



Monitoring report form (Version 03.2)

Monitoring report

| | |
|--|---|
| Title of the project activity | Rwanda Electrogaz Compact Fluorescent Lamp (CFL) distribution project |
| Reference number of the project activity | 3404 |
| Version number of the monitoring report | 5 |
| Completion date of the monitoring report | 19/05/2014 |
| Registration date of the project activity | 30/05/2010 |
| Monitoring period number and duration of this monitoring period | First Monitoring Period: 30/05/2010 – 31/07/2012 |
| Project participant(s) | <p>Rwanda: Energy, Water and Sanitation Authority (EWSA);</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 Naturgas 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(ies) | Rwanda |

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|--|--|
| Sectoral scope(s) and applied methodology(ies) | Sectoral Scope 3: Energy demand AMS-II.J. ver. 3 - Demand-side activities for efficient lighting technologies AMS-II.C. ver. 11 - Demand-side energy efficiency activities for specific technologies |
| Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD | 62,934 tCO ₂ |
| Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period | 23,491 tCO ₂ |
| Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012 (if applicable) | 23,491 tCO ₂ |
| Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable). | Not applicable |

SECTION A. Description of project activity**A.1. Purpose and general description of project activity**

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, EWSA¹, 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 EWSA 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. Thus far 3 phases of distribution have been completed with distribution of 360,923 bulbs. As per the PDD, the total number of CFLs to be distributed in the 4 phases is 800,000.

The total emission reductions achieved during the monitoring period from 30/05/2010 to 31/07/2012 are 23,491 tCO₂.

A.2. Location of project activity

Location: Rwanda

Region: Country-wide

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

EWSA 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 EWSA. Each number is unique to a customer and provides complete information, including address and contact information.

A.3. Parties and project participant(s)

| Party involved ((host) indicates a host Party) | Private and/or public entity(ies) project participants (as applicable) | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|--|---|---|
| Rwanda (host) | Energy, Water and Sanitation Authority (EWSA) | NO |
| Netherlands | Netherlands' Ministry of Infrastructure and the Environment (IenM) | YES |
| Germany | BASF SE; KfW | NO |

¹ The name of this entity is EWSA (Energy, Water and Sanitation Authority), according to Law no 43/2000 of 07/12/2010. Prior to this date 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 EWSA is used in the MR to refer to the project entity, unless there is a historical or legal reason to use an earlier name. The MOC for the change of name has been submitted on September 27, 2012.

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|---|---|-----|
| Austria | Kommunalkredit Public Consulting GmbH | NO |
| Denmark | Maersk Olie og Gas A/S; DONG Naturgas 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 Rückversicherungsgesellschafts 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 of applied methodology
AMS-II.J. “Demand-side activities for efficient lighting technologies” (Version 3)
AMS-II.C. “Demand-side energy efficiency activities for specific technologies” (Version 11)
“Tool to calculate the emission factor for an electricity system” (Version 2)

A.5. Crediting period of project activity

Fixed crediting period

Start Date: 30/05/2010

Length: 10 years 0 months

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

The project is implemented in 4 phases. The first three phases of distribution are completed. The procurement for the purchase of 400,000 CFLs for phase 4 is finalized. The CFLs are in EWSA's warehouse since December 2011. Their distribution started in July 2012.

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 | N/A | Mid 2010 to early 2011 (monthly recorded) | (Started in July 2012) |

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 more time than expected, mainly due to procurement delays, leading to a delay of about 6 months. The planned supply of phase 4 of 400,000 CFLs in mid-2010 was delivered in December 2011 and their distribution started in July 2012.

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 REMA). The Rwanda National University has 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

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.

| ICL Power rate Group (W) | 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 resulted 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 2 per household. Phase 2 was limited to 5 per household. Phase 3 was limited to 4 per household. The number of lamps distributed per household was always fewer than six.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

Temporary deviations applied during this monitoring period: NA⁴

B.2.2. Corrections

NA

B.2.3. Permanent changes from registered monitoring plan or applied methodology

NA

B.2.4. Changes to project design of registered project activity

NA

B.2.5. Changes to start date of crediting period

NA

B.2.6. Types of changes specific to afforestation or reforestation project activity

NA

SECTION C. Description of monitoring system

Data Collection Procedures

Data collection procedures applicable for both Component 1 (AMS-II.J, Version 03) and Component 2 (AMS-II.C, Version 11)

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.

⁴ M-DEV0264, approved 17/11/2009 (before registration). It was accepted that 20 W CFL may replace 100 W incandescent bulbs; however, for the purpose of emission reduction calculations, 20 W CFL are considered to replace 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).

