CLEAN DEVELOPMENT MECHANISM

AM0091

Large-scale Methodology

Energy efficiency technologies and fuel switching in new and existing buildings

Version 02.0

Sectoral scope(s): 03

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Climate Change

TABLE OF CONTENTS **Page**

1. INTRODUCTION 4

2. SCOPE, APPLICABILITY, AND ENTRY INTO FORCE 4

2.1. Scope 4

2.2. Applicability 4

2.3. Entry into force 6

3. NORMATIVE REFERENCES 6

3.1. Selected approach from paragraph 48 of the CDM modalities and procedures 7

4. DEFINITIONS 7

5. BASELINE METHODOLOGY 9

5.1. Project boundary 9

5.2. Identification of the baseline scenario and demonstration of additionality 11

5.2.1. Construction of new buildings 11

5.2.2. Retrofitting existing buildings 12

5.3. Baseline emissions 13

5.3.1. Step 1. Identification of building unit categories 15

5.3.2. Step 2. Identification of baseline building units 15

5.3.3. Step 3. Calculation of emissions of each baseline building unit 19

5.3.4. Step 4. Calculation of the top 20 per cent benchmark for specific emissions of baseline building units 27

5.3.5. Step 5a. Calculation of baseline emissions based on the top 20 per cent benchmark 31

5.3.6. Step 5b. Modelling baseline emissions 33

5.3.7. Step 6. Update of the baseline emission calculation 34

5.3.8. Retrofitting existing buildings 35

5.4. Project emissions 35

5.4.1. Step 1. Identification of building unit categories 37

5.4.2. Step 2. Identification of project building units 37

5.4.3. Step 3. Calculation of emissions of each project building unit 39

5.4.4. Step 4a. Calculation of project emissions 45

5.4.5. Step 4b. Modelling project emissions 59

5.5. Leakage emissions 62

5.5.1. Fugitive methane emissions 63

5.5.2. Determination of fossil fuel consumption in project building units 64

5.5.3. Determination of fossil fuel consumption in baseline building units 65

5.5.4. CO_2 emissions from LNG 68

5.6. Emission reductions 68

5.7. Changes required for methodology implementation in 2nd and 3rd crediting periods 72

5.8. Data and parameters not monitored 72

6. MONITORING METHODOLOGY 77

6.1. Data and parameters monitored 77

APPENDIX 1. LIST OF BUILDING UNIT CATEGORIES 111

APPENDIX 2. SAMPLE FORMAT FOR BASELINE BUILDING SURVEY QUESTIONNAIRE 114

APPENDIX 3. SAMPLE FORMAT FOR PROJECT BUILDING SURVEY QUESTIONNAIRE 119

1. Introduction

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

Table 1. Methodology key elements

Typical projects	Project activities implementing energy efficiency- measures and/or fuel switching in new or existing building units (residential, commercial, and/or institutional building units). Examples of the measures include efficient appliances, efficient thermal envelope, efficient lighting systems, efficient heating, ventilation and air conditioning (HVAC) systems, passive solar design, optimal shading, building energy management systems (BEMS), intelligent energymetering and switch to less carbon intensive fuel.
Type of GHG emissions mitigation action	Energy efficiency. Electricity and/or fuel savings through energy efficiency improvement. 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 and/or fuel switching in new or existing buildings.

2.2. Applicability

3. This methodology applies to project activities that implement energy efficiency measures and/or fuel switching in new or existing building units (residential, commercial, and/or institutional building units whose detailed categories are as defined in appendix 1). Examples of the measures include efficient appliances, efficient thermal envelope, efficient lighting systems, efficient heating, ventilation and air conditioning (HVAC) systems,[1] passive solar design, optimal shading, building energy management systems (BEMS),[2] intelligent energy metering, and fuel switching, excluding switching to biomass.[3] Project proponents should clearly describe in the PDD whether a proposed project activity involves the construction of new buildings, retrofitting existing one or the combination of both (construction new and retrofitting existing buildings) and which are the measures to be implemented under the project activity.

[1] HVAC (Heating, Ventilation and Air Conditioning) systems include filtration and, where required by the climate, humidification and dehumidification as well as heating and cooling.

[2] BEMSs (Building Energy Management Systems) are control systems for individual buildings or groups of buildings that use computers and distributed microprocessors for monitoring, data storage, controlling and communication.

[3] The use of biogas/biomass could lead to methane emissions and leakage emissions, for example due to diversion of biomass from other uses to the project. These emission sources are not accounted for in the emission reductions calculation of the current version of this methodology. Thus, the use of biogas/biomass is excluded.

