



**Monitoring report form for CDM programme of activities
(Version 03.0)**

MONITORING REPORT		
Title of the PoA	SHINE – Distribution of LED Lightbulbs in India	
UNFCCC reference number of the PoA	10484	
Version numbers of the PoA-DD applicable to this monitoring report	07	
Version number of this monitoring report	01	
Completion date of this monitoring report	26/03/2020	
Monitoring period number	First Monitoring Period	
Duration of this monitoring period	12/01/2020 – 15/03/2020 (both days inclusive)	
Monitoring report number for this monitoring period	01	
Coordinating/managing entity	Brightspark Energy Private Limited	
Host Parties	Host Party of the PoA	Is this the host Party of a CPA covered in this monitoring report? (yes/no)
	India	Yes
Applied methodologies and standardized baselines	AMS-II.C- Demand-side energy efficiency activities for specific technologies, Version 15.0	
Sectoral scopes	Sectoral Scope 3: Energy demand	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by all CPAs covered in this monitoring report in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	NIL	2,352 tCO ₂ e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the CPA-DDs for the CPAs covered in this monitoring report	2,346 tCO ₂ e	

PART I Monitoring of programme of activities (PoA)

SECTION A. Description of PoA

A.1. General description of PoA

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The purpose of the PoA- “SHINE – Distribution of LED Lightbulbs in India” is to reduce fossil-fuel based electricity consumption in the lighting usage of India’s residential and commercial sector by introducing more energy efficient LED lamps/tubes to replace incandescent lightbulbs (“ICLs”) and fluorescent lamps (FLs)¹, thereby contributing to the reduction of greenhouse gas emissions.

With a mission to provide energy efficient technology to the poorest communities in the developing countries, the PoA is committed towards accelerating the shift from inefficient electricity guzzling ICL (or florescent tubes) to more efficient long-life luminaries such as LEDs. It also addresses the objective of The National Mission for Enhanced Efficiency under the National Action Plan for Climate Change².

Brightspark Energy Private Limited (BEPL) is the Coordinating Managing Entity (CME) of this SSC-PoA. Ecoeye Co., Ltd. and other Korean Parties have fully financed all LEDs to be distributed by the CPA implementer at free of cost in each CPA under this PoA. They also have provided all the operation & distribution cost to operate this CPA in a financially sustainable condition. Carbon revenue supports the aforesaid activities, without which these activities and thus this program would not take place.

The LEDs distributed under the scheme would follow the Bureau of Indian Standards (BIS) mandated technical specifications i.e. IS 16102:2012 for self-ballasted LEDs or that of equivalent international standard.

The first LED was registered in August 2018. In the first monitoring period the PoA reduced 2,352 tCO_{2e}.

A.1.1. Corresponding generic component project activities (CPAs)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
SHINE – Distribution of LED Lightbulbs in India – XXX	07	Sectoral Scope 3: Energy Demand	AMS-II.C- Demand-side energy efficiency activities for specific technologies, Version 15.0

A.1.2. CPAs included in the PoA

Title and UNFCCC reference number of the CPA	Version of the PoA-DD	Title and reference number of the corresponding generic CPA	Crediting period type and duration	Covered in this monitoring report? (yes/no)
SHINE-Distribution of LED Lightbulbs in India-1; 10484-P1-0001-CP1	07	SHINE – Distribution of LED Lightbulbs in India – XXX	Renewable 12/01/2020-11/01/2027	Yes
SHINE-Distribution of LED Lightbulbs in India-2; 10484-P1-0002-CP1	07	SHINE – Distribution of LED Lightbulbs in India – XXX	Renewable 12/01/2020-11/01/2027	Yes
SHINE-Distribution of LED Lightbulbs in India-3; 10484-P1-0003-CP1	07	SHINE – Distribution of LED Lightbulbs in India – XXX	Renewable 06/03/2020-05/03/2027	Yes
SHINE-Distribution of LED Lightbulbs in India-4; 10484-P1-0004-CP1	07	SHINE – Distribution of LED Lightbulbs in India – XXX	Renewable 12/01/2020-11/01/2027	Yes

¹ Commonly known as tube-light in India.

²http://www.moef.nic.in/sites/default/files/Pg01-52_2.pdf,

A.2. Coordinating/managing entity

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Brightspark Energy Private Limited

SECTION B. Implementation of PoA**B.1. Description of implemented PoA**

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Brightspark Energy Private Limited (BEPL) is the Coordinating/Managing Entity (CME) of the SSC-PoA under which the CPAs are included and currently is the only project participant. Four CPAs have been included in the PoA until the end of the present monitoring period and this monitoring report covers all of them. Ecoeye Co., Ltd. has been responsible for financing the implementation of the 4 CPAs.

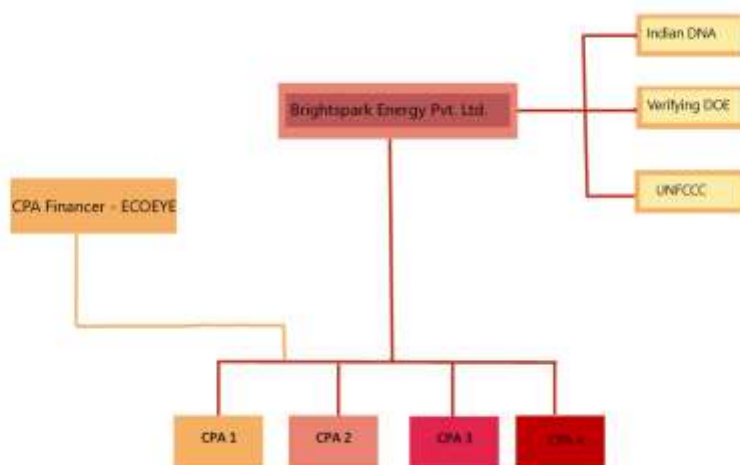


Figure 1: Management Structure of the PoA

BEPL has distributed the LEDs to the households under CPAs, prepared the monitoring report and hired third party for ex-post monitoring surveys. Sampling plan has been implemented individually for each of the four CPAs.