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| | <i>General Information:</i> <i>Interviewer</i> <i>Date of interview</i> <i>Name and Address (or description of location of dwelling)</i> <i>Ownership status (owner/tenant/other).</i> |
| 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 | EWSA |
| 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 |
| <p><u>Data collection procedures applicable for Component 2 (AMS-II.C, Version 11) only</u></p> <p><u>Annual checks of a sample of non-metered systems to ensure that they are still operating</u></p> <p>The percentage of CFLs that are still operating is captured through annual surveys on a sample of non-metered lamps. The percentage of functioning non-metered CFLs will be used to discount the energy savings and thus emission reductions.</p> <p>AMS-II.C is applicable only for Phases 3 (part of CFLs distributed) and 4 (Component 2). This monitoring period does not comprise Phase 4, since CFL distribution under Phase 4 started in July 2012 and this monitoring period ended in July 2012. Therefore, annual checks are only required for Phase 3 as per AMS-II.C, version 11. Since the end date of CFL distribution for Phase 3 was December 2010, the first annual check needs to be conducted between January and December 2011 (it was actually conducted in June 2011).</p> <p>The information for the annual check has been captured in the ex-post surveys that monitor installation and operation of the CFLs for the purpose of Component 1. Samples are performed simultaneously with the ex-post surveys for Component 1. This means that a separate sampling was not conducted for the annual check, but the results of Phase 3 (that conclude to annual check of lamps that are still operation (AMS-II.C) similar to proportion of lamps that are still working under the lamp failure rate determination (AMS-II.J)) were used. It was possible to combine the surveys for Component 1 and Component 2 because both components are implemented in same areas, install lamps from the same procurement process, and supplied by the same electricity network.</p> <p>The relevant survey for this monitoring period was undertaken in June 2011. Therefore, the third ex-post survey, which was finalized in June 2011, is used to determine the percentage of CFLs that are still operating for phase 3. It should be noted that only CFLs from existing customers have been considered in the ER calculations for Component 1 (i.e. 79,299 CFLs), and only CFLs from new customers have used for the ERs calculation under Component 2 (i.e. 96,514). For further reference, please check the ER calculation spreadsheet.</p> | |
| Data | <ul style="list-style-type: none"> Record whether CFLs distributed under the project activity are operational <i>General Information:</i> <i>Interviewer</i> <i>Date of interview</i> <i>Name and Address (or description of location of dwelling)</i> <i>Ownership status (owner/tenant/other).</i> |
| 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 | EWSA |
| 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 |

Recording the “power” of the device installed using nameplate data or bench tests of a sample of the units installed

The power rate of the distributed lamps is recording during the distribution phase using nameplate data.

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|-------------------------|---|
| Data | “power” (rated Wattage) of CFLs distributed under the project activity that are installed |
| Data generation | Data are captured in the distribution software or in a registry by each EWSA distribution branches and consolidated in a central database. The power rate is also evidenced through the CFL specifications and test reports |
| Responsible | EWSA |
| 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 database is stored until two years after the end of the crediting period |

Metering a sample of the units installed for their operating hours using run time meters

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|-------------------------|--|
| Data | Average daily operating hours of project lamps |
| Data generation | Run-time meters with index set at zero installed on a sample of the total number of project CFLs; date of installation recorded On index recording date, index of the run time meter is noted The index is divided by the number of days of the monitored period to determine the operating hours per day of the monitored CFL The mean is calculated based on the observed values for the monitored CFLs |
| Responsible | EWSA |
| Location | Installation locations of distributed CFLs |
| Data recording | Data recorded on paper or electronically |
| Data aggregation | Data are aggregated in an excel spread sheet |
| Archiving | The database of monitoring results is stored until two years after the end of the crediting period |

Organizational Structure

EWSA, 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.

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

Initially, the project activity was partially included in EWSA’s Urgent Electricity Rehabilitation Project (UERP), which 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, EWSA is directly in charge of the procurement.

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

- The EWSA CFL distribution staff was trained on the benefits of CFLs at the beginning of the project.
- The EWSA CFL distribution staff was also trained on the procedures for distribution and data recording in accordance with the requirements of the methodologies and the 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 EWSA 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 the EWSA 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 EWSA 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 or at renewal of crediting period

Data and parameters applicable for Component 1 (AMS-II.J, Version 03) and 2 (AMS-II.C, Version 11)

| | |
|--------------------------|---|
| Data / Parameter: | $EF_{CO_2,ELEC,y} / EF_{grid}$ |
| Unit: | kg CO ₂ e/kWh |
| Description: | Emission factor for the national electricity grid for 2007 |
| Source of data: | The calculation is detailed in section B.6.3. of the registered PDD. All references are included in the annex to the PDD. 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 Electrogaz (now EWSA). |
| Value(s) applied: | 0.6540 |
| Purpose of data: | Calculation of baseline emissions and emission reductions |
| Additional comment: | |

Data and parameters applicable for Component 1 (AMS-II.J, Version 03)

| | |
|--------------------------|---|
| Data / Parameter: | TD_y |
| Unit: | - |
| Description: | Average annual technical grid losses in year y |
| Source of data: | Methodology default value |
| Value(s) applied: | 0.1 |
| Purpose of data: | Calculation of net energy savings and emission reductions |
| Additional comment: | |

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|--------------------------|---|
| Data / Parameter: | NTG |
| Unit: | - |
| Description: | Net-to-gross adjustment factor |
| Source of data: | Methodology default value |
| Value(s) applied: | 0.95 |
| Purpose of data: | Calculation of net energy savings and emission reductions |
| Additional comment: | |

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|--------------------------|------------|
| Data / Parameter: | $P_{i,BL}$ |
| Unit: | Watts |

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|---------------------|--|
| Description: | Rated power of the baseline incandescent lamps of the group of “I” lighting devices or 75W if the baseline lighting device is a 100W ICL and the project lighting device a 20W CFL |
| Source of data: | Provided by EWSA |
| Value(s) applied: | $P_{A,BL} = 25W$, $P_{B,BL} = 40W$, $P_{C,BL} = 60W$, $P_{D,BL} = 75W$ |
| Purpose of data: | Calculation of energy savings and emission reductions |
| 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 |
| Purpose of data: | Calculation of baseline emissions |
| Additional comment: | |

| | |
|--------------------------|---|
| Data / Parameter: | L_i |
| Unit: | Years |
| Description: | Equipment lifetime |
| Source of data: | Technical specification set in the tender, provided by EWSA |
| Value(s) applied: | At least 6000 hours |
| Purpose of data: | Calculation of emission reductions |
| Additional comment: | |

| | |
|--------------------------|--|
| 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 |
| Purpose of data: | Calculation of energy savings and emission reductions |
| Additional comment: | The annual number of operating hours is calculated as 3.5 hours/day x 365 days/year. |

