

CDM-MP82-A03

Draft Small-scale Methodology

AMS-II.E.: Energy efficiency and fuel switching measures for buildings

Version 12.0

Sectoral scope(s): 03

DRAFT



United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The Executive Board of the Clean Development Mechanism (CDM-EB), at its 103rd meeting (EB 103 report, para. 35), requested the Methodologies Panel (MP) to revise the methodology to include methods and equations to calculate emission reductions for projects that do not apply "TOOL31: Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings".

2. Purpose

2. The purpose of the revision is to address the situations indicated in the mandate from the Board at its 103rd meeting.

3. Key issues and proposed solutions

3. The methodology neither contained detailed methods and equations to determine emission reductions from energy efficiency measures implemented in residential, commercial and institutional buildings, nor detailed monitoring requirements of key parameters, such as electricity and fuel consume by the buildings included in the project activity. As a result, the above requirements were subject to interpretation.
4. The proposed revision includes methods and equations to identify the baseline, determine emission reductions from energy savings and fuel switching for projects involving both construction of new building units ("new buildings") and retrofit of existing building units ("existing building") and monitoring provisions for the relevant parameters. The methodology also contains provisions to address cross effects, such as projects involving energy efficiency, fuel switching and renewable energy.
5. The methodology proposes an additional approach to determine emission reductions in residential building units only, based on the specific CO₂ emissions per occupant of the top-20% best performing building units.
6. The following parameters are determined for the baseline building unit and shall remain fixed:
 - (a) Construction features (for projects involving new buildings);
 - (b) Average number of occupants;
 - (c) Heating-Degree-Days (HDD) and Cooling-Degree-Days (CDD) of the region where the baseline building unit is located;
 - (d) Quantity of electricity and type of fuel consumed.
7. The following parameters shall be monitored for the project building unit during the crediting period:
 - (a) Average number of occupants;

- (b) Heating-Degree-Days (HDD) and Cooling-Degree-Days (CDD) of the region where the baseline building unit is located;
 - (c) Quantity of electricity and type of fuel consumed.
8. A call for public inputs on the draft revised version proposed by the Panel at its 81st meeting was launched between 03 March to 01 April. The following comments were received from a stakeholder:
- (a) On the proposed new section “5.5. Emission reductions from project activities applying a standardized CO₂ emission factor per occupant”, the stakeholder agrees with the inclusion of the parameter “Occupancy” to reflect the behavior of the building unit’s occupants, however equation 7 is not appropriate since the relation between energy consumption and number of occupants is not linear;
 - (b) On the monitoring of the parameter “Occupancy_{j,BL}” (Data / Parameter table 7), the stakeholder proposes to include the use of statistical methods in addition to get this information directly from the owners of all building units included in the project;
 - (c) Among the two thresholds proposed for the Gross Floor Area (GFA) to identify similar buildings for projects involving new buildings, the stakeholder proposes to adopt 50.

4. Impacts

9. The revision of the methodology, if approved, will broaden the applicability of the methodology which will potentially facilitate the development of more CDM project activities and Programmes of Activities in the building sector.

5. Subsequent work and timelines

10. The methodology is recommended by the MP for consideration by the Board at its 107th meeting. No further work is envisaged.

6. Recommendations to the Board

11. The MP recommends that the Board adopt this final draft methodology, to be made effective at the time of the Board’s approval.

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1. Introduction

1. The following table describes the key elements of the methodology:

Table 1. Methodology key elements

Typical project(s)	Installation of, or replacement or retrofit of, existing equipment with energy efficiency (e.g. efficient appliances, better insulation) and optional fuel switching (e.g. switch from oil to gas) measures in residential, commercial or institutional buildings
Type of GHG emissions mitigation action	Energy efficiency: Electricity and/or fuel savings through energy efficiency improvement. Optionally, use of less-carbon-intensive fuel

2. Scope, applicability, and entry into force

2.1. Scope

2. The scope of this methodology includes project activities that implement energy efficiency measures (including savings of electricity and fuel) and/or fuel switching in new or existing residential, commercial or institutional building units or group of building units – a non-binding detailed list of building categories is presented in Appendix 1. ~~This category comprises any energy efficiency and fuel switching measure implemented at a single building, such as a commercial, institutional or residential building, or group of similar buildings, such as a school, district or university.~~
3. This ~~category methodology~~ covers project activities aimed primarily at energy efficiency.¹ Examples include technical energy efficiency measures (such as efficient appliances, better insulation and optimal arrangement of equipment, **BEMS – Building Energy Management Systems**) and fuel switching measures (such as switching from oil to gas).
4. The technologies may replace existing equipment or be installed in new facilities and shall not transferred from another project activity.
5. The aggregate energy savings of a single project may not exceed the equivalent of 60 GWh per year.

2.2. Applicability

6. This ~~category methodology~~ is applicable to project activities where it is possible to directly measure and record the energy use within the project boundary (e.g. electricity and/or fossil fuel consumption).
7. This ~~category methodology~~ is applicable to project activities where the impact of the measures implemented (improvements in energy efficiency) by the project activity can be

¹ Project activities that involves primarily fuel switching falls into category III.B; therefore, fuel-switching measures that are part of a package of energy efficiency measures at a single location may be part of a project activity included in this project category.

clearly distinguished from changes in energy use due to other variables not influenced by the project activity (signal to noise ratio).

8. Project activities that involve fuel switching and/or the installation of renewable energy technologies to generate electricity for self-consumption (e.g. rooftop solar PV panels) are eligible under this methodology, if the following requirements are met:

(a) For fuel switching measures:

(i) Fuel switching is implemented as part of a package of energy efficiency measures at a single building, and project activities that involve primarily fuel switching shall apply the appropriate type III methodology (e.g. AMS-III.B.);

(ii) To address potential cross-effects between the energy efficiency and fuel switching measures, the baseline for the fuel switching component is set after considering the effects of the implementation of the energy efficiency measures (i.e. the fuels consumed by building in the project activity shall be adjusted taking into account the energy efficient building scenario);

(b) For renewable energy technologies:

(i) Emission reductions from installation of renewable energy technologies shall be determined as per an applicable Type I methodology (e.g. "AMS-I.F.: Renewable electricity generation for captive use and mini-grid");

(ii) The electricity consumed from renewable energy technologies and the electricity consumed from the grid or from captive power plant are measured through appropriate and reliable measurement procedures;

(iii) To address potential cross-effects between the energy efficiency and fuel switching measures, the baseline for the renewable energy technology component is set after considering the effects of the implementation of the energy efficiency measures.

2.3. Entry into force

9. The date of entry into force is the date of the publication of the EB ## meeting report on DD Month YYYY.

2.4. Applicability of sectoral scopes

10. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology, application of sectoral scope 03 is mandatory.

3. Normative references

11. Project participants shall take into account the General guidelines for SSC CDM methodologies, Attachment B to Appendix B, "TOOL21: Demonstration of additionality of small-scale project activities" and "TOOL22: Leakage in biomass small-scale project activities" provided at <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html>.

12. This methodology also refers to the latest approved versions of the following approved methodology(ies):
- (a) "TOOL03: Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion" (hereinafter referred as TOOL03);
 - (b) "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (hereinafter referred as TOOL05);
 - (c) "TOOL07: Tool to calculate the emission factor for an electricity system" (hereinafter referred as TOOL07);
 - (d) "TOOL19: Demonstration of additionality of microscale project activities" (hereinafter referred as TOOL19);
 - (e) "TOOL21: Demonstration of additionality of small-scale project activities" (hereinafter referred as "TOOL21");
 - (f) "TOOL31: Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings" (hereinafter referred as TOOL31);
 - (g) "AMS-I.F.: Renewable electricity generation for captive use and mini-grid";
 - (h) "AMS-III.B.: Switching fossil fuels".

