MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

CONTENTS

* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version: 1 Date: 29/09/2011

VISAKHAPATNAM (INDIA) OSRAM CFL DISTRIBUTION CDM PROJECT
CDM Project : 1754
Monitoring period number: 2 from 01/04/2010 to 31/08/2011

SECTION A. General description of the project activity

A.1. Brief description of the project activity:

1. Purpose of the project activity and the measures taken to reduce greenhouse gas emissions

The project was registered on 12/02/2009 under reference number 1754. Further information regarding the project can be found in the registered project design document available on the official UNFCCC website: http://cdm.unfccc.int/Projects/DB/TUEV-SUED1206629154.85/view

The purpose of the project is to increase the efficiency of the domestic lighting use in the project area by replacing inefficient incandescent lamps (GLS) by highly efficient OSRAM Long Life Compact Fluorescent Lamps (CFL). As a result electricity is saved and therefore greenhouse gas (GHG) emissions are reduced. The project is registered under small scale methodology AMS-II.C. v. 9 "Demand-side energy efficiency activities for specific technologies".

The following measures have been implemented in accordance with the registered project design document and the respective methodology:

1. Replacement of eligible[1] incandescent bulbs by project energy efficient lamps (CFL). (here referred as CFL Distribution) Project Lamps have been directly installed in households by distribution teams, to assure the eligibility of the replaced lamps as well as the correct installation of the new devices. The CFLs have been distributed to participating households for a minimal fee of 15 INR (equivalent to the cost of an incandescent lamp in the Indian market). The amount was fixed in discussions with the Bureau of Energy Efficiency (BEE), Ministry of Power which defined this amount for the nationwide CFL PoA program. The amount is collected by the utility EPDCL through the electricity bill.

2. Installation of meter equipment by Meter Company (appointed by Bureau of Energy Efficiency/BEE, Government of India) to determine daily operating hours of:

    a. Baseline sample group (Baseline Metering)

    b. Project sample group (Spot check Metering)

3. Functionality check of installed CFLs in sample group (Cross Check)

2. Brief description of the installed technology and equipments

CFLs have been distributed to residential electricity consumers in the project boundary on the basis of equivalent lumen output. I.e. CFLs with a rated wattage lower than baseline devices have been distributed to maintain the same lumen output as the baseline devices (see Table 1). The project devices (CFLs) have been distributed to consumers at small fee (15 INR).

3. Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.):

- Registration Date: 12/02/2009
- Start and end of replacement campaign: 02/11/2008-22/01/2010
- Start and End of baseline measurement of usage hours: 13/11/2009 – 10/02/2010

[1] Eligibility criteria as defined in the registered PDD,

- Start of spot check´s (continuous) measurement of usage hours: 01/04/2010
- Start and End of cross-check survey for monitoring period 2: 07/07/2011 - 08/08/2011
- 1st Monitoring Period: 12/02/2009-31/03/2010
- 2nd Monitoring Period: 01/04/2010 - 31/08/2011

4. Total emission reductions achieved in this monitoring period

From 01/04/2010 - 31/08/2011 the project has achieved 45,954 tCO_2 emission reductions.

A.2. Project Participants

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) Project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host)	Private entity: Osram India Pvt. Ltd.	No
Germany	Private entity: Osram GmbH	No
Germany	Private entity: RWE Power AG, Essen	No

A.3. Location of the project activity:

Country: India
State: Andhra Pradesh
District: Visakhapatnam
Region: City of Visakhapatnam and rural areas of Visakhapatnam district (whole district of Visakhapatnam), the project boundary is the official border of the Visakhapatnam district.

The location of the project corresponds to the PDD (see section A.4.1.3 and A.4.1.4. of the PDD)

There are no GPS coordinates available for this project. This point was raised during the validation & registration process and was resolved as follows:
Corrective Action Request (CAR) No.8 that was raised during the validation process where the audit team requested the project proponent (PP) to clearly document the distinct geographical boundary of Yamunanagar and Sonipat in PDD using GPS data.
The PP clarified that the use of GPS was not possible, but the project activity will cover the whole district of Visakhaptnam. The list of mandals getting covered in this district is listed in table 1.

It is understood that it would not be feasible to define the geographical co-ordinates of the project boundary, which is entire district of Visakhaptnam. The complete list of households in Visakhaptnam, which are connected to grid and are registered customer of EPDCL (the only distribution company in the area), have been obtained from EPDCL. The total number of households available from this list would be participating in the project activity.

Table 1: Mandals in Visakhaptnam

Mandal Code	Mandal Name	Mandal Code	Mandal Name	Mandal Code	Mandal Name
1	Munchingiputtu	16	Nathavaram	31	Pedagantyada

2	Pedabayalu	17	Narsipatnam	32	Paravada
3	Hukumpeta	18	Rolugunta	33	Anakapalli
4	Dumbriguda	19	Ravikamatham	34	Munagapaka
5	Arakuvalley	20	Butchayyapeta	35	Kasimkota
6	Ananthagiri	21	Chodavaram	36	Makavarapalem
7	Devarapalle	22	K Kotapadu	37	Kotauratla
8	Cheedikada	23	Sabbavaram	38	Payakaraopeta
9	Madugula	24	Pendurthi	39	Nakkapalli
10	Paderu	25	Anandapuram	40	S. Rayavaram
11	Gangaraju Madugula	26	Padmanabham	41	Yelamanchili
12	Chintapalle	27	Bheemunipatnam	42	Rambilli
13	Gudemkothaveedhi	28	Visakhapatnam	43	Atchutapuram
14	Koyyuru	29	Visakhapatnam (U)		
15	Golugonda	30	Gajuwaka		

A.4. Technical description of the project

The following baseline devices were replaced under the campaign by its corresponding project device:

Table 2: Substitution schedule for incandescent (GLS) lamps[2]

GLS bulb (Watt)	60	100
CFL (Watt)	15	20

The CFL-type used in the project activity is the OSRAM DULUX EL LONGLIFE with B22d base for direct replacement of incandescent lamps. It has the following specifications:
• Extra Long average life of 15,000 hours
• More than 500,000 switching cycles to meet the highest demands in terms of frequent switching and durability in the professional /commercial sector and for high-quality domestic applications.
• Up to 80% lower energy consumption compared to similar conventional light bulbs

Further technical data of the CFL-type used in the project activity:

	OSRAM DULUX EL LONGLIFE 15W B22d	OSRAM DULUX EL LONGLIFE 20W B22d
Number of Tubes	3	3
Warmstart (preheating)	Yes	Yes
Wattage	15	20
Luminous Flux (lm)	855	1,170
Efficacy (lm/W)	57	58.5
Light Colour	865	865
Colour Rendering Index (R_a)	>80	>80
Length (mm)	128±3	145±3
Diameter (mm)	45	45
Weight (g)	65	73
Emergency Power Suitability	No	No
Average Life time (h)[1]	15,000	15,000

[2] For justification of the CFL-types chosen for substitution (regarding Lumen) see PDD Enclosure "Technical datasheet project CFL".

Additional Information: OSRAM DULUX EL LONGLIFE comply with:
- IEC 60968 Safety Requirements
- IEC 60969 Performance Requirements
- IEC 61000-3-2 Limits for harmonic current emission
- IEC 61547 Immunity Requirements
- Radio interference according to CISPR 15
- RoHS

[1] Switching Cycle: 90min on, 15min off

For the technical data sheet please refer to appendix 1 - enclosure 1 to the PDD available under http://cdm.unfccc.int/UserManagement/FileStorage/V4NZQ0GI5WDL2PF16K3JYMOEURBXCA .

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

The project activity is a type (ii), category C project activity. The applied methodology is the small scale methodology AMS-II.C. v. 9 "Demand-side energy efficiency activities for specific technologies". The Grid Emission Factor used for baseline and project emissions calculation has been calculated in accordance with the provisions in AMS-I.D.