Data and parameters applicable for Component 2 (AMS-II.C, Version 11)

| | |
|--------------------------|--|
| Data / Parameter: | P_{i,BL} |
| Unit: | Watts |
| Description: | Power of the incandescent lamps in the baseline scenario |
| Source of data: | Baseline survey conducted in April 2008 |
| Value(s) applied: | 83.3 |
| Purpose of data: | Calculation of baseline emissions |
| Additional comment: | |

| | |
|--------------------------|--|
| Data / Parameter: | P_{i,PJ} |
| Unit: | Watts |
| Description: | Power of the CFLs installed of the group of <i>i</i> devices |
| Source of data: | Provided by EWSA, technical specification set in the tender |
| Value(s) applied: | P _{a,PJ} = 15W, P _{b,PJ} = 20W |
| Purpose of data: | Calculation of project emissions |
| Additional comment: | |

D.2. Data and parameters monitored

Data and parameters applicable for Component 1 (AMS-II.J, Version 03) and 2 (AMS-II.C, Version 11)

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|---|--|
| Data / Parameter: | Customer information (for components 1 and 2) |
| Unit: | - |
| Description: | Customer Identification Number (unique – as per EWSA records) Name of head of household Address or description of location of household |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Recorded by EWSA (Lamps distribution databases) |
| Value(s) of monitored parameter: | Recorded information is available to the DOE; personal information not publicly released |
| Monitoring equipment: | NA |
| Measuring/ Reading/ Recording frequency: | Once at bulb distribution |
| Calculation method (if applicable): | NA |
| QA/QC procedures: | Customer presents a EWSA bill, prepaid purchase or voucher to substantiate information (component 1) Compare to EWSA records from the Commercial Department data base (component 2) |
| Purpose of data: | Calculation of baseline, project emissions and emission reductions |
| Additional comment: | Components 1 and 2 |

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|---------------------------------------|--|
| Data / Parameter: | Distribution date (Components 1 and 2) |
| Unit: | Date |
| Description: | Date of the CFL distribution uniquely recorded for each customer participant |
| Measured/ Calculated / Default: | Measured |

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| Source of data: | Recorded by EWSA (Lamps distribution databases) |
| Value(s) of monitored parameter: | Available to the DOE in the project distribution database |
| Monitoring equipment: | NA |
| Measuring/ Reading/ Recording frequency: | Once at distribution |
| Calculation method (if applicable): | NA |
| QA/QC procedures: | NA |
| Purpose of data: | Calculation of emissions reductions |
| Additional comment: | Components 1 and 2 Dates are reported monthly for the purpose of the ER calculations |

Data and parameters applicable for Component 1 (AMS-II.J, Version 03)

| | |
|--|---|
| Data / Parameter: | $Q_{PJ,i}$ |
| Unit: | - |
| Description: | Number (quantity) of pieces of CFLs of type <i>i</i> distributed under the project, |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Recorded by EWSA (Lamps distribution databases) |
| Value(s) of monitored parameter: | <ul style="list-style-type: none"> For distributed CFL, <i>i</i> = 15 W Phase 3: 56,726 For distributed CFL, <i>i</i> = 20 W Phase 1: 40,328 Phase 2: 132,042 Phase 3: 22,573 |
| Monitoring equipment: | NA |
| Measuring/ Reading/ Recording frequency: | Once at distribution |
| Calculation method (if applicable): | NA |
| QA/QC procedures: | Equipment storage control system for inputs and outputs is applied at both EWSA central store at Kigali and in all antennas and stations. The IDs of the beneficiaries are compared to avoid duplication in each phase. |
| Purpose of data: | Calculation of energy savings and emissions reductions |
| Additional comment: | Component 1. The number of CFL distributed is compared to the number of ICL collected and received at the central storage in Kigali. The lowest number is used as monitored values for ERs calculation. |

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|---|--|--|--|--|--|--|
| Data / Parameter: | P _{i,PJ} | | | | | |
| Unit: | Watts | | | | | |
| Description: | Rated power of the project CFLs of the group of “i” lighting devices, i | | | | | |
| Measured/ Calculated / Default: | Default | | | | | |
| Source of data: | Technical specifications set in the tender | | | | | |
| Value(s) of monitored parameter: | Phase 1 and Phase 2 20 W Phase 3 15 W and 20 W | | | | | |
| Monitoring equipment: | NA | | | | | |
| Measuring/ Reading/ Recording frequency: | Once at distribution | | | | | |
| Calculation method (if applicable): | NA | | | | | |
| QA/QC procedures: | As part of the CFLs procurement process, bidders provided CFL test certificates in all phases. For phase 2, EWSA conducted a mission in China to participate in the testing of a sample of CFLs in a laboratory. This mission was part of EWSA quality control approach set up in the bidding process of Phase 2, where the selected supplier was requested to finance a trip in a laboratory where a sample of CFLs supplied will be tested in the presence of EWSA staff | | | | | |
| Purpose of data: | Calculation of baseline emissions | | | | | |
| Additional comment: | Component 1 | | | | | |