4. Definitions

13. In addition to the definitions contained in the Glossary of CDM terms, the following definitions shall apply for the purpose of this methodology:
- (a) **Building unit** – distinct space in a building allotted to a specific user, which can be either a tenant or owner. If a building has more than one tenant/owner², a building unit is defined as a subordinate structure of a building rented by one tenant or used by an owner³. If a building is used by a single tenant/owner, the building unit is equal to the entire building⁴;
 - (b) **Gross floor area (GFA)** – area occupied by internal walls and partitions of a building unit. If a building unit contains common service areas in its physical boundary (meeting rooms, corridors, lift wells, plant and machinery, etc.), include GFA of the common service areas. Otherwise, GFA of the common service areas shall be excluded;
 - (c) **Heating Degree days (HDD)** – heating degree days are a measure of how much (in degrees), and for how long (in days), the outside air temperature was below a

² A tenant/owner can be either an individual, or a group of individuals sharing the same building unit.

³ Residential building unit is an example. The term residential building unit refers to a single housing unit. Namely, a single-family home is one residential building unit while a building with ten apartments has ten residential building units.

⁴ Schools are a typical example. As a school is normally occupied by an owner (e.g. municipality), the entire school building, not each classroom, is considered as a building unit.

certain level. They are commonly used in calculations relating to the energy consumption required to heat buildings;

- (d) **Cooling Degree Days (CDD)** – cooling degree days are a measure of how much (in degrees), and for how long (in days), the outside air temperature was above a certain level. They are commonly used in calculations relating to the energy consumption required to cool buildings;
- (e) **B-settings** – physical base properties of a building, such as building envelope (e.g. dimensions and building geometry, location of building surfaces such as windows, doors and skylights, orientation of external surfaces, building shades and shading from nearby objects, relative position of the building thermal zones) and thermal properties (layer-by-layer description of the building materials with their conductivity, specific heat and density);
- (f) **T-settings** – tenancy-related characteristics of a building, such as internal loads (occupancy or average number of people per time period,⁵ lighting and equipment power density⁶, internal load schedules and plug loads, including their counts, nameplate data, usage schedules and diversity of operations, and building operations reflecting occupant behavior.⁷

5. Baseline methodology

5.1. Project boundary

14. The project boundary is the physical, geographical site of the building(s).

5.2. Baseline Demonstration of additionality

15. Provisions from the TOOL21 or TOOL19 shall be followed to demonstrate additionality for both energy savings and fuel switching components of the project.
16. ~~The energy baseline consists of the energy use of the existing equipment that is replaced in the case of retrofit measures and of the facility that would otherwise be built in the case of a new facility.~~
17. ~~Each energy form in the emission baseline is multiplied by an emission coefficient. For the electricity displaced, the emission coefficient is calculated in accordance with provisions under the “TOOL07: Tool to calculate the emission factor for an electricity system”. For fossil fuels, the IPCC default values for emission coefficients may be used.~~

⁵ Such as population counts in weekdays, weekends and holidays, assignments to thermal zones.

⁶ Data collected may include fixture counts, fixture types, nameplate data from lamps and ballasts, 24-hour weekday, weekend and holiday schedule of lighting use, characteristics of fixtures for estimating radiative and connective heat flows, thermal zone assignments and diversity of operations.

⁷ Such as control temperatures, window opening, other related schedules, actual weather data, energy consumption (by fuel type) in the first 12 months of building operation.

5.3. Emission Reductions

18. The methodology provides three options to determine emission reductions: based on ex-post monitoring of fuel and electricity consumed (Option 1), based on a standardized tCO₂ emission factor per m² (Option 2) and based on a standardized value of tCO₂ emissions per occupant of building (Option 3).

5.3.1. Option 1: emission reductions determined based on ex-post monitoring of fuel and electricity consumption

19. Under this option emission reductions are determined as the sum of the emission reductions associated with the savings of electricity, savings of fuel and fuel switching by the project building *j* during the crediting period.

$$ER_y = \sum_j ER_{Elec\ Savings,j,y} + ER_{Fuel\ Savings,j,y} + ER_{Fuel\ Switching,j,y} \quad \text{Equation (1)}$$

Where:

ER_y	=	Emission reductions in year <i>y</i> (tCO ₂)
$ER_{Elec\ Savings,j,y}$	=	Emission reductions due to electricity savings from the building unit <i>j</i> in year <i>y</i> (tCO ₂)
$ER_{Fuel\ Savings,j,y}$	=	Emission reductions due to fuel savings from the building unit <i>j</i> in year <i>y</i> (tCO ₂)
$ER_{Fuel\ Switching,j,y}$	=	Emission reductions due to fuel switching from the building unit <i>j</i> in year <i>y</i> (tCO ₂)
<i>j</i>	=	Each building unit included in the project activity

20. Emission reductions from electricity savings are calculated as the difference between the electricity that would have been consumed by the baseline building unit ($EC_{BL,j}$) and the electricity consumed by the building unit *j* during the crediting period, multiplied by the CO₂ emission factor of the source supplying electricity to the building unit *j*.

$$ER_{Elec\ Savings,j,y} = \frac{EC_{BL,j} - EC_{j,y}}{1 - TDL_{AVG-k,y}} \times EF_{EL,k,y} \quad \text{Equation (2)}$$

Where:

$EC_{BL,j}$	=	Electricity that would have been consumed by the baseline building unit <i>j</i> (MWh), determined as the average electricity consumed over the 3 years prior to the start date of the project activity
$EC_{j,y}$	=	Electricity consumed by the project building unit <i>j</i> in year <i>y</i> (MWh)
$EF_{EL,k,y}$	=	Weighted average CO ₂ emission factor of the sources <i>k</i> that supply electricity to the building unit <i>j</i> in year <i>y</i> (tCO ₂ /MWh), excluding renewable energy technologies. If there is no separate monitoring of electricity consumed from different sources or there are no plausible method of distinguishing between the sources, use the source with the lowest CO ₂ emission factor

$TDL_{AVG-k,y}$ = Average technical transmission and distribution losses for consuming electricity from source k in year y

21. The electricity sources k can be either an electric grid, a captive power plant or a combination of both, and the $EF_{EL,k,y}$ shall be determined based on the scenarios listed in section 6.2.1.1 of the TOOL05.
22. If the project involves the installation of solar PV panels to supply electricity to the building unit, emission reductions from this source shall be claimed under a Type I methodology (e.g. AMS-I.F.), taking into account any potential cross-effects. If the electricity consumed from the solar PV panels and from the source k cannot be measured separately or be distinguished, project participants may determine the electricity consumed from the solar PV panels:
- By multiplying the capacity of the solar panel by a conservative default value of twelve per cent (12%) for the annual average value for availability; or
 - Based on modelling softwares, e.g. the “RETScreen® International Photovoltaic Project Model” included in the “RETScreen Clean Energy Project Analysis Software”⁸.
23. Emission reductions from fuel savings are calculated as the difference between the energy content of the fuel that would have been consumed by the baseline building unit ($ECF_{BL,j}$) and the energy content of the fuel(s) consumed by the building unit j during the crediting period, multiplied by the CO₂ emission factor of the fuel consumed by the building unit j .

$$ER_{Fuel\ Savings,j,y} = \left(ECF_{BL,j} - \sum_f ECF_{f,j,y} \right) \times EF_{CO_2,AVG-f,y} \quad \text{Equation (3)}$$

Where:

$ECF_{BL,j}$ = Energy content of the fuel(s) that would have been consumed by the baseline building unit j (GJ), representing the average of the product between the mass or volume of fuel consumed by the NCV of the fuel in GJ per mass or volume units over the 3 years prior to the start date of the project activity.

$ECF_{f,j,y}$ = Energy content of the fuel type f consumed by the project building unit j in year y (GJ).