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

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Not applicable

B.2.2. Inclusion of monitoring plan

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Not applicable

B.2.3. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

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Not applicable

B.2.4. Changes to programme design

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Not applicable

B.2.5. Changes specific to afforestation or reforestation activities

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Not applicable

PART II Monitoring of CPAs

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All the four CPAs included in this monitoring report have common generic CPA, apply the same methodology and have been implemented in the same country, that is India, hence all 4 have been grouped together.

SECTION C. Implementation of CPAs**C.1. Description of implemented CPAs**

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Each of the four SSC-CPAs developed under the PoA involve distribution and installation of LED lamps within domestic premises in areas where outreach of LED has been minimal owing to unawareness, limited availability of LED technology as well as high upfront cost of the LEDs. Ecoeye Co., Ltd., and other Korean Companies has fully financed all improved LED bulbs distributed to the households, and the total project cost per LED bulb is USD 1.65 including the cost of a LED. This replacement scheme was available only for grid connected consumers who voluntarily decided to be a part of this programme. Door to door distribution was mainly carried out for all the four CPAs, however, in some places distribution through kiosks was also undertaken. The distribution work was undertaken by a third party commissioned by Brightspark Energy Pvt. Ltd.

Individual project activity involved installation of self-ballasted LED to replace existing ICL used in the household. The electronic ballast integrated in the LED is a non-removable part. The table below shows the lumen output and rated lifetime of the LEDs installed in the individual project activity against the replaced ICLs. The project LEDs meet or exceed the rated normal lumen output of the replaced ICL.

SHINE-Distribution of LED Lightbulbs in India-1; 10484-P1-0001-CP1					
	ICL (baseline)	LED (project)	ICL (baseline)	LED (project)	
Wattage (W)	60	9	100	12	14
Lumen output (lm)	715	900	1,350	1,350	1,400
Rated Lifetime (hours)	1,000	25,000	1,000	25,000	25000
SHINE-Distribution of LED Lightbulbs in India-2; 10484-P1-0002-CP1					
	ICL (baseline)	LED (project)	ICL (baseline)	LED (project)	
Wattage (W)	60	9	100	12	14
Lumen output (lm)	715	900	1,350	1,350	1,400
Rated Lifetime (hours)	1,000	25,000	1,000	25,000	25000
SHINE-Distribution of LED Lightbulbs in India-3; 10484-P1-0003-CP1					
	ICL (baseline)	LED (project)	ICL (baseline)	LED (project)	
Wattage (W)	60	9	100	12	14
Lumen output (lm)	715	900	1,350	1,350	1,400
Rated Lifetime (hours)	1,000	25,000	1,000	25,000	25000
SHINE-Distribution of LED Lightbulbs in India-4; 10484-P1-0004-CP1					
	ICL (baseline)	LED (project)	ICL (baseline)	LED (project)	
Wattage (W)	60	9	100	12	14
Lumen output (lm)	715	900	1,350	1,350	1,400

Rated Lifetime (hours)	1,000	25,000	1,000	25,000	25000
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*Rated normal Lumen output for 60 W and 100 W of ICLs as per Table 2; AMS II.C. version 15

** Rated normal Lumen output for 9 W and 12/14 W LED as per Test Report from accredited Lab

The project LEDs are in compliance with Indian Standard IS 16102 (Part 1-Safety Requirements; Part 2-Performance Requirements), which is the national standard for self-ballasted LED lamps. The specifications of the project LEDs are as below:

- Self-ballasted type
- Rated lifetime of 25,000 hours
- Embossed or laser printed with project logo for clear unique identification



The implementation of the project activity involves the distribution of long life quality LEDs per household to the grid connected consumers in the CPA area. This is one to one exchange, meaning, the consumer gets one LED in place of one ICL (in working condition) and INR 15 is collected per bulb as single time fee for destruction of ICL. Each LED bulb at the time of distribution has been assigned a unique identity by combination of the name of the consumer, grid connection number, address and contact number. The CPA specific implementation chronology is presented as follows:

UNFCCC Ref No	10484-P1-0001-CP1
Start date of LED distribution	30/08/2018
1 st ex-post Monitoring survey	11/03/2020 – 16/03/2020
1 st Monitoring Period	12/01/2020 – 15/03/2020

UNFCCC Ref No	10484-P1-0002-CP1
Start date of LED distribution	04/01/2019
1 st ex-post Monitoring survey	14/03/2020 – 20/03/2020
1 st Monitoring Period	12/01/2020 – 15/03/2020

UNFCCC Ref No	10484-P1-0003-CP1
Start date of LED distribution	06/03/2020
1 st ex-post Monitoring survey	16/03/2020 – 20/03/2020
1 st Monitoring Period	12/01/2020 – 15/03/2020

UNFCCC Ref No	10484-P1-0004-CP1
Start date of LED distribution	05/10/2018
1 st ex-post Monitoring survey	11/03/2020 – 16/03/2020
1 st Monitoring Period	12/01/2020 – 15/03/2020

The DISCOM (Distribution Company) maintains a database of domestic users identifiable on the basis of a unique connection number and/or address used for billing purposes. The distribution activities were carried

out by first accessing this consumer database of the grid connected residential consumers from the CPA area.