| Data / Parameter: | Q _{BL,i} | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|-------------------------------|---------|---------|--------|--|-----------|--|-------------------------------|--|--|--|-----------|-----|---------|---------|---------|--|--|--|------|------|------|------|------------------|----|-----|---|---|---|------------------|----|--------|-------|--------|---|------------------|----|--------|--------|--------|---|------------------|----|--------|--------|---|--------|-------|---|--------|---------|--------|--------|
| Unit: | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Description: | Number (quantity) of pieces of incandescent lamps (ICLs) of type i exchanged under the project | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Measured/ Calculated / Default: | Measured | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Source of data: | Recorded by EWSA (Lamps distribution databases) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Value(s) of monitored parameter: | <table><tr><th colspan="2">ICL types</th><th colspan="4">Values per Phase and CFL type</th></tr><tr><th>Parameter</th><th>(W)</th><th>Phase 1</th><th>Phase 2</th><th colspan="2">Phase 3</th></tr><tr><th></th><th></th><th>20 W</th><th>20 W</th><th>15 W</th><th>20 W</th></tr><tr><td>P_{ABL}</td><td>25</td><td>953</td><td>0</td><td>0</td><td>0</td></tr><tr><td>P_{BBL}</td><td>40</td><td>12,330</td><td>1,068</td><td>22,059</td><td>0</td></tr><tr><td>P_{CBL}</td><td>60</td><td>11,961</td><td>51,266</td><td>34,667</td><td>0</td></tr><tr><td>P_{DBL}</td><td>75</td><td>15,084</td><td>79,708</td><td>0</td><td>22,573</td></tr><tr><td>Total</td><td>-</td><td>40,328</td><td>132,042</td><td>56,726</td><td>22,573</td></tr></table> | | | | | | ICL types | | Values per Phase and CFL type | | | | Parameter | (W) | Phase 1 | Phase 2 | Phase 3 | | | | 20 W | 20 W | 15 W | 20 W | P _{ABL} | 25 | 953 | 0 | 0 | 0 | P _{BBL} | 40 | 12,330 | 1,068 | 22,059 | 0 | P _{CBL} | 60 | 11,961 | 51,266 | 34,667 | 0 | P _{DBL} | 75 | 15,084 | 79,708 | 0 | 22,573 | Total | - | 40,328 | 132,042 | 56,726 | 22,573 |
| ICL types | | Values per Phase and CFL type | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Parameter | (W) | Phase 1 | Phase 2 | Phase 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 20 W | 20 W | 15 W | 20 W | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| P _{ABL} | 25 | 953 | 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| P _{BBL} | 40 | 12,330 | 1,068 | 22,059 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| P _{CBL} | 60 | 11,961 | 51,266 | 34,667 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| P _{DBL} | 75 | 15,084 | 79,708 | 0 | 22,573 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | - | 40,328 | 132,042 | 56,726 | 22,573 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Monitoring equipment: | NA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | |
|---|---|
| Measuring/ Reading/ Recording frequency: | Once at CFL distribution |
| Calculation method (if applicable): | NA |
| QA/QC procedures: | <p>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.</p> <p>Overall, the numbers of ICLs derived from the reports are compared to the number of ICLs in the database and the lowest values are always used for ERs calculations. For Phase 1, the report found a total of 41,169 ICLs, of which the lower value of 40,328 ICLs is used in ER calculation. For Phase 2 and Phase 3, the report found 136,325 ICLs and 87,626 ICLs compared to 132,042 ICLs and 79,299 ICLs respectively.</p> |
| Purpose of data: | Calculation of energy savings and emissions reductions |
| Additional comment: | <p>For Component 1 only. Collected ICLs are matched to distributed project CFLs on a 1 to 1 basis.</p> <p>ICL with rated power equal or above 75W are conservatively counted as 75W ICLs in the baseline. 65W ICL are conservatively counted as 60W ICL in the baseline.</p> <p>The monitored values are derived from the comparison between the number of ICL collected and received at the central storage in Kigali. The lowest number is used for ERs calculation.</p> <p>The emission reduction calculations apply the minimum number of bulbs between ICLs collected and CFLs distributed.</p> |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|---------------|---------------|----------------|--|------------|-------------|-------------|-------------|---------|-----|--------|--------|--------|---------|---|-------|--------|--------|---------|---|--------|--------|--------|--------------|------------|---------------|---------------|----------------|
| Data / Parameter: | P_{i,BL} | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Unit: | Watts | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Description: | Rated power of the baseline incandescent lamps (ICLs) of the group of “I” lighting devices or 75W if the baseline lighting device is a 100W ICL and the project lighting device a 20W CFL | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Measured/ Calculated / Default: | Measured as taken from ICL nameplate | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Source of data: | Recorded by EWSA using lamp marking | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Value(s) of monitored parameter: | <p>25 W, 40 W, 60 W and 75 W</p> <p>The following table summarized the number of ICLs for each baseline wattage category.</p> <table><tr><td></td><td>25W</td><td>40 W</td><td>60 W</td><td>75 W</td></tr><tr><td>Phase 1</td><td>953</td><td>12,330</td><td>11,961</td><td>15,084</td></tr><tr><td>Phase 2</td><td>0</td><td>1,068</td><td>51,266</td><td>79,708</td></tr><tr><td>Phase 3</td><td>0</td><td>22,059</td><td>34,667</td><td>22,573</td></tr><tr><td>Total</td><td>953</td><td>35,457</td><td>97,894</td><td>117,365</td></tr></table> | | | | | 25W | 40 W | 60 W | 75 W | Phase 1 | 953 | 12,330 | 11,961 | 15,084 | Phase 2 | 0 | 1,068 | 51,266 | 79,708 | Phase 3 | 0 | 22,059 | 34,667 | 22,573 | Total | 953 | 35,457 | 97,894 | 117,365 |
| | 25W | 40 W | 60 W | 75 W | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phase 1 | 953 | 12,330 | 11,961 | 15,084 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phase 2 | 0 | 1,068 | 51,266 | 79,708 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Phase 3 | 0 | 22,059 | 34,667 | 22,573 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | 953 | 35,457 | 97,894 | 117,365 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Monitoring equipment: | NA | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | |
|---|---|
| Measuring/ Reading/ Recording frequency: | Once at CFL distribution |
| Calculation method (if applicable): | NA |
| QA/QC procedures: | A third party was engaged to certify the number of ICLs collected. The report is currently available for Phase 1, 2 and 3. The sampling methodology is based on the ISO 2859-1: 1999. |
| Purpose of data: | Calculation of energy savings and emissions reductions. |
| Additional comment: | Component 1 The numbers of ICL per wattage of baseline devices are consolidated as shown in the previous table. Only final numbers used in ER calculation are used. Note that for Phase 1, ICLs with unreadable wattage were assigned a wattage proportional to the distribution of wattages in the bulbs with a wattage measurement. Refer to "Component 1 Monitored PBL" in ERs calculation spreadsheet. |