A.6. Registration date of the project activity:

12/02/2009

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

Crediting Period of 10 years, starting on 12/02/2009 until 11/02/2019

A.8. Name of responsible person(s)/entity(ies):

Organization:	OSRAM GmbH
Street/P.O.Box:	Hellabrunner Straße 1
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City:	Munich
State/Region:	
Postfix/ZIP:	81543
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Represented by:	Mr. Boris Bronger
Title:	Head of CDM Projects World
Salutation:	Mr.
Last Name:	Bronger
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SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

Start and end of replacement campaign in Vizakhpatnam: 02/11/2008 – 22/01/2010.

All measures as described in the registered PDD have been successfully implemented and are operational. Table 3 gives an overview of all devices installed. In Table 4 the participation statistics are shown.

CFL Distribution statistics	Absolute [-]	Share [%]
Total amount of CFL distributed	669,036	100%
15 W CFL	645,703	96.512%
20 W CFL	23,333	3.488%

Table 3: CFL Distribution Statistics

Participation Statistics	Absolute [-]	Share [%]
Households entered into Project DB	762,201	100%
Households participating	669,036	87.777%
Households not participating:	93,165	12.223%
Reason:		
- Not a Household (Commercial)	2,640	0.346%
- Service Disconnection	1,719	0.226%
- No Qualifying GLS Point	239	0.031%
- Not willing to Participate	29,491	3.869%
- Not at Home	21,072	2.765%
- Household Not Found	38,004	4.986%

Table 4: Project Participation Statistics

All households in the monitoring group equipped with meters (spot-check group) have been selected randomly from the total household data provided by the utility. The meters are installed over the complete project area, state of Vizakhapatnam. The number of meters per section is depending on the number of households per section. All spot-check households have been equipped with a CFL at the beginning of the monitoring period.

Quality assurance measures:

CFL Distribution

- CDM distribution training: all team members received professional training, information and instruction manual was handed over (ref. document: Bilingual Training Manual English/ Telugu).
- Pre-sorting of Distribution forms by section and for each distribution team
- Direct installation of CFLs in households door-to-door by distribution teams
- Easy to understand distribution form with bilingual instructions printed on backside (ref. doc.: Form B)
- Distribution process in 5 steps:
  1. Verification of correct household (service connection/SC no. and/or electricity bill) & Explanation of project idea and benefits to household
  2. Checking for eligible GLS
  3. Exchange of GLS to CFL lamp

4. Functionality test of CFL
5. Filling out of form: lamp type exchanged, date & signature

- Data entry screen of web application similar to Form B to ensure easy data entry
- Several input validations by the CDM database to ensure correct and complete data entry
- Frequent and random quality checks of data entry by supervisor for 3 % of all forms entered
- Full documentation of CFL installation in CDM Database (ref.: CDM Database -> Household details)

GLS Destruction

- Especially designed packaging to prevent misuse of lamps, ensure easy collection of GLS and destruction process
- Sticker indicating Wattage for easy counting and sealing of packaging
- Supervision of counting, destruction and disposal process by Pollution control officer and APEPDCL official (ref. doc.: Form G)
- Data entry of all forms into Database; reviewable in database

Baseline Study

- The Baseline usage hours were measured during the first monitoring interval from 13/11/2009 - 10/02/2010. As defined in the PDD the baseline study is measured only once and the results are applied for the calculation of the baseline emissions throughout the full crediting period.
- The average operating hours verified during the initial verification of the project activity is 4.631.
- The average number of meters that provided a correct value during the baseline monitoring is 194.
- The correctness of the baseline measurement was verified during the initial verification of the projects. For further information please refer the first monitoring report : http://cdm.unfccc.int/UserManagement/FileStorage/M5U9OL1EXQT8367WHJNGF4RZPCDVAB .

Internal audits

- PP conducts frequent internal audits (at least once a year)
- Internal audit include visits of random project and metering households, random verification of the documentation as well as of the project database

B.2. Revision of the monitoring plan

Not applicable

B.3. Request for deviation applied to this monitoring period

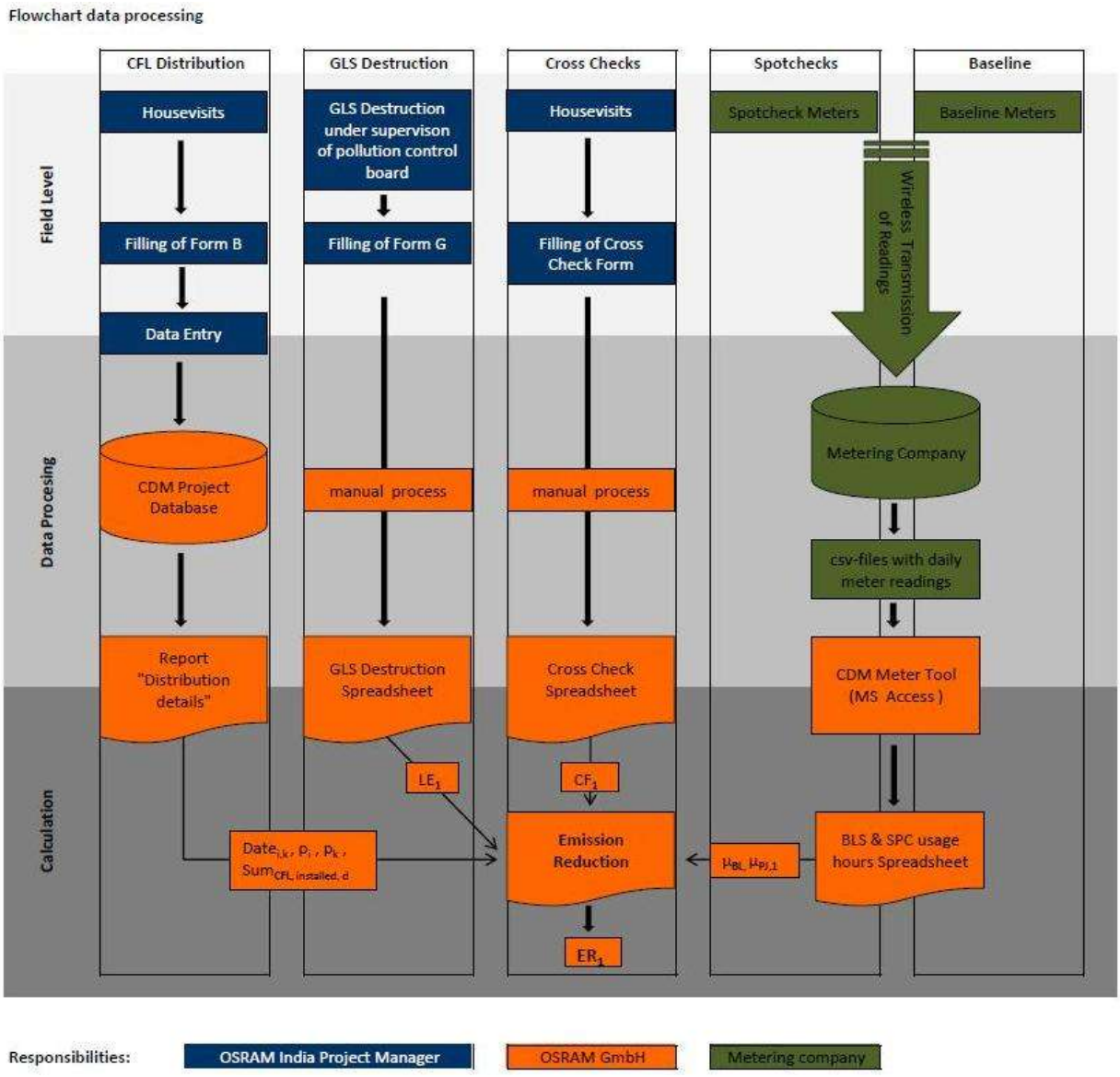
Not applicable

B.4. Notification or request of approval of changes

Not applicable

SECTION C. Description of the monitoring system

The following flowchart gives an overview of the flow of data from field level to the calculation of the emission reductions.



1. Continuous measurement of daily usage of distributed CFLs

In compliance with PDD and methodology, the project proponent uses a measured value for the 'daily operating hours' parameter, based on the continuous measurement of the project CFLs in a sample of households having participated in the project.

