Indicative simplified baseline and monitoring methodologies
for selected small-scale CDM project activity categories

TYPE III - OTHER PROJECT ACTIVITIES

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>.

III.AE. Energy efficiency and renewable energy measures in new residential buildings

Technology/measure

1. This category comprises activities that lead to reduced consumption of electricity in new, grid connected residential buildings (single or multiple-family residences[1]) through the use of one or more of the following measures: efficient building design practices, efficiency technologies, and renewable energy technologies. Examples include efficient appliances, high efficiency heating and cooling systems, passive solar design, thermal insulation, and solar photovoltaic systems. All equipment and building materials used in the project activity residences must be new and not transferred from another project activity. All project activity residences must comply with or exceed applicable standards and regulations (e.g., building codes).

2. The methodology does not quantify emission reductions for residences using biomass for energy supply.

3. If the energy efficient equipment contains refrigerants, then the refrigerant used in the project case shall be CFC free. Project emissions from the baseline refrigerant and/or project refrigerants shall be considered in accordance with the guidance of the Board (EB 34, paragraph 17).

4. Baseline residences are those that have been built and occupied within the prior five years from the start of the project activity, are not part of the project activity, are within approximately 100 kilometers of the project residences, and, as compared to project residences, have a similar size in terms of floor area (within approximately ± 50%), are located in a similar micro-climate (e.g., similar average rainfall, wind, and temperature), and are occupied by residents of a similar socio-economic class. Baseline residences must have been built in compliance with all applicable energy standards (e.g., building codes) when they both exist and are assumed to be enforced[2],[3].

5. This methodology is applicable only for determining emission reductions associated with changes in grid electricity consumption between project and baseline residences. Therefore, project residences shall not use fossil or biomass fuels for space heating or cooling, i.e., such heating or cooling systems, if they exist, must be powered by electricity. Furthermore:

- If baseline residences use electricity for domestic water heating then the project houses must not use fossil fuel for domestic water heating (i.e., project residences must use electricity and/or renewable energy for water heating), and

[1] For this methodology, the term residence refers to a single housing unit. For example, a single family home is one residence and a building with ten apartments has ten residences.

[2] Greater than 50% of residences built comply with building energy codes and standards

[3] The requirements in this paragraph are assumed to be determined, *ex ante*, by observation or review of public records and not by baseline residence occupant surveys.

Indicative simplified baseline and monitoring methodologies
for selected small-scale CDM project activity categories

II.x. Energy efficiency and renewable energy measures in new residential buildings (cont)

- If baseline residences use electricity for cooking then the project houses must not use fossil fuel for cooking[4].

Boundary

6. The project activity boundary is the physical extent of the new residential development(s) where efficiency and/or renewable energy technologies are installed.

Emission Reductions

7. Emissions reductions shall only be claimed for electricity savings from grid connected project activity residences.

8. The calculation of emission reductions from electricity is as follows:

$$ER_y = \sum_i ES_{y,i} \times EF_{elec,y} \times \left(1 + TD_y\right) \quad \textbf{(1)}$$

Where:

ER_y	Emission reductions from electricity savings in year y, tCO_2
i	Residence type (e.g., single family and multifamily)
y	Crediting period year
$ES_{y,i}$	Annual electricity savings from project activity residences in year y for residence type i, MWh
$EF_{elec,y}$	Grid electricity emission factor for year y, as per the procedures of AMS I.D, tCO_2/MWh
TD_y	Average annual technical grid losses (transmission and distribution) during year y for the grid serving the project residences, 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 as accurate and reliable

[4] It is acceptable to use this methodology if both the project and baseline residences use fossil or biomass fuels for domestic water heating and/or cooking on the assumption that the project activity does not cause an increase in domestic water heating or cooking requirements. However, project proponents are encouraged in all cases to utilize high efficiency domestic water hearing and cooking systems in the project residences.