4. The methodology is applicable under the following conditions:

(a) Building units eligible for applying the methodology should belong to residential, commercial and institutional categories as defined in appendix 1;[4]

(b) The sources of emissions eligible under the methodology are those including consumption of electricity, fossil fuel, and chilled water as well as leakage of refrigerant used in the building units;[5]

(c) None of the project building units, that are used for the calculation of project emissions, and chilled/hot water systems, that supply water to the project building units, is fed electrical or thermal energy by biogas systems. This condition is to be verified both ex ante ($BIOG_{PJ,ex\text{-}ante}$) and ex post ($BIOG_{PJ,y}$);

(d) None of the project building units, that are used for the calculation of project emissions, and chilled/hot water systems, that supply water to the project building units, is fed electrical or thermal energy by biomass. This condition only concerns biomass-fired boilers, and excludes smaller appliances where only an insignificant amount of biomass is burned (e.g. barbecue pits). It is to be verified both ex ante ($BIOM_{PJ,ex\text{-}ante}$) and ex post ($BIOM_{PJ,y}$);

(e) None of the project building units, used for the calculation of project emissions, and chilled/hot water systems, supplying water to the project building units, is supplied electrical or thermal energy by cogeneration systems. This condition is to be verified both ex ante ($COGEN_{PJ,ex\text{-}ante}$) and ex post ($COGEN_{PJ,y}$);[6]

(f) The difference between HDD/CDD between municipalities in which the project building units are located should not be more than +/- 20 per cent;

(g) None of the project building units used for the calculation of project emissions use chlorofluorocarbon (CFC) as a refrigerant. This condition is to be verified both ex ante ($CFC_{PJ,ex\text{-}ante}$) and ex post ($CFC_{PJ,y}$);

(h) None of the project building units used for the calculation of project emissions claim CERs for emission reductions achieved by using efficient appliances being credited in other project activities registered as CDM projects. The overlapping use of the efficient appliances is to be verified both ex ante ($OVERL_{PJ,ex\text{-}ante}$) and ex post ($OVERL_{PJ,y}$). If there is no CDM project receiving CERs from the use of efficient appliances within the host country, this applicability condition is deemed satisfied. Otherwise, a discount factor shall be applied to the energy consumption of the project building units in order to avoid possible double-counting of emission reductions;

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[4] If the project participants require other categories than the ones listed in appendix 1, a request for revision of this methodology shall be made. Building units in other categories may be constructed as a part of the project activity, but shall be excluded from the application of the methodology.

[5] Other energy consumption sources can be added by submitting a request for revision of this methodology.

[6] The current version of this methodology does not calculate emissions from the use of heat supplied by cogeneration systems. Thus, the use of cogeneration is excluded.

(i) All the project building units must comply with all applicable national energy standards (e.g. building codes) in the project boundary, if they both exist and are enforced. This condition is to be verified both ex ante ($COMP_{PJ,ex\text{-}ante}$) and ex post ($COMP_{PJ,y}$);

(j) The renewable energy technologies that emit a material amount of GHG emissions (e.g. geothermal power plants, reservoir-type hydro power plants) are not allowed as a captive power source to project building units. However, geothermal plants are allowed to provide steam for chilled/hot water systems;

(k) The methodology is not applicable if only fuel switching measures are implemented in project building units;

(l) When whole building computerised simulation tools are used to estimate emission reductions, only those computerised simulation tools that have successfully met the analytical verification and have a current empirical validation requirements as defined in the International Energy Agency's BESTEST[7] protocol shall be used with this methodology. In addition, project participants shall demonstrate that the building energy simulations and related calibrations have been performed by skilled operator(s) as demonstrated by having at least three years of relevant experience and professional education and/or training.

5. In addition, the applicability conditions included in the tools referred to above apply.

2.3. Entry into force

6. The date of entry into force of the revision is the date of the publication of the EB 77 meeting report on 21 February 2014.

3. Normative references

7. This baseline and monitoring methodology is based on the following proposed new methodology:

(a) "NM0328: Energy efficiency and fuel switching measures in new buildings", prepared by Perspectives GmbH for Abu Dhabi Future Energy Company (Masdar).

8. This methodology also refers to the latest approved versions of the following tools:

(a) "Tool to calculate the emission factor for an electricity system";

(b) "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";

(c) "Tool to calculate baseline, project and/or leakage emissions from electricity consumption";

[7] 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. eQUEST and EnergyPlus are two examples of computer models/tools that have been certified per the BESTEST protocol. For more information for eQUEST and other eligible computer models/tools, please refer to <http://doe2.com/DOE2/index.html> and <http://apps1.eere.energy.gov/buildings/tools_directory/>.

(d) “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period”;

(e) “Tool for the demonstration and assessment of additionality”;

(f) “Tool to determine the remaining lifetime of equipment”.

9. For more information regarding the proposed new methodologies and the tools as well as their consideration by the Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM), please refer to <http://cdm.unfccc.int/goto/MPappmeth>.

3.1. Selected approach from paragraph 48 of the CDM modalities and procedures

10. The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.

4. Definitions

11. The definitions contained in the Glossary of CDM terms shall apply.

12. For the purpose of this methodology, the following definitions apply:

(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/owner,[8] a building unit is defined as a subordinate structure of a building rented by one tenant or used by an owner.[9] If a building is used by a single tenant/owner, the building unit is equal to the entire building;[10]

(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) **Residential building unit** - a building unit used as one of the dwelling purposes listed in appendix 1;

(d) **Commercial building unit** – a building unit used for one of the activities focusing on the exchange of goods and/or services for a profit listed in appendix 1;

(e) **Institutional building unit** – a building unit used for one of the activities focusing on not-for-profit services in the public's interest listed in appendix 1;

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

[9] 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.