In line with PDD's terminology, this sample of measured households is called Spot Check Group.

Working Principle of the meter device used:
Time measurement is done by micro controller with inbuilt oscillator. Frequency of oscillator is decided by external crystal. In this case a crystal of 32.768 KHz is used. Internally microcontroller divides this clock to generate 1 count per 15 seconds. Thus least count of meter is 15 seconds. Hence, every 15 seconds the measured data is saved in the flash memory of the GSM based meter. Stored electricity consumption data is sent to the central server every time the CFL/ICL is switched on. In case the bulb is kept on of for a longer period of time, cumulative data is sent through a SMS to central server every 4 hours of continuous usage.

Error Margin of the measurement:
The maximum error in time measurement is 0.002 % as per engineering calculations by the meter manufacturer: The accuracy of the meter was tested by an independent laboratory. The test reports were shown to the DOE during the verification.

Calibration Interval of the meter device:
The calibration interval of the hour meters is: "Within 3 years to take care of effect of component ageing." (PDD, Annex 4, A.4)

Spot check Group

- Stratified random sampling of spot check households generated manually using the consumer data provided by the utility (Spot check Sequence list)
- Training of meter teams for procedure to be followed for meter installation
- Installation of more meters than required for statistical representativeness
- Easy to understand distribution form with bilingual instructions printed on backside (ref. doc.: Form F)
- Functionality test of meter prior to installation by meter company
- Meter & CFL Installation process in 5 steps:
  1. Verification of correct household (service connection/SC no. and/or electricity bill) & explanation of project idea and benefits to household
  2. Checking for eligible GLS
  3. Exchange of GLS to CFL lamp & Installation of Meter
  4. Functionality test of CFL
  5. Filling out of form: lamp type exchanged, meter number installed, date & signature
- Data entry screen of web application similar to Form F to ensure easy data entry
- The calibration interval of the hour meters is: "Within 3 years to take care of effect of component ageing." (PDD, Annex 4, A.4)
- In case meters do not send a message for 7 days, an indicator in the database turns red and a member of the metering team is dispatched to the corresponding monitoring household where the team member conducts a functionality check, replacement, repair, etc.
- In case of malfunction or in case the meter cannot be found, the meter readings are excluded from the database and are thus not accounted for.

2 . The number of project devices working is a monitored parameter.

At the start of the monitoring of the project activity, the number of functional devices is obtained from the distribution records of the project.
During the project activity, this value is adjusted based on the findings of an annual check of a sample of non metered systems which is conducted to ensure that they are still operating. In the PDD's terminology the group of households surveyed during cross-check surveys is referred to as Project Cross Check Group. The surveys consist of a physical check of all operating project CFLs in the household as follows:

Cross Check

- Stratified random sampling of cross check households automatically generated by the database using actually entered data from the distribution (cross check sequence list)
- Training of cross check teams for procedure to be followed for cross checks
- Functionality check of at least 200 CFLs
- Easy to understand cross check form (bilingual)
- Cross-Check process in 3 steps:
  1. Verification of correct household (service connection/SC no. and/or electricity bill) & explanation of project idea and benefits to household
  2. Checking for eligible CFL / Functionality test of CFL
  3. Filling out of form: result of cross-check, date & signature
- Cross Checks will be conducted once every Monitoring Period

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors	
Data / Parameter:	$EF_{CO2,ELEC}$
Data unit:	$kgCO_2/kWh$
Description:	CO_2 grid emission factor of the project electricity system . The factor used is the Combined Margin (incl. Imports) published by the Indian Central Electricity Authority (CEA) version 2.0. available in internet under http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver2.pdf
Source of data used:	Central Electricity Authority of India (CEA): CO_2 baseline data
Value(s) :	0.850 $kgCO_2/kWh$
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline and Project emissions
Additional comment:	The project activity will use an ex-ante grid emission factor. Hence the grid emission factor is fixed over the crediting period. The factor used is the Combined Margin (incl. Imports) published by the Central Electricity Authority (CEA).

D.2. Data and parameters monitored	
Data / Parameter:	$Date_{START,2}$
Data unit:	Date (day/month/year)
Description:	Date of the start of the monitoring interval 2
Measured /Calculated /Default:	The date of the start was fixed by the project coordinator
Source of data:	Project coordinator sets the date
Value(s) of monitored parameter:	01/04/2010
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Monitoring Interval
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	
Measuring/ Reading/ Recording frequency:	Once a monitoring period
Calculation method (if applicable):	
QA/QC procedures applied:	Date will be fixed and stored in the project database

Data / Parameter:	$Date_{END,2}$
Data unit:	Date (day/month/year)
Description:	Date of the end of the monitoring interval 2
Measured /Calculated /Default:	The date of the start was fixed by the project coordinator
Source of data:	Project coordinator sets the date
Value(s) of monitored parameter:	31/08/2011
Indicate what the data are	Monitoring Interval

used for (Baseline/ Project/ Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	
Measuring/ Reading/ Recording frequency:	Once a monitoring period
Calculation method (if applicable):	
QA/QC procedures applied:	Date will be fixed and stored in the project database

Data / Parameter:	$Date_{START,BL}$
Data unit:	Date (day/month/year)
Description:	Date of the start of the baseline study BL interval
Measured /Calculated /Default:	The date of the start will be fixed by the project coordinator
Source of data:	Project coordinator sets the date
Value(s) of monitored parameter:	13/11/2009
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	
Measuring/ Reading/ Recording frequency:	Once at start date of the baseline study interval
Calculation method (if applicable):	
QA/QC procedures to be applied:	Date will be fixed and stored in the project database

Data / Parameter:	$Date_{END,BL}$
Data unit:	Date (day/month/year)
Description:	Date of the end of the baseline study BL interval
Measured /Calculated /Default:	The date of the start will be fixed by the project coordinator
Source of data:	Ninety days after the baseline study start date ($Date_{START,BL}$)
Value(s) of monitored parameter:	10/02/2010
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration,	

validity)	
Measuring/ Reading/ Recording frequency:	Once at end date of the baseline study interval
Calculation method (if applicable):	
QA/QC procedures to be applied:	Date will be fixed and stored in the project database

Data / Parameter:	$o_{r, d, q}$
Data unit:	Hours
Description:	Operating hours of GLS bulb *i* on day d as given by valid meter *r* in month *q* during the baseline study in the baseline households
Measured /Calculated /Default:	Measured
Source of data:	Readings of meters
Value(s) of monitored parameter:	4.631[3]
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Installation of Baseline GSM Meters (one per bulb) in randomly selected households. Wireless transmission of meter values via Textmessages (SMS) to metering company appointed by the Bureau of Energy Efficiency (BEE), Goverment India.
Measuring/ Reading/ Recording frequency:	Measured
Calculation method (if applicable):	
QA/QC procedures to be applied:	Automatic and continuously applied plausibility check of the data. Data review through project coordinator and automatic recognition of wrong data formats by the database; data storage electronic. Validity of meters evaluated according to procedure described for parameter $n_{r,d}$

Data / Parameter:	$n_{SCRAP,i}$
Data unit:	No.
Description:	Number of scrapped GLS bulbs handed in by households until the end of the monitoring period
Measured /Calculated /Default:	Measured
Source of data:	Distribution team/GLS scrap protocol
Value(s) of monitored parameter:	679,323
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	GLS Destruction
Monitoring equipment (type, accuracy class, serial number,	All GLS bulbs which have been replaced by CFL lamps have been collected, counted & destroyed. New packaging concept for CFL lamps has been developed. Packaging had increased size (diameter) which allows the replaced

[3] Value shows the average over the full Baseline metering period after daylight correction and all statistical corrections

calibration frequency, date of last calibration, validity)	GLS bulb to be stored inside the original CFL lamp packaging. Sticker used to indicate the wattage and to seal the packaging. By this measurement, transportation & counting of returned GLS bulbs was simplified. To assure that the GLS bulbs will not be reused, the lamps have been counted and destroyed in presence and under supervision of an independent body. Automatic and continuously applied plausibility check of the data. Data review through project coordinator; data storage in paper Documentation of GLS Destruction using Booklets containing Form G: GLS Destruction
Measuring/ Reading/ Recording frequency:	
Calculation method (if applicable):	
QA/QC procedures to be applied:	Automatic and continuously applied plausibility check of the data. Data review through project coordinator and automatic recognition of wrong data formats by the database; data storage paper (until first verification) and electronic.

