



Indicative simplified baseline and monitoring methodologies
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 in residential applications. The high-efficiency technology to replace existing equipment must be new equipment not transferred from another activity.
2. The total lumen output of the efficient lighting device should be equal to or more than that of the lighting device being replaced, according to the table below:

Baseline Technology- Incandescent Lamp (Watt)	Minimum Light Output (Lumen)
40	415
60	715
75	940
100	1350

3. Project participants are encouraged to replace incandescent lamps with the lowest eligible wattage of the efficient lighting equipment that delivers the equivalent or better lumen than the baseline lamp, as this would result in maximum emission reductions.
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:
 - (i) A relevant national or international testing standard shall be followed to determine the rated lifetime¹ of the lighting equipment; the project design document shall cite the standard² used to determine the rated lifetime of efficient lamps distributed under the project activity.

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



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6. Efficient lighting technology under the project activity (e.g. uncovered compact fluorescent lamp with integrated electronic ballast) shall, in addition to the standard lamp specifications³, be marked for clear unique identification for the project. Such marking may for example include:

- Batch number providing information on period of manufacture;
- Standard to which the lamp type is certified.

7. The project design document shall explain the proposed method of distribution of efficient lighting equipment and how the incandescent bulbs will be returned, stored and monitored before destruction. Measures to replace the defective equipment shall be explained. It shall also be explained how the proposed measures eliminate any possibilities for double accounting of emission reductions.

8. The project activity must 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 measures:

- (i) Direct installation of efficient lighting equipment⁴;
- (ii) Charging at least a minimal price⁵ for efficient lighting equipment;
- (iii) Restricting the number of lamps per household distributed through the project activity.

9. For efficient lighting equipment not directly installed, project participants shall take measures to encourage efficient lamps being installed in locations where the (daily) utilization hours can be expected to be equal to or greater than 3.5 hours per day (e.g. educating the recipients of the efficient lighting equipment).⁶

Boundary

10. The project boundary is the physical, geographical location of each measure (each piece of energy efficient lighting equipment) installed.

Crediting Period

11. With this methodology, Certified Emission reductions can only be earned only for the rated lifetime (rated life to 50% failures) of efficient lighting equipment, not to exceed one crediting period of up to 10 years.

³ For example power rating, lumen output, correlated colour temperature, voltage, power factor, frequency.

⁴ To ensure efficient lamps are used in locations where the (daily) efficient lighting equipment utilization hours can be expected to be at least 3.5 hours per day.

⁵ For example cost equivalent of an incandescent lamp being replaced.

⁶ For example, encouraging placement of efficient lighting equipment in areas other than bathrooms or storage rooms.



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Emission Reductions

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

- (i) Determine the technology of the lamps (e.g. incandescent, CFLs, tubular), nameplate/rated power (Watts) and daily hours of operation⁷ of the lamps in the baseline situation in the project area through a baseline survey;
- (ii) Calculate the gross electricity savings from an individual lamp by comparing the nameplate/rated power rating of the new lighting equipment with that of the baseline lamp and multiplying by annual hours of operation;
- (iii) Calculate the net electricity saving (NES) by correcting the gross electricity savings for leakage, free ridership and transmission & distribution losses.

The electricity saved by the project activity in year y is calculated as follows:

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

Where:

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

Where:

- NES_y Net electricity saved in year y (kWh)
- $Q_{PJ,i}$ Number (quantity) of pieces of equipment of type i distributed and commissioned under the project activity (units)
- i Counter for equipment type
- n Number of types of equipment
- 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)

⁷ Use lower of the following: a) 3.5 hours per 24 hrs period; b) Daily usage hours determined by the baseline survey. To use a different value for 'daily operating hours' continuous measurement of usage hours of baseline lamps for a minimum of 90 days at representative sample households (used a random sample that determines an estimate within $\pm 10\%$ of the actual value with a 90% confidence is required. The days selected for measurement of operating hours shall be representative of the annual variation of daylight hours in the region.