| | |
|---|--|
| Data / Parameter: | N_{sample,s} |
| Unit: | - |
| Description: | Number of sampled CFLs during the post installation survey s |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Survey reports |
| Value(s) of monitored parameter: | 1 st ex-post monitoring survey: Phase 1: 100 2 nd ex-post monitoring survey: Phase 1: 100, Phase 2: 200 3 rd ex-post monitoring survey: Phase 1: 110, Phase 2: 125, Phase 3: 120 |
| Monitoring equipment: | NA |
| Measuring/ Reading/ Recording frequency: | As per AMS-II.J (Version 03), ex-post surveys are conducted: – Once in the first year of installation, and – Once every 3 years, or once for every 30% of elapsed rated lifetime (whichever is shorter) 1 st ex-post monitoring survey: April, 2008 2 nd ex-post monitoring survey: October, 2009 3 rd ex-post monitoring survey: June, 2011 |
| Calculation method (if applicable): | NA |

| | |
|---------------------|---|
| QA/QC procedures: | <p>As per AMS-II.J, version 03, 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)⁵ and described by Bartlett et al (2001)⁶:</p> $n_t = \frac{(t)^2 \times (p \times q)}{(d)^2}$ <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> $n_t = \frac{(1.645)^2 \times (0.25)}{(0.1)^2} = 68$ |
| Purpose of data: | Calculation of baseline emissions |
| Additional comment: | Component 1 |

| | |
|--|--|
| 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: | 1 st ex-post monitoring survey: Phase 1: 84 2 nd ex-post monitoring survey: Phase 1: 88; Phase 2: 160 3 rd ex-post monitoring survey: Phase 1: 58; Phase 2: 74; Phase 3: 77 |
| Monitoring equipment: | NA |

⁵ Cochran, W.E., 1977. Sampling Techniques, 3rd edition, Wiley

⁶ James E. Bartlett, II, Joe W. Kotrlik, Chadwick C. Higgins. 2001. Organizational Research: Determining Appropriate Sample Size in Survey Research. Information Technology, Learning, and Performance Journal, Vol. 19, No. 1, Spring 2001. Pages 43 – 50.

| | |
|---|---|
| Measuring/ Reading/ Recording frequency: | As per AMS-II.J, ex-post surveys are conducted: – Once in the first year of installation, and – Once every 3 years, or once for every 30% of elapsed rated lifetime (whichever is shorter) 1 st ex-post monitoring survey: April, 2008 2 nd ex-post monitoring survey: October, 2009 3 rd ex-post monitoring survey: June, 2011 |
| Calculation method (if applicable): | NA |
| QA/QC procedures: | NA |
| Purpose of data: | Calculation of baseline emissions |
| Additional comment: | Component 1 |

Data and parameters applicable for Component 2 (AMS-II.C, Version 11)

| | |
|---|--|
| Data / Parameter: | N_i |
| Unit: | - |
| Description: | Number (quantity) of pieces of CFLs of type <i>i</i> distributed under the project |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Recorded by EWSA |
| Value(s) of monitored parameter: | <ul style="list-style-type: none"> For distributed CFL, <i>i</i> = 15 W Phase 3: 25,524 For distributed CFL, <i>i</i> = 20 W Phase 3: 70,990 |
| Monitoring equipment: | NA |
| Measuring/ Reading/ Recording frequency: | Once at distribution |
| Calculation method (if applicable): | NA |
| QA/QC procedures: | Equipment storage control system for inputs and outputs is applied at both EWSA central store at Kigali and in all antennas and stations. |
| Purpose of data: | Calculation of baseline emissions |
| Additional comment: | Component 2 |

