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for selected small-scale CDM project activity categories

TYPE II - ENERGY EFFICIENCY IMPROVEMENT PROJECTS

Project participants shall take into account the general guidance to the methodologies, information on additionality, abbreviations and general guidance on leakage provided at: <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html>.

II.J.   *Demand-side activities for efficient lighting technologies*

Technology/measure

1.   This category comprises activities that lead to efficient use of electricity through the adoption of self-ballasted compact fluorescent lamps (CFLs) to replace incandescent lamps (ICLs) in residential applications. Eligible self-ballasted CFLs have integrated ballasts as a non-removable part. The CFLs adopted to replace existing equipment must be new equipment and not transferred from another activity.

2.   The total lumen output of the CFL should be equal to or more than that of the ICL being replaced; lumen output of ICL & CFL shall be determined in accordance with relevant national or international standard/s. ~~In the case of ICL,~~ Values in Table 1 may be used as an alternative option to such standards. If a lamp wattage is not in Table 1, linearly interpreted value shall be used to determine the minimum light output requirements e.g., ~~492.5~~ 493 Lumens for a 45 W lamp.

Table 1: Light Output Requirements

Baseline Technology - Incandescent Lamp (Watt)	Minimum Light Output (Lumen)
25	230
40	415
50	570
60	715
75	940
90	1,227
100	1,350
150	2,180
200	3,090

3.   ~~Project participants are encouraged to replace incandescent lamps with CFLs that have long average life (or rated average life)times and the lowest eligible wattage that delivers the equivalent or better lumen output than the replaced lamp, as this will result in maximum Emission Reductions. However, this methodology does not preclude the use of higher wattage CFLs as long as the lumen output requirements are met.~~

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4.   The aggregate electricity savings by a single project activity may not exceed the equivalent of 60 GWh per year.

5.   ~~High quality lamps that have been independently tested must be used. To ensure this a relevant national or international testing standard shall be followed to determine the rated lifetime[1] of the lighting equipment;~~ The average life or the rated average life[2] of the CFLs shall be known *ex ante*. IEC 60969 (Self Ballasted Lamps For General Lighting Services - Performance Requirements) or an equivalent national standard shall be used to determine the average life. The project design document shall cite the standard[3] ~~used.~~ If the average life value is not available *ex ante*, it shall be made available for verification before or at the same time that the results of the second ex-post monitoring survey, as required per paragraph 18 (b), are available for verification. ~~to determine the rated lifetime of efficient lamps distributed under the project activity.~~ The laboratory conducting and certifying the tests to determine CFL average life shall comply with the requirements of a relevant national or international standard, e.g., ISO/IEC 17025.

6.   CFLs utilized under the project activity shall, in addition to the standard lamp specifications[4], be marked for clear unique identification for the project.

7.   The project design document shall explain the proposed method of distribution of efficient lighting equipment and how ~~the following activities~~ ICL collection (e.g., exchanged for project CFLs) ~~stored~~ and destruction[5] will be conducted and documented.~~;~~ ~~baseline incandescent lamps returned collected (e.g., exchanged for project CFLs) stored and destroyed[4].~~ The Project design document shall also explain how the proposed procedures eliminate double counting of Emission Reductions, for example due to CFL manufacturers, wholesale providers or others possibly claiming credit for Emission Reductions for the project CFLs.

8.   The project activity shall be designed to limit undesired secondary market effects (e.g., leakage) and free riders by ensuring that replaced lamps are exchanged and destroyed. Further project participants are required to undertake at least one of the following actions:

(i)   Directly installing the CFLs;

(ii)   Charging at least a minimal price[6] for efficient lighting equipment;

(iii)   Restricting the number of lamps per household distributed through the project activity to six.

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[1] ~~'Rated lifetime' or 'rated average life' or 'rated life to 50% failures' is the expected time at which 50% of any large number of lamps reach the end of their individual life.~~

[2] *See annex 2 for definitions of Average Life and* Rated Average Life.