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- 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.
- NTG Net-to-gross adjustment factor, a default value of 0.95 to be used unless a more appropriate value based on a lighting use survey from the same region and not older than 2 years is available
- $P_{i, BL}$ Rated power of the baseline lighting devices of the group of “ i ” lighting devices (Watts)
- $P_{i, PJ}$ 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, use lower of the following: a) 3.5 hours per 24 hrs period; b) Daily usage hours determined by the baseline survey. A different value for ‘daily operating hours’, 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)
- BP Baseline Penetration Factor⁹ ($BP = 1 - (\# \text{ of pieces of screw-in or lock-in efficient lighting equipment} / \text{total } \# \text{ of pieces of screw-in or lock-in lighting equipment})$), based on *ex ante* representative sample survey; BP is only applicable to ‘Project Activity under Programme of Activities (CPA of PoA)’ and in other cases set BP to ‘1.0’

The Lamp Failure Rate (LFR_y) is the % of lamps that have failed during a year. The rated lifetime is used to calculate the *ex ante* Lamp Failure Rate as follows:

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

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

Where:

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

⁹ This factor captures the penetration of the project technology in the baseline situation. This factor is only applicable for project activities under a program of activities i.e. CPA of a PoA.



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- L_i Rated average life for equipment type i (hours)
- R_i % of lamps of type i operating at the rated lifetime (use a value of 50)
- X_i Number of operating hours per year for equipment type i (hours)
- y Counter for year
- (iv) Emissions reduction is net electricity savings (NES) times an emission factor (EF) calculated in accordance with provisions under AMS-I.D.

$$ER_y = NES_y \times EF_{CO_2, ELEC, y} \quad (4)$$

Where:

$EF_{CO_2, ELEC, y}$ Emission factor in year y calculated in accordance with the provisions in AMS-I.D (tCO₂/MWh)

ER_y Emission reductions in year y (tCO₂e)

13. 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.

14. *Ex post* monitoring and adjustment of net electricity savings:

- (i) 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 lamps placed in service and operating under the project activity. The results of this survey are used to determine the quantity of lamps ($Q_{PJ, i}$) in the emission reduction calculation;
- (ii) Subsequent *ex post* monitoring surveys are carried out at the following intervals to determine the quantity of lamps ($Q_{PJ, i}$) in operation for use in subsequent emission reduction calculations until such time as CERs are being requested, (choose either of the following two options):
 1. Once every 3 years;
 2. Once for every 30% of the elapsed rated lifetime of the lamp.¹⁰

15. On the basis of *ex post* monitoring surveys, the net electricity savings are adjusted considering the actual lamp failure data. If the failure rates are higher than the *ex ante* estimate, subsequent emission reduction claims will compensate for the overestimations (linear failure rates of lamps may be assumed).

¹⁰ For example assuming a rated lifetime of 8000 hours and annual hours of operation of 1095, since the first *ex post* monitoring survey is done in year 1, the subsequent surveys take place in years 4, 6 and 8 as appropriate in accordance with the rated lifetime.



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Monitoring

16. Monitoring includes (i) an *ex ante* baseline survey, (ii) recording of lamp distribution data, and (iii) *ex post* monitoring surveys as defined in paragraph 13:

- (i) An *ex ante* baseline representative sample survey will be conducted to provide key information about existing equipment. The survey should be sufficient to determine daily average lighting usage, type of baseline technology and power rating of the equipment as specified in the Annex 1. Where applicable it should also collect data to determine the Baseline Penetration Factor (BP);
- (ii) 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;
- (iii) The emission reductions are calculated *ex ante* and adjusted *ex post* following the monitoring surveys, as described under paragraphs above.

Generic instructions for conducting the surveys

17. The following survey principles shall be followed:
- 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 should be used adapting it to local circumstances as necessary.