$EF_{CO_2,AVG-f,y}$ = Average CO₂ emission factor of the different fuel types f that are consumed by the building unit j in year y (tCO₂/GJ).
If the project does not monitor the consumption of different fuels separately, use the source with the lowest CO₂ emission factor for $EF_{CO_2,AVG-f,y}$.

⁸ In doing so, the requirements from paragraph 34(b)(ii) of “AMS-I.L: Electrification of rural communities using renewable energy”, version 3.0, shall be followed.

24. The energy content of the fuel type f consumed by the building unit j in year y is calculated as the product between the mass or volume of fuel consumed and the net calorific value of the fuel.

$$ECF_{f,j,y} = FC_{f,j,y} \times NCV_f \quad \text{Equation (4)}$$

Where:

$FC_{f,j,y}$	=	Quantity of fossil fuel type f consumed by the building unit j in year y (mass or volume units)
$NCV_{f,y}$	=	Net calorific value of the fuel type f in year y

25. Emission reductions from fuel switching are determined based on the amount of fuel type f consumed by the building unit j in during the crediting period, multiplied by the NCV of the fuel type f and by the difference between the CO₂ emission factors of the baseline fuel f, BL and the project fuel f .

$$ER_{Fuel\ Switching,j,y} = EFC_{f,j,y} \times (EF_{CO_2,f,BL} - EF_{CO_2,AVG-f,y}) \quad \text{Equation (5)}$$

Where:

$EFC_{f,j,y}$	=	Energy content of the fuel type f consumed by the project building unit j in year y (GJ)., determined based on the equation (4) above.
$EF_{CO_2,f,BL}$	=	CO ₂ emission factor of the fuel type f consumed by the building unit j in the baseline (tCO ₂ /GJ), determined according to the provisions from the TOOL03.
$EF_{CO_2,AVG-f,y}$	=	Weighted average CO ₂ emission factor of the different fuel types f that are consumed by the building unit j in year y (tCO ₂ /GJ).

26. The quantity of electricity and fossil fuels that would have been consumed by the baseline building unit associated with the building unit j ($EC_{BL,j}$ and $EFC_{BL,j}$, respectively) are determined separately for projects involving the construction of new buildings and for the retrofit of existing building units.

27. $EC_{BL,j}$ and $EFC_{BL,j}$ shall remain fixed throughout the project lifetime if the requirements listed below are met, otherwise these parameter shall be determined via a calibrated computer simulation modelling for the specific year – refer to Appendix 2 for details for running a computer simulation modelling⁹.

- For residential building units, the building unit's j average number of occupants per year ($Occupancy_{j,y}$) during the crediting period is between $\pm 20\%$ of the average baseline building unit's j occupancy ($Occupancy_{j,BL}$) over the last 3 years prior to the start date of the project activity;
- For commercial and institutional building units, the average yearly operating hours ($h_{OP,y}$) of the unit j is at least 30 hours/week;

⁹ As an alternative to simulation modelling, a complete direct measurement of all building units included in the project activity can be applied to adjust the baseline proportionally to the changes in occupancy, CDD and HDD if the project involves more than 300 building units.

- (c) The Cooling Degrees Days (CDDs) of the region where the building unit j is located observed during each year of the crediting period (CDD_y) are within $\pm 20\%$ of the average CDD over the last 3 years prior to the start date of the project activity¹⁰ (CDD_{BL});
- (d) The Heating Degrees Days (HDDs) of the region where the building unit j is located observed during each year of the crediting period are within $\pm 20\%$ of the average HDD over the last 3 years prior to the start date of the project activity (HDD_{BL});

5.3.1.1. Retrofit of existing building units

28. For project activities involving the retrofit of an existing building unit j , the baseline electricity consumed and the baseline fuel consumed are, respectively, the average electricity and the average energy content of the fuel consumed by the existing building unit over the last 3 years prior to the start date of the project activity.
29. The type of fuel consumed by existing buildings f, BL shall be documented in the PDD. If the baseline building consumes more than one type of fuel, the parameter $EF_{CO_2, f, BL}$ shall represent the weighted average CO₂ emission factor of the different fuels – if the separate monitoring of the different fuels is not possible, $EF_{CO_2, f, BL}$ shall refer to the source with the lowest CO₂ emission factor.
30. Sampling can be used to determine $EC_{BL, j}$ and $EFC_{BL, j}$ only if similar building units are included in the sample, where similar buildings are defined in section 5.3.1.2.1 below. The latest version of the “Standard: Sampling and surveys for CDM project activities and programme of activities” and the “Guideline: Sampling and surveys for CDM project activities and programmes of activities” shall be followed¹¹.

5.3.1.2. New buildings

31. The baseline electricity and fuel consumed by new buildings shall be determined through a sample-based measurement in similar buildings chosen in accordance with section 5.3.1.2.1 below. Electricity and fuel consumed may also be determined through computer simulation modelling that meet the conditions below:
- (a) it has successfully met the analytical verification and empirical validation requirement as defined in the International Energy Agency’s BESTEST¹² protocol or in a comparable international or national standard (e.g. ASHRAE 140); or
- (b) it is publicly available and peer-reviewed scientific studies have acknowledged that it successfully simulates the energy consumption of residential buildings.

¹⁰ HDDs and CDDs can be obtained in <<https://www.degreeedays.net/#>>. The base temperatures used to determine HDDs and CDDs shall be the same in the baseline and project scenarios.

¹¹ When determining the sample size, project participants may define the sample size, strata and clusters based on the variability of different building features, e.g. U-value or thickness of insulators, heat-pump sizes, etc.

¹² The Building Energy Simulation Test (BESTEST) is a methodology for testing computer models (as implemented in software tools) using a combination of empirical validation, analytical verification and comparative analysis techniques.

32. To determine the electricity (EC_{BL}), the quantity of fuel (EFC_{BL}) and type of fuel (f, BL) consumed by a baseline building, the following requirements apply:

(a) If there is a legally mandated code on energy performance and/or equipment performance standard(s), the inputs to the computer simulation tool shall be based on minimum energy requirements in the building code and/or equipment performance standard(s) for the subject building type(s) or classification(s).

(b) If there is no legally mandated building code nor equipment performance standard(s) on energy performance, the construction features and type of fuel that would have been consumed by the baseline building to feed the computer simulation tool shall be based on:

(i) An opinion provided by a construction company or expert (e.g. a third-party architect or Chartered Engineer);

(ii) An existing building unit that:

a. Has been constructed less than 3 years prior to the start date of the project activity;

b. Is used for the same purpose of the project building unit;

c. Meets the occupancy, CDD and HDD requirements specified in paragraph 27 of the project building unit;

d. Has a Gross Floor Area (GFA) of $\pm 20\%$ of the project building unit.

5.3.1.2.1. Sample of Similar Buildings

33. Under this option, the electricity (EC_{BL}), the quantity of fuel (EFC_{BL}) and type of fuel (f, BL) consumed by the baseline building are determined based on records of the highest annual electricity and the fuel with the lowest CO₂ emission factor consumed by a sample of similar building units whose construction has been finalized over the last 5 years and that have been occupied at least over the last 3 years. Sampling shall follow the latest version of the "Standard: Sampling and surveys for CDM project activities and programme of activities" and the "Guideline: Sampling and surveys for CDM project activities and programmes of activities".

34. Similar building units are defined as building units that:

(a) Belong to the same building category and that are used for the same purpose of the project building unit j ;

(b) Are located in an area with similar socio-economic conditions to the one in which the project building units are located;

(c) Are located in the same city or metropolitan region. If there are no new similar units in the city or metropolitan region, select a similar building unit from a region with average temperature and humidity within $\pm 10\%$ of the average temperature and humidity of the region of the project building unit;

(d) Have a GFA of $\pm 20\%$ of the project building unit j ;

- (e) Meets the occupancy requirements specified in paragraph 27 of the project building unit.