The potential recipient households were educated to install the LED in high-usage areas, such as veranda/porch/balcony, common areas, living room area and kitchen to maximize the energy savings. The distribution of LEDs and replacement of previously used ICLs in households in the CPA area was done using the following methods:

- Direct installation at each household;
- Dedicated distribution points as advertised by the CPA investor in the local media e.g. local DISCOM offices, retail outlets, resident association offices, schools etc.

After the completion of LED installation stage, the collected ICLs were stored in separate boxes according to the wattage and clearly labelled as per their contents. These ICL boxes were transferred to centrally designated ICL storage facilities. Further arrangement was made with ICL waste disposal agency to collect ICLs from these centrally designated storage facilities (collection points) for the destruction of ICLs in safe manner.

Brightspark Energy Pvt. Ltd. hired third party waste disposal agencies for destruction of collected ICLs, who have collected the stored ICLs from the respective CPAs and destroyed as per the legal norms of Govt of India. The detail such as contractual agreement with the agencies, photos and videos of ICL destruction including the destruction certificates have been shared with the verifying DOE.

To prevent double counting the LEDs utilized under the 'SHINE' scheme, in addition to being marked for standard lamp specifications, were also marked with programme logo as shown above.

The total GHG emission reductions achieved in this monitoring period is 2,352 tCO₂ equivalents.

C.2. Location of CPAs

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The political boundary of India is the country/ geographical boundary of the SSC-PoA. It lies north of equator between 8°44' to 37°6' north latitude and 68°7' to 97°25' east longitude³.

The geographical location of each of the CPAs is as follows:

10484-P1-0001-CP1

The CPA implemented in the south Indian state of Telangana, within the Telangana State Southern Power Distribution Company Limited (TSSPDCL) network circle.

10484-P1-0002-CP1

The CPA implemented within the North-East Indian region e.g. states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. These states comprise the North Eastern Grid circle in the grid map of India.

10484-P1-0003-CP1

The CPA will be implemented in the following states within the stated co-ordinates:

State	Latitude ⁴	Longitude
Uttar Pradesh	27° 40' N	80° 00'E
Haryana	30.30 N	74.60 E
Himachal Pradesh	32° 29' N	75° 10' E

³ https://en.wikipedia.org/wiki/Geography_of_India

⁴ https://www.mapsofindia.com/lat_long/

Bihar	25° 11' N	85° 32' E
Jharkhand	23° 45' N	85° 30' E
Odisha	26° 00' N	94° 20' E

10484-P1-0004-CP1

The CPA will be implemented in Telangana state within the TSNPDCL-Northern Power Distribution Company of Telangana Limited, network circle.

C.3. Post-registration changes to CPAs**C.3.1. Temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies, standardized baselines or other methodological regulatory documents**

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Not applicable

C.3.2. Corrections

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Not applicable

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

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Start date of crediting period was changed for the included CPA as follows:

Reference number of the specific-case CPA	Start date of crediting period at the time of CPA inclusion	Revised start date of crediting period	Date of approval from CDM EB
10484-P1-0003-CP1	12/01/2020	06/03/2020	26/03/2020

C.3.4. Inclusion of monitoring plan

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Not applicable

C.3.5. Permanent changes to the included monitoring plans, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

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Not applicable

C.3.6. Changes to project design

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Not applicable

C.3.7. Changes specific to afforestation or reforestation CPA

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Not applicable

SECTION D. Description of monitoring system of CPAs

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The overall monitoring system under all the SSC-CPAs can be summarised in the figure 2 & 3. These two figures outline the key elements of the hierarchy and data monitoring plan for a SSC-CPA, highlighting responsible entities and their tasks, interaction channels among them, and key monitoring parameters.

