Monitoring report form for CDM programme of activities
(version 01.0)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form for CDM programme of activities" at the end of this form.

MONITORING REPORT		
Title of the programme of activities (PoA)	Demand side energy efficiency measures in building lighting systems.	
UNFCCC reference number of the PoA	9593	
Version number(s) of the PoA-DD(s) applicable to this monitoring report	2	
Coordinating/managing entity (CME)	UGL Services Premas Operations Limited[1]	
Version number of this monitoring report	01.0	
Completion date of this monitoring report	29/09/2017	
Monitoring period number and dates covered by this monitoring report	First Moniotirng Period 06/06/2014 – 31/05/2017	
Monitoring report number for this monitoring period	01	
Host Party(ies)	Host Party(ies) of the PoA	Is this a host Party to a specific-case CPA covered in this monitoring report?(yes/no)
	Singapore	Yes
Sectoral scope(s)	Energy Demand	
Selected methodology(ies)	AMS-II.C.: Demand-side energy efficiency activities for specific technologies	
Selected standardized baseline(s)	Not Applicable	
Total amount of GHG emission reductions or net GHG removals by sinks for all specific-case-case CPAs in the PoA covered in this monitoring report	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	-	16,223

[1] Refer section E.2 of this monitoring report

PART I - Programme of activities

SECTION A. Description of PoA

A.1. Brief description of the PoA

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The PoA is in relation to implementation of energy efficient lighting systems in buildings (including residential, commercial and industrial) across Singapore. The CDM Programme Activities (CPAs) under this PoA will either include (a) installation and operation of more energy efficient lighting luminaires replacing existing luminaires in existing buildings; or (b) installation and operation of more energy efficient lighting luminaires in new buildings. Each CPA will be implemented in a geographically distinct location within Singapore. The PoA and CPA will be managed by the CME.

The goal of the PoA is to significantly contribute towards energy efficiency measures by reducing the consumption of electricity in building lighting systems. By doing so, the programme will assist in reducing greenhouse gas (GHG) emissions in relation to avoided electricity usage. This will also result in lower spending on utility bills in various buildings across Singapore.

With respect to each CPA under this PoA, the Managing Entity/CPA implementer/Contractor may potentially distribute information about the benefits of undertaking such energy efficiency programme including its associated economic, social and environmental benefits. This will help in creating awareness amongst interested stakeholders.

A.1.1. Generic CPA(s)

Title, identification/reference number and/or version number of the generic CPA(s) of the PoA	Sectoral scope(s)	Applied methodology(ies) or combination of methodologies and/or standardized baseline(s)
Part II of the following PoA: **PoA 9593 – Demand side energy efficiency measures in building lighting systems (Version 2)**	Energy Demand	AMS-II.C: Demand-side energy efficiency activities for specific technologies (Version 14.0) Methodological tool: Tool to calculate the emission factor for an electricity system (Verison 2.2.1)

A.1.2. Specific-case CPA(s) covered in this monitoring report

Reference number of the specific-case CPA included in the PoA as of the end of this monitoring period	Title, identification/ reference number and version number of the generic CPA to which the specific-case CPA applies	Crediting period dates of the specific-case CPA	Is this specific-case CPA covered in this monitoring report? (yes/no)
CPA 9593-01	Part II of the following PoA: PoA 9593 – Demand side energy efficiency measures in building lighting systems (Version 2)	05/06/2014 – 04/06/2021	yes

A.2. Contact information of the coordinating/managing entity (CME) and/or responsible persons(s)/entity(ies)

>>

Mr Panchaksharam Thirumalavan
Manager, Energy & Sustainability Division
UGL Services Premas Operations Limited (Coordinating & Managing Entity)
Blk 750 Oasis, #01-01, Technopark@Chai Chee, Chia Chee Road, Singapore 469001
Email: thiru.p@cwservices.com
DID: +65 6876 6263

SECTION B. Implementation of PoA

B.1. Implementation of the management system of the PoA

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Description of the operational and management arrangements established by the CME for the implementation of the PoA, including:

1. A record keeping system for CPA under the PoA

The CPA has been following the monitoring requriements and record keeping system stipulated in the applied baseline and monitoring methodology. In summary, CME has variefied that the CPA is maintaining appropriate records and documenting relevant variables including:

- Removal of existing luminaries and installation new energy efficient luminaires (Light Emitting Diodes – LEDs)
- Number of existing luminaires replaced and newly installed LEDs.
- Wattage of the existing luminaires and newly installed LEDs

The CME has collected the aforesaid documents from the project owner to ensure that the CPA has met all the requirements.The following records have been collected from CPA implementer in monthly basis to comply with monitoring requirements:

- Operating hours and electricity consumption (kWh) of the newly installed LEDs through sampling process
- Complaints received regarding faulty luminaires during operation

2. A system/procedure to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA

The registered PoA has established specific mechanism for verification of CPA prior to include udner the PoA to avoid double accounting and its been followed in proper manner. So far there is no new CPA has been included under this PoA since registeration.

3. The SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity

As per the Guidelines on assessment of de-bundling for SSC project activities, version 03 issued at the EB's 54th meeting, paragraph 10 allows exemption from de-bundling check as follows:
"*If each of the independent subsystems/measures (e.g., biogas digester, solar home system) included in the CPA of a PoA is no larger than 1% of the small-scale thresholds defined by the methodology applied, then that CPA of PoA is exempted from performing de-bundling check i.e., considering as not being a debundled component of a large scale activity*".

LED distributed under the PoA will be no larger than the 1% SSC threshold threshold value is maximum electrical energy saving of 60 GWhr (1% of 60 GWh is 0.6 GWh) or emission reduction of 60 $ktCO_2$ per year (1% of 60 $ktCO_2$ is 0.6 $ktCO_2$/yr).

4. The provisions to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA

The managing entity will obtain an authorisation letter from each of the CPA implementers intending to participate under this PoA and to act collectively for the purpose of the PoA.

B.2. Implementation of single sampling plan(s)

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A single sampling plan is applicable for all the CPAs covered under this PoA. The overall plan is as follows:

Description of Implemented Sampling Plan:

The registered PoA-DD and CPA-DD has adopted a precision level of 10% associated to a confidence interval of 90% to define the sample size. The smapling follows the recommendations by "Guidelines for Sampling and Surveys for CDM Project Activities and Programme of Activities" (version 2.0, Annex 5, EB69).

The sampled population is the total number of HDB blocks installed with LED lightings under each CPA. This population is homogeneous as all the buildings are residential buildings. However, the number of LED lightings installed in each block are varied.

The CME has the primary database for the CPA and the database contains all the information related to project such as technical details of lumianires (existing & LED), location of each HDB buildings (including block number & street/avenue/road) and disposal records of existing lumianires.

Sample Size:

Sample size has been determined in accordance with "Guidelines for Sampling and Surveys for CDM Project Activities and Programme of Activities" as follows:

$$n \geq \frac{1.645^2 N \times p(1-p)}{(N-1)\times 0.1^2 \times p^2 \times 1.645^2 p(1-p)}$$

Where:

n	:	Sample size
N	:	Total number of households
p	:	Our expected proportion
1.645	:	Represents the 90% confidence required
0.1	:	Represents the 10% relative precision (0.1 × 0.5 = 0.05 = 5% points either side of *p*)

Selection of Sample Size:

The simple random sampling is applied for the CPA as the entire populations are homogeneous. However, based on the total sample size (calculated in accordance with guideline), the number of sample selected from each Town Council is propotional to the size of Town Council.

