	75 (based on ex-post monitoring survey in September 2013)

Monitoring equipment	N/A
Measuring/reading/recording frequency:	<p>Four ex-post monitoring surveys have been conducted as shown below based on the requirement of the frequency in AMS-II.J (version 3) 1st ex-post monitoring survey: April, 2008</p> <p>2nd ex-post monitoring survey: October, 2009</p> <p>3rd ex-post monitoring survey: June, 2011</p> <p>4th ex-post monitoring survey: September 2013</p> <p>Given the above ex-post surveys were all conducted before the approval of the post-registration dated December 2, 2016. Based on the approved revised PDD. the revised sampling approach applies only to surveys conducted after the approval of the post registration changes.</p>
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	Calculation of baseline emissions
Additional comments:	The ex-post surveys were conducted well before the approval of the post-registration change. The procedures defined in AMS-II. J version 03 were followed at the time of the survey instead of AMS-II. J version 7 which results in a temporary deviation from the methodology.

Data/parameter:	LFR_{i,y}
Unit	Fraction
Description	Lamp Failure Rate for equipment type i in year y (fraction)
Measured/calculated/default	Measured
Source of data	0.375
Value(s) of monitored parameter	Refer to the ER calculation
Monitoring equipment	N/A
Measuring/reading/recording frequency:	At least every three years after installation of equipment (as per procedures in paragraph 29 and 30 of AMS-II.J, version 07)
Calculation method (if applicable):	<p>The Lamp Failure Rate is determined through ex post monitoring surveys applying the "Standard: Sampling and surveys for CDM project activities and programme of activities" and the "Guideline: Sampling and surveys for CDM project activities and programmes of activities".</p> <p>As per AMS-II.J, version 03, the sample size is determined by minimum 90% confidence interval and the 10% maximum error margin. The sample size will be applied to each Phase separately. According to the sampling plan described in B.7.2, the sample size for each Phase will be at least 271 CFLs to be surveyed and the number of lamps that still in operation will be counted. The data of each checked CFL will be recorded on the survey questionnaire while the ex-post installation survey is conducted. One questionnaire is filled in per each sampled customer. The information from the questionnaire is afterwards entered into a survey database; this database is related to one monitoring interval. The number of sampled CFLs will be divided by the number of CFLs received by each customer to determine the number of customers to visit.</p> <p>The Lamp failure rate is calculated by dividing the number of lamps that are found not working during household visits by the total number of lamps actually surveyed.</p>
QA/QC procedures:	Application of standardized data forms and compliance protocols.
Purpose of data:	Calculation of project emissions
Additional comments:	Please note that the revised sampling approach applies only to surveys conducted after the approval of the post registration changes. A deviation is therefore requested to use the monitoring requirements in the initially registered PDD for previous monitoring periods)

D.3. Implementation of sampling plan

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$N_{\text{sample},s}$ Number of sampled CFLs during the post installation survey s & $N_{\text{OK},s}$ Number of sampled CFLs which are functional during the post installation surveys

Implemented sampling design

The sampling objective was to determine the ex-post Lamp Failure Rate for adjustment of the net electricity savings and emission reduction calculations. As per AMS-II.J, the sampling size was determined by minimum 90% confidence interval and 10% maximum error margin; and the size of the sample was to be no less than 100. The target population is the distributed CFLs under Phase 1 through Phase 3. The sampling method was applied to each Phase separately. The number of households is determined by dividing the sample size by the number of CFLs distributed per household in each phase. Multi-stage sampling was applied where clusters (first stage) corresponded to REG branches, which are located in various administrative entities called sectors and districts, and clusters were randomly selected. In the second stage, households were selected randomly, in each selected cluster (REG branch).

The following method was used to select the cluster and the households to be surveyed based on the number of CFLs to be covered by the survey:

1. Make a list of antennas (23 total in Phase 3)
2. Establish a sample selection interval
3. Pin point the distributed lamps named population
4. Calculate cumulative population
5. Choose randomly a number which is a starting point
6. Add the sampling interval for moving to the next step and select the cluster within which the number falls. Proceed until enough branches are selected to fulfil the sample size requirement (see table below)
7. Within the cluster, five households to be surveyed are randomly selected (except for the first survey of Phase 1, where households were randomly selected proportionally to the quantity of bulbs distributed).

The number of samples for the survey relevant for this monitoring report is presented in the below table.