5.3.2. Option 2: emission reductions determined based on a standardized CO₂ emission factor per m²

35. For project activities that apply a standardized baseline that standardizes the specific CO₂ emissions per m², determined based on the “TOOL31: Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings”, emission reductions are determined separately for new buildings and for existing buildings¹³ based on the equation below:

$$ER_y = BE_y - PE_y \quad \text{Equation (6)}$$

Where:

ER_y = Emission reductions in year y (tCO₂e)

BE_y = Baseline emissions in year y (tCO₂e)

PE_y = Project emissions in year y (tCO₂e)

36. BE_y represents the energy that would have been consumed by buildings from the same category i and located in the same geographical scope in the absence of the project, and is determined as:

$$BE_y = \sum_i \sum_j (SE_{CO_2, Top20\%, i} \times GFA_{j, i, y}) \quad \text{Equation (7)}$$

Where:

$SE_{CO_2, Top20\%, i}$ = Average specific CO₂ emissions of the top 20 per cent performing building units in building unit category i included in the sample over the applicable data coverage period (tCO₂/(m² year)). This parameter is determined following the “TOOL31: Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings”.

$GFA_{j, i, y}$ = Gross floor area of the project building unit j in building unit category i in year y (m²)

j = Building units included in the project activity

i = Building unit categories

¹³ The definitions of cohort of new buildings and cohort of existing buildings from the tool shall apply.

37. PE_y represents the emissions associated with the consumption of energy by the project buildings in the project scenario, and is determined as:

$$PE_y = \sum_i \sum_j \left(\frac{EC_{j,i,y} \times EF_{elec,y}}{1 - TDL_y} \right) + (FC_{k,j,i,y} \times NCV_k \times EF_{CO2,k}) \quad \text{Equation (8)}$$

Where:

$FC_{k,j,i,y}$	=	Fossil fuel type k consumed by the project building unit j in building unit category i in year y (mass or volume units)
NCV_k	=	Net calorific value of the fossil fuel type k (GJ/mass or volume units)
$EF_{CO2,k}$	=	CO ₂ emission factor of the fossil fuel type k (tCO ₂ /GJ)
$EC_{j,i,y}$	=	Electricity consumed by the project building unit j in building unit category i in year y (MWh)
$EF_{elec,y}$	=	Emission factor of the electric grid supplying electricity to the project building unit j in building unit category i (tCO ₂ e/MWh)
TDL_y	=	Average technical transmission and distribution losses for providing electricity to the grid to which the project building unit j in building unit category i is connected

38. The parameters $EC_{j,i,y}$, $FC_{k,j,i,y}$ and $GFA_{j,i}$ can be determined by sampling, with 90/10 confidence/precision levels in accordance with the latest version of the standard "Sampling and surveys for CDM project activities and programme of activities".

5.3.3. Option 3 emission reductions determined based on a standardized tCO₂ emission factor per occupant

39. For project activities involving residential building units only, baseline emissions can be determined by multiplying a standardized CO₂ emission factor per occupants ($SE_{CO2,Top20\%,occ,i}$) by the number of occupants of a residential building unit j during the crediting period ($Occ_{j,i,y}$), as indicated by the equation below:

$$BE_y = \sum_i \sum_j (SE_{CO2,Top20\%,occ,i} \times Occ_{j,i,y}) \quad \text{Equation (9)}$$

Where:

$SE_{CO2,Top20\%,occ,i}$	=	Average specific CO ₂ emissions of the top 20 per cent performing building units in building unit category i included in the sample over the applicable data coverage period based on the average number of occupants (tCO ₂ /(person. year))
$Occ_{j,i,y}$	=	Average number of occupants of the project building unit j in building unit category i in year y (m ²)
j	=	Building units included in the project activity
i	=	Building unit categories

40. The average specific CO₂ emissions from the top-20% best performing buildings under the building category *i* over the applicable data coverage period for new and existing buildings¹⁴ is determined following the equation below:

$$SE_{CO_2,Top20\%,occ,i} = \frac{\sum_j SE_{CO_2,Top20\%,occ,j,i,BL}}{J_{i,BL}} \quad \text{Equation (10)}$$

Where:

$SE_{CO_2,Top20\%,occ,i}$ = Specific CO₂ emissions of building unit *j* in the top 20% performing building units in building unit category *i* included in the sample over the relevant data coverage period based on the number of occupants (tCO₂/(person·year))

$J_{i,BL}$ = Total number of the top 20 per cent performing building units of building unit category *i* in each of the years of the applicable data coverage period, calculated as the product of the number of baseline building units in building category *i* included in the sample and 20 per cent, rounded up to the next integer if it is decimal

41. The specific emissions of baseline building unit *j* in building unit category *i* included in the sample over the applicable data coverage period are determined following the equation below:

$$SE_{j,i,occ,BL} = \frac{BE_{electricity,j,i,BL} + BE_{fuel,j,i,BL} + BE_{water,j,i,BL}}{OCC_{j,i,BL}} \quad \text{Equation (11)}$$

Where:

$SE_{j,i,occ,BL}$ = Specific CO₂ emissions of baseline building unit *j* in building unit category *i* included in the sample over the applicable data coverage period based on the average number of occupants (tCO₂/(person·year))

$BE_{electricity,j,i,BL}$ = Baseline emissions from electricity consumption of baseline building unit *j* in building unit category *i* included in the sample over the applicable data coverage period (tCO₂/year)

$BE_{fuel,j,i,BL}$ = Baseline emissions from fossil fuel consumption of baseline building unit *j* in building unit category *i* included in the sample over the applicable data coverage period (tCO₂/year)

$BE_{water,j,i,BL}$ = Baseline emissions from chilled/hot water consumption of baseline building unit *j* in building unit category *i* included in the sample over the applicable data coverage period (tCO₂/year)

$OCC_{j,i,BL}$ = Average number of occupants living in the baseline building unit *j* in building unit category *i* included in the sample over the applicable data coverage period (person)

42. $BE_{electricity,j,i,BL}$, $BE_{fuel,j,i,BL}$ and $BE_{water,j,i,BL}$ are determined based on sections 4.1 to 4.3 of the TOOL31.

¹⁴ The definitions and requirements from the TOOL31 shall be applied mutatis mutandis.

43. Project emissions and emission reductions are determined based on section 5.3.2 above mutatis-mutandis.

5.4. Leakage

44. If the energy efficiency technology is equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered.

6. Monitoring methodology

Data / Parameter table 1.

Data / Parameter:	$EC_{j,y} / EC_{BL,j}$
Data unit:	MWh
Description:	$EC_{j,y}$: Electricity consumed by the project building unit j in year y $EC_{BL,j}$: Electricity that would have been consumed by the baseline building unit j
Source of data:	Based on the provisions from the latest version of TOOL05.
Measurement procedures (if any):	Based on the provisions from the latest version of TOOL05.
Monitoring frequency:	Based on the provisions from the latest version of TOOL05. The monitoring requirements for $EC_{PJ,j,y}$, specified in the tool, shall apply
QA/QC procedures:	Based on the provisions from the latest version of TOOL05.
Any comment:	<p>Preferably, the consumption of electricity from different sources shall be monitored separately.</p> <p>This parameter can be determined based on sampling, provided that:</p> <ul style="list-style-type: none"> the latest version of the “Standard: Sampling and surveys for CDM project activities and programme of activities” and the “Guideline: Sampling and surveys for CDM project activities and programmes of activities” is followed; only similar building units, defined in section 5.3.1.2.1, shall be included in one sample. If the project involves building units that do not comply with the definition of similar building units, sampling shall be conducted individually for each different groups of buildings; the average electricity consumed by the building units included in each sample is multiplied by the number of similar building units to determine $EC_{j,y}$. <p>The parameter $EC_{BL,j}$ does not need to be monitored ex-post, however it shall be determined and fixed ex-ante by following the measurement procedures and QA/QC procedures above.</p>

Data / Parameter table 2.