Data / Parameter:	$n_{r,d}$
Data unit:	No.
Description:	Number of meters r that provide a valid value for day d during the baseline study
Measured /Calculated /Default:	Measured
Source of data:	Server/Project Database
Value(s) of monitored parameter:	194[4]
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Installation of Baseline Meters in randomly selected households (Baseline Survey Group). All installed meters for the baseline study are registered in the metering company database. Only meters delivering valid daily data records or daily operating hours are counted.Wireless transmission of meter values via textmessages (SMS) to metering company appointed by the Bureau of Energy Efficiency (BEE), Government of India.
Measuring/ Reading/ Recording frequency:	Every Day
Calculation method (if applicable):	
QA/QC procedures to be applied:	Data will be checked either manually and/or by automated procedures in the database

Data / Parameter:	$Date_{i,k}$
Data unit:	Date
Description:	Date of the replacement of GLS bulb *i* by CFL *k*
Measured /Calculated /Default:	Measured
Source of data:	Distribution team/Distribution form
Value(s) of monitored parameter:	02/11/2008-22/01/2010
Indicate what the data are	CFL Distribution

[4] Value shows average of meters providing a valid value over the full baseline metering period

used for (Baseline/ Project/ Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The date of replacement has been recorded on the standardized Distribution Form (Form B) while the replacement of GLS bulb by CFL lamp was physically taking place. Date for GLS bulb replacement has been recorded for each replacement separately The information from the distribution form was afterwards entered into the project database. Storage of Distribution Form (Form B)
Measuring/ Reading/ Recording frequency:	
Calculation method (if applicable):	
QA/QC procedures applied:	Application of standardized data forms and compliance protocols; data review through project coordinator; data storage paper (until first verification) and electronically.

Data / Parameter:	p_i
Data unit:	W
Description:	p_i is the power of the GLS bulb *i* used before replacement.
Measured /Calculated /Default:	Lamp marking
Source of data:	Lamp marking data of GLS
Value(s) of monitored parameter:	60 W or 100 W
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	CFL Distribution
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Read by the distribution team from the lamp while replacement is taking place and recorded on the distribution form. Afterwards distribution data is entered into the project database
Measuring/ Reading/ Recording frequency:	
Calculation method (if applicable):	
QA/QC procedures applied:	Application of standardized data forms and compliance protocols; data review through project coordinator; data storage as paper (until first verification) and electronically. Data for power rating will be recorded for each replacement separately

Data / Parameter:	p_k
Data unit:	W
Description:	Power rating of the CFL *k* used to replace GLS bulb *i*
Measured /Calculated /Default:	Lamp marking
Source of data:	Lamp marking data of CFL
Value(s) of monitored parameter:	15 W or 20 W
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	CFL Distribution

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Read by the distribution team from the lamp while replacement is taking place and recorded on the distribution form. Afterwards distribution data is fed into the project database.
Measuring/ Reading/ Recording frequency:	
Calculation method (if applicable):	
QA/QC procedures applied:	Application of standardized data forms and compliance protocols; data review through project coordinator; data storage as paper (until first verification) and electronically. Data for power rating will be recorded for each replacement separately

Data / Parameter:	BN_k
Data unit:	-/ t_c xxx
Description:	Batch number (production number) of each CFL *k*
Measured /Calculated /Default:	
Source of data:	Lamp marking data; Distribution team/Distribution form
Value(s) of monitored parameter:	t_c 828 t_c 848 t_c 858 t_c 868
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	CFL Distribution
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The Batch number has been recorded on the distribution form while the replacement of GLS by CFL was physically taking place. The batch number has been recorded for each replacement separately. The information from the distribution form has been entered into the project database afterwards.
Measuring/ Reading/ Recording frequency:	
Calculation method (if applicable):	
QA/QC procedures applied:	Application of standardized data forms and compliance protocols; data review through project coordinator; data storage as paper (until first verification) and electronically.

Data / Parameter:	$o_{m,d,2}$
Data unit:	hours
Description:	Operating hours of the distributed CFL k on day d as given by valid meter m in a spotcheck households during monitoring interval 2.
Measured /Calculated /Default:	Measured
Source of data:	Readings of measuring instruments.
Value(s) of monitored parameter:	4.612 [5]
Indicate what the data are used for (Baseline/ Project/ Leakage emission	Spotcheck

[5] Value shows the average over the full metering period statistically corrected to a confidence level of 95%

calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Installation of Spotcheck GSM Meters (one per CFL) in randomly selected households (stratified random sampling). Wireless transmission of meter values via textmessages (SMS) to metering company appointed by the Bureau of Energy Efficiency (BEE), Government India. The calibration interval of the hour meters is: "Within 3 years to take care of effect of component ageing." (PDD, Annex 4, A.4)
Measuring/ Reading/ Recording frequency:	Daily operating hours
Calculation method (if applicable):	
QA/QC procedures applied:	Automatic and continuously applied plausibility check of the data. Data review through project coordinator and automatic recognition of wrong data formats by the database; data storage electronic. Validity of meters evaluated according to procedure described for parameter $n_{m,d,1.}$

Data / Parameter:	$n_{m,d,2}$
Data unit:	No.
Description:	Number of meters *m* that provide a valid value for day *d* during the monitoring interval *2*
Measured /Calculated /Default:	Measured
Source of data:	Server/Metering company database
Value(s) of monitored parameter:	148.896
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	All installed meters in the spotcheck households (during the monitoring interval) are registered in the project database. Only meters delivering valid daily data records, daily operating hours are counted. The data will have a daily monitoring frequency.
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	
QA/QC procedures applied:	Data will be checked either manually and/or by automated procedures in the database.

Data / Parameter:	$Date_{c,2}$
Data unit:	Date
Description:	Date of cross-check in cross-check household c for monitoring period *2*
Measured /Calculated /Default:	Measured
Source of data:	Cross-Check team/Cross-Check form
Value(s) of monitored parameter:	07/07/2011 - 08/08/2011
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Cross-Check (project monitoring)

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The date of the cross-check has been recorded on the cross-check form during the cross-check (checking whether the project CFL lamp is still functioning). Date of the cross-check has been recorded for each cross-check household separately. The information from the cross-check form will be afterwards entered into the project database. Storage of cross-check form until verification is completed.
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	
QA/QC procedures applied:	Application of standardized data forms and compliance protocols; data review through project coordinator; data storage as paper and electronically.

Data / Parameter:	$n_{all,2}$
Data unit:	No.
Description:	Number of checked CFLs during cross-check *CC* in monitoring interval 2.
Measured /Calculated /Default:	Calculated
Source of data:	Cross-Check team/Cross-Check form
Value(s) of monitored parameter:	514
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Cross-Check
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The data of each checked CFL lamp has been recorded on the cross-check form during the cross-check (checking whether the project CFL lamp is still functioning). This has been done by the cross-check team. The data of the cross-check has been recorded for each cross-check household separately. The information from the cross-check form will be afterwards entered into the project database. The project database sums up all CFL lamps that were checked during the cross-check in monitoring interval 2.
Measuring/ Reading/ Recording frequency:	Cross-Check has to be done per each monitoring interval separately
Calculation method (if applicable):	
QA/QC procedures applied:	Application of standardized data forms and compliance protocols; data review through project coordinator; data storage as paper and electronically.