Survey #	Sampling Frame	Final Sample Size (#CFLs)	Number of CFLs per household	Number of households surveyed	Number of clusters (branches surveyed)
September 2013	Phase 3 CFLs	120	4	30	9

Collected Data

The collected data is summarized in the survey report.

Analysis of the collected data

Survey #	Sampling Frame	$N_{\text{OK},s}$	$N_{\text{sample},s}$	$\text{LFR}_{i,y}$
September 2013	Phase 3 CFLs	75	120	0.375

Demonstration confidence/precision requirements

The reliability of the sampling approach is checked to confirm that the 90/10 confidence/precision level requirement is met. As per the Standard for "Sampling and surveys for CDM project activities and program of activities" version 04.1, paragraph 11 (a) (i), the absolute precision level was

calculated for all surveys under each phase. As it can be seen in the table below, the absolute precision level of 10% was achieved for all of them (for further information on the calculation of the absolute precision level, please see excel sheet named "Absolute Precision Calculation").

	Survey 4 – September 2013
Phase 3	7.28%

SECTION E. Calculation of emission reductions or net anthropogenic removals

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

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As per AMS-II.J (version 7), the emissions reduction by the project activity in year y is calculated directly as follows.

$$ER_y = NES_y * EF_{CO_2,ELEC,y}$$

Where:

$EF_{CO_2,ELEC,y}$ = Emission factor in year y calculated in accordance with the provisions in AMS I.D (tCO₂/MWh)

ER_y = Emission reductions in year y (tCO₂e)

$$NES_y = \sum Q_{PJ,i} * (1 - LFR_{i,y}) * ES_i * NTG / (1 - TD_y)$$

$$ES_i = (P_{i,BL} - P_{i,PJ}) * O_i * 365/1000$$

Where:

NES_y = Net electricity saved in year y (kWh)

$Q_{PJ,i}$ = Number (quantity) of pieces of equipment of type i distributed under the project activity (units)

i = Counter for equipment type

ES_i = Estimated annual electricity savings for equipment of type i , for the relevant technology (kWh)

$LFR_{i,y}$ = Lamp Failure Rate for equipment type i in year y (fraction)

TD_y = Average annual technical losses (transmission and distribution) in year y

NTG = Net-to-gross adjustment factor, a default value of 0.95

$P_{i,BL}$ = Rated power of the baseline lighting devices of the group of " i " lighting devices (Watts) or 75W if the baseline lighting device is a 100W ICL and the project lighting device a 20W CFL⁶

$P_{i,PJ}$ = Rated power of the project lighting devices of the group of " i " lighting devices (Watts)

O_i = Average daily operating hours of the lighting devices replaced by the group of " i " lighting devices

The Lamp Failure Rate (LFR_y), the % of lamps that have failed, is calculated based on the results of the ex-post surveys as follows:

$$LFR_y = 1 - (N_{OK,x} / N_{Sample,s})$$

⁶ For conservativeness, and as agreed by the EB following with a request for deviation of AMS-II.J, when a 100W ICL is replaced by a 20W CFL, it is considered in the electricity savings calculations "that 20 W CFL is replacing a 75 W incandescent bulb (which is the next available standard wattage of incandescent bulb for which the light output of 20 W CFL will be equivalent or higher)".

Survey #	Sampling Frame	N _{OK,s}	N _{sample,s}	LFR _{i,y}
September 2013	Phase 3 CFLs	75	120	0.375

With respect to $Q_{PJ,i}$, since the quantity of collected ICLs and distributed CFLs do not match (fewer ICLs than CFLs), the ER calculation considers only as many CFLs as correspond to a collected ICL, to ensure conservativeness.

The detailed CERs calculation for component 1 is in the ER calculation spreadsheet.

Full calculations for all project components, for the entire monitoring period, are demonstrated in the ER calculation spreadsheet.

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

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N/A

E.3. Calculation of leakage emissions

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N/A

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

	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
Total	19,763	0	0	0	19,763	19,763

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO ₂ e)	Amount estimated ex ante (t CO ₂ e)
20,949*	19,763

*The PDD value been calculated by prorating the PDD values by the number of days to match this monitored period (01/04/2014 to 31/12/2015).

E.6. Remarks on increase in achieved emission reductions

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There is no increase in the actual GHG emission reductions achieved during this monitoring period as compared to estimates in the registered PDD.

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
06.0	7 June 2017	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: <ul style="list-style-type: none"> • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report		