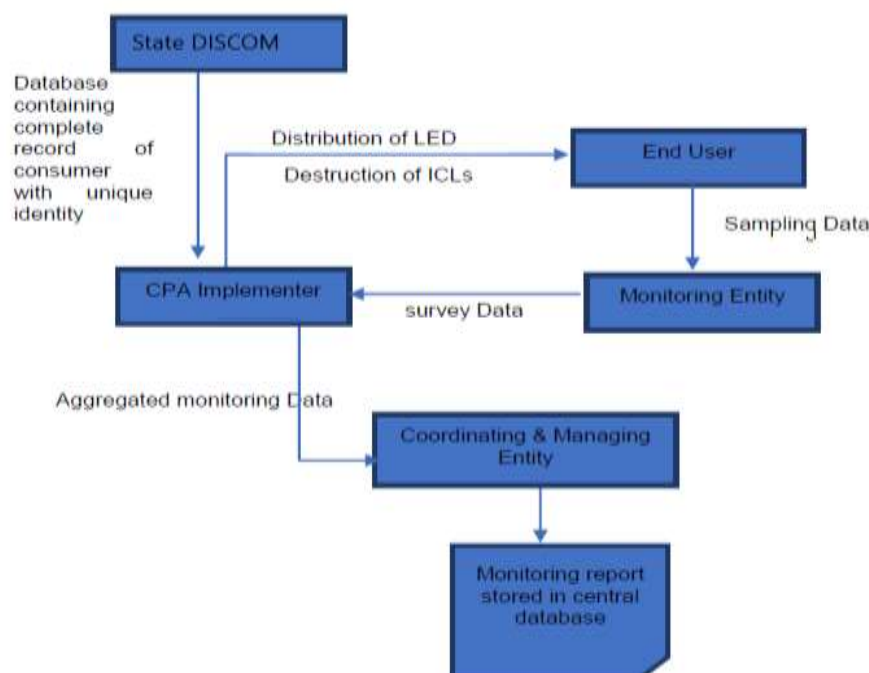


Figure 2: Role of stakeholders involved in the CPA

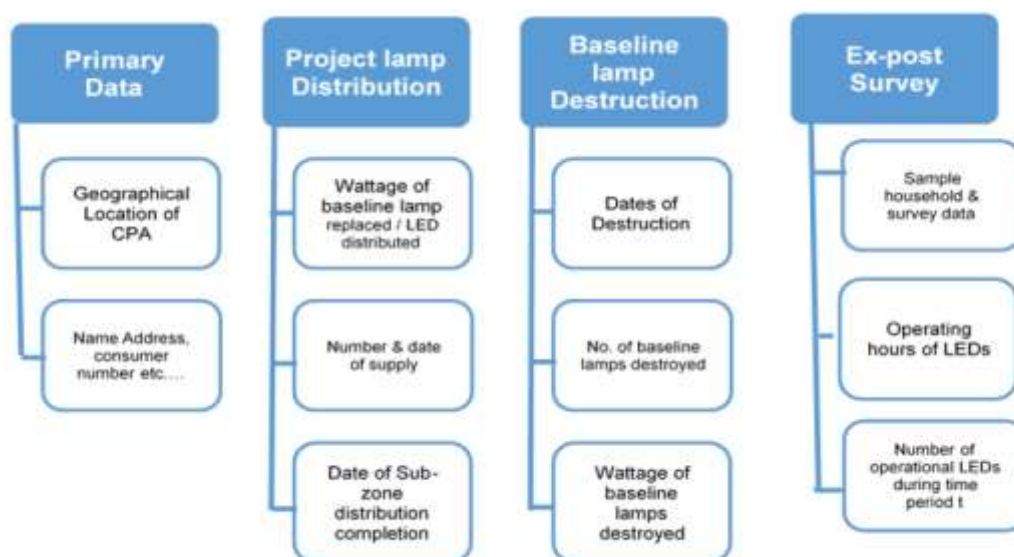


Figure 3: SSC-CPA Database components as per SHINE scheme

As per applied methodology AMS-II.C., the monitoring for the SSC-CPAs have been carried out at the following levels:

- 1.LED distribution
- 2.Ex-post Monitoring Survey
- 3.Baseline ICL destruction

1.LED Distribution

The LEDs were distributed by the CME with support from third party, using the following methods:

- Direct installation at each household;

- Distribution through dedicated distribution points as advertised by the CME in local media e.g. local DISCOM offices, retail outlets, resident association offices, schools etc.

Information regarding following parameters was collected at the time of LED distribution

Parameter	Description	Data Unit	Monitoring Method	Data collection method	Frequency	Sampling
$\rho_{i \text{ baseline}}$	Electrical power demand of baseline lamps	watts	on-site visit by distribution team at the time of project implementation.	Data was collected via smart phone or tablet app module connected to data cloud. This was relayed in real time to a central DMS. Industry standard software, infrastructure and back up procedures were followed ensuring full auditability and long-term data integrity and security so that data is not misreported, overwritten or lost	Once, at the time of CPA implementation	100 per cent of data was monitored
$n_{i \text{ baseline}}$	Number of pieces of baseline lamps replaced.	number				
$\rho_{i \text{ project}}$	Electrical power demand of project devices	watts				
$n_{i \text{ project}}$	Number of project devices distributed	number				

2.Ex-post Monitoring Survey

Monitoring survey was carried out through computer assisted personal interview (CAPI) where part of data was collected via smart phone or tablet app module connected to data cloud and part was collected through questionnaires along with physical observations where respondents were requested to fill pre-compiled questionnaire.

The data so collected was collated by the CME. The following parameters were monitored:

Parameter	Description	Data Unit	Monitoring Method	Data collection method	Frequency	Sampling
$O_{i \text{ project}}$	Average annual Operating hours of project lamps	hours	Remote survey via data loggers	The operating hours was measured continuously for a period of 90 days with the help of run time meters installed on a sample of lighting points. The data thus measured was used for calculating average annual operating hours.	once, concurrent with the first ex-post monitoring.	Random samples were collected from each SSC-CPA area using statistical tools. Sample size was determined to have at least 95% confidence level and 10% maximum margin of error.
$n_{i \text{ operational}}$	Number of group 'i' project lamps that	number	Survey through physical on-site visit by third party monitoring	Physical observation and recording response in questionnaires to	Annual.	Random samples were collected from non

	are operational during time interval 't'		team.	assess whether <ul style="list-style-type: none"> • LEDs have project logo • They were operational 		monitored samples in SSC-CPA area using statistical tools. Sample size was determined to have at least 95% confidence level and 10% maximum margin of error.
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3.ICL Destruction

After the completion of LED installation stage, the collected ICLs were stored in separate boxes according to the wattage and clearly labelled as per their contents. These ICL boxes were transferred to centrally designated ICL storage facilities. Further arrangement was made with ICL waste disposal agency to collect ICLs from these centrally designated storage facilities (collection points) for the destruction of ICLs in safe manner.

At the beginning of the monitoring interval y, each SSC-CPA verified whether the number of distributed LEDs was equal to or less than the number of returned and destroyed ICLs in the SSC-CPA area.

Following the Random ICL Inspection, all ICLs collected were transported from the collection point to a disposal facility which is qualified and authorized to destroy ICLs (ICL Destruction Facility). Upon arrival at the ICL Destruction Facility, the waste disposal agency has ensured that there has been no change in the total number of ICLs from that recorded at the Collection Point. After the completion of ICL destruction, waste management company issued a "Certificate of Destruction".