Data / Parameter:	$n_{ok,2}$
Data unit:	No.
Description:	Number of distributed CFLs to cross-check households which are found and functional during cross-check of monitoring interval 2.
Measured /Calculated /Default:	Measured
Source of data:	Cross-check team/Cross-Check form
Value(s) of monitored parameter:	393
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Cross-Check (project monitoring)

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The data of each checked CFL lamp has been recorded on the cross-check form during the cross-check (checking whether the project CFL lamp is still functioning). This has been done by the cross-check team. The data of the cross-check has been recorded for each cross-check household separately. The information from the cross-check form will be afterwards entered into the project database. The project database sums up all CFL lamps that were checked during the cross-check in monitoring interval 2.
Measuring/ Reading/ Recording frequency:	Cross-Check has to be done per each monitoring interval separately
Calculation method (if applicable):	$n_{all,2}$ minus CFL found not functioning in monitoring interval 2
QA/QC procedures applied:	Application of standardized data forms and compliance protocols; data review through project coordinator; data storage paper and electronically.

SECTION E. Emission reductions calculation

The calculation of emission reductions was conducted as shown in the following chapters. A detailed flowchart explaining the steps of obtaining data in the field, data processing up to calculation of emission reductions has been provided to the DOE during verification. All steps of the emission reduction calculation are shown in Illustration 1.

Abbreviations used for the calculation of emission reductions:

GLS	General lighting Services, i.e. an incandescent lamp
CFL	Compact Fluorescent Light (with integrated ballast)
$E_{BL,v}$	Energy baseline (electricity) in MWh per monitoring interval v
C_{Fv}	Correction factor for distributed CFLs which are not functional during the crosscheck. C_{Fv} represents the share of CFLs that are still operating
μ_{BL}	Average baseline operating hours per day
$d_{k,v}$	Days of operation of each distributed CFL k in monitoring interval v derived from $Date_{START,v}$, $Date_{END,v}$ (and $Date_{i,k}$ in first monitoring interval)
$\hat{p}_{CC,v}$	Share of CFLs not found operating during cross check in monitoring interval v
$n_{all,v}$	Number of checked CFLs during cross check in monitoring interval v
z	Standard normal for a confidence level of 95% (z = 1.96)
$n_{ok,v}$	Number of distributed CFLs distributed to cross-check households which are functional
μ_{BL}	Average baseline operating hours per day
$\mu_{BL,d,adjust}$	Mean of the operating hours for day d during the baseline study interval adjusted by confidence interval
dur_{BL}	Duration of the total baseline study interval in days derived from $Date_{START,BL}$, $Date_{END,BL}$ (corresponds to 90 days)
$\sigma_{BL,d}$	Standard deviation of operating hours for day *d* during baseline study interval
$n_{r,d}$	Number of meters *r* that provide a valid value for day *d* during the baseline study
$\mu_{BL,d}$	Mean of the operating hours for day d in the baseline interval adjusted by $\alpha_{daylight,q}$
$\alpha_{daylight,q}$	Adjustment factor for the mean operating hours measured during the baseline period in month *q* compared to the weighted annual average of daylight hours derived from the daylight hours in month *q* compared to the weighted annual average.
$o_{r,d,q}$	Operating hours from meter *r* for day *d* for which complete data is available

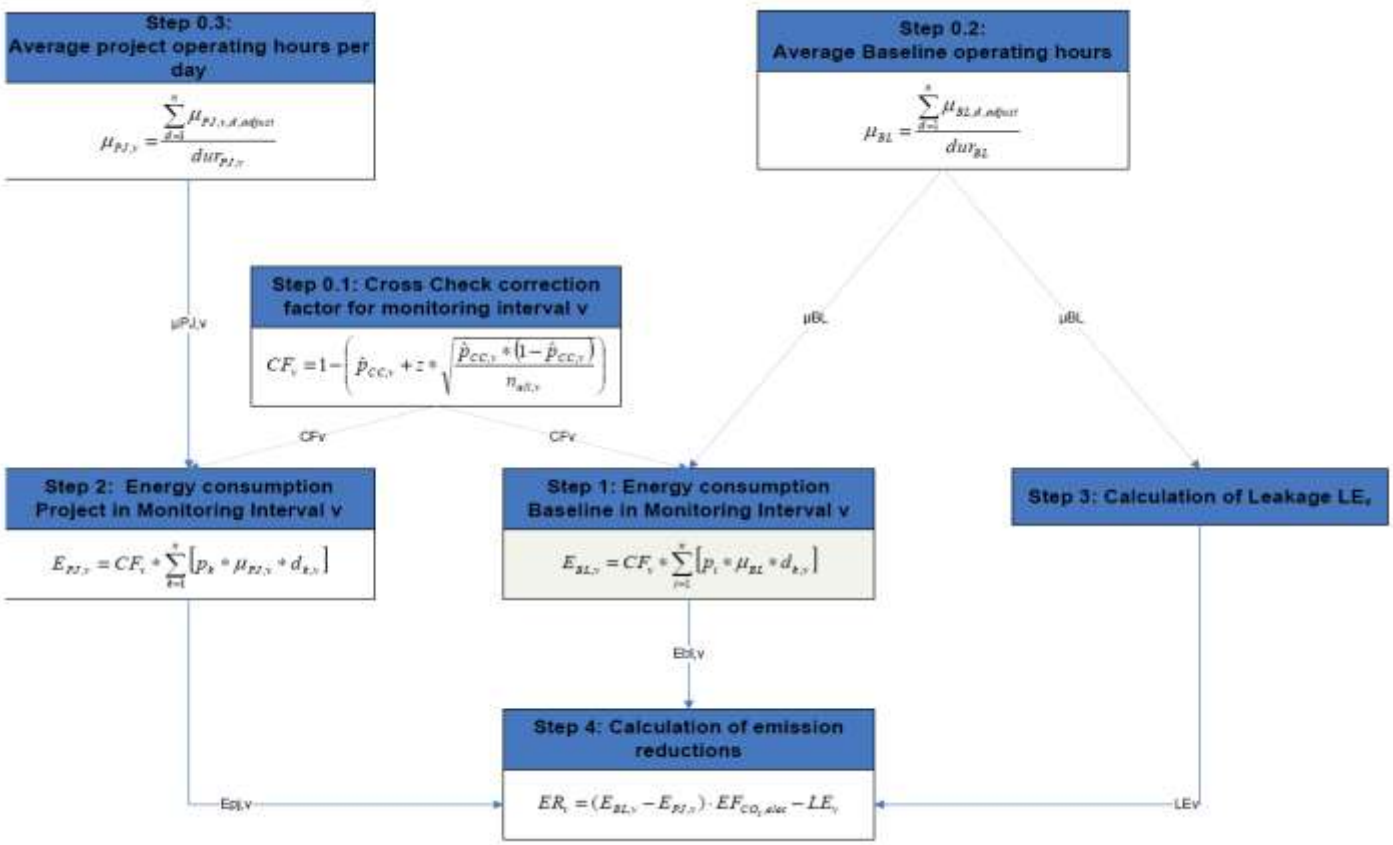


Illustration 1: Overview of calculations

Step 0.1: Calculation of the Cross Check correction factor

According to the PDD a functionality check had to be conducted for at least 200 project CFLs. The result is then statistically corrected to a confidence level of 95 % (see Illustration 2).

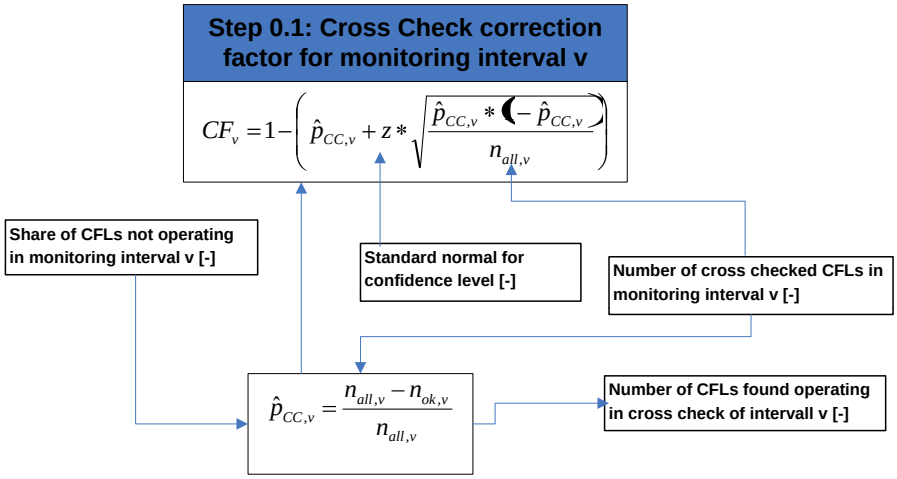


Illustration 2: Calculation of the Cross Check correction factor

In total 514 CFLs have been surveyed. To achieve statistically unbiased and representative results stratified random sampling was used and a strict procedure was followed during cross-checks. Table 5 gives an overview of the crosscheck results.