Data Collection:

Once the CPA sample list established by the CME, the town council representatives are briefed on the selected HDB buildings and data requirements. The town council representatives are Property Manager (PM) who is incharge of monitoring the parameters listed under section G.2 in this monitoring report. Each Town Council has many divisions and they are managed by the Property Officers (PO).

The POs are visited to the selected sample HDB buildings and fill in a dedicated forms in monthly basis. The forms are as follows:

1. Electricity Meter Reading (in kWh)
2. Turn-On and Turn-Off timing set in the Timer Switch (in HH:MM)

The readings taken by the PO submitted to PM for their verification and approval. Upon PM approval, the scanned copy of report (in pdf format) sent to CME for analysis and compilation purpose. All the PMs and POs had received a detailed instruction on how to take reading and propertly fill in the form. Additional explanations were given by phone to all PMs and POs whenever necessary.

In addition, one more parameter which is replacement of faulty lights was monitored in all HDB buildings by PMs. This parameter recorded as follows:

1. Received tenant's complaints on faulty lights by one of the staffs in Town Council
2. The staff has recorded the details of complaints (time & date of complaint received and type & location of fault occured)
3. The complaint is forwarded (in a daily basis) to contractor who is incharge of repairing the faulty lights within 24 hours and inform to Town Council on work completion.
4. The staff has recorded the date and time of work completed
5. The PM is forwarded the faulty reports (in excel file format) to CME in end of each month.

The CME's manager has the responsible to check LED operations in all town councils. The manager has selected number of non-sampled HDB buildings (equal to sample group) and visit end of each year to check the operation of LED lightings.

The collected data is summarized in electronic spreadsheet and available for verification by DOE.

Data Analysis:

The CME's manager checks the quality of data reported on the forms. Each HDB building data which are incoherent and not filled is excluded from the calculation and considered as invalid. The high possibility of invalid data occurred in Electricity Meter reading taken by the Property Officers.

To quantify the monthly electricity consumption estimated based on two meter readings which are taken in beginning and end of each month. The monthly consumption is as follows:

Electricity consumption (kWh/month)	=	Reading taken in end of the month (kWh)	–	Reading taken in beginning of the month (kWh)

The data is considered as invalid if the monthly consumption is zero or negative value or extremely higher than the average consumption of other months.

Confidence/precision Level:

The CPA has adopted a precision level of 10% associated to a confidence interval of 90% to define the sample size. The CME's CDM Manager is verified that the 10% precision level has been met. Further explanation provided in Section G.3.

Roles and responsibilities:

CME CDM Manager: Knowledge of CDM projects and internal organization of the CME. Coollecting all the forms filled in by the Town Councils' property officer and manager. Analysis of the collected data. Preparation of the monitoring report and associated documents.

Property Manager (Town Councils): Knowledge of the pCDM program. Review and approve the monitored data. Collection of all forms filled up by the property officers.

Property Officers (Town Councils): Knowledge of the pCDM program. Data collection (e.g. meter reading) from each sampling block and filled up the forms.

SECTION C. Post-registration changes to the PoA (including the generic CPA(s))

C.1. Corrections

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N.A

C.2. Inclusion of a monitoring plan to the registered PoA-DD (including its generic CPA-DD(s)), if a monitoring plan was not included at the time of registration

>>
N.A

C.3. Permanent changes to the monitoring plan as described in the registered PoA-DD, applied methodology, or applied standardized baseline

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N.A

C.4. Changes to the programme design of the registered PoA-DD (including corresponding changes to project design of the generic CPA-DD(s)) and updates to the eligibility criteria for inclusion of specific-case CPAs in the PoA

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N.A

C.5. Types of changes specific to afforestation and reforestation activities

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N.A

PART II - Specific-case component project activity(ies)

SECTION D. Description of specific-case CPA(s)

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D.1. Brief description of implemented specific-case CPA(s)

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The CPA has involved demand side energy efficiency measures in building lighting systems through replacement of existing luminaires with more energy efficient “Light Emitting Diodes” (LEDs) lighting luminaires in the corridors, staircases and void decks of several existing buildings located in 6 Town councils nationwide. The buildings/blocks participating under the CPA are residential buildings which had been constructed and owned by “Housing & Development Board (HDB)” of Singapore. The HDB is Singapore's public housing authority and a statutory board under the Ministry of National Development. The buildings included under the CPA are referred to as “HDB blocks” or “HDB buildings”. The estimated annual energy savings and emission reduction achieved d by the CPA is 13 GWh and 6,291 tCO_2/yr respectively.

The CPA has been implemented in 6 town councils all over Singapore. The town councils are the administrative branch of the Singapore government who is managing all the HDB blocks located in their town premises. The town councils are as follows:

1. Ang Mo Kio Town Council
2. Moulmein – Kallang Town Council
3. Marine Parade Town Council
4. Pasir Ris – Punggol Town Council

5. Tampines Town Council
6. East Coast Town Council

Each HDB building included in this CPA is uniquely identified based on building number and street/avenue which is avoiding any double counting.

Technical Description

An LED light is a solid-state luminaires that uses light-emitting diodes (LEDs) as the source of light. Several LEDs are grouped together in a single fixture to achieve the appropriate light output for particular application. Each luminaires shall be provided with its own inbuilt electronic control gear. The electronic control gear shall be placed in its own housing and supply cable connected via certified plug and socket connector.

The CPA has replaced 251,500 existing luminaires by 285,150 LED luminaires where 4ft existing luminaires are replaced by 2 nos of 2ft LED luminaires and other existing luminaires are replaced by 1 no of 2ft LED luminaires (As shown in table below).

The CPA has replaced the following existing light profile by LED luminaire:

S/N	Existing Light	New LED Luminaire
1	2 ft T8 Fluorescent Light	Replaced with 2 ft LED Luminaire
2	2 ft T5 Fluorescent Light	Replaced with 2 ft LED Luminaire
3	Staircase Half-Landing	Replaced with 2 ft LED Luminaire with motion sensor
4	Staircase Full Landing	Replaced with 2 ft LED Luminaire
5	4 ft T8/T5 Fluorescent Light	Replaced with 2 nos. of 2 ft LED Luminaire with additional wiring & casing
7	Decorative Light (PL, PLC, 2D)	Replaced with 2 ft LED Luminaire
8	Recessed Down light	Replaced with Recessed LED Luminaire

Following is the technical specifications of LED luminaire:

Parameter	Values	
	General (2ft) LED Luminaire	Recessed LED luminaire
Model No	DAVIS-OPTILED-228	2018050505
System power	≤12 W	
Power factor	0.9477	0.9522
Colour Rendering Index (CRI)	73 Ra	78 Ra
Correlated Colour Temperature	6364 K	3436 K
Electronic Control Gear		
Efficiency	80% minimum (Verified)	
Athd	15% maximum (Verified)	