| | |
|--|---|
| Data / Parameter: | P_{i,PJ} |
| Unit: | Watts |
| Description: | Rated power of the project CFLs of the group of " <i>i</i> " lighting devices |
| Measured/ Calculated / Default: | Measured as taken from technical specifications |
| Source of data: | Technical specifications set in the tender |
| Value(s) of monitored parameter: | Phase 3: 15 W and 20 W |

| | |
|--|--|
| Monitoring equipment: | NA |
| Measuring/ Reading/ Recording frequency: | Once at distribution |
| Calculation method (if applicable): | NA |
| QA/QC procedures: | As part of the CFLs procurement process, bidders provided CFL test certificates in all phase. For phase 2, EWSA conducted a mission in China to participate in the testing of a sample of CFLs in a laboratory. This mission was part of EWSA quality control approach set up in the bidding process of Phase 2, where the selected supplier was requested to finance a trip in a laboratory where a sample of CFLs supplied will be tested in the presence of EWSA staff. |
| Purpose of data: | Calculation of project emissions |
| Additional comment: | Component 2 |

| | |
|--|--|
| Data / Parameter: | $O_{k,d,m}$ |
| Unit: | Hours |
| Description: | Operating hours of the distributed CFL k on day d as given by valid meter m |
| Measured/ Calculated / Default: | Measured from a sample |
| Source of data: | Readings of measuring instruments |
| Value(s) of monitored parameter: | Mean Value: 4.4 Individual values available in an excel spreadsheet |
| Monitoring equipment: | Run-time meters installed at sample of CFLs |
| Measuring/ Reading/ Recording frequency: | Once annually or at the end of each monitoring period. |
| Calculation method (if applicable): | On recording date, index of the run time meter is noted. The index is divided by the number of days of the monitored period to determine the operating hours per day of the monitored CFL. The mean is calculated based on the observed values for the monitored sample CFLs. |
| QA/QC procedures: | Meter technology and calibration and metering procedures was to have been described by the manufacturer at the time of purchase. Validity and reliability of meters are evaluated. The run-time meter manufacturer did not provide any calibration procedures. EWSA uses the equipment from the Electricity Technical Control Bureau operating with the time measuring device to test the accuracy of metering. |
| Purpose of data: | Calculation of energy savings and emissions reductions |
| Additional comment: | Component 2 |

D.3. Implementation of sampling plan**(1) Data and parameters determined by a sampling approach: Component 1:**

$N_{\text{sample},s}$ 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 EWSA 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 (EWSA 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 (21 total in Phases 1 and 2; 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 fulfill the sample size requirement (see table below)
7. Within the cluster, 5 (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. The survey date is June 2011, which corresponds to the third survey for Phase 1, second survey for Phase 2 and first survey for Phase 3.

| Survey # | Sampling Frame | Final Sample Size (#CFLs) | Number of CFLs per household | Number of households surveyed | Number of clusters (branches surveyed) |
|-----------------|----------------|---------------------------|------------------------------|-------------------------------|--|
| 1) April 2008 | Phase 1 CFLs | 100 | 2 | 50 | 7 |
| 2) October 2009 | Phase 1 CFLs | 100 | 2 | 50 | 10 |
| | Phase 2 CFLs | 200 | 5 | 40 | 8 |
| | Total | 300 | - | 90 | - |
| 3) June 2011 | Phase 1 CFLs | 110 | 2 | 55 | 11 |
| | Phase 2 CFLs | 125 | 5 | 25 | 5 |
| | Phase 3 CFLs | 120 | 4 | 30 | 6 |
| | Total | 355 | - | 110 | - |

Collected Data

The collected data is summarized in the survey report.

Analysis of the collected data

| Survey # | Sampling Frame | N _{OK,s} | N _{sample,s} | LFR _{i,y} |
|-----------------|----------------|-------------------|-----------------------|--------------------|
| 1) April 2008 | Phase 1 CFLs | 84 | 100 | 0.160 |
| 2) October 2009 | Phase 1 CFLs | 88 | 100 | 0.120 |
| | Phase 2 CFLs | 160 | 200 | 0.200 |
| 3) June 2011 | Phase 1 CFLs | 58 | 110 | 0.473 |
| | Phase 2 CFLs | 74 | 125 | 0.408 |
| | Phase 3 CFLs | 77 | 120 | 0.358 |

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 1 – April 2008 | Survey 2 – October 2009 | Survey 3 – June 2011 |
|---------|-----------------------|-------------------------|----------------------|
| Phase 1 | 6.02% | 5.34% | 7.82% |
| Phase 2 | - | 4.65% | 7.23% |
| Phase 3 | - | - | 7.20% |

(2) Data and parameters determined by a sampling approach: Component 2:

O_{k,d,m} Operating hours of the distributed CFL *k* on day *d* as given by valid meter *m*

Implemented sampling design

Run-time meters were installed on a sample of the total number of CFLs installed under Phase 3, Component 2 of the project activity. According to the PDD, a run time meter had to be installed on 0.1% of bulbs (96,514 bulbs * 0.1% = 97 bulbs, minimum). An oversample of 44% was applied and 140 run-time meters were installed. To assure a random selection and to base the measurement on different lighting locations per household, meters were installed using systematic sampling (on each of the CFLs distributed to every 1000th new customer who benefits from the project, in each of the antennas / stations (i.e. 1, 1001, 2001, etc.)). Thirty-five (35) households were included in the sample. The first run-time meters were installed with Phase 3 CFLs from November 2009 to December 2010. The hour meters were reinstalled, or read if they had been installed correctly initially, in July - August 2011. The second reading took place in April – July 2012.