Cross Check Results:	Variable	Absolute	Share
CFLs cross checked:	$n_{sample,\ CC,\ 2}$	514	100.000%
CFL working:	$n_{OK,2}$	393	76.459%
CFL not working/not found:	$p_{CC,2}$	121	23.541%
Standard normal for confidence level of 95 %	z	1.96	-
Cross Check correction factor:	**CF_2**		**0.728**

Table 5: Cross Check Results

E.1. Baseline emissions calculation

As per the PDD the Baseline operating hours have to be measured for a continuous period of 90 days. The measurement was conducted by the meter company which was appointed by the Bureau of Energy Efficiency (BEE), Government of India. OSRAM instructed and supervised the full metering process.

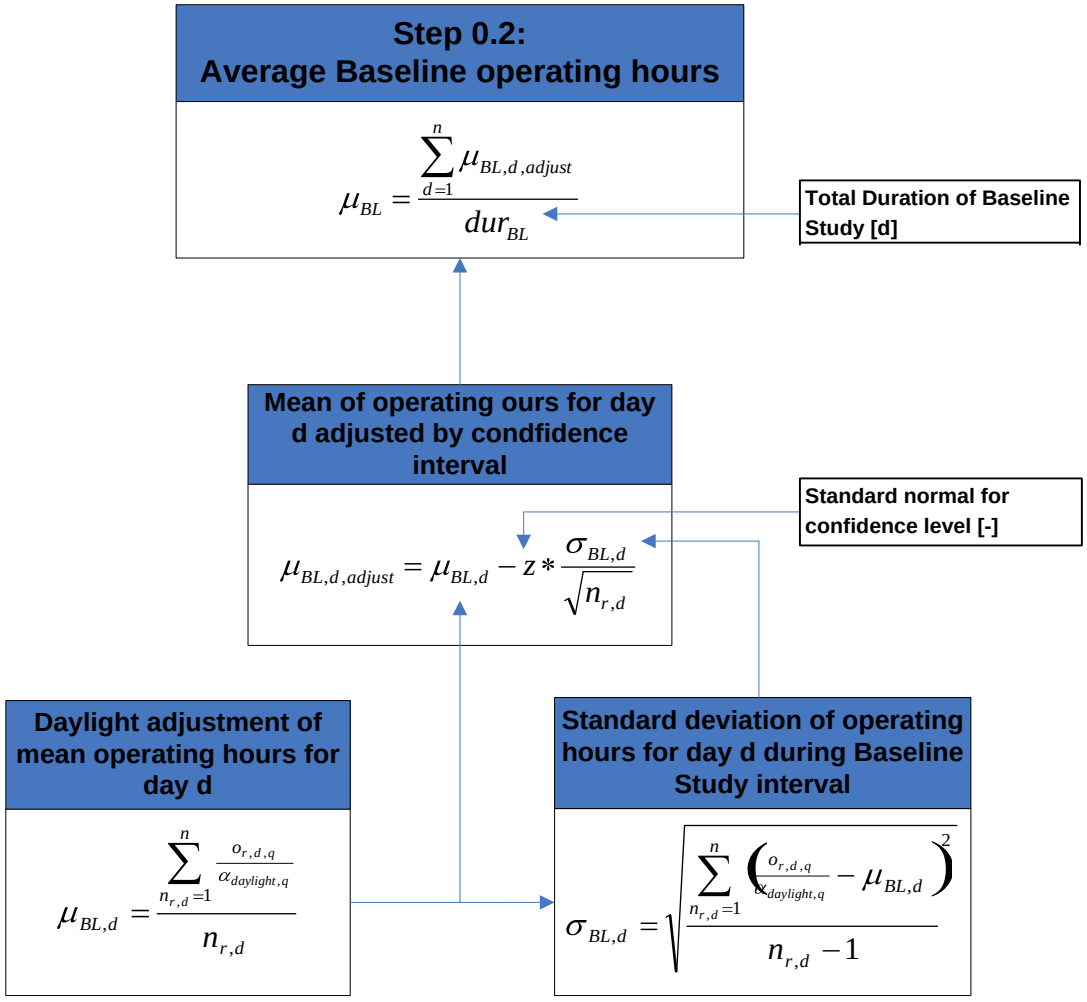


Illustration 3: Calculation of average Baseline operating hours

The baseline was metered over the required period of 90 days continuously. Based on the daily meter values delivered by the meter company, the average Baseline operating hours are calculated as shown in **Illustration 3**. Each meter value was corrected using the daylight adjustment factors shown in Table 6.

Table 6: Factors for adjustment of operating hours measured during the baseline

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
$\alpha_{daylight,q}$	0.937	0.921	0.901	0.896	0.871	1.026	1.133	1.153	1.167	1.072	0.983	0.940

The meter values were statistically corrected to a confidence level of 95 %. The final average baseline usage hours amount to μ_{BL} = 4.631 h.

Step 0.3: Calculation of the average project operating hours

The measurement of the project operating hours was conducted by the meter company, which was appointed by the Bureau of Energy Efficiency (BEE), Government of India. OSRAM instructed and supervised the full metering process.

Based on the daily meter values delivered by the meter company, the average project operating hours are calculated.

The meter values were statistically corrected to a confidence level of 95 %. The final average project operating hours amount to $\mu_{PJ,2}$ = 4.612 h.