D.2. Geographical references or other means of identification of the location of the specific-case CPA(s)

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The geopgraphical location of CPA 9593-01: Replacement of existing luminaires with LED lighting luminaires in several buildings across 6 Town Councils in Singapore (Version 2) is as follows:

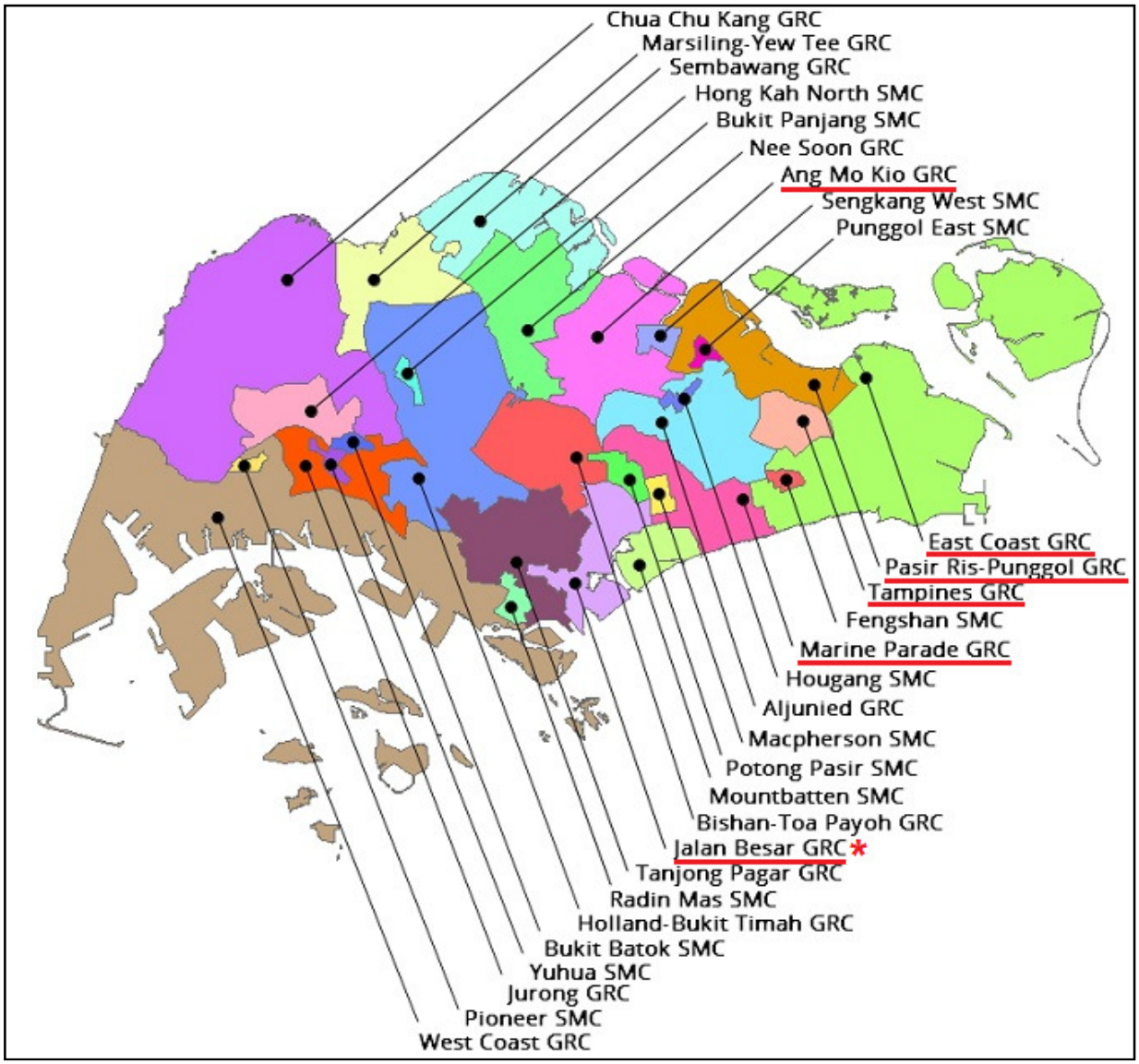

Figure 1: Boundaries of 6 town councils (underlined in red colour) in Singapore Map

Note:

* Moulmein-Kallang Town Council (MKTC) was one of the six town councils covered under this CPA at the time of registration. Currently MKTC is included under the new Jalan Besar GRC in accordance with new electoral boudnaries released by the Election Department of Singapore.

  However, there is no change in building number and street/avenue of HDB Buidlings (from MKTC) covered under this CPA.

SECTION E. Post-registration changes to specific-case CPA(s)

E.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

>>
N.A

E.2. Corrections

>>
N.A

E.3. Changes to the start date of the crediting period of the specific-case CPA(s)

>>
N.A

E.4. Inclusion of a monitoring plan into the specific-case CPA(s) that was not included at registration

>>
N.A

E.5. Permanent changes to the monitoring plan as described in the registered specific-case CPA-DD(s), applied methodology or standardized baseline

>>
N.A

E.6. Changes to project design of the specific-case CPA(s)

>>
N.A

E.7. Types of changes specific to afforestation and reforestation specific-case CPA(s)

>>
N.A

SECTION F. Description of the monitoring system of specific-case CPA(s)

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The CME has set the procedures verifying the emission reduction achieved by the CPA annually in accordance witht the paragraphs 31, 32 and 33 of AMS-II.C (Version 14) methodology.

The methodology states that either “wattage of luminaires (monitor at the time of installation only) and operational time” or “electricity consumption by the luminaire” needs to be monitored for a sample group selected in the project boundary. However, the monitoring procedure covers all the three parameters such as wattage, operational time and electricity consumption. This means the actual electricity consumption (monitored through electricity meters) can be used to cross check with the electricity consumption calculated based on wattage & operating hours (as per equation 8 of the AMS-II.C) and whichever is higher will be taken as $EP_{PJ,y}$ (Energy consumption in project activity in year y) for project emission calculation.

The following parameters are monitored to calculate the emission reduction:

1. **Monthly basis**
   a. Operating hours
   b. Electricity consumption
   c. Replacement of faulty lumianries
2. **Yearly basis**
   a. Operation of lumianries in non-sampled group

The CME is responsible for record and manage the data as per the monitoring requirements defined in the registered CPA and the collected data will be available for the verification process.