Collected Data

Collected data is provided in the attached spreadsheet.

Analysis of the collected data

Upon follow-up by the project entity, 51 of the installed hour meters were observed to be obviously defective, lost or inaccessible. Therefore the number of hour meters that potentially could provide valid information was

89; these provided an average of 5.9 hours/day. Upon checking the reliability of these results, it was found that the precision did not achieve the 95/15 level (as specified in the PDD); the precision was 18%. As per the “General Guidelines for sampling and surveys for small-scale CDM project activities” version 1, page 7, a quality control and assurance methodology was applied to the project, and all values above 12 hours were considered outliers. This was based on the conservative approach that there is an average of 12 nighttime hours per day (actually this the shortest day in the year, i.e. June 27). This resulted in 77 valid readings. This range represents the clear majority of the results, excludes results that seem unrealistic based on common usage times and results in an *Ok,d,m* of 4.4 hours. This is conservative, since when all the readings from 0 to 24 hours (i.e., results that are physically possible) are considered, the average is 5.9 hours/day. To ensure that the mean operating hours value obtained is representative of the population, the error margin is calculated from the readings. Descriptive statistics of the collected data are described here.

The accuracy of the sample, that was estimated using the conservative approach described above, was 14.23% (below the 15% threshold as per the PDD).

| Parameter | Value | Description |
|----------------------------|--------------|--------------------|
| Population | 96,514 | CFL bulbs |
| Sample meters | 77 | Meter readings |
| Mean operating hours | 4.4 | Hours/day |
| Standard Deviation | 2.82 | |
| Confidence Interval Radius | 0.6296 | |
| Margin of error | 14.23% | |

Demonstration on whether the required confidence/precision has been met

The PDD monitoring plan requires confidence / precision of 95/15 for this parameter. The actual achieved confidence / precision was 95/14.23. Therefore, the requirement has been met.

Furthermore, the Guidelines for Sampling and Surveys for CDM Project Activities and Programme of Activities, Version 4.0, has been applied to double check the validity of sampling approach and it has been concluded that only 36 meters are actually needed to meet the 95/15 confidence and precision using the mean operating hour and the standard deviation (refer “Component 2 Monitored Oi” in ERs calculation spreadsheet).

Checks of a sample of non-metered systems to ensure that they are still operating

Implemented sampling design

The sampling objective is to determine the percentage of systems that are still operating. The target population is the distributed CFLs under Phase 3. This monitoring parameter is also required under Component 1 (i.e. lamp failure rate). Therefore, the same survey was used to determine both parameters: the percentage of lamps that are still operations and the lamp failure rate. The parameter “annual check of lamps that are still in operation” (AMS-II.C) is actually the parameter “proportion of lamps that are still working” used to estimate the lamp failure rate determination (AMS-II.J), since they both refer to the amount of CFL lamps that are still functioning. The combined survey was possible because both components are implemented in the same area, are supplied by the same electricity network and the bulbs and time of distribution are identical. In addition, this parameter only depends on the time elapsed since the installation of the lamp, but not on when the household was electrified (i.e. new customer –Component 2- or existing customer – Component 1-). Multi-stage sampling was applied where clusters (first stage) corresponded to EWSA branches, which are located in various administrative entities called sectors and districts, and clusters were randomly selected from all the branches.

Moreover, 5 households (second stage) are visited in each selected cluster (EWSA 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
2. Establish a sample selection interval
3. Pin point the distributed lamps named population
4. Calculate cumulative population

⁷ Source: <http://weatherspark.com/averages/29294/Kigali-Rwanda>

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.
7. Within the cluster the households to be surveyed are randomly selected.

The number of samples for the survey relevant for this monitoring report was as follows. Survey date: June 2011.

| Sampling Frame | Final Sample Size (number of CFLs) | Number of CFLs per household | Number of households surveyed | Number of clusters (branches surveyed) |
|----------------|------------------------------------|------------------------------|-------------------------------|--|
| Phase 3 CFL | 120 | 4 | 30 | 6 |

Collected Data

The collected data is summarized in the survey report.

Analysis of the collected data

| | Systems operational | Systems sampled | Percentage of systems that are still operating |
|---------|---------------------|-----------------|--|
| Phase 3 | 77 | 120 | 64% |

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

Component 1

As per AMS-II.J, 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 to be used unless a more appropriate value based on a lighting use survey from the same region and not older than 2 years is available

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 CFL⁸
 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:

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

| Survey # | Sampling Frame | N _{OK,s} | N _{sample,s} | LFR _{i,y} |
|-----------------|----------------|-------------------|-----------------------|--------------------|
| 1) April 2008 | Phase 1 CFLs | 84 | 100 | 0.160 |
| 2) October 2009 | Phase 1 CFLs | 88 | 100 | 0.120 |
| | Phase 2 CFLs | 160 | 200 | 0.200 |
| 3) June 2011 | Phase 1 CFLs | 58 | 110 | 0.473 |
| | Phase 2 CFLs | 74 | 125 | 0.408 |
| | Phase 3 CFLs | 77 | 120 | 0.358 |