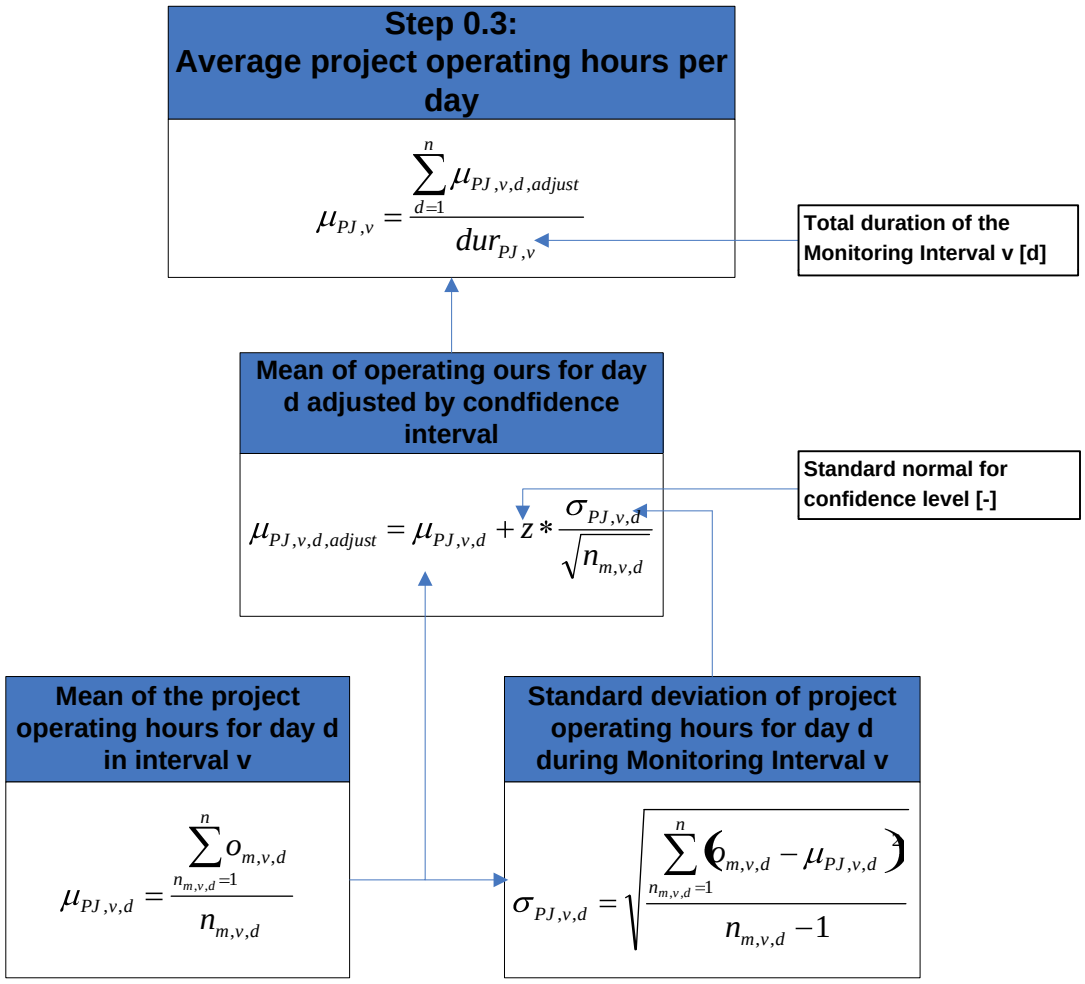


Illustration 4: Calculation of average project operating hours

<u>Step 1: Calculation of the Energy consumption of the Baseline</u>

The formulas applied for calculating the Energy consumption of the Baseline is shown in Illustration 5.

Step 1: Energy consumption Baseline in Monitoring Interval v

$$E_{BL,v} = CF_v * \sum_{i=1}^{n} [p_i * \mu_{BL} * d_{k,v}]$$

Illustration 5: Calculation of energy consumption baseline

As for each distributed CFL the date of installation/replacement of GLS is recorded in the database, the average amount of CFLs of each type (15 W or 20 W) which was correctly installed on each day of the monitoring interval can be determined.

Each 15 W CFL has replaced a 60 W GLS bulb and a 20 W CFL has replaced a 100 W GLS bulb.

Applying this and the results derived from Step 0.1 (Cross Check correction factor) and Step 0.2 (Baseline operating hours) the Energy consumption of the Baseline for Monitoring Interval 2 $E_{BL,2}$ can be calculated. The result is shown in Table 7.

Step 1: Energy Consumption Baseline			
Duration of Monitoring Interval 2	d_2	[d]	518
Total no of 60 W GLS replaced by project activity		[pcs]	645,703
Total no of 100 W GLS replaced by project activity		[pcs]	23,333
Cross Check Correction Factor	CF_2	[-]	0.728
Average operating hours Baseline	μ_{BL}	[h]	4.631
Energy Consumption Baseline	$E_{BL,2}$	**[kWh]**	**71,718,290**

Table 7: Energy Consumption Baseline

The energy that would have been consumed without the project activity (Baseline) amounts to $E_{BL,2}$ = 71,718,290 kWh.

AMS-II.C. requires the application of the following formula for calculation of the energy baseline (EB) if the energy displaced is electricity:

$$EB = \sum_i n_i * p_i * o_i$$

Where:

EB	is the annual energy baseline in kWh per year.
Σ_i	is the sum over the group of "i" devices replaced for which the replacement is operating during the year, implemented as part of the project.
n_i	is the number of devices of the group of "i" devices replaced for which the replacement is operating during the year
p_i	is the power of the devices of the group of "i" replaced. In the case of a retrofit programme, "power" is the weighted average of the devices replaced.
o_i	is the average annual operating hours of the devices of the group of "i" devices replaced

For reasons of precision we substantiate the above formula (while maintaining it conceptually) and use the following formula for calculation of the energy baseline (EBL):

$$E_{BL,v} = CF_v * \sum_{i=1}^{n} p_i * \mu_{BL} * d_{k,v}$$

Where:

$E_{BL,v}$	Energy baseline (electricity) in MWh per monitoring interval v
C_{Fv}	Correction factor for distributed CFLs which are not functional during the crosscheck. C_{Fv} represents the share of CFLs that are still operating.
p_i	Power rating of the replaced GLS bulbs i used before replacement
μ_{BL}	Average baseline operating hours per day
$d_{k,v}$	Days of operation of each distributed CFL k in monitoring interval v derived from $Date_{START,v}$, $Date_{END,v}$ (and $Date_{i,k}$ in first monitoring interval)

The formula required for calculation of CF_v is:

$$CF_v = 1 - \left(\hat{p}_{CC,v} + z * \sqrt{\frac{\hat{p}_{CC,v} * (1 - \hat{p}_{CC,v})}{n_{all,v}}} \right)$$

Where:

CF_v	Correction factor for distributed CFL which are not operating during the cross-checkin the monitoring interval v
$\hat{p}_{CC,v}$	Share of CFLs not found operating during cross check in monitoring interval v
$n_{all,v}$	Number of checked CFLs during cross check in monitoring interval v
z	Standard normal for a confidence level of 95% (z = 1.96)

$\hat{p}_{CC,v}$ is calculated as follows:

$$\hat{p}_{CC,v} = \frac{n_{all,v} - n_{ok,v}}{n_{all,v}}$$

Where:

$\hat{p}_{CC,v}$	Share of CFLs not found operating during cross check in monitoring interval v
$n_{ok,v}$	Number of distributed CFLs distributed to cross-check households which are functional
$n_{all,v}$	Number of distributed CFLs distributed to cross-check households

The formula required for calculation of μ_{BL} is:

$$\mu_{BL} = \frac{\sum_{d=1}^{n} \mu_{BL,d,adjust}}{dur_{BL}}$$

Where:

μ_{BL}	Average baseline operating hours per day
$\mu_{BL,d,adjust}$	Mean of the operating hours for day d during the baseline study interval adjusted by confidence interval
dur_{BL}	Duration of the total baseline study interval in days derived from $Date_{START,BL}$, $Date_{END,BL}$ (corresponds 90 days)

The formula required for calculation of $\mu_{BL,d,adjust}$ is:

$$\mu_{BL,d,adjust} = \mu_{BL,d} - z * \frac{\sigma_{BL,d}}{\sqrt{n_{r,d}}}$$

Where:

$\mu_{BLd,adjust}$	Mean of the operating hours for day d during the baseline study interval adjusted by confidence interval
$\mu_{BL,d}$	Mean of the operating hours for day d during the baseline study interval
z	Standard normal for a confidence level of 95% (z = 1.96)
$\sigma_{BL,d}$	Standard deviation of operating hours for day *d* during baseline study interval
$n_{r,d}$	Number of meters *r* that provide a valid value for day *d* during the baseline study

The formula required for calculation of $\mu_{BL,d}$ is:

$$\mu_{BL,d} = \frac{\sum_{r=1}^{n} \frac{o_{r,d,q}}{\alpha_{daylight,q}}}{n_{r,d}}$$

Where:

$\mu_{BL,d}$	Mean of the operating hours for day d in the baseline interval adjusted by $\alpha_{daylight,q}$
$n_{r,d}$	Number of meters r that provide a valid value for day *d* during the baseline study
$o_{r,d,q}$	Operating hours from meter *r* for day *d* for which complete data is available
$\alpha_{daylight,q}$	Adjustment factor for the mean operating hours measured during the baseline period in month *q* compared to the weighted annual average of daylight hours (see Table 6 for overview of $\alpha_{daylight,q}$) derived from the daylight hours in month *q* compared to the weighted annual average.

The formula required for calculation of $\sigma_{BL,d}$

$$\sigma_{BL,d} = \sqrt{\frac{\sum_{r=1}^{n} \left(\frac{\sigma_{r,d,q}}{\alpha_{daylight,q}} - \mu_{Bl,d} \right)^2}{n_{r,d} - 1}}$$

Where:

$\sigma_{BL,d}$	Standard deviation of operating hours for day *d* during baseline study interval
$o_{r,d,q}$	Operating hours from meter *r* for day *d* for which complete data is available
$\mu_{BL,d}$	Mean of the operating hours for day *d* in the baseline interval adjusted by $\alpha_{daylight,q}$
$n_{r,d}$	Number of meters r that provide a valid value for day d during the baseline study

The formula required for calculation of p_{NR}

$p_{NR} = p_{NR,avg} - SE_w * z$

Where:

$p_{NR,avg}$	Mean of the measured wattages.
SE_w	Standard error of the mean
z	Standard normal for a confidence level of 95% (z = 1.96)

The formula required for calculation of SE_w

$$SE_w = \frac{s}{\sqrt{n}}$$

Where:

s	Standard deviation measured wattages.
n	Number of lamps where the wattage was measured

E.2. Project emissions calculation

In analogy to the baseline case the energy use in the project is calculated.