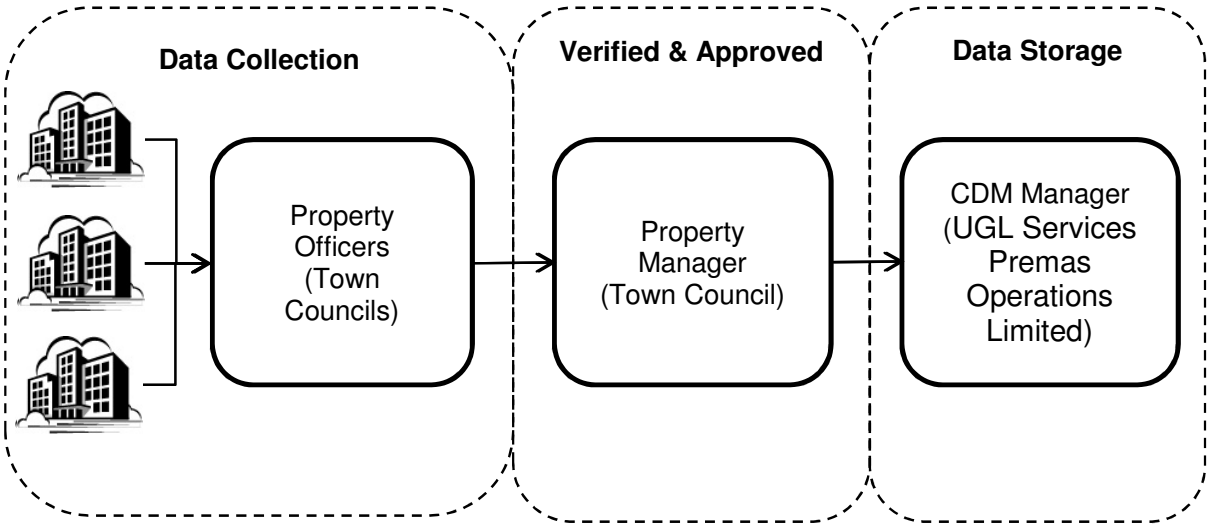
Record Keeping System

The CPA has to follow the record keeping and monitoring requirements stipulated in applied Baseline and Monitoring Methodology. In summary, the CME will ensure that each CPA will maintain appropriate records documenting relevant variables including:

- Removal of existing luminaries and installation of new energy efficient luminaires (date of such removal and installation.)
- Number of luminaires replaced and newly installed energy efficient luminaires.
- Power of the replaced luminaires (determined through sampling process in case of large population size)
- Operating hours of the newly installed energy efficient luminaires (determined through sampling process in case of large population size)
- Energy consumption of the newly installed energy efficient luminaires (determined through sampling process for a large population size in ex-ante format)
- Details pertaining to the project sample group
- In case of installing more energy efficient lighting luminaires in new buildings the baseline technology will be determined in accordance with baseline and monitoring methodologies for selected small scale CDM project activity.

The CPA implementer will make available copies of the aforesaid documents to the CME, so that the latter could ascertain that the aforesaid record keeping requirements are being met by the CPA implementer.

Data Flow Diagram



SECTION G. Data and parameters

G.1. Data and parameters fixed ex ante, at registration, inclusion or renewal of crediting period

Data/parameter	**$EF_{CO2,ELEC,y}$; $EF_{CO2,y}$**
Unit	tCO_2/MWh
Description	Combined margin emission factor in year *y*
Source of data	Energy Market Authority (EMA) of Singapore. Reference: https://www.ema.gov.sg/statistic.aspx?sta_sid=20140729MPY03nTHx2a1
Value(s) applied	0.42 tCO_2/MWh
Choice of data or measurement methods and procedures	The National Climate Change Committee operating under the Ministry of Environment, Government of Singapore has calculated the Operating Margin Emission Factor and the Build Margin Emission Factor for the Singapore Power Grid. These factors have been calculated using the "Tool to calculate the emission factor for an electricity system" (provided by the CDM EB of the UNFCCC) based on most recently available data. The managing entity has calculated the Combined Margin Emission Factor by applying 0.5 weights to be operating margin emission factor and build margin emission factor.
Purpose of data	Used to calculate the baseline and project emissions
Additional comments	Combined Margin Emission Factor so determined is on ex-ante basis and will remain constant for the entire crediting period.

Data/parameter	l_y
Unit	Percentage
Description	Average annual technical grid losses (transmission and distribution) during year *y* for the grid serving the locations where the devices are installed.
Source of data	Data is collected from SP Services Limited, a member of the Singapore Power Group. SP Services Limited has determined transmission loss factors for respective loads derived using the methodology approved by the EMA (Energy Market Authority), Government of Singapore. Reference: https://www.mypower.com.sg/About/Transmission_Loss_Factors.html#transmission
Value(s) applied	3.6
Choice of data or measurement methods and procedures	This is in line with the methodology AMS II.C./version14.
Purpose of data	Used to calculate the baseline and project power consumption
Additional comments	This factor is determined on ex-ante basis and will remain constant for the entire crediting period.

Data/parameter	$S_{Metered,\ i}$
Unit	Number
Description	Total sample size of buildings used for monitoring operating hours and electricity consumption of project devices. The Project Sample Group for a given CPA will be identified and documented before the start date of crediting period of that CPA.

\Source of data

Sample size will be determined based on EB69, Annex 5, Version 2.0 "Guidelines for Sampling and Surveys for CDM Project Activities and Programme of Activities", paragraph 50 states that:

$$n \geq \frac{1.645^2 N \times p(1-p)}{(N-1)\times 0.1^2 \times p^2 \times 1.645^2 p(1-p)}$$

Where:

n	:	Sample size
N	:	Total number of metered blocks
p	:	Our expected proportion
1.645	:	Represents the 90% confidence required
0.1	:	Represents the 10% relative precision (0.1 × 0.5 = 0.05 = 5% points either side of *p*)

The calculation of sampling blocks as follows:

Total number of metered blocks (*N*)	1,353
Our expected proportion (*p*)	80%*
Represents the 90% confidence required	1.645
Represents the 10% relative precision (0.1 × 0.5 = 0.05 = 5% points either side of *p*)	0.1
Sample size (n)	$\geq \frac{1.645^2 N \times p(1-p)}{(N-1)\times 0.1^2 \times p^2 + 1.645^2 p(1-p)}$ $\geq \frac{1.645^2 \times 1353 \times 0.8(1-0.8)}{(1353-1)\times 0.1^2 \times 0.8^2 + 1.645^2 0.8(1-0.8)}$ $\geq \frac{2.706025 \times 1353 \times 0.16}{(1352 \times 0.01 \times 0.64) + (2.706025 \times 0.16)}$ ≥ 64.47452

Note:
* In this project activity, the timer switches and electricity meters are the primary monitoring equipments which would capture the monitoring parameters. In that case, the failure rate happened of those equipments are very rare as they are electronically programmed and operated. Hence, we assume that the expected proportion is 80% for this sample calculation.

Value(s) applied	65
Choice of data or measurement methods and procedures	The population size will be identified and documented before the start date of crediting period of a given CPA. The population size is to be determined based on data collected from reliable sources of data including tender documents submitted by the main contractor to the CPA implementer for evaluating its proposal of either (a) replacing existing luminaries with more efficient luminaires in existing buildings or (b) installing energy efficient luminaires in new buildings; located in a distinct geographical location.
Purpose of data	To monitor the operating hours and electricity consumption in the project.
Additional comments	The project sample size so determined (based on the population size and other parameters) will remain constant for the entire crediting period for a given CPA.