[3] ~~National standards or in the absence of national standards, international standards (e.g., IEC 60969) may be used.~~

[4] For example power rating, lumen output, correlated colour temperature, voltage, power factor, frequency.

[5] Proposed method for collection and destruction shall allow for ~~random~~ verification ~~by a DOE~~. An example method is collection of ICLs, recording of ICL wattage and destruction in decentralised or centralised locations, and destruction documented via witnessing by local environmental officials or time stamped video records. With recorded documentation of ICL destruction, the destruction can precede verification.

[6] For example cost equivalent of an incandescent lamp being replaced.

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9.   Whether the CFLs are directly installed or not directly installed, the project design document shall define actions to be taken to encourage CFLs being installed in locations within the residences where the utilization hours are relatively high, for example common areas. For CFLs not directly installed these actions can include educating the CFL recipients of the best uses for CFLs.

Boundary

10.   The project boundary is the physical, geographical location of each measure (each CFL) installed.

Crediting Period

11.   With this methodology, Certified Emission Reductions can only be earned for the average rated lifetime rated of project CFLs, not to exceed one crediting period of up to 10 years.

Emission Reductions

12.   *Ex ante* calculations are done as per the following steps:

   (i)   Estimate the nameplate/rated power (Watts) of the baseline incandescent lamps to be replaced.

   (ii)   Determine operating hours of project (and baseline) lamps using one of the following two options:

   • Option 1: A default value of 3.5 hours per 24 hrs period for 'daily operating hours', i.e., factor O_i in equation 2, is chosen *ex ante* and is used ex post throughout the crediting period. In this case no surveying to determine O_i is required.

   • Option 2: Instead of using a default value of 3.5 hours for O_i, a measured value can be used for the ex-ante estimate using the sampling requirements indicated in the definition of O_i for equation (2).

   Default value for daily hours of operation of baseline incandescent lamps is 3.5 hours per 24 hrs period. Use the default value or the measured value determined from the representative sample

   (iii)   Calculate the annual gross electricity savings from an individual lamp by comparing the nameplate/rated power rating of the CFL with that of the baseline incandescent lamp and multiplying by (i) annual hours of operation and (ii) the estimated number of CFLs that are part of the project. If more than one type (wattage) of CFL is to be used, repeat calculation for each type;

   (iv)   Calculate the annual net electricity saving (NES), for each year of the assumed crediting period, by correcting the gross electricity savings for leakage, a net-to-

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gross adjustment (NTG) factor, transmission & distribution losses, and Lamp Failure Rate[7].

13.   The electricity saved by the project activity in year *y* is calculated as indicated in equations (1) and (2):

$$NES_y = \sum_{i=1}^{n} Q_{PJ,i} \times (1 - LFR_{i,y}) \times ES_i \times \frac{1}{(1 - TD_y)} \times NTG \tag{1}$$

Where:

$$ES_i = (P_{i,BL} - P_{i,PJ}) \times O_i \times 365 / 1000 \tag{2}$$

Where:

NES_y	Net electricity saved in year *y* (kWh)
$Q_{PJ,i}$	Number (quantity) of pieces of equipment (CFLs) of type *i* distributed or installed under the project activity (units). In total for all "i", this value shall be equal to or less than the documented number of all baseline incandescent lamps destroyed. Once all of the project CFLs are distributed or installed, $Q_{PJ,i}$ is a constant value independent from *y*
i	Counter for equipment type
n	Number of types of equipment i
ES_i	Estimated annual electricity savings for equipment of type *i*, for the relevant technology (kWh)
$LFR_{i,y}$	Lamp Failure Rate for equipment type *i* in year *y* (fraction)
TD_y	Average annual technical 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 10% shall be used for average annual technical grid losses, if no recent data are available or the data cannot be regarded accurate and reliable

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[7] Calculate annual savings with consideration of lamp failure rate as indicated in Equation 3 using either Average Life or Rated Average Life of CFLs