SECTION E. Data and parameters

E.1. Data and parameters fixed ex ante

Data/Parameter	EF _{CO2,ELEC,y}
Unit	tCO2/MWh
Description	Combined margin emission factor for Indian grid calculated according to equation 16 of methodological tool 07- 'Tool to calculate the emission factor for an electricity system'; version 07
Source of data	CO2 Baseline Database for the Indian Power Sector, User Guide; Version 13.0 (June 2018) ⁵
Value(s) applied	0.92
Choice of data or measurement methods and procedures	The SSC-CPA owner shall apply the latest grid emission factor database available on the CEA website and fix the value ex-ante.
Purpose of data/parameter	Used in calculation of Emission reduction.
Additional comments	none

Data/Parameter	⁶ L _{i gW}
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⁵ http://www.cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver13.pdf

Data unit	Hours
Description	rated average operating hours for LED type <i>i</i>
Source of data	manufacturer's specification
Value(s) applied	25,000
Choice of data or measurement methods and procedures	Determined from independent life-tests of the LEDs as per national / international standard or any other industry admissible test. The value is fixed ex-ante.
Purpose of data	Emission reduction calculation
Additional comment	none

Data/Parameter	$L_{i\ 12W}$
Data unit	Hours
Description	rated average operating hours for LED type <i>i</i>
Source of data	manufacturer's specification
Value(s) applied	25,000
Choice of data or measurement methods and procedures	Determined from independent life-tests of the LEDs as per national / international standard or any other industry admissible test. The value is fixed ex-ante.
Purpose of data	Used for emission reduction calculation
Additional comment	none

Data/Parameter	$L_{i\ 14W}$
Data unit	Hours
Description	rated average operating hours for LED type <i>i</i>
Source of data	manufacturer's specification
Value(s) applied	25,000
Choice of data or measurement methods and procedures	Determined from independent life-tests of the LEDs as per national / international standard or any other industry admissible test. The value is fixed ex-ante.
Purpose of data	Used for emission reduction calculation
Additional comment	none

E.2. Data and parameters monitored

Data/Parameter	Π_i baseline (60W)/(100W)
Unit	number
Description	Number of pieces of 60W/100W baseline lamps replaced.
Measured/calculated/default	Measured
Source of data	Actual collection record as stored in database

⁶ 9W & 12W are indicative. Project lamps may be outside this range

Value(s) of monitored parameter		100 W	60 W	
	10484-P1-0001-CP1	5,126	73,357	
	10484-P1-0002-CP1	4,643	4,458	
	10484-P1-0003-CP1	44,120	26,823	
	10484-P1-0004-CP1	0	10,034	
Monitoring equipment	None.			
Measuring/reading/recording frequency	Once at the time of project implementation			
Calculation method (if applicable)	Not applicable			
QA/QC procedures	Data was collected via smart phone/ tablet app module connected to data cloud allowing data validation checks to be enforced at the point of collection, hence minimizing errors.			
Purpose of data/parameter	Emission reduction calculation			
Additional comments	data will be stored in the project database for at least two years after the crediting period or the last issuance			

Data/Parameter	Π_i baseline scrapped (60W)/(100W)			
Unit	number			
Description	Number of pieces of 60W/100W baseline lamps destroyed.			
Measured/calculated/default	Measured			
Source of data	Actual collection record as stored in database			
Value(s) of monitored parameter		100 W	60 W	
	10484-P1-0001-CP1	5,126	73,357	
	10484-P1-0002-CP1	4,643	4,458	
	10484-P1-0003-CP1	44,120	26,823	
	10484-P1-0004-CP1	0	10,034	
Monitoring equipment	none			
Measuring/reading/recording frequency	Once at the time of project implementation			
Calculation method (if applicable)	Not applicable			
QA/QC procedures	Number of baseline lamps that are destroyed will be cross checked with Π_i baseline (60W/100W)			
Purpose of data/parameter	Requirement of the applied methodology.			
Additional comments	none			

Data/Parameter	Π_i project (9W)/(12W)/(14W)			
Unit	number			
Description	Number of pieces of 9W/12W/14W project lamps distributed			
Measured/calculated/default	Measured			
Source of data	Actual collection record as stored in database			

Value(s) of monitored parameter		14 W	12 W	9 W
	10484-P1-0001-CP1	5,126	0	73,357
	10484-P1-0002-CP1	4,643	0	4,458
	10484-P1-0003-CP1	0	44,120	26.823
	10484-P1-0004-CP1	0	0	10,034
Monitoring equipment	none			
Measuring/reading/recording frequency	Once at the time of project installation.			
Calculation method (if applicable)	Not applicable			
QA/QC procedures	Data was collected via smart phone/tablet app module connected to data cloudallowing data validation checks to be enforced at the point of collection, hence minimizing errors.			
Purpose of data/parameter	Emission reduction calculation			
Additional comments	data will be stored in the project database for at least two years after the crediting period or the last issuance			