<table>
<tr><td>Data/parameter</td><td>$S_{Non\text{-}Metered,\ i}$</td></tr>
<tr><td>Unit</td><td>Number</td></tr>
<tr><td>Description</td><td>The managing entity will identify and document a sample group of non metered buildings (forming part of a given CPA) which will be subject to annual checks to ensure that the energy efficient luminaires installed in such buildings are still operating. The sample group of non metered buildings will be identified and documented before the start date of crediting period of that CPA.</td></tr>
<tr><td>Source of data</td><td>Sample size will be determined based on EB69, Annex 5, Version 2.0 “Guidelines for Sampling and Surveys for CDM Project Activities and Programme of Activities”, paragraph 50 states that:
$$n \geq \frac{1.645^2 N \times p(1-p)}{(N-1)\times 0.1^2 \times p^2 \times 1.645^2\, p(1-p)}$$
Where:
n : Sample size
N : Total number of non-metered blocks
p : Our expected proportion
1.645 : Represents the 90% confidence required
0.1 : Represents the 10% relative precision (0.1 × 0.5 = 0.05 = 5% points either side of p)

The calculation of sampling blocks as follows:
<table>
<tr><td>Total number of non-metered blocks (N)</td><td>0</td></tr>
<tr><td>Our expected proportion (p)</td><td>80%*</td></tr>
<tr><td>Represents the 90% confidence required</td><td>1.645</td></tr>
<tr><td>Represents the 10% relative precision (0.1 × 0.5 = 0.05 = 5% points either side of p)</td><td>0.1</td></tr>
<tr><td>Sample size (n)</td><td>$$\geq \frac{1.645^2 N \times p(1-p)}{(N-1)\times 0.1^2 \times p^2 + 1.645^2\, p(1-p)}$$
$$\geq \frac{1.645^2 \times 0 \times 0.8(1-0.8)}{(0-1)\times 0.1^2 \times 0.8^2 + 1.645^2 0.8(1-0.8)}$$
$$\geq 0$$</td></tr>
</table>
Note:
* In this project activity, the timer switches and electricity meters are the primary monitoring equipments which would capture the monitoring parameters. In that case, the failure rate happened of those equipments are very rare as they are electronically programmed and operated. Hence, we assume that the expected proportion is 80% for this sample calculation.</td></tr>
<tr><td>Value(s) applied</td><td>0</td></tr>
<tr><td>Choice of data
or measurement methods
and procedures</td><td>The population size will be identified and documented before the start date of crediting period of a given CPA. The population size is to be determined based on data collected from authentic and reliable sources of data including tender documents submitted by the main contractor to the CPA implementer for either (a) replacing existing luminaries with more efficient luminaires in existing buildings or (b) installing energy efficient luminaires in new buildings; located in a distinct geographical location.

In this CPA, all the blocks are metered blocks and therefore, this parameter is not applicable.</td></tr>
<tr><td>Purpose of data</td><td>To monitor the operating hours and electricity consumption in the project.</td></tr>
</table>

Additional comments	This parameter not applicable for this CPA as all the blocks are metered blocks

Data/parameter	$n_{BL,i}$ (in case of replacement of luminaires in existing buildings)
Unit	Number
Description	Number of devices of the group of *"i" baseline* devices (e.g., 40W incandescent bulb, 5hp motor) replaced, for which the project energy efficient equipment is operating during the year.
Source of data	Data is collected at the time of replacing the existing luminaires with the more energy efficient luminaires. The collected data will be recorded and archived as baseline data Reference: Emission Reduction Spreadsheet and Tender document
Value(s) applied	251,546
Choice of data or measurement methods and procedures	Data pertaining to replaced luminaires will be collected and recorded in special data logs developed for this purpose. These data logs will be signed by (a) The CPA implementer, (b) The main contractor who has been appointed to perform the replacement. Therefore this source of data is regarded as the most reliable source of data.
Purpose of data	To calculate the baseline electricity consumption
Additional comments	Value of this parameter under a given CPA will remain constant for the entire crediting period.

Data/parameter	$n_{PJ,i}$ (in case of luminaires installed in new buildings)
Unit	Number
Description	Number of newly installed energy efficient luminaires
Source of data	Data is collected at the time of installing energy efficient luminaires. The collected data will be recorded and archived. As provided under section E.6.2 above, a one to one ratio is considered for the number of baseline luminaires to project luminaires, this is because the baseline technology (i.e. the nameplate wattage of baseline luminaires) identified for the project will be such that it is capable to provide same level of output and service (lux) similar to the project technology.
Value(s) applied	285,159 (basically 1:1 replacement occurred for the project activity other than 4ft baseline luminaire is replaced by 2 nos of 2ft LED luminaires)
Choice of data or measurement methods and procedures	Data will be collected and recorded in special data logs developed for this purpose. This data logs will be signed by (a) The CPA implementer, (b) The main contractor. Therefore this source of data is regarded as the most authenticate and reliable source of data.
Purpose of data	To calculate the project electricity consumption
Additional comments	Value of this parameter under a given CPA will remain constant for the entire crediting period.

Data/parameter	$\rho_{BL,i}$ (in case of replacement of luminaires in existing buildings)
Unit	Watt
Description	Power of the devices of the group of *"i"* baseline devices (e.g., 40W incandescent bulb, 5hp motor). In the case of a retrofit activity, "power" is the weighted average of the devices replaced. Power of a representative sample of the replaced devices to be determined.

Source of data	Data is collected at the time of replacing the existing luminaires with the more energy efficient luminaires. The collected data will be recorded and archived. Reference: Tender Document
Value(s) applied	The wattage of existing luminaires are:
Choice of data or measurement methods and procedures	Data to be collected from reliable source of information, OR, Data to be recorded as part of the luminaire replacement process in special data logs developed for this purpose. These data logs will be signed by (a) The CPA implementer, (b) The main contractor who has been appointed to perform the replacement. Therefore this source of data is regarded as the most reliable source of data.
Purpose of data	To calculate the baseline electricity consumption
Additional comments	Value for this parameter under each CPA will remain constant for the entire crediting period.

S/N	Existing Light	Wattage
1	2 ft T8 (Low loss Ballast)	25
2	2 ft T8 (Electronic Ballast)	21
3	2 ft T5 (Electronic Ballast)	17
4	4 ft T8 (Low loss Ballast)	43
5	4 ft T8 (Electronic Ballast)	39
6	Decorative Light (PL, PLC, 2D)	22
7	Recessed Down light	17

Data/parameter	$\rho_{PJ,i}$ (in case of luminaires installed in new buildings)
Unit	Watt
Description	Power of the LED luminaires (general 2ft & Recessed) which would otherwise would have been implemented in the baseline scenario.
Source of data	The baseline scenario will be determined in accordance with Clause 14 of the Indicative Simplified Baseline and Monitoring Methodologies for Selected Small Scale CDM Project Activity Categories – "Type II and III Greenfield Projects (new facilities)". Reference: Test Report of LED lights
Value(s) applied	12
Choice of data or measurement methods and procedures	This data is collected in line with the methodological requirement and also the Indicative Simplified Baseline and Monitoring Methodologies for Selected Small Scale CDM Project Activity Categories. Therefore this source of data is regarded as the most reliable source of data.
Purpose of data	To calculate the project electricity consumption
Additional comments	Value for this parameter under each CPA will remain constant for the entire crediting period.