Indicative simplified baseline and monitoring methodologies
for selected small-scale CDM project activity categories

II.x. Energy efficiency and renewable energy measures in new residential buildings (cont)

ES_y is estimated separately for different residence types (i.e., multifamily versus single family residences) for each crediting period year, using one of the following options, chosen *ex ante*:

(a) Annual *ex post* comparison of measured annual average electricity consumption of a sample of the occupied project residences with an estimate of the annual average electricity consumption of baseline residences as determined using a calibrated computer simulation model of the baseline residences, taking into account actual weather conditions;

(b) Annual *ex post* comparison of measured annual average electricity consumption of a sample of the occupied project residences with a sample of baseline residences (comparison group) using regression analyses.

9. For using option 8 (a), annual electricity savings determined with a calibrated computer simulation model shall be conducted using the following protocol:

- Energy savings for project residences shall be determined using Option D as defined in the International Performance Measurement and Verification Protocol, Concepts and Practices for Determining Energy Savings in New Construction, Prepared by Efficiency Valuation Organization, EVO 30000 – 1.2006, or current version.
- Monthly electricity consumption data from a sample of occupied project residences shall be collected for each year of the crediting period to determine the annual electricity consumption value, for each year of the crediting period, of all occupied project residences. The sample shall be selected to determine electricity consumption with a minimum confidence level of 90% and a maximum error bound of ±10%. The minimum sample size of occupied residences shall be 100, however if the project has fewer than 100 residences, then all occupied project residences' electricity consumption shall be used. In determining electricity consumption of all project residences, only occupied residences shall be included in the totals.
- A computer simulation model shall be used to determine the annual baseline residence electricity consumption value for an average baseline residence, for each year of the crediting period. Baseline electricity consumption is then determined by multiplying the annual electricity consumption of an average baseline residence times the number of occupied project residences. Input to the model will include actual weather data and characteristics of the project residences, such as occupied floor area, number of residences, etc. The model shall meet the specifications of and be calibrated per the requirements of ASHRAE[5] Guideline 14-2002, Measurement of Energy and Demand Savings, Whole Building Calibrated Simulation Performance Path[6].
- For the purposes of model calibration, monthly electricity consumption data from a sample of occupied baseline residences shall be collected. The sample shall be selected to determine average annual electricity consumption with a minimum confidence level of 90% and a maximum error bound of ±10%. The minimum sample

[5] American Society of Heating, Ventilating, and Air Conditioning Engineers, Atlanta, Georgia, USA.
[6] Or current version or equivalent guideline.

size of occupied residences shall be 100, however if the project has fewer than 100 residences, then an equivalent number of baseline residences can be used. Information on building and occupant characteristics, and monthly weather data, for use in model calibration, shall also be collected for the same baseline residences to define "average" conditions for model calibration. The model shall be calibrated for the first crediting period year and every third year thereafter (e.g., year 4, 7, 10) using data (energy use, weather data, residence characteristics) collected during the same years that the model is calibrated.

- Separate computer simulation models shall be constructed and calibrated for single and multi-family baseline residences.

10. For using option 8 (b), annual electricity savings determined with comparison group and regression analyses shall be done using the following protocol:

- A regression model shall be developed and used to determine per residence, average daily electricity savings for each crediting year;
- A sample of 100[7] project residences should be included in the regression analysis. The number of baseline residences (comparison group) should also be 100. If the project has fewer than 100 residences, then all project residences and an equal sample of baseline residences shall be used[8];
- The regression model shall use average daily energy consumption (determined from monthly electricity consumption billing data) during the post-project residence installation period (the crediting period) as the dependent variable and at least (a) weather, (b) a value for non-variable base load electricity consumption, and (c) an indicator of participation (EE=1 if project and 0 otherwise) as the primary independent variables. Other variables[9] should be included in the model as indicated through surveys or other means for both baseline and project residences. The regression model has the following specification:

$$\mathrm{ADC}_{\mathrm{j,m,y}} = \alpha + \beta \mathrm{EEj} + \lambda_1 HDD_{j,m,y} + \lambda_2 CDD_{j,m,y} + \gamma X_j \quad \textbf{(2)}$$

This model needs to be separately evaluated for each residence type *i* (single versus multifamily) and each residence in the baseline or project sample *j*. The objective of Equation 2 is to solve for β, the estimate of daily electricity savings for the prior 12 month period. Annual Electricity savings are then determined by the following equation:

$$ES_{y,i} = \beta_i \times (365\ days/years) \times N_i \quad \textbf{(3)}$$

[7] This sample size is based on an assumed coefficient of variation of 50% and 90/10 confidence and precision requirement.