Project Activity under Programme of Activities

18. If the methodology is applied to a project activity (CPA) under a programme of activities (PoA):

An assessment of Baseline Penetration Factor (BP) shall be done for each of the CPA of PoA separately through *ex ante* baseline survey for use in emission reduction calculation as per Equation 1.



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- (a) Monitoring should include a verification that the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. The scrapping of replaced equipment should be documented and independently verified;
- (b) Leakage on account of cross effects (interactive effects, for example increased heating load due to introduction of efficient lighting technologies) shall be considered¹¹ unless it is demonstrated that any one of the following conditions are met:
 - (i) Heating Degree Days (HDDs) to base 18⁰C in the geographic location of the project is equal to or less than 1000 in a year;
 - (ii) The *ex ante* survey determines that space heating in the project location is not done for more than two months in a year;
 - (iii) There is less than 10% penetration of space heating equipment in the location of the project activity;
 - (iv) The number of CFLs distributed per household is four or less.

¹¹ Consideration of interactive effects may be proposed through the request for revision process.



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ANNEX I

***Ex ante* baseline survey and *Ex post* Monitoring Survey Templates**

***Ex ante* Baseline Survey Template**

General Information

- Interviewer;
- Date of interview;
- Name and Address (or description of location of dwelling);
- Ownership status (owner / tenant / other).



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Lamp Hours of Operation and Baseline Penetration

Lamp	Location (categories to be adapted to suit local needs)	Type of Lamp: e.g. Incandescent (I) Fluorescent Tube Light (FTL) CFL Energy Saving (CFL) Other (O) – please describe	Type of Fitting: Screw (S) Pin (P) Other (O)	Lamp Wattage	Average Use (hours per day)	In Working Condition? y/n <input type="checkbox"/> or <input type="checkbox"/>
1.1	Bedrooms					
1.2						
1.X						
2.1	Kitchen					
2.2						
2.X						
3.1	Family Room					
3.2						
3.X						
4.1	Dining Room					
4.2						

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Lamp	Location (categories to be adapted to suit local needs)	Type of Lamp: e.g. Incandescent (I) Fluorescent Tube Light (FTL) CFL Energy Saving (CFL) Other (O) – please describe	Type of Fitting: Screw (S) Pin (P) Other (O)	Lamp Wattage	Average Use (hours per day)	In Working Condition? y/n <input type="checkbox"/> or <input type="checkbox"/>
4.X						
5.1	Bathroom & Other					
5.2						
5.X						

(Add rows as needed to capture all bulbs)

- Identify the most well used lamps in the household;
- Determine total number of light sockets in the household;
- Determine total number of incandescent lamps in service;
- Determine total number of CFLs.



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CFL Awareness and Lamp Purchase Habits

- Have you heard about energy saving CFLs (compact fluorescent lamps)?
- If yes:
 - Where did you first hear about them?
 - Do you regularly purchase them?
 - What are the main reasons that you do/don't regularly purchase CFLs?
- If no, would you be willing to buy an energy saving CFL that is more expensive than a conventional incandescent bulb?
- Regarding your last purchase of lamps:
 - What type of lamp was it?
 - Where did you purchase it?
 - What was the cost?

Other data

- Where applicable question/s on the space heating practice in the region may be added



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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 (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 by the end-user and, if so, with what type/wattage of lamp.

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Lamp ID	Installed/ operational?	Reasons for failures	Replacement Lamp Type Installed by Household*	Replacement Lamp Wattage Installed by Household	Replacement CFL Bulb Installed at Time of Survey?	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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History of the document

Version	Date	Nature of revision
02	EB 44, Annex 21 28 November 2008	The revisions clarify the project design requirements, consideration of electricity T&D losses in the baseline, frequency of <i>ex post</i> surveys, and estimation of cross-effects of lighting and heating.
01	EB 41, Annex 16 02 August 2008	Initial adoption.