Data / Parameter:	$EF_{EL,k,y}$
Data unit:	tCO ₂ /MWh
Description:	Average CO ₂ emission factor of the sources k that supply electricity to the building unit j in year y
Source of data:	If the source k is an electric grid, calculate the combined margin emission factor, using the procedures in the latest approved version of TOOL07. If the source k is a captive fossil fuel fired power plant, calculate based on the parameters $FC_{n,i,t}$ (quantity of fossil fuel type i fired in the captive power plant n in the time period t), $NCV_{i,t}$ (average net calorific value of fossil fuel type i used in the period t), $EF_{CO_2,i,t}$ (average CO ₂ emission factor of fossil fuel type i used in the period t) and $EG_{n,t}$ (Quantity of electricity generated in captive power plant n in the time period t)
Measurement procedures (if any):	Refer to the monitoring provisions of these parameters in the latest version of TOOL05
Monitoring frequency:	Refer to the monitoring provisions of these parameters in the latest version of TOOL05
QA/QC procedures:	Refer to the monitoring provisions of these parameters in the latest version of TOOL05
Any comment:	If there is no separate monitoring of electricity consumed from different sources k , the source with the lowest CO ₂ emission factor shall be used

Data / Parameter table 3.

Data / Parameter:	$TDL_{AVG-k,y}$
Data unit:	%
Description:	Average technical transmission and distribution losses for consuming electricity from source k in year y
Source of data:	Based on the provisions from the latest version of TOOL05
Measurement procedures (if any):	Based on the provisions from the latest version of TOOL05
Monitoring frequency:	Based on the provisions from the latest version of TOOL05
QA/QC procedures:	Based on the provisions from the latest version of TOOL05
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	$EF_{CO_2,f,BL}$ / $EF_{CO_2,AVG-f,y}$
Data unit:	tCO ₂ /GJ
Description:	$EF_{CO_2,f,BL}$: Average CO ₂ emission factor of the different fuel types f that are consumed by the baseline building unit j . $EF_{CO_2,f,y}$: Average CO ₂ emission factor of the different fuel types f that are consumed by the building unit j in year y
Source of data:	Based on the provisions from the latest version of TOOL03. When applying the tool, requirements for $EF_{CO_2,i,y}$, specified in the tool, shall apply
Measurement procedures (if any):	Based on the provisions from the latest version of TOOL03. When applying the tool, requirements for $EF_{CO_2,i,y}$, specified in the tool, shall apply
Monitoring frequency:	Based on the provisions from the latest version of TOOL03. When applying the tool, requirements for $EF_{CO_2,i,y}$, specified in the tool, shall apply
QA/QC procedures:	Based on the provisions from the latest version of TOOL03. When applying the tool, requirements for $EF_{CO_2,i,y}$, specified in the tool, shall apply
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	$FC_{f,j,y}$
Data unit:	Mass or volume units
Description:	Quantity of fossil fuel type f consumed by the building unit j in year y
Source of data:	Based on the provisions from the latest version of TOOL03.
Measurement procedures (if any):	Based on the provisions from the latest version of TOOL03.
Monitoring frequency:	The monitoring requirements for $FC_{i,j,y}$, specified in the tool, shall apply
QA/QC procedures:	Based on the provisions from the latest version of TOOL03.
Any comment:	This parameter can be determined based on sampling, provided that: <ul style="list-style-type: none"> the latest version of the “Standard: Sampling and surveys for CDM project activities and programme of activities” and the “Guideline: Sampling and surveys for CDM project activities and programmes of activities” is followed; only similar building units, defined in section 5.3.1.2.1, shall be included in the sample. If the project involves building units that do not comply with the definition of “similar building units”, sampling shall be conducted individually for each different groups of buildings; the average fuel consumed by the building units included in each sample is multiplied by the number of similar building units to determine $FC_{f,j,y}$

Data / Parameter table 6.

Data / Parameter:	$NCV_{f,y}$
Data unit:	GJ/mass or volume unit
Description:	Net calorific value of the fuel type f in year y
Source of data:	Based on the provisions from the latest version of TOOL03. The monitoring requirements for $NCV_{i,y}$, specified in the tool, shall apply
Measurement procedures (if any):	Based on the provisions from the latest version of TOOL03. The monitoring requirements for $NCV_{i,y}$, specified in the tool, shall apply
Monitoring frequency:	Based on the provisions from the latest version of TOOL03. The monitoring requirements for $NCV_{i,y}$, specified in the tool, shall apply
QA/QC procedures:	Based on the provisions from the latest version of TOOL03. The monitoring requirements for $NCV_{i,y}$, specified in the tool, shall apply
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	$Occupancy_{j,BL}$
Data unit:	Persons
Description:	Average yearly occupancy of the residential baseline building unit
Source of data:	Building unit owner
Measurement procedures (if any):	(i) Directly answer (ii) Determined based on baseline surveys
Monitoring frequency:	N/A. This parameter will be determined once and will remain fixed through the project lifetime
QA/QC procedures:	-
Any comment:	The following requirements apply when baseline surveys are used to determine this parameter: - Default number of occupants can be determined for buildings with different ranges of GFA; - The survey shall be conducted following the standard "Sampling and surveys for CDM project activities and programmes of activities".

Data / Parameter table 8.

Data / Parameter:	$Occupancy_{j,y}$
Data unit:	Persons
Description:	Average yearly occupancy of the residential building unit j in year y
Source of data:	Building unit owner

Measurement procedures (if any):	(i) Directly answer; (ii) Determined based on surveys conducted during the first year of the crediting period
Monitoring frequency:	At least once every two years (biennially)
QA/QC procedures:	-
Any comment:	The following requirements apply when surveys conducted during the first year of the crediting period are used to determine this parameter: - Default number of occupants shall be determined for buildings with different ranges of GFA if the baseline survey was conducted for buildings with different ranges of GFA; - The survey shall be conducted following the standard "Sampling and surveys for CDM project activities and programmes of activities".

Data / Parameter table 9.

Data / Parameter:	$h_{OP,y}$
Data unit:	Hours
Description:	Average yearly operating hours of the institutional building unit j
Source of data:	Building unit owner/building unit user
Measurement procedures (if any):	Directly answer
Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	-

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Data / Parameter table 10.

Data / Parameter:	CDD_y, CDD_{BL}
Data unit:	Degree-days
Description:	CDD_y : Cooling Degrees Days of the region where the building unit j is located during year y . CDD_{BL} : Cooling Degrees Days of the region where the baseline building unit is located during year y
Source of data:	< http://www.degree-days.net/# >
Measurement procedures (if any):	-
Monitoring frequency:	CDD_y : Yearly CDD_{BL} : Not monitored, the parameter will remain fixed through the project lifetime
QA/QC procedures:	-
Any comment:	The base temperature used to determine CDD_y and CDD_{BL} shall be the same and shall be documented in the PDD

Data / Parameter table 11.

Data / Parameter:	<i>HDD_y</i>, <i>HDD_{BL}</i>
Data unit:	Degree-days
Description:	<i>HDD_y</i> : Heating Degrees Days of the region where the building unit <i>j</i> is located during year <i>y</i> . <i>HDD_{BL}</i> : Heating Degrees Days of the region where the baseline building unit is located during year <i>y</i>
Source of data:	< http://www.degree-days.net/# >
Measurement procedures (if any):	-
Monitoring frequency:	<i>HDD_y</i> : Yearly. <i>HDD_{BL}</i> : Not monitored, the parameter will remain fixed through the project lifetime
QA/QC procedures:	-
Any comment:	The base temperature used to determine <i>HDD_y</i> and <i>HDD_{BL}</i> shall be the same and shall be documented in the PDD]

21. In the case of retrofit measures, monitoring shall consist of:

- (a) Documenting the specifications of the equipment replaced;
- (b) Calculating the energy savings due to the measures installed.