Since this was the first CDM project registered under methodology ASM-II.J, the ex-ante LFR was specified neither on the registered PDD nor on the ex-ante ER calculation spreadsheet. However, based on the information available at validation the PP has calculated the ex-ante LFR as follows (for further information on how the LFR has been calculated has been provided in excel sheet "ERs_CalculationsRwandaCFLs"):

| Year | Sep 07 - Aug 08 | Sep 08 - Aug 09 | Sep 09 - Aug 10 | Sep 10 - Aug 11 | Sep 11 - Aug 12 | | |
|------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|--|
| | 1 | 2 | 3 | 4 | 5 | | |
| LFR _{i,y} - Phase 1 | 0.106 | 0.213 | 0.319 | 0.426 | 1.000 | | |
| Year | Sep 08 - Aug 09 | Sep 09 - Aug 10 | Sep 10 - Aug 11 | Sep 11 - Aug 12 | Sep 12 - Aug 13 | | |
| LFR _{i,y} - Phase 2 | 1 | 2 | 3 | 4 | 5 | | |
| | 0.106 | 0.213 | 0.319 | 0.426 | 1.000 | | |
| Year | Jun 09 - May 10 | Jun 09 - May 11 | Jun 09 - May 12 | Jun 09 - May 13 | Jun 09 - May 14 | | |
| LFR _{i,y} - Phase 3 | 1 | 2 | 3 | 4 | 5 | | |
| | 0.106 | 0.213 | 0.319 | 0.426 | 1.000 | | |

⁸ 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)".

LFR ex-ante calculations VS ex-post measured values

| Phase # | Ex-post Survey # | Ex-ante calculation | Monitored value |
|---------|------------------|---------------------|-----------------|
| 1 | 1 (Apr 2008) | 0.106 | 0.160 |
| | 2 (Oct 2009) | 0.319 | 0.120 |
| | 3 (Jun 2011) | 0.426 | 0.473 |
| 2 | 1 (Oct 2009) | 0.213 | 0.200 |
| | 2 (June 2011) | 0.319 | 0.408 |
| 3 | 1 (June 2011) | 0.213 | 0.358 |

As it can be seen in the table above, in most of the cases the ex-ante LFR is lower than the actual LFR. Therefore, following the UNFCCC clarification #354, and in the absence of a mortality curve developed in accordance with a national or international standard, the ex-post LFR is used in those cases in which it is higher than the ex-ante LFR. In order to be conservative, the ex-ante LFR is used when it is higher than the monitored value. This is considered a conservative approach. Also, LFR values have been calculated from the date of completion of the installation of all equipment, and thus it is in accordance with UNFCCC clarification SSC #670.

With respect to **QPJ,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 attached calculation spreadsheet.

Component 2

As per AMS-II.C, the emissions reduction by the project activity in year y is calculated directly as follows.

$$ER_y = (E_{BL} - E_{PJ}) * EF_{grid} * (\% \text{ in operation})$$

Where:

ER_y = Annual reduction of GHG emissions

BE_y = Annual GHG emissions in baseline scenario

PE_y = Annual GHG emissions in project scenario

E_{BL} = Annual electricity consumption by the ICLs in the baseline scenario

E_{PJ} = Annual electricity consumption by the CFLs in the project scenario

EF_{grid} = Emission Factor of the connected grid

% in operation = percent of sampled CFLs which are functional (based on ex-post survey)

$$E_{BL \text{ or } PJ} = \sum (N_i * P_{i,BL \text{ or } PJ} * O_i) / (1 - I_y)$$

Where:

$E_{BL \text{ or } PJ}$ = annual energy baseline (BL) or project (PL) in kWh per year

N_i = the number of devices installed of the group i devices

$P_{i,BL \text{ or } PL}$ = the power of the device installed of the group i devices (either recorded for CFLs or assumed for ICLs)

O_i = the average annual operating hours of the devices

I_y = Average annual technical grid losses (transmission and distribution) during year y for the grid serving the locations where the devices are installed, expressed as a fraction.

The percentage of functioning non metered CFLs (64%, as demonstrated in Section D).is used to discount the energy savings and thus emission reductions.

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

E.2. Calculation of project emissions or actual net GHG removals by sinks

NA

E.3. Calculation of leakage

NA

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

| Item | Baseline emissions or baseline net GHG removals by sinks (t CO ₂ e) | Project emissions or actual net GHG removals by sinks (t CO ₂ e) | Leakage (t CO ₂ e) | Emission reductions or net anthropogenic GHG removals by sinks (t CO ₂ e) |
|--------------|--|---|-------------------------------|--|
| Total | 23,491 | 0 | 0 | 23,491 |

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

| Item | Values estimated in ex-ante calculation of registered PDD | Actual values achieved during this monitoring period |
|---|---|--|
| Emission reductions or GHG removals by sinks (t CO₂e) | 62,934* | 23,491 |

* The PDD value been calculated by prorating the PDD values by the number of days to match this monitored period (30/05/2010 to 31/07/2012).

E.6. Remarks on difference from estimated value in registered PDD

There is no increase in the actual GHG emission reductions achieved during this monitoring period as compared to estimates in the registered PDD. The main reason for the achievement of fewer emission reductions than estimated in the registered PDD, is:

- The delay in the distribution of the CFLs, especially those of Phase 4, which represent 50% of the bulbs to be distributed under the project.
- The lower number of verified collected ICL compared to the estimate in the PDD.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

| Item | Actual values achieved up to 31 December 2012 | Actual values achieved from 1 January 2013 onwards |
|---|--|--|
| Emission reductions or GHG removals by sinks (t CO₂e) | 23,491 [corresponding to dates 30/05/2010 – 31/07/2012] | N/A |

Document information

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|---|-----------------|--|
| 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 anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, 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). |
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