Data/Parameter	$n_{i \text{ operational}} (9W)/(12W)/(14W)$			
Unit	number			
Description	Total number of 9W/12W/14W project lamps that are operational during monitoring period			
Measured/calculated/default	Calculated from survey data			
Source of data	First ex-post monitoring survey of sample of non-metered households			
Value(s) of monitored parameter		14 W	12 W	9 W
	10484-P1-0001-CP1	5,126	0	73,357
	10484-P1-0002-CP1	4,643	0	4,458
	10484-P1-0003-CP1	0	44,120	26.823
	10484-P1-0004-CP1	0	0	10,034
Monitoring equipment	Not applicable			
Measuring/reading/recording frequency	Annually			
Calculation method (if applicable)	<p>The $n_{i \text{ operational}}$ value is calculated from the results of n_i survey, as follows:</p> <ul style="list-style-type: none"> •Obtain the ratio of the number project lamps of type 'i' with SHINE logo found installed & operating in the sample households and the number of lamps of type 'i' claimed to be distributed in the sample households •Multiply the ratio obtained by the total number of lamps of type i claimed to be distributed in the CPA area <p>The claimed number of lamps is capped by the number of ICLs destroyed.</p>			
QA/QC procedures	Monitoring survey was conducted by qualified and experience third party agency in accordance with the requirement of methodology so that the estimate of $n_{i \text{ operational}}$ obtained is unbiased and reliable.			
Purpose of data/parameter	Emission reduction calculation			
Additional comments	data will be stored in the project database for at least two years after the crediting period or the last issuance			

Data/Parameter	<i>O_i project (9W)/(12W)/(14W)</i>				
Unit	Hours				
Description	Average annual operating hours of type 'i' project lamp				
Measured/calculated/default	Measured				
Source of data	First ex-post monitoring survey				
Value(s) of monitored parameter					
		10484-P1-0001-CP1	10484-P1-0002-CP1	10484-P1-0003-CP1	10484-P1-0004-CP1
	Operating Hours	6.67	6.67	6.67	6.67
Monitoring equipment	Run time meters				
Measuring/reading/recording frequency	Once concurrent with first ex-post monitoring				
Calculation method (if applicable)	The operating hours was be measured continuously for a period of 90 days with the help of run time meters installed on a sample of lighting points. The data thus measured was used for calculating average daily operating hours. The value obtained was multiplied with 365 days to give average annual operating hours of project lamps.				
QA/QC procedures	Not required				
Purpose of data/parameter	Baseline and project emission calculation				
Additional comments	data will be stored in the project database for at least two years after the crediting period or the last issuance				

Data/Parameter	<i>ρ_i baseline 60W, 100 W</i>				
Unit	Watts				
Description	Rated power of 60 W & 100 W baseline lamps replaced				
Measured/calculated/default	Measured				
Source of data	Actual collection record as stored in CPA database				
Value(s) of monitored parameter	100 W and 60 W				
Monitoring equipment	None				
Measuring/reading/recording frequency	Once at the time of project installation.				
Calculation method (if applicable)	Not applicable				
QA/QC procedures	Data was collected via smart phone/tablet app module connected to data cloud allowing data validation checks to be enforced at the point of collection, hence minimizing errors.				
Purpose of data/parameter	Emission reduction calculation				
Additional comments	None				

Data/Parameter	<i>ρ_i project 9W, 12W, 14W</i>				
Unit	Watts				
Description	Rated power of the LEDs of 9W, 12W and 14W project lamps (Watts)				
Measured/calculated/default	Measured				

Source of data	Actual collection record as stored in CPA database				
Value(s) of monitored parameter		10484-P1-0001-CP1	10484-P1-0002-CP1	10484-P1-0003-CP1	10484-P1-0004-CP1
	Rated Poawr of installed LEDs	9 W and 14 W	9 W and 14 W	9 W and 12 W	9 W
Monitoring equipment	None				
Measuring/reading/recording frequency	Once at the time of project installation.				
Calculation method (if applicable)	Not applicable				
QA/QC procedures	Data was collected via smart phone/tablet app module connected to data cloud allowing data validation checks to be enforced at the point of collection, hence minimizing errors.				
Purpose of data/parameter	Emission reduction calculation				
Additional comments	none				

Data/Parameter	ly
Unit	per cent
Description	Average annual technical grid losses
Measured/calculated/default	Default
Source of data	AMS II.C, version 15
Value(s) of monitored parameter	10%
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Not applicable
Calculation method (if applicable)	Not applicable
QA/QC procedures	Not applicable
Purpose of data/parameter	Emission reduction calculation
Additional comments	This value shall not include non-technical losses such as commercial losses (e.g., theft/pilferage)

E.3. Implementation of sampling plan

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(a) Sampling Design

Due to the large number of LEDs distributed as part of the CPA, it was not economically feasible to monitor each individual LED distributed. Therefore, representative sampling was undertaken as part of a SSC-CPA-wide Sampling Plan that is designed in line with the requirements of the "Standard for sampling and surveys for CDM project activities and programme of activities" from EB86, Annex 3 (the *Sampling standard*). Therefore separate sampling was conducted for both the CPAs.

(i) Objective and Reliability Requirements:

The objective was to obtain an unbiased and reliable estimate of the proportion or mean value of the following key variables over the course of the crediting period, and with 95/10 confidence/prevision.

Monitored Parameters:

Parameter	Description of Parameter
O_i project	<i>Operating hours of replaced ICL lamps or installed LEDs using run time meters</i>
n_i operational	<i>Number of operational project lamps during the monitoring period</i>

(ii) Target Populations:

The proposed project activities employ a homogenous technology with similar operating characteristics i.e. LED; but are dispersed amongst a large number of DISCOM connected consumers.

The target population is the end user representative of the project scenario using the LED technology. A list of end users with contact details is maintained in the Project Database.

(iii) Sampling Frame

The sampling frame is representative of the population and consists of all households where incandescent bulbs will be replaced by LEDs under proposed CPA.