22. In the case of a new facility, monitoring shall consist of:

- (a) Metering the energy use of the building(s);
- (b) Calculating the energy savings of the new building(s).

23. For project activities that apply a standardized baseline that standardizes the specific CO₂ emissions based on the TOOL31, the parameters listed in the tables below and the

provisions on data and parameters monitored in the tools referred to in this methodology apply.

Data / Parameter table 124.

Data / Parameter:	$GFA_{j,i,y}$						
Data unit:	m ²						
Description:	Gross floor area of the project building unit <i>j</i> in building unit category <i>i</i> in year <i>y</i>						
Source of data:	<table border="1"> <thead> <tr> <th>Data source</th> <th>Conditions for using the data source</th> </tr> </thead> <tbody> <tr> <td>1. Building plan</td> <td>Preferred source</td> </tr> <tr> <td>2. On-site measurement</td> <td>If the building plan is not available</td> </tr> </tbody> </table>	Data source	Conditions for using the data source	1. Building plan	Preferred source	2. On-site measurement	If the building plan is not available
Data source	Conditions for using the data source						
1. Building plan	Preferred source						
2. On-site measurement	If the building plan is not available						
Measurement procedures (if any):	-						
Monitoring frequency:	The parameter shall be determined before the start of the building's construction						
QA/QC procedures:	When determined through the building plan, confirm on-site that building geometry represented in the plan is accurate						
Any comment:	<p>When determined using sampling, the requirements of the latest version of the standard "Sampling and surveys for CDM project activities and programme of activities" shall be followed.</p> <p>This parameter shall be monitored only when emission reductions are determined through the application of a standardized baseline that standardizes the specific CO₂ emissions of buildings.</p> <p>The monitoring of this parameter is only required for project activities that apply a standardized baseline that standardizes the specific CO₂ emissions based on the TOOL31</p>						

Data / Parameter table 132.

Data / Parameter:	$EC_{j,i,y}$
Data unit:	MWh
Description:	Electricity consumed by the project building unit <i>j</i> in building unit category <i>i</i> in year <i>y</i> (MWh)
Source of data:	As per the latest version of the "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Measurement procedures (if any):	<p>As per the latest version of the "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"</p> <p>When applying the tool, requirements for $EG_{P,j,grid,y}$ specified in the tool should apply to electricity consumed from the grid ($EC_{j,i,y}$)</p>

Monitoring frequency:	As per the latest version of the “TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”
QA/QC procedures:	As per the latest version of the “TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”
Any comment:	<p>When determined using sampling, the requirements of the latest version of the standard “Sampling and surveys for CDM project activities and programme of activities” shall be followed.</p> <p>Values shall be cross-checked against electricity purchase receipts/invoices.</p> <p>The monitoring of this parameter is only required for project activities that apply a standardized baseline that standardizes the specific CO₂ emissions based on the TOOL31.</p>

Data / Parameter table 143.

Data / Parameter:	$EF_{elec,y}$
Data unit:	tCO ₂ e/MWh
Description:	Emission factor of the electric grid supplying electricity to the project building unit <i>j</i> in building unit category <i>i</i>
Source of data:	As per the latest version of the “TOOL07: Tool to calculate the emission factor for an electricity system”
Measurement procedures (if any):	As per the latest version of the “TOOL07: Tool to calculate the emission factor for an electricity system”
Monitoring frequency:	<p>As per the latest version of the “TOOL07: Tool to calculate the emission factor for an electricity system”.</p> <p>If the grid emission factor is fixed ex-ante, no monitoring is required</p>
QA/QC procedures:	As per the latest version of the “TOOL07: Tool to calculate the emission factor for an electricity system”
Any comment:	The monitoring of this parameter is only required for project activities that apply a standardized baseline that standardizes the specific CO ₂ emissions based on the TOOL31.-

Data / Parameter table 154.

Data / Parameter:	TDL_y
Data unit:	%
Description:	Average technical transmission and distribution losses for providing electricity to the grid to which the project building unit <i>j</i> in building unit category <i>i</i> is connected
Source of data:	As per the latest version of the “TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”
Measurement procedures (if any):	As per the latest version of the “TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”

Monitoring frequency:	As per the latest version of the “TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”
QA/QC procedures:	As per the latest version of the “TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”
Any comment:	-

Data / Parameter table 165.

Data / Parameter:	$FC_{k,j,i,y}$
Data unit:	Mass or volume units
Description:	Fossil fuel type k consumed by the project building unit j in building unit category i in year y (mass or volume units)
Source of data:	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”. When applying the tool, requirements for $FC_{i,j,y}$ should be followed
Measurement procedures (if any):	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
Monitoring frequency:	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
QA/QC procedures:	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”. Values shall be cross-checked against fuel purchase receipts/invoices
Any comment:	The monitoring of this parameter is only required for project activities that apply a standardized baseline that standardizes the specific CO ₂ emissions based on the TOOL31.-

Data / Parameter table 176.

Data / Parameter:	NCV_k
Data unit:	GJ/mass or volume units
Description:	Net calorific value of the fossil fuel type k
Source of data:	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”. When applying the tool, requirements for NCV_k should be followed
Measurement procedures (if any):	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
Monitoring frequency:	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
QA/QC procedures:	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
Any comment:	The monitoring of this parameter is only required for project activities that apply a standardized baseline that standardizes the specific CO ₂ emissions based on the TOOL31.-

Data / Parameter table 187.

Data / Parameter:	$EF_{CO_2,k}$
Data unit:	tCO ₂ /GJ
Description:	$EF_{CO_2,k}$: CO ₂ emission factor of the fossil fuel type <i>k</i>
Source of data:	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
Measurement procedures (if any):	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
Monitoring frequency:	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
QA/QC procedures:	As per the latest version of the “TOOL03: Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”
Any comment:	The monitoring of this parameter is only required for project activities that apply a standardized baseline that standardizes the specific CO ₂ emissions based on the TOOL31.

Data / Parameter table 19.

Data / Parameter:	$Occ_{j,i,y}$
Data unit:	Person
Description:	Average number of occupants of the project building unit <i>j</i> in building unit category <i>i</i> in year <i>y</i>
Source of data:	Survey with project buildings
Measurement procedures (if any):	-
Monitoring frequency:	Yearly, based on survey
QA/QC procedures:	-
Any comment:	The requirements of the latest version of the standard “Sampling and surveys for CDM project activities and programme of activities” shall be followed. This parameter shall be monitored only when the project involves residential building units and the baseline emissions are determined based on a standardized CO ₂ emission factor per occupants

6.1. Project activity under a programme of activities

24. The following conditions apply for use of this methodology in a project activity under a programme of activities:

- (a) In case the project activity involves fossil fuel switching measures leakage resulting from fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels outside of the project boundary shall be considered. The guidance provided in the leakage section of ACM009 as in annex 1 the appendix of this document shall be followed in this regard;
- (b) In case the project activity involves the replacement of equipment, and the leakage effect of the use of the replaced equipment in another activity is neglected because the replaced equipment is scrapped, an independent monitoring of scrapping of

replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose, scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified.