[8] For example, if the baseline residence and project residence sample sizes are each 100, then the number of required annual observations for baseline and project residences (data sets with monthly average daily energy consumption, HDD, CDD, X, and α data) equals (100 residences) X (2) X (12 months), or 2,400.

[9] For example, number and age of occupants, floor area, heating system type, cooling system type, number and average power rating of appliances.

Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories

II.x. Energy efficiency and renewable energy measures in new residential buildings (cont)

Where:

$ADC_{j,m,y}$	Average daily electricity consumption during the post-treatment year *y* for both the project and baseline residences (residence *j* for month m). ADC is computed by dividing the total bill for month m by the number of days in the billing period. Each year, 12 ADC values are computed and used
EEj	Set to 1 if energy efficiency improvements have been installed and 0 otherwise (i.e., project residences have a 1 in all months and baseline residences have a 0 in all months
α	Non-variable base load electricity consumption, for example electricity consumption associated with appliances in constant operation
$HDD_{j,m,y}$	Average daily heating degree days based for residence *j* in month m
$CDD_{j,m,y}$	Average daily cooling degree days based for residence *j* in month m
X_j	Important characteristics that need to be included for project and baseline residences (number of occupants, occupied floor area, heating system type, cooling system type)
β	Estimate of daily electricity savings for a 12 month period
N	Number of project residences

- To be utilized to determine emission reductions the t-test associated with β has to be ≤-1.645, for a 90% confidence.
- To be utilized to determine emission reductions the regression model must be documented with a complete report indicating at least who completed the regression analyses, key assumptions, the regression results, the survey instrument(s), final sample results, and comparison between baseline and project homes with respect to key variables (size, occupancy, etc.)

Monthly baseline and project residence electricity consumption and weather data, current for each crediting period year, must be used for the regression analyses. However, new survey data for updating X coefficient(s) and α are not required for each crediting year. Such data only needs to be collected, and used to update the value for α and the X coefficient(s), for the first crediting period year and every third year thereafter (e.g., year 4, 7, 10).

11. Measures are limited to those that result in emissions reductions of less than or equal to 60 kt CO_2 equivalent annually by a single project activity.

Indicative simplified baseline and monitoring methodologies
for selected small-scale CDM project activity categories

II.x. Energy efficiency and renewable energy measures in new residential buildings (cont)

12. If renewable energy, electricity-generating systems (e.g., a photovoltaic system) are installed as part of the project residences and deliver all of their output to the grid (and none to the project residences) then the net amount of documented electricity production can be added to the value of ES, annual electricity savings from project activity residences calculated per paragraphs 9 or 10.

Leakage

13. No leakage is expected.

Monitoring

14. Monitor the following:

- Monthly electricity consumption of a sample of project residences, collected using utility revenue meter data or other calibrated electricity metering equipment, collected for each year of the crediting period;
- Monthly HDD and CDD for baseline and project residences, collected for each year of the crediting period;
- For renewable energy systems delivering electricity only to the project grid, net monthly electricity production provided to the grid of all project residences' renewable energy electricity-generating systems, collected using utility revenue meter data or other calibrated electricity metering equipment, collected for each year of the crediting period;
- If calibrated model simulation approach is used, survey data of baseline residence characteristics as determined necessary for model calibration, collected in years indicated in paragraph 9;
- If regression analysis is used, survey data of baseline and project residence characteristics as determined necessary for regression analyses, collected in years indicated in paragraph 10;
- Annual records of project residence occupancy to determine the quantity N_i that are occupied during each crediting year.

Project activity under a programme of activities

15. No special considerations required.

- - - - -

Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories

II.x. Energy efficiency and renewable energy measures in new residential buildings (cont)

History of the document

Version	Date	Nature of revision(s)
01	EB 48, Annex 14 17 July 2009	Initial adoption.
Decision Class: Regulatory **Document Type**: Standard **Business Function**: Methodology		