G.2. Data and parameters monitored

Data/parameter	**O_i**
Unit	Hours
Description	Average annual operating hours. Operating hours of a representative sample of project devices.
Measured/calculated/ default	Measured

Source of data	The time is programmed inside the timer switch which will keep the constant operating hours.
Value(s) of monitored parameter	<table><tr><th>Periods</th><th>Baseline</th><th>Project</th></tr><tr><td>Jun 2014 – Dec 2014</td><td>2,499</td><td>2,502</td></tr><tr><td>Jan 2015 – Dec 2015</td><td>4,392</td><td>4,398</td></tr><tr><td>Jan 2016 – Apr 2016</td><td>4,392</td><td>4,396</td></tr><tr><td>Jan 2017 – May 2017</td><td>1,825</td><td>1,821</td></tr></table>
Monitoring equipment	Operating hour timers
Measuring/reading/ recording frequency	As large number of buildings is expected to be participating in this CPA, it will be practically not possible to employ resources to monitor the operating hours of luminaires in each of such buildings. Instead each CPA will involve implementation of measurement equipments in sample group of buildings. Hence the timers are fixed to maintain the constant operating hours according to the seasons such as winter and summer. The timer's function will be verified periodically. The timer switch with accuracy level of ±15seconds or less per month in calendar timers and 0.05% of timer accuracy.
Calculation method (if applicable)	Mean monthly operating hours and its standard deviation will be calculated for each month based on the data collected for each timer forming part of the project sample group. The above values are arrived using the below formulas mentioned in the registered CPA-DD, section D.7.2: For baseline operating hours = $MOH - 1.645\frac{\sigma}{\sqrt{n}}$ For project operating hours = $MOH + 1.645\frac{\sigma}{\sqrt{n}}$
QA/QC procedures	Timers switch will be subject to monthly review in the project sample group to determine whether they are operating accurately or not, in case any timers are found faulty they will be immediately replaced. As per the timer switch supplier statement, the switches are no need to calibrate.
Purpose of data	Calculation of baseline emission
Additional comments	The programmable timer switch in operation in accordance with the local regulation. The conservative operating hours of luminaires in residential blocks are 12 hours per day.

Data/parameter	ρ_i
Unit	Watt
Description	Power of the LEDs installed in the project
Measured/calculated/ default	Default
Source of data	This name plate power of the LEDs which will remain constant for the entire crediting period. Reference document: Test reports of LED lights
Value(s) of monitored parameter	12

Monitoring equipment	Not Applicable
Measuring/reading/ recording frequency	At the time of installation, the name plate wattage of installed equipment will be recorded.
Calculation method (if applicable)	Not Applicable
QA/QC procedures	N.A
Purpose of data	Calculation of project emission
Additional comments	-

Data/parameter	**Energy Use**
Unit	kWh
Description	Electricity consumption by the sampling blocks
Measured/calculated/ default	Measured
Source of data	Dedicated electricity meter reading
Value(s) of monitored parameter	<table><tr><th>Periods</th><th>Consumption (MWh)</th></tr><tr><td>Jun 2014 – Dec 2014</td><td>9,309</td></tr><tr><td>Jan 2015 – Dec 2015</td><td>15,681</td></tr><tr><td>Jan 2016 – Dec 2016</td><td>15,622</td></tr><tr><td>Jan 2017 – May 2016</td><td>6,521</td></tr></table>
Monitoring equipment	Electricity Meters
Measuring/reading/ recording frequency	The meter reading will be taken for beginning and end of each and every month. The difference between the 2 values considered as a monthly electricity consumption.
Calculation method (if applicable)	Based on the monthly consumption collected from each sampling block, the average consumption by each LED per day is calculated as follows:<table><tr><th>Periods</th><th>Average Consumption (kWh per LED per Day)</th></tr><tr><td>Jun 2014 – Dec 2014</td><td>4.4894</td></tr><tr><td>Jan 2015 – Dec 2015</td><td>4.4114</td></tr><tr><td>Jan 2016 – Dec 2016</td><td>4.4592</td></tr><tr><td>Jan 2017 – May 2016</td><td>4.4624</td></tr></table>The above average has been multiplied with the total number of LEDs installed in the project boundary to reach overall consumption.
QA/QC procedures	Manual log sheets will be available for the verification process. The recorded value will be cross checked with the calculated electricity consumption (from name plate details and operating hours) of each building. The calibration will be carried out for each and every energy meter at a frequency of five years from the installation date. The CME will keep all the supplier issued initial calibration certificates as an evidence.
Purpose of data	Calculation of project emission
Additional comments	-

Data/parameter	Monitoring of scrapping of replaced luminaires
Unit	NA
Description	Scrapping of replaced luminaires to be subject to independent monitoring.
Measured/calculated/ default	

Source of data	1. Agreement between project owner and licensed waste collectors 2. Photographs of removed luminaires 3. Bills & Disposal receipts
Value(s) of monitored parameter	NA
Monitoring equipment	
Measuring/reading/ recording frequency	Scrapping of replaced luminaires to be subject to independent monitoring and reporting. A copy of all document related to disposal will be made available to the DOE.
Calculation method (if applicable)	Project (CPA) basis
QA/QC procedures	NA
Purpose of data	Justify the removed equipments are properly disposed as per the local regulation/supplier instruction
Additional comments	All data will be electronically archived as part of the monitoring for a period of two years from the end of crediting period for the CPA.

G.3. Implementation of specific-case CPA level sampling plan

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This single sampling plan (explained in Section B.2) is applicable for CPA 9593-01 and the implemented sampling plan is as follows:

Description of Implemented Sampling Plan:

The total population is 1,353 HDB blocks installed with LED lightings under CPA 9593-01. This population is homogeneous as all the buildings are residential buildings. However, the number of lights installed in each HDB buildings are varied.

Sample Size:

The registered CPA has adopted a precision level of 10% associated to a confidence interval of 90% to define the sample size. The sample size has been determined in accordance with "Guidelines for Sampling and Surveys for CDM Project Activities and Programme of Activities" (version 2.0, Annex 5, EB69) as follows:

$$n \geq \frac{1.645^2 N \times p(1-p)}{(N-1)\times 0.1^2 \times p^2 \times 1.645^2 p(1-p)}$$

Where:

n	:	Sample size
N	:	Total number of households (1,353 HDB Blocks)
p	:	Our expected proportion (80%)
1.645	:	Represents the 90% confidence required (90%)
0.1	:	Represents the 10% relative precision (10%)

From the above equation, the calculated sample size is 65.