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Appendix 1. List of building unit categories

1. Recommended criteria of building unit types under this methodology are provided below.
 - (a) **Residential building units** – building units used as one of the following dwelling purposes:
 - (i) **Single-family (low-rise or high-rise)** - this category includes constructions for a single family or household, such as bungalows, cottages, stand-alone houses, semi-detached houses, town houses and row houses;
 - (ii) **Multi-family (low-rise or high-rise)** - this category includes apartments in a building that comprises of more than two apartments, that are further sub-divided into:
 - a. Buildings with 1 to 5 building units;
 - b. Buildings with 5 to 10 building units;
 - c. Buildings with 10 to 20 building units;
 - d. Buildings with more than 20 building units.
 - (b) **Commercial building units** - building units used for one of the following activities focusing on the exchange of goods and/or services for a profit:
 - (i) **Office (low-rise or high-rise)** - this category includes, for example, administrative and professional offices, government offices, and banks or other financial institutions;
 - (ii) **Hotel (low-rise or high-rise)** - this category includes, for example, hotels, motels, and guest houses;
 - (iii) **Warehouse & storage (low-rise or high-rise)** - this category includes, for example, distribution and shipping centers; (iv) **Mercantile & service (low-rise or high-rise)** - this category includes the following:
 - a. **Retail** - this category includes, for example, shopping stores for furniture, cloths, drugs, books, or building supplies, rental centers for videos or vehicles, dealer shops or showrooms for vehicles, and studios or galleries;
 - b. **Food sales** - this category includes, for example, grocery stores or food markets, gas stations with convenience stores, convenience stores, and beer, wine, liquor stores;
 - c. **Service** - this category includes, for example, auto repair shops, post offices, photocopy center, beauty parlour or barber shop, gas stations without convenience stores, cleaning, and tanning salon;

- d. **Other mercantile & service** - this category includes mercantile & service building units that belong to none of the above categories:
 - i. **Food service (low-rise or high-rise)** - this category includes, for example, restaurants or cafeterias, fast foods, bars, reception halls, and catering services;
 - ii. **Entertainment (low-rise or high-rise)** - this category includes, for example, cinemas, sports arenas, casinos, and night clubs;
- (c) **Institutional building units** – building units used for one of the following activities focusing on not-for-profit services in the public's interest;
 - (i) **Education (low-rise or high-rise)** - this category includes, for example, preschools or day-care centers, elementary or middle schools, colleges or universities, adult education, career or vocational training, and religious education;
 - (ii) **Public assembly (low-rise or high-rise)** - this category includes the following:
 - a. **Social or meeting** - this category includes, for example, community centers, lodges, meeting halls, convention centers, senior centers, student activities centers, and parliamentary buildings;
 - b. **Culture** - this category includes, for example, museums, theatres, operas, and concert halls;
 - c. **Religious worship** - this category includes, for example, temples, mosques, and churches;
 - d. **Recreation** - this category includes, for example, gymnasiums, indoor swimming pools, buildings to serve outdoor recreational facilities and outdoor swimming pools;
 - e. **Other public assembly** - this category includes public assembly building units that belong to none of the above categories;
 - f. **Health care (low-rise or high-rise)** - this category includes the following
 - (iii) **Health care** - this category includes, for example, hospitals, clinics, and rehabilitation centers;
 - a. **Nursing** - this category includes, for example, nursing homes, assisted living centers, or other residential care buildings;
 - b. **Other health care** - this category includes health care building units that belong to none of the above categories;

- (iv) **Public order and safety (low-rise or high-rise)** - this category includes the following:
 - a. **Stations** - this category includes, for example, police and fire stations, other public service stations for road and park maintenance, civil defence;
 - b. **Prisons** - this category includes, for example, jails, reformatories, and penitentiaries;
 - c. **Judiciary** - this category includes, for example, courthouses and probation offices;
 - d. **Other public order and safety** - this category includes public order and safety building units that belong to none of the above categories;
- (v) **Institutional lodging (low-rise or high-rise)** - this category includes, for example, retirement homes, convent or monastery, shelters, orphanage, or children's homes, halfway houses, and military barracks.

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Appendix 2. Guidance for running computer simulation modelling

1. A calibrated building model of the project building unit(s) is developed to:
 - (a) Match (via calibration) the actual energy consumption of the project building; and
 - (b) Estimate baseline building energy consumption;
 - (c) Determine the electrical savings between the project and baseline buildings.
2. For retrofits of existing buildings, EC_{BL} is determined based on the electricity consumed over the 1-year period using a calibrated whole building model of the baseline building. The model's B-settings for the baseline building shall match the original building features before the retrofit. The baseline model's weather and T-settings shall match those in the calibrated model of the project activity building(s).
3. For new buildings, EC_{BL} is determined based on electricity over a period of a year by the building unit j , calculated using a calibrated model of a "reference" baseline building¹, generated by a whole building computerized simulation tool:
 - (a) The baseline building shall:
 - (i) Have the same size of the project building unit j (i.e. height or number of floors, and floor area);
 - (ii) Have a window-to-wall ratio and front façade orientation on the site the same as that can be demonstrated as typical of the project location (i.e. in the neighbourhood); and
 - (iii) Exclude all the project activity measures, such that the B-settings for the baseline building will be that which would have been constructed in the absence of the project activity;
 - (b) The baseline model's weather, and T-settings shall match those in the calibrated model of the project building unit j);
 - (c) Where there is a legally mandated code on energy performance at the time of project implementation, if the energy consumption (electricity + fuel) of the baseline building as calculated using whole building computerized simulation tool are lower than those associated with the minimum energy requirements in the building code for the subject building type(s) or classification(s) in the same climate zone (e.g. in kWh/m²/year), then the simulation results shall be used as the baseline. However, if the baseline energy consumption from simulation is higher than those associated with the minimum energy requirements in the building code, then the latter shall be used as the baseline.

¹ Options to identify the "reference" baseline building are indicated in section 5.3.1.2 of the methodology.

4. If special tenancy lease arrangements² for the building unit j are in place, any legally binding item/clause will have to be reflected in the T-settings for the model.

5. The modelling process is conducted as described in the steps below:

(a) Step 1: Data collection for the project building unit j :

(i) B-settings:

a. Building Envelope (e.g. building geometry, location of building surfaces such as windows, building shades, relative position of the building thermal zones); and

b. Thermal Properties (layer-by-layer description of the building materials with their conductivity, specific heat, and density);

(ii) Specification of the space conditioning system, including its performance;

(iii) Control systems;

(iv) T-settings:

a. Internal loads (occupancy or average number of people per time period; lighting and equipment power density; internal load schedules);

b. Building operation (control temperatures, window opening and related schedules, reflecting occupant behaviour);

c. Actual weather data; and

d. Energy consumed over the specific 1-year period;

(b) Step 2: Model calibration:³

(i) A simulation input file for the project building is developed based on input data from Step 1;

(ii) The computer simulation results for the project building are compared to the actual energy consumption during the specific 1-year, and the whole building model is calibrated following the “Whole Building Calibrated Simulation” path in the latest ASHRAE Guideline 14;

(c) Step 3: Computer simulation and energy savings:

(i) After the project model calibration has been completed in Step 2, the calibrated model is representative of the project building unit j ;

² A special tenancy lease arrangement includes various forms of legally binding energy efficiency-focused contracts, or “green lease” contracts (covering broader environmental impact considerations).

³ Calibration is the process of adjusting the input data or parameters in a model (as opposed to changing the form of the model) to match its output with the measured data from the real-world system. During this process, assumptions about the building’s internal loads and operational characteristics are adjusted to produce a closer match between the simulated and actual energy usage.

(ii) The calibrated model is modified to represent the baseline building.