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NTG	Net-to-gross adjustment factor, a default value of 0.95 is to be used unless a more appropriate value based on a lighting use survey from the same region and not older than 2 years is available
$P_{i, BL}$	Rated power of the baseline lighting devices of the group of "*i*" lighting devices (Watts)
$P_{i, PJ}$	Rated power of the project lighting devices of the group of "*i*" lighting devices (Watts)
O_i	Average daily operating hours of the lighting devices replaced by the group of "*i*" lighting devices. For ex-post values use either[8] (a) 3.5 hours per 24 hour period or (b) the average measured value determined from measurements of a representative sample conducted once, prior to or concurrent with the first ex-post monitoring survey (see paragraph 18 below). Note that surveying to assess retention rates is still required even if a default value for O_i is chosen. use 3.5 hours per 24 hrs period or the measured value determined from the representative sample; 'daily operating hours' other than 3.5 hrs/day, corrected for seasonal variation of lighting hours if any, may be used only if it is based on continuous measurement of usage hours of baseline lamps for a minimum of 90 days at representative sample households (sampling determined by minimum 90% confidence interval and 10% maximum error margin). For the latter option i.e., to use the measured value, the measurements shall be repeated at a unique representative sample[9] of households at the time of each ex-post monitoring activity and the most recently measured value is used for daily operating hours. In no case, however, may a value greater than 5 hours per 24 hour period shall be used under this methodology.

14.   To use a value for 'daily operating hours' other than 3.5 hrs/day, a continuous measurement of usage hours of baseline or project lamps for a minimum of 90 days at representative sample households is required. Also see requirements in paragraph 21.(a random sample that determines an estimate within ± 10% of the actual value with a 90% confidence) prior to or at the same time as the first ex-post measurement and then at the same time as each subsequent ex-post measurement. The days selected for measurement of operating hours shall either be representative of the annual variation of daylight hours in the region or a correction shall be applied to account for annual variation in daylight. For further instructions on sampling and surveys see the latest version of General guidelines for sampling and surveys for SSC project activities.

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[8] The project participant shall decide prior to the first ex- post measurement whether to use the 3.5 hours default value or ex post measured operating hours for determining O_i in equation 2. If the project participant is undecided prior to the first ex-post measurement as to which option to use, approaches to each option under consideration should be described in the PDD, with details of a sampling plan. However, once an approach is implemented, the project participant may not switch options. In particular, it is not possible to collect measured operating hour data (which may, for example, show 3 hours per day of operation) and then switch back to use the default value of 3.5 hours.

[9] Households chosen as samples for the ex ante measurement are excluded.

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15.   The Lamp Failure Rate ($LFR_{i,y}$) is the % of lamps that have failed during a year. The average life or the rated average lifetime is used to calculate the Lamp Failure Rate as follows:

$$\text{If } y * X_i < L_i, LFR_{i,y} = y * X_i * (100 - R_i)/(100 \times L_i) \tag{3}$$

$$\text{If } y * X_i > or = L_i, LFR_{i,y} = 1$$

Where:

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

L_i Average Life (or Rated Average Life until average life value is available) for equipment type i (hours)

R_i % of lamps of type i operating at the end of average life or the rated average lifetime (use a value of 50)

X_i Number of operating hours per year for equipment type i (hours)

y Counter for year

16.   Emissions reduction is net electricity savings (*NES*) times an Emission Factor (*EF*) calculated in accordance with provisions under AMS-I.D.

$$ER_y = NES_y \times EF_{CO2,ELEC,y} \tag{4}$$

Where:

$EF_{CO2,ELEC,y}$ Emission Factor in year y calculated in accordance with the provisions in AMS-I.D (tCO_2/MWh)

ER_y Emission Reductions in year y (tCO_2e)

17.   The electricity savings from the efficient lighting equipment installed by the project activity shall be considered from the date of completion of installation of the equipment.