For a CPA, the sample frame is developed from the respective state utility customer account records. The frame consists of currently active accounts with a unique service code. The units in the sampling frame meet the following criteria:

- All units have an alpha/ numerical identifier
- All units can be easily traced –contact information, geographical location and other relevant information of beneficiary is present
- Every element of the population is present only once in the frame

No elements from outside the population of interest are present in the frame

(iv) Sampling Method

Considering the homogenous nature of target population, ‘Simple Random Sampling’ was used in which unbiased random selection of individual households was carried out to ensure that from the many samples which are drawn, the average sample accurately represented the target population.

(v) Sample Size

For the estimation of the proportion or mean value a 95/10 confidence/precision is required for annual sampling.

Of the parameters to be monitored, **n_i operational** is the number that can be achieved by extrapolating the percentage of the LEDs found in operation during survey and one is a mean value **O_i project**.

The sample size calculated as per the simple random sampling approach for the required two parameters are mentioned in the table below. While arriving the sample sizes, various types of LEDs distributed and their power ratings have been considered.

Sample Size	10484-P1-0001-CP1	10484-P1-0002-CP1	10484-P1-0003-CP1	10484-P1-0004-CP1
O_i project	256	256	257	256
n_i operational	164	157	163	158

On estimating the sample size, 20% of non-response has been considered and thus total of 308 households (for 10484-P1-0001-CP1, 10484-P1-0002-CP1 & 10484-P1-0004-CP1 each) and 309 households (for 10484-P1-0003-CP1) were targeted for estimating operating hours and 197 (for 10484-P1-0001-CP1), 189 (for 10484-P1-0002-CP1), 196 (for 10484-P1-0003-CP1) & 190 (for 10484-P1-0004-CP1) households were targeted for parameter **n_i operational**.

(b) Data:

(i) Field Measurements:

The method of collecting data was field surveys of required sample size of LED users in the database. Data was collected from the field surveys, entered in the database and included in the monitoring report.

(ii) Quality Assurance/Quality Control

The required confidence and precision were met for all parameters. The sample size calculation is provided to verifying DOE.

a. Data archiving

Hard copies of the surveys will be kept and the registration database has a back up. A back-up of the registration database will also be stored on an electronic medium by the CME. All data monitored and required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever is later.

b. Analysis

Data obtained from the samples were used to estimate proportions and mean values for the parameters described above. The values were then factored into the emissions reduction calculations.

c. Implementation

The sampling was conducted by trained personnel, part of the CPA Implementer team, and an experienced third party entity. The CPA Implementer is responsible for managing household data collection and entry into the project database. Field personnel received training on how to properly deal with surveying techniques and reduce errors and sign a document certifying that there was no conflict of interest of those involved in data collection and analysis.

SECTION F. Calculation of emission reductions or net anthropogenic removals

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

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The emission reduction by the CPA will be calculated in accordance with **equation 10**, of the small-scale methodology AMS II.G., Version 15.0.

$$ER_y = (BE_y - PE_y) - LE_y$$

Where:

ER_y	Emission reductions in year y (tCO ₂ e)
BE_y	Baseline emission in year y (tCO ₂ e)
PE_y	Project emission in year y (tCO ₂ e)
LE_y	Leakage emission in year y (tCO ₂ e)

Baseline Emission (BE_y)

$$BE_y = E_{BL,y} \times EF_{CO2,ELEC,y} + Q_{ref,BL} \times GWP_{ref,BL}$$

As the project entails replacement of LED in place of ICLs hence no refrigerant is involved. The above equation is then modified as:

$$BE_y = E_{BL,y} \times EF_{CO2,ELEC,y}$$

BE_y = Baseline emissions in year y (tCO₂e)

$E_{BL,y}$ = Energy consumption for the baseline (ICLs) in year y (kWh)

$EF_{CO2,ELEC,y}$ = Electricity emissions factor.

Energy consumption for baseline in year y is calculated as:

$$E_{BL,y} = 0.95 \times \sum_i (n_i \times \rho_i \times o_i / (1 - l_y))$$

where

n_i = Number of pieces of equipment of the group of 'i' baseline equipment (ICLs) replaced.

ρ_i = Electrical power demand (kW) of the group of 'i' baseline equipment (e.g. 60W or 100W incandescent lamps).
In the case of more than one type of ICLs are replaced, electrical power demand is the weighted average of the rated power (kW) of group i baseline equipment (ICLs).

o_i = Average annual operating hours of the group of 'i' baseline equipment (ICLs).

l_y = 0.10

0.95 = Net to gross adjustment factor

For calculating the baseline emission (for monitoring period from 12/01/2020 to 15/03/2020), annual baseline emission per ICL has calculated for each type (i.e. each for 100W & 60W) of baseline lamp and then apportioned according to the working days for each household as per the database in the ER calculation sheet.

For 100 W ICLs

$$\begin{aligned} E_{BL,y} &= 0.95 \times (1 \times 0.1 \times 2,434.55) / (1 - 0.10) \\ &= 256.98 \text{ kWh} \end{aligned}$$

$$\begin{aligned} BE_y &= 256.98 \times 0.92/1000 \\ &= 0.236 \text{ tCO}_2\text{e/ICL/year} \end{aligned}$$

For 60 W ICLs

$$\begin{aligned} E_{BL,y} &= 0.95 \times (1 \times 0.06 \times 2,434.55) / (1 - 0.10) \\ &= 154.19 \text{ kWh} \end{aligned}$$

$$\begin{aligned} BE_y &= 154.19 \times 0.92/1000 \\ &= 0.142 \text{ tCO}_2\text{e/ICL/year} \end{aligned}$$