(d) Step 4: Documentation:

(i) Software Version: Report the name and version number of the whole building simulation software used, including certification or evidence of BESTEST validation;

(ii) Steps 1 and 3 input files to define the project and baseline building models, including:

- a. Building physical properties;
- b. Characteristics of the space conditioning system;
- c. Initial load and operating assumptions;
- d. Typical year weather file;
- e. Occupancy schedules;
- f. HVAC and lighting control settings; and
- g. Lighting schedules;

(iii) Step 2 information documenting the calibration process, including:

- a. Initial simulation results for baseline building; and
- b. Accuracy with which the simulation results match the calibration energy data;

(iv) Physical base B properties of the baseline and project buildings, including but not limited to:

- a. Building envelope (e.g. building geometry, location of building surfaces such as windows, building shades, relative position of the building thermal zones); and
- b. Thermal properties (layer-by-layer description of the building materials with their conductivity, specific heat, and density);

(v) Specification of the space conditioning system of the project and baseline buildings;

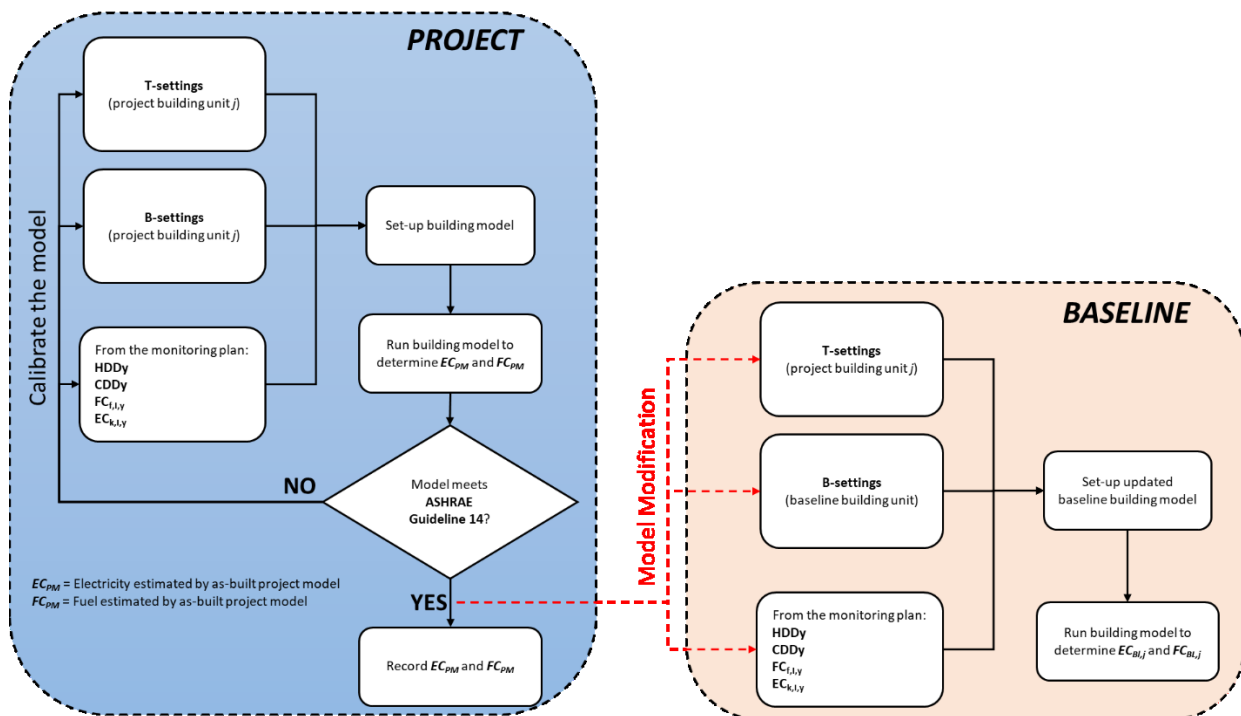
(vi) Specification of the control systems and control settings of the project and baseline buildings;

(vii) Information about actual baseline and project buildings tenancy-related T settings:

- a. Internal loads (occupancy or average number of people per time period, lighting and equipment power density, internal load schedules); and

- b. Building operations (control temperatures, window opening and related schedules, reflecting occupant behaviour);
- (viii) Weather files for the project location with hourly data of temperature, humidity, wind direction and speed, total and diffuse solar radiation;
- (ix) Any other relevant information, including special tenancy lease arrangements, if applicable; and
- (x) Name and qualifications of the person(s) involved in the computer simulation analyses and calibration.

Figure 1. Flowchart of the methodology using a whole building simulation tool



- 6. EC_{BL,j} and FC_{BL,j} from the computer simulation modelling shall be used only for the year when the requirements from paragraph 27 in section 5.3.1 are not met, i.e. these values won't replace the original values indicated in the PDD.

Document information*

<i>Version</i>	<i>Date</i>	<i>Description</i>
12.0	3 July 2020	<p>MP 82, Annex 3</p> <p>To be considered by the Board at EB 107.</p> <p>The draft version of this document (CDM-MP81-A03) was available for public input from 3 March to 1 April 2020. It received one input.</p> <p>Revision to include methods, equations and monitoring requirements to calculate emission reductions for projects that do not apply "TOOL31: Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings".</p>
11.0	29 November 2018	<p>EB 101, Annex 13</p> <p>Revision to incorporate elements from "TOOL31: Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings" to allow its application to this methodology.</p>
10.0	02 November 2007	<p>EB 35, Annex 31</p> <p>To clarify that the methodologies are only applicable to project activities where it is possible to directly measure and record the energy use within the project boundary (e.g., electricity and/or fossil fuel consumption) and where the impact of the measures implemented by the project activity to improve energy efficiency can be clearly distinguished from changes in energy use due to other variables not influenced by the project activity (e.g. changes in ambient conditions).</p>
09.0	27 July 2007	<p>EB 33, Annex 28</p> <p>Revision of the approved small-scale methodology AMS-II.E to allow for its application under a programme of activities (PoA).</p>
08.0	23 December 2006	<p>EB 28, Annex 30</p> <p>To broaden its applicability to include retrofit project activities, and to exclude technical line losses from the calculation of the emission factor.</p>

* This document, together with the 'General Guidance' and all other approved SSC methodologies, was part of a single document entitled: Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities until version 07. After version 07 the document was divided into separate documents: 'General Guidance' and separate approved small-scale methodologies (AMS).

<i>Version</i>	<i>Date</i>	<i>Description</i>
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History of the document: Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities

Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities contained both the General Guidance and Approved Methodologies until version 07. After version 07 the document was divided into separate documents: 'General Guidance' and separate approved small-scale methodologies (AMS).

<i>Version</i>	<i>Date</i>	<i>Description</i>
07	25 November 2005	EB 22, Para. 59 References to "non-renewable biomass" in Appendix B deleted.
06	20 September 2005	EB 21, Annex 22 Guidance on consideration of non-renewable biomass in Type <i>i</i> methodologies, thermal equivalence of Type II GWhe limits included.
05	25 February 2005	EB 18, Annex 6 Guidance on 'capacity addition' and 'cofiring' in Type <i>i</i> methodologies and monitoring of methane in AMS-III.D included.
04	22 October 2004	EB 16, Annex 2 AMS-II.F was adopted, leakage due to equipment transfer was included in all Type <i>i</i> and Type II methodologies.
03	30 June 2004	EB 14, Annex 2 New methodology AMS-III.E was adopted.
02	28 November 2003	EB 12, Annex 2 Definition of build margin included in AMS-I.D, minor revisions to AMS-I.A, AMS-III.D, AMS-II.E.
01	21 January 2003	EB 7, Annex 6 Initial adoption. The Board at its seventh meeting noted the adoption by the Conference of the Parties (COP), by its decision 21/CP.8, of simplified modalities and procedures for small-scale CDM project activities (SSC M&P).

Decision Class: Regulatory

Document Type: Standard

Business Function: Methodology

Keywords: energy efficiency, fuel switching, simplified methodologies, retrofit, type (ii) projects