18.   *Ex post* monitoring and adjustment of corresponding Net Electricity Savings (NES_y):

   (a)   First *ex post* monitoring survey, carried out within the first year after installation of all efficient lighting equipment will provide a value for the number of CFLs placed in service and operating under the project activity. The results of this survey are used to determine the quantity of CFLs ($Q_{PJ,i}$) in the Emission Reduction calculation to determine the *ex post* Lamp Failure Rate ($LFR_{i,y}$) for use in *ex post* Emission Reduction calculations.

   (b)   Subsequent *ex post* monitoring surveys are carried out at the following intervals to determine the *ex post* Lamp Failure Rate ($LFR_{i,y}$) and where relevant *ex post* average daily operating hours (O_i) for use in *ex post* Emission Reduction calculations until such time as CERs are being requested, (choose either of the

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following two options that define the minimum requirement for the frequency of the survey)[10]:

  1.   Once every 3 years;

  2.   Once for every 30% of the elapsed ~~rated lifetime~~ Rated Average Life or Average Life of the lamp.

(c)   The surveys will consist of identifying CFLs, marked per paragraph 6, that are installed and operating. Only CFLs with an original marking can be counted as installed. While CFLs replaced as part of a regular maintenance or warranty program can be counted as operating, ~~missing or non-operating CFLs~~ cannot be replaced as part of this monitoring survey process and counted as operating for the purposes of determining $Q_{PJ,i}$.

19.   Changes to Lamp Failure Rate ($LFR_{i,y}$) and treatment of differences between Rated Average Life and Average Life for adjustment of Net Electricity Savings (NES_y): The Net Electricity Savings shall be modified for changes to the Lamp Failure Rate as may be indicated by *ex post* monitoring survey results and/or on the basis of CFL Average Life values if a CFL Rated Average Life was used initially. The modifications shall be made using the following methods:

  (a)   If Rated Average Life values were used initially for calculating LFR_y, per equation (3), as soon as Average Life values are available they shall be used for calculation of subsequent year $LFR_{i,y}$ values.

  (b)   If the ex-post monitoring surveys indicate that the failure rate is <u>equal to or less than</u> the $LFR_{i,y}$ value indicated using equation (3) with ex-ante or prior year, ex-post monitoring values, for subsequent years $LFR_{i,y}$ shall continue to be determined using Equation (3) and the established Average Life values for L_i.

  (c)   However, for subsequent years, L_i values in $LFR_{i,y}$ equation (3) shall be adjusted if the ex-post monitoring surveys indicate that the failure rate ($LFR_{i,y}$) is <u>greater than</u> the value indicated using equation (3) with Average Life or prior year, ex-post monitoring values. In this situation, a new value for L_i shall be determined using equation (3) and new values of $LFR_{i,y}$ shall be used beginning from the first calculation year after completion of the ex-post survey.

  (d)   ~~On the basis of ex post monitoring surveys, the net electricity savings are adjusted considering the actual lamp failure data. If the ex post failure rates ($LFR_{i,y}$) are higher or lower than the *ex ante* estimate, subsequent Emission Reduction claims shall be based on linear failure rate curve reconstructed for the remaining period of the crediting period[11]. However, under no circumstances can a estimate of $LFR_{i,y}$~~

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[10] For example assuming a rated lifetime of 10,000 hours and annual hours of operation of 1,278, since the first ex post monitoring survey is done in year 1, the subsequent surveys take place in years 4 and 7 with the crediting period ending in year 8.

[11] ~~Crediting period ends at rated lifetime as in the ex ante calculation.~~

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value be lower than that indicated in the mortality curve[12] of the CFL determined as per the independent tests referenced in paragraph 5 of this methodology.