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

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Project emissions on account of electricity used by the project equipment shall be calculated according to following equations:

$$PE_y = E_{PE,y} \times EF_{CO2,ELEC,y} + PE_{ref,y}$$

PE_y	=	Project emissions in year y (tco2e)
$EP_{PJ,y}$	=	Energy consumption in project activity in year y. This shall be determined ex post based on monitored values
$EF_{CO2,y}$	=	Emission factor for electricity or thermal baseline energy. The emissions associated with grid electricity consumption should be calculated in accordance with the procedures of AMS-I.D. For fossil fuel displaced reliable local or national data for the emission factor shall be used; IPCC default values should be used only when country or project-specific data are not available or difficult to obtain
$PE_{ref,y}$	=	Project emissions from physical leakage of refrigerant from the project equipment in year y (tco2e/y)

As the project entails replacement of LED in place of ICLs hence no refrigerant is involved. The above equation is then modified as:

$$PE_y = E_{PE,y} \times EF_{CO2,ELEC,y}$$

$$E_{PE,y} = 0.95 \times \sum_i (n_i \times \rho_i \times o_i / (1 - l_y))$$

n_i	=	Number of group 'i' project devices operating during time interval t in year y.
ρ_i	=	Electrical power demand (kW) of the group 'i' project devices measured during the time interval t in year y.
o_i	=	Operating hours of group of 'i' project devices in the time interval t in year y
0.95	=	Net to gross adjustment factor

For calculating the project emission (for monitoring period from 12/01/2020 to 15/03/2020), annual project emission per LED has calculated for each type (i.e. each for 9W, 12W & 14W) of project lamp and then apportioned according to the working days for each household as per the database in the ER calculation sheet.

For 12 W LEDs

$$E_{PE,y} = 0.95 \times (1 \times 0.012 \times 2,434.55) / (1 - 0.10)$$

$$= 30.84 \text{ kWh}$$

$$PE_y = 30.84 \times 0.92/1000$$

$$= 0.028 \text{ tCO}_2\text{e/LED/year}$$

For 14 W LEDs

$$E_{PE,y} = 0.95 \times (1 \times 0.014 \times 2,434.55) / (1 - 0.10)$$

$$= 35.98 \text{ kWh}$$

$$PE_y = 35.98 \times 0.92/1000$$

$$= 0.033 \text{ tCO}_2\text{e/LED/year}$$

For 9 W LEDs

$$E_{PE,y} = 0.95 \times (1 \times 0.009 \times 2,434.55) / (1 - 0.10)$$

$$= 23.14 \text{ kWh}$$

$$PE_y = 23.14 \times 0.92/1000$$

$$= 0.021 \text{ tCO}_2\text{e/LED/year}$$

F.3. Calculation of leakage emissions

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According to the applied methodology, leakage emissions have to be considered if the energy efficiency technology involves equipments transferred from another activity. In the proposed CPA, LEDs that will be distributed to the households are not transferred from another activity; hence leakage emissions are not applicable.

Hence

$$ER_y = BE_y - PE_y$$

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

CPA UNFCCC reference number	Baseline GHG emissions or baseline net GHG removals (t CO ₂ e)	Project GHG emissions or actual net GHG removals (t CO ₂ e)	Leakage GHG emissions (t CO ₂ e)	GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e)		
				Before 01/01/2013	From 01/01/2013	Total amount
10484-P1-0001-CP1	2,037	303	0	0	1,734	1,734
10484-P1-0002-CP1	303	43	0	0	260	260
10484-P1-0003-CP1	167	21	0	0	146	146
10484-P1-0004-CP1	249	37	0	0	212	212
Total	2,756	404	0	0	2,352	2,352

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

CPA UNFCCC reference number	Amount achieved during this monitoring period (t CO ₂ e)	Amount estimated ex ante for this monitoring period in the CPA-DD (t CO ₂ e)
10484-P1-0001-CP1	1,734	1,670
10484-P1-0002-CP1	260	207
10484-P1-0003-CP1	146	252

10484-P1-0004-CP1	212	217
Total	2,352	2,346

F.5.1. Explanation of calculation of “amount estimated ex ante for this monitoring period in the CPA-DD”

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	Estimated LEDs installed	tCO ₂ e/year as per CPA DD	Actual LEDs installed	tCO ₂ e/year as per actual ICS installed	No. of days (for comparable period)	tCO ₂ e
10484-P1-0001-CP1	3,000,000	3,64,202	78,483	9,527	64	1,670
10484-P1-0002-CP1	700,000	90,810	9,101	1,180	64	207
10484-P1-0003-CP1	700,000	90,810	70,943	9,203	10	252
10484-P1-0004-CP1	700,000	86,220	10,034	1,235	64	217
Total		632,042		21,145		2,346

F.6. Remarks on increase in achieved emission reductions

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Emission reduction achieved for CPAs 10484-P1-0001-CP1 & 10484-P1-0002-CP1 are more than the estimated ex-ante calculation. At the time of ex-ante calculation, daily operating hours were assumed as 5 hours per day while as per the monitoring survey, average operating hours comes to be 6.67 hours per day. Actual emission reductions achieved for CPAs 10484-P1-0003-CP1 & 10484-P1-0004-CP1 are less than the value estimated in ex-ante calculation.

F.7. Remarks on scale of small-scale CPAs

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N/A

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
03.0	31 May 2019	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 02.0 of the “CDM project standard for programmes of activities” (CDM-EB93-A07-STAN); • Add a section on remarks on the observance of the scale limit of small-scale CPAs during the crediting periods; • Add "changes specific to afforestation or reforestation activities/CPA" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R PoAs between two commitment periods; • Make structural and editorial improvements.
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