Step 2: Calculation of the Energy Consumption of the Project

The calculation of the energy consumption of the project group is analogue to the calculation of the Baseline Energy consumption. Instead of the power rating of the replaced GLS the power rating of the distributed CFLs, instead of the operating hours baseline the operating hours of the spot check group are used (see Illustration 6).

Step 2: Energy consumption Project in Monitoring Interval v
$E_{PJ,v} = CF_v * \sum_{k=1}^{n} [p_k * \mu_{PJ,v} * d_{k,v}]$

Illustration 6: Calculation of the energy consumption of the project

The results of the calculation of the energy consumption of the project are summarized in Table 8.

Step 2: Energy Consumption Project			
Duration of Monitoring Interval 1	d_2	[d]	518
Average of 15 W CFL installed over full MI		[pcs]	645,703
Average of 20 W CFL installed over full MI		[pcs]	23,333
Cross Check Correction Factor	CF_2	[-]	0.728
Average operating hours Project	$\mu_{PJ,2}$	[h]	4.612
Energy Consumption Project	$E_{PJ,2}$	**[kWh]**	**17,654,602**

Table 8: Energy Consumption Project

The energy consumed with the project activity amounts to $E_{PJ,2}$ = 17,654,602 kWh.

The formula required for calculation of $E_{PJ,v}$ is:

$$E_{PJ,v} = CF_v * \sum_{k=1}^{n} p_k * \mu_{PJ,v} * d_{k,v}$$

Where:

$E_{PJ,v}$	Energy use in the project (electricity) in MWh per monitoring interval *v*
CF_v	Correction factor for distributed CFL which are not operating during the cross-check in the monitoring interval *v*. CF_v represents the share of CFLs that are still operating
p_k	Power rating of the distributed CFL *k*
$\mu_{PJ,v}$	Average operating hours per day in monitoring period *v*
$d_{k,v}$	Days of operation of each distributed CFL *k* in monitoring interval *v* derived from $Date_{START,v}$, $Date_{END,v}$ (and $Date_{i,k}$ in first monitoring interval)

The formula required for calculation of $\mu_{PJ,v}$ is:

$$\mu_{PJ,v} = \frac{\sum_{d=1}^{n} \mu_{PJ,v,d,adjust}}{dur_{PJ,v}}$$

Where:

$\mu_{PJ,v}$	Average project operating hours per day in the monitoring interval *v*
$\mu_{PJ,v,d,adjust}$	Mean of the operating hours for day *d* during the monitoring interval *v* adjusted by confidence interval
$dur_{PJ,v}$	Duration of the monitoring interval *v* in days derived from $Date_{START,v}$, $Date_{END,v}$

The formula required for calculation of $\mu_{PJ,v,d,adjust}$ is:

$$\mu_{PJ,v,d,adjust} = \mu_{PJ,v,d} + z * \frac{\sigma_{PJ,v,d}}{\sqrt{n_{m,v,d}}}$$

Where:

$\mu_{PJ,v,d,adjust}$	Mean of the operating hours for day *d* during the monitoring interval *v* adjusted by confidence interval
$\mu_{PJ,v,d}$	Mean of the operating hours for day *d* during the monitoring interval *v*
z	Standard normal for a confidence level of 95% (z = 1.96)
$\sigma_{PJ,v,d}$	Standard deviation of operating hours for day *d* during monitoring interval *v*
	Number of meter instruments *m* that provide a valid value for day *d* during monitoring interval *v*

The formula required for calculation of $\mu_{PJ,v,d}$ is:

$$\mu_{PJ,v,d} = \frac{\sum_{m=1}^{n} o_{m,d,v}}{n_{m,d,v}}$$

Where:

$\mu_{PJ,v,d}$	Mean of the operating hours for day *d* during the monitoring interval *v*
$o_{m,d,v}$	Operating hours from measuring instrument *m* for day *d* for which complete data is available
$n_{m,d,v}$	Number of meter instruments *m* that provide a valid value for day *d* during the monitoring interval *v*

The formula required for calculation of $\sigma_{PJ,v,d}$ is:

$$\sigma_{PJ,v,d} = \sqrt{\frac{\sum_{m=1}^{n} \left(o_{m,d,v} - \mu_{PJ,d,v} \right)^2}{n_{m,d,v} - 1}}$$

Where:

$\sigma_{PJ,v,d}$	Standard deviation of operating hours for day *d* during monitoring interval *v*
$o_{m,v,d}$	Operating hours from measuring instrument *m* for day *d* for which complete data is available
$n_{m,d,v}$	Number of meter instruments *m* that provide a valid value for day *d* during the monitoring interval *v*
$\mu_{PJ,d,v}$	Mean of the operating hours for day *d* during the monitoring interval *v*

E.3. Leakage calculation

As the full amount of GLS replaced by CFLs was destroyed in the GLS Destruction Process, no leakage has to be considered.

Hence the leakage in the first (and all following) monitoring intervals is $LE_2 = 0$ $kgCO_2$.

E.4. Emission reductions calculation / table

Total baseline energy consumption: 71,718,290 kWh
Total project energy consumption: 17,654,602 kWh
Total leakage: 0 tCO_2
Total emission reductions: 45,954 tCO_2

Calculation of total emission reduction:

$$ER_v = E_{BL,v} - E_{PJ,v} * EF_{CO2,ELEC} - LE_v$$

Where:

ER_v	Emission reductions during monitoring interval v
$E_{BL,v}$	Energy baseline (electricity)
$E_{PJ,v}$	Energy project (electricity)
$EF_{CO2,ELEC}$	CO_2 emission factor for displacement of electricity in the grid serving the household consumers that participate in the project (fixed for the entire crediting period)
LE_v	Leakage emissions in monitoring interval v
v	Monitoring interval

Considering the results derived in the previous steps the Emission reductions achieved due to the project activity can be calculated as shown in Illustration 7.

Step 4: Calculation of emission reductions
$ER_v = (E_{BL,v} - E_{PJ,v}) \cdot EF_{CO_2,elec} - LE_v$

Illustration 7: Calculation of emission reductions

The results of the calculation of the emission reductions of the project are summarized in Table 9.

Step 4: Emission Reductions			
Energy Consumption Baseline	$E_{BL,2}$	[kWh]	71,718,290
Energy Consumption Project	$E_{PJ,2}$	[kWh]	17,654,602
Leakage	LE_2	[$kgCO_2$]	0
Grid Emission Factor	$EF_{CO2,\ ELEC}$	[$kgCO_2$/kWh]	0.850
Emission Reductions	**ER_2**	**[tCO_2]**	**45,954**

Table 9: Emission reductions

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

From 01/04/2010 - 31/08/2011 the project has achieved 45,954 tCO_2 emission reductions which means that the emission reductions per one year or 365 days were ER_{year} = 32,381 tCO_2, which are lower than the estimated value, corresponding with average emission reductions of 38.334 tCO_2 per year in the registered PDD.

The formula required for calculation of the emission reductions per year ER_{year} is:

$$ER_{year} = \frac{ER_{total}}{n_d} * 365$$

Where:

ER_{total}	tCO_2 emission reductions of the project during the all monitoring period
n_d	Duration days of the monitoring report

Item	Values applied in ex-ante calculation of the registered CDM-PDD for one year	Actual value reached during one year of the monitoring period	Actual value reached during the monitoring period
Emission reductions (tCO_2)	**38,334**	**32,381**	**45,954**

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

The reason for the decrease of emission reductions as compared to the PDD estimates is that less CFLs were found in operating condition than expected in the PDD.