Monitoring

20.   Monitoring includes (i) recording of lamp distribution data, and (ii) *ex post* monitoring surveys as defined in paragraph 18:

(i)   During project activity implementation, the following data are to be recorded:

- Number of pieces of equipment distributed under the project activity, identified by the type of equipment and the date of supply;

- The number and power of the replaced devices;

- Data to unambiguously identify the recipient of the equipment distributed under the project activity;

(ii)   The Emission Reductions are calculated *ex ante* and adjusted *ex post* following the monitoring surveys, as described under paragraphs above.

21.   **Generic instructions for conducting the surveys and sampling**

The following survey principles shall be followed for activities related to determining number of CFLs placed in service and operating under the project activity and, if required, determining the number of operating hours of baseline and project lamps:

- The sampling size is determined by minimum 90% confidence interval and the 10% maximum error margin; the size of the sample shall be no less than 100;

- Sampling must be statistically robust and relevant i.e., the survey has a random distribution and is representative of target population (size, location);

- The method to select respondents for interviews is random;

- The survey is conducted by site visits;

- Only persons over age 12 are interviewed;

- The project document must contain the design details of the survey.

A generic questionnaire is included in Annex 1. This questionnaire can be adapted to local circumstances as necessary.

Project activity under a programme of Activities

Avoidance of leakage through scrapping of replaced equipment is addressed under paragraph 7, no special provisions are required therefore.

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[12] Percentage of lamps operating over time.

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Annex I

Ex post monitoring survey template

General Information

Interviewer;

Date of interview;

Name and Address (or description of location of dwelling);

Ownership status (owner/tenant/other).

Proper Installation/Operation

Check whether each CFL distributed under the project activity is installed and operational (based on records on the type/number of efficient lamps distributed to each individual household);

Record whether CFLs distributed under the project activity are operational;

Determine whether defective CFLs were replaced as part of warranty or regular maintenance or by the end-user and, if so, with what type/wattage of lamp.

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Lamp ID	Installed/ operational? (if No complete next column)	Reasons for failures (Defective, poor performance, in reserve, sold/given away)	Replacement Lamp Type Installed by Household Incadescent (I) Fluorescent Tube Light (FTL) CFL Energy Saving (CFL) Light Emitting Diodes (LED) Other (O) – please describe	Replacement Lamp Wattage Installed by Household	Replacement CFL Bulb Installed at Time of Survey? – or –	Replacement CFL Wattage
1						
2						
3						
4						
5						
6						

(Add rows to match number of efficient lamps distributed to each household under the CDM project activity)

- If other than efficient lamps, also ask why an efficient lamp like CFL was not used?

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Annex 1

DEFINITIONS

Life (of an individual lamp): the length of time during which a complete lamp operates:

- To burn out; or

- Any other criterion of life performance defined in IEC 60696 or an equivalent national standard applied;

Average life (life to 50% failures): the length of time during which 50% of the lamps reach the end of their individual life

Rated average life (rated life to 50% failures): the life declared by the manufacturer or responsible vendor as being the expected time at which 50% of any large number of lamps reach the end of their individual lives

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History of the document

Version	Date	Nature of revision
04	EB xx, Annex # dd mm 2010	The revisions include *inter alia*: • Definitions of Average life and Rated average life of lamp; • Deletion of Annex 1 for ex post monitoring survey; • Provisions to use lamp's rated average life for ex-ante emission reduction estimation; • Additional clarifications on how to take into account ex-post survey data on Lamp Failure rate and ex post determined lamp's average life.
03	EB 47, Annex 21 28 May 2009	The revisions include *inter alia*: • Broader range of eligible incandescent and CFL Wattages; • Deletion of cross effect calculations and baseline penetration assessment for PoAs; • Provisions to use results of *ex post* surveys to correct CFL attrition rates; • Fixed average daily utilisation hours of CFL (3.5 hrs/day).
02	EB 44, Annex 22 28 November 2008	The revisions clarify the project design requirements, consideration of electricity T&D losses in the baseline, frequency of *ex post* surveys, and estimation of cross-effects of lighting and heating.
01	EB 41, Annex 16 02 August 2008	Initial adoption.