Selection of Sample Size:

The simple random sampling is applied for the CPA as the entire populations are homogeneous. However, based on the total sample size (calculated in accordance with guideline), the number of sample selected from each Town Council is propotional to the size of Town Council as follows:

Town Councils	Total	Percentage	Overall Sample Size	Sample Size
Ang Mo Kio	384	28%	65	18
Moulmein – Kallang	139	10%		7
Marine Parade	109	8%		5
Pasir Ris – Punggol	393	29%		19
Tampines	285	21%		14
East Coast	43	3%		2
Total	1,353	100%		65

Data Collection:

Once the CPA sample list established by the CME, the town council representatives are briefed on the selected HDB buildings and data requirements. The town council representatives, Property Manager (PM) is incharge of monitoring the parameters which are listed under section G.2 in this monitoring report. Each Town Council has many divisions and they are managed by the Property Officers (PO). The POs are visited to the selected sample HDB buildings and fill in a dedicated forms in monthly basis. The forms are as follows:

1. Electricity Meter Reading (in kWh)
2. Turn-On and Turn-Off timing set in the Timer Switch (in HH:MM)

The readings taken by the PO submitted to PM for their verification and approval. Upon PM approval, the scanned copy of report (in pdf format) sent to CME for analysis and compilation purpose. All the PMs and POs had received a detailed procedure instructing them how to correctly fill in the form. Additional explanations were given by phone to all PMs and POs whenever necessary.

In addition, one more parameter which is replacement of faulty lights was monitored in all HDB buildings by PMs. This parameter recorded as follows:

1. Received tenant's complaints on faulty lights by one of the staffs in Town Council
2. The staff has recorded the details of complaints (time & date of complaint received and type & location of fault occured)
3. The complaint is forwarded (in a daily basis) to contractor who is incharge of repairing the faulty lights within 24 hours and inform to Town Council on work completion.
4. The staff has recorded the date and time of work completed
5. The PM is forwarded the faulty reports (in excel file format) to CME in end of each month.

The CME's manager has the responsible to check LED operations in all town councils. The manager has selected number of non-sampled HDB buildings (equal to sample group) and visit end of each year to check the operation of LED lightings.

The collected data is summarized in electronic spreadsheet and available for verification by DOE.

Data Analysis:

The CME's manager checks the quality of data reported on the forms. Each HDB building data which are incoherent and not filled is excluded from the calculation and considered as invalid. The high possibility of invalid data occurred in Electricity Meter reading taken by the Property Officers.

To quantify the monthly electricity consumption estimated based on two meter readings which are taken in beginning and end of each month. The monthly consumption is as follows:

Electricity consumption (kWh/month) = Reading taken in end of the month (kWh) – Reading taken in beginning of the month (kWh)

The data is considered as invalid if the monthly consumption is zero or negative value or extremely higher than the average consumption of other months.

Confidence/precision Level:

The CPA has adopted a precision level of 10% associated to a confidence interval of 90% to define the sample size. The CME's CDM Manager is verified that the 10% precision level has been met.

The verification of requried confidence/precision level as follows:

(i) Standard error of the mean

The formula for the standard error means is $\sqrt{(1-f)\frac{s^2}{n}}$

Where:

Symbols	Description	Value	Remarks
f	Sampling fraction	0.04804	Based on sample size (65 blocks) and total population (1,353 blocks)
s	Sample standard deviation	0.01214	Standard deviation of overall daily operating hours
n	Sample size	65	65 blocks out of 1,353 blocks
-	Standard error mean	0.001469	-

(ii) t-value

The t-value is identified based on the 90% confidence level in the statistical table[2] is 1.671.

(iii) Precision

The precision associated with an estimate is = t-value × standard error of the mean

t-value × standard error of the mean = 1.671 × 0.001469 = ± 0.00245

The ratio of this relative to the mean LED usage is $\frac{0.00245}{12.2669} = 0.000199$ and so the relative precision is 0.02%. The data are therefore within the requried specification.

Roles and responsibilities:

CME CDM Manager: Knowledge of CDM projects and internal organization of the CME. Coollecting all the forms filled in by the Town Councils' property officer and manager. Analysis of the collected data. Preparation of the monitoring report and associated documents.

Property Manager (Town Councils): Knowledge of the pCDM program. Review and approve the monitored data. Collection of all forms filled up by the property officers.

Property Officers (Town Councils): Knowledge of the pCDM program. Data collection (e.g. meter reading) from each sampling block and filled up the forms.

[2] https://home.ubalt.edu/ntsbarsh/Business-stat/StatistialTables.pdf

SECTION H. Calculation of GHG emission reductions or net GHG removals by sinks

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

In accordance with paragraph 13 of selected methodology, baseline will be the product of the baseline energy consumption of equipment/appliances and the emission factor for the electricity displaced.

Option 1:

$$BE_y = E_{BL,y} \times EF_{CO_2,ELEC,y} + Q_{ref,BL} \times GWP_{ref,BL} \quad \text{---------- (1)}$$

Since this CPA does not involve using refrigerant, baseline emission is:

$$BE_y = E_{BL,y} \times EF_{CO_2,ELEC,y}$$

$$BE_y = [\sum_i (n_{BL,i} \times \rho_{BL,i} \times o_{BL,i}) / (1 - l_y)] \times EF_{CO2,ELEC,y} \quad \text{----------(2)}$$

Where:

BE_y	Baseline emissions in year y (tCO_2e)
$E_{BL,y}$	Energy consumption in the baseline in year y (kWh)
$EF_{CO_2,ELEC,y}$	Emission factor in year y calculated in accordance with the provisions in AMS-I.D (tCO_2/MWh)
$n_{BL,i}$	Number of devices of the group of "i" devices (e.g., 40W incandescent bulb, 5hp motor) replaced, for which the project energy efficient equipment is operating during the year
$\rho_{BL,i}$	Power of the devices of the group of "i" baseline devices (e.g., 40W incandescent bulb, 5hp motor). In the case of a retrofit activity, "power" is the weighted average of the devices replaced. In the case of new installations, "power" is the weighted average of devices on the market. In the case of a retrofit activity, electrical power demand is the weighted average of the rated power (kW) of group *i* baseline equipment. For motors, the electrical power demand of baseline equipment is determined based on spot-measurement and/or short-term monitoring data.[3]
$o_{BL,i}$	Average annual operating hours of the devices of the group of "i" baseline devices
l_y	Average annual technical grid losses (transmission and distribution) during year y for the grid serving the locations where the devices are installed, expressed as a fraction. This value shall not include non-technical losses such as commercial losses (e.g., theft/pilferage). The average annual technical grid losses shall be determined using recent, accurate and reliable data available for the host country. This value can be determined from recent data published either by a national utility or an official governmental body. Reliability of the data used (e.g., appropriateness, accuracy/uncertainty, especially exclusion of non technical grid losses) shall be established and documented by the project participant. A default value of 0.1 shall be used for average annual technical grid losses, if no recent data are available or the data cannot be regarded accurate and reliable

[3] Short-term monitoring compensates for small, short-term rapid fluctuations in power in an otherwise constant process. Short-term monitoring should be conducted for a period of at least six hours.

The baseline emission is calculated as follows:

<table>
<tr><th rowspan="2">Symbol</th><th colspan="4">Values</th></tr>
<tr><th>Jun 2014 – Dec 2014</th><th>Jan 2015 – Dec 2015</th><th>Jan 2016 – Dec 2016</th><th>Jan 2017 – May 2017</th></tr>
<tr><td>$n_{BL,i}$</td><td colspan="4">
<table>
<tr><th colspan="3">2ft</th><th colspan="2">4ft</th><th rowspan="2">Down Light</th><th rowspan="2">Decorative Light</th></tr>
<tr><th>T5</th><th>T8 (LB)</th><th>T8 (EB)</th><th>T8 (LB)</th><th>T8 (EB)</th></tr>
<tr><td>0</td><td>69,451</td><td>54,631</td><td>22,381</td><td>11,232</td><td>15,796</td><td>78,055</td></tr>
</table>
</td></tr>
<tr><td>$\rho_{BL,i}$</td><td colspan="4">
<table>
<tr><th colspan="3">2ft</th><th colspan="2">4ft</th><th rowspan="2">Down Light</th><th rowspan="2">Decorative Light</th></tr>
<tr><th>T5</th><th>T8 (LB)</th><th>T8 (EB)</th><th>T8 (LB)</th><th>T8 (EB)</th></tr>
<tr><td>17</td><td>25</td><td>21</td><td>43</td><td>39</td><td>17</td><td>22</td></tr>
</table>
</td></tr>
<tr><td>$o_{BL,i}$</td><td>2,499</td><td>4,392</td><td>4,392</td><td>1,825</td></tr>
<tr><td>l_y</td><td colspan="4">3.6%</td></tr>
<tr><td>$E_{BL,y}$</td><td>16,253 MWh</td><td>28,563 MWh</td><td>28,563 MWh</td><td>11,869 MWh</td></tr>
<tr><td>$EF_{CO_2,ELEC,y}$</td><td colspan="4">0.42 tCO_2/MWh</td></tr>
<tr><td colspan="5">Based on equation (2): $BE_y = \left[\sum_i (n_{BL,i} \times \rho_{BL,i} \times o_{BL,i})/(1-l_y)\right] \times EF_{CO2,ELEC,y}$</td></tr>
<tr><td>BE_y</td><td>6,826 tCO_2</td><td>11,997 tCO_2</td><td>11,997 tCO_2</td><td>4,985 tCO_2</td></tr>
<tr><td>BE_y</td><td colspan="4">35,806 tCO_2</td></tr>
</table>

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

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$$PE_y = E_{PJ,y} \times EF_{CO_2,y} \quad \text{----------(3)}$$

Where:

PE_y	Project emissions in year y (tCO_2e)
$E_{PJ,y}$	Energy consumption in project activity in year *y*. This shall be determined *ex post* based on monitored values
$EF_{CO_2,y}$	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

Project energy consumption in case of project activities that displace grid electricity is determined as follows using the data of the project equipment or system:

$$E_{PJ,y} = \sum_i (n_{PJ,i} \times \rho_{PJ,i} \times o_{PJ,i})/(1-l_y) \quad \text{----------(4)}$$

$\sum_i$	Sum over the group of "i" devices (e.g., 40W incandescent bulb, 5hp motor) replaced, for which the project energy efficient equipment is operating during the year, implemented as part of the project activity
$n_{PJ,i}$	Number of devices of the group of "i" devices (e.g., 40W incandescent bulb, 5hp motor) replaced, for which the project energy efficient equipment is operating during the year
$\rho_{PJ,i}$	Power of the devices of the group of "i" baseline devices (e.g., 40W incandescent bulb, 5hp motor). In the case of a retrofit activity, "power" is the weighted average of the devices replaced. In the case of new installations, "power" is the weighted average of devices on the market
$o_{PJ,i}$	Average annual operating hours of the devices of the group of "i" baseline devices
l_y	Average annual technical grid losses (transmission and distribution) during year y for the grid serving the locations where the devices are installed, expressed as a fraction. This value shall not include non-technical losses such as commercial losses (e.g., theft/pilferage). The average annual technical grid losses shall be determined using recent, accurate and reliable data available for the host country. This value can be determined from recent data published either by a national utility or an official governmental body. Reliability of the data used (e.g., appropriateness, accuracy/uncertainty, especially exclusion of non technical grid losses) shall be established and documented by the project participant. A default value of 0.1 shall be used for average annual technical grid losses, if no recent data are available or the data cannot be regarded accurate and reliable

The project emission is calculated as follows:

Symbol	**Values**			
	Jun 2014 – Dec 2014	**Jan 2015 – Dec 2015**	**Jan 2016 – Dec 2016**	**Jan 2017 – May 2017**
$n_{PJ,i}$	285,561			
$\rho_{PJ,i}$	12 W			
$o_{PJ,i}$	2,502	4,398	4,396	1,821
l_y	3.6%			
$E_{PJ,y}$	8,894 MWh	15,634 MWh	15,626 MWh	6,473 MWh
$EF_{CO_2,y}$	0.42 tCO_2/MWh			
Based on equation (3) & (4): $PE_y = \left[\sum_i (n_{PJ,i} \times \rho_{PJ,i} \times o_{PJ,i})/(1-l_y)\right] \times EF_{CO_2,y}$				
PE_y	3,735 tCO_2	6,566 tCO_2	6,563 tCO_2	2,719 tCO_2
PE_y	**19,583 tCO_2**			

H.3. Calculation of leakage

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Leakages is not considered because the replaced equipments were scrapped. An independent monitoring procedure in place to monitoring the scrapping of replaced equipments in relation to this CPA.

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

Specific-case CPA reference number	Baseline emissions or baseline net GHG removals by sinks (tCO_2e)	Project emissions or actual net GHG removals by sinks (tCO_2e)	Leakage (tCO_2e)	GHG emission reductions or net GHG removals by sinks (tCO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
CPA 9593-01	35,805	19,583	-	-	16,223	16,223
Total	**35,806**	**19,583**	**-**	**-**	**16,223**	**16,223**

H.5. Comparison of GHG emission reductions or net GHG removals by sinks with estimates in the included CPA-DD(s)

Specific-case CPA reference number	Value estimated in ex ante calculation in the included CPA-DD(s)	Actual values achieved by the specific-case CPA(s) during this monitoring period
CPA 9593-01	18,873	16,223
Total	**18,873**	**16,223**

H.6. Remarks on difference from the estimated value in the included CPA-DD(s)

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The actual emission reduction achieved during this monitoring period is 1% less than the emission reduction estimated in the CPA–DD.

The difference comes from the following reason:

1) Proejct operating hours longer than the baseline operating hours due to renovation, reconstruction and lift upgrading works occurred in residential blocks during the monitoring period
2) The operational timing (On & Off-time) set in timer switch might be little bit higher (5 to 10 minutes) than the baseline operational timing.

Appendix 1. Contact information of coordinating/managing entity and/or responsible persons/entities

Coordinating/managing entity and/or responsible person/entity	☒ Coordinating/managing entity ☒ Person/entity responsible for completing the CDM-MR-FORM
Organization name	UGL Services Premas Operations Limited
Street/P.O. Box	750
Building	Oasis
City	Singapore
State/Region	Singapore
Postcode	469000
Country	Singapore
Telephone	+65 6876 0088
Fax	+65 6876 6496
E-mail	thiru.p@cwservices.com
Website	www.ugl-premas.com
Contact person	Panchaksharam Thirumalavan
Title	Manager
Salutation	Mr
Last name	Panchaksharam
Middle name	-
First name	Thirumalavan
Department	Energy & Sustainability
Mobile	-
Direct fax	+65 6876 6496
Direct tel.	+65 6876 6263
Personal e-mail	thiru.p@cwservices.com

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Document information

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