[10] 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 in this methodology.

(f) **Chilled water system** - comprises all components needed to provide the cooling services by chilled water. It comprises one or several chillers plus ancillary equipment such as pumps for circulating chilled water and the condensing water and the fans to be used for circulating the cooling air in the condenser, associated piping, and the fans used to facilitate cooling at the cooling tower;

(g) **Chilled water** - water or water mixture that circulates through an evaporator unit, where it is cooled by a refrigerant as the latter evaporates. The chilled water in turn circulates to the applications that need to be cooled (e.g. space in buildings), where it exchanges heat, and is re-circulated back to the evaporation unit;

(h) **Heating Degree days (HDD)**[11] - heating degree days are a measure of how much (in degrees), and for how long (in days), the outside air temperature was below a certain level. They are commonly used in calculations relating to the energy consumption required to heat buildings;

(i) **Cooling Degree Days (CDD)**[12] - 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;

(j) **Hot water system** - a hot water system comprises all components needed to provide hot water. It consists of heat sources, water treatment apparatus, water heaters, pipelines to transport the hot water, and devices to regulate and control the water’s temperature;

(k) **B-settings** refer to physical base properties of a building as below:

    (i) 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);

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

(l) **T-settings** refer to the tenancy-related characteristics of a building as below:

    (i) Internal loads;

        a. Occupancy or average number of people per time period (such as population counts in weekdays, weekends and holidays, assignments to thermal zones);

        b. Lighting and equipment power density. 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;

[11] <http://www.degreedays.net/#>.

[12] <http://www.degreedays.net/#>.

c. Internal load schedules and plug loads, including their counts, nameplate data, usage schedules and diversity of operations;

d. Building operations reflecting occupant behaviour:

i. Control temperatures;

ii. Window opening;

iii. Other related schedules;

iv. Actual weather data;

v. Energy consumption (by fuel type) in the first 12 months of building operation.

(m) **Municipality** - a political unit, such as a city, town, or village, incorporated for local self-government;

(n) **Administrative bounda**ry - a limit or border of a geographic area under the jurisdiction of some governmental entity.

5. Baseline methodology

5.1. Project boundary

13. The spatial extent of the project boundary encompasses the area covering all the project and baseline building units. In addition, the spatial extent of the energy supply systems that supply energy to the project and baseline building units is included in the project boundary.

14. The spatial extent of an electricity system is as defined in the latest version of the "Tool to calculate the emission factor for an electricity system".

15. The spatial extent of a chilled/hot water system(s) encompasses:

(a) All thermal sources directly serving the chilled/hot water system(s). In the case of geothermal heat extraction, the site of the geothermal heat extraction including geothermal wells, re-injection wells, pumps, geothermal water storage tanks, etc.;

(b) All equipment including chillers, heating systems, pipes, sub-stations, pumps, cooling towers, meters, transformers and control equipment used for the supply of the energy service through chilled/hot water to users that are or will be connected to the chilled/hot water system(s);

(c) The electricity system to which the chilled/hot water system(s) is connected.

16. The greenhouse gases (GHGs) included in or excluded from the project boundary are shown in Table 2.

Table 2. Emission sources included in or excluded from the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	Electricity consumption in buildings	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
	Fuel consumption in buildings	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
	Chilled/hot water consumption in buildings	CO_2	Yes	Main emission source
		CH_4	Yes	If a chilled/hot water system(s) is supplied heat by a geothermal plant(s), fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam shall be accounted for
		N_2O	No	Minor emission source
		Refrigerants that are GHGs	Yes	Major emission source
	Leakage of refrigerant(s) in buildings	Refrigerants that are GHGs	Yes	All GHGs as defined by Annex A of Kyoto Protocol shall be considered, as per CDM Modalities and Procedures. However, if it is justified that the CDM project activity does not result in an increase of such emissions and the project emissions from the use of a refrigerant(s) is omitted from the calculation of the project emissions, the source shall be excluded
Project activity	Electricity consumption in buildings	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
	Fuel consumption in buildings	CO_2	Yes	Main emission source
		CH_4	Yes	Minor emission source
		N_2O	No	Minor emission source
	Chilled/hot water consumption in buildings	CO_2	Yes	Main emission source
		CH_4	Yes	If a chilled/hot water system(s) is supplied heat by a geothermal plant(s), fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam shall be accounted for
		N_2O	No	Minor emission source

Source		Gas	Included	Justification/Explanation
		Refrigerants that are GHGs	Yes	Major emission source
	Leakage of a refrigerant(s) in buildings	Refrigerants that are GHGs	Yes	All GHGs as defined by Article 1, paragraph 5[13] of the Convention shall be considered. However, if it is justified that the CDM project activity does not result in an increase of such emissions, the source may be excluded

5.2. Identification of the baseline scenario and demonstration of additionality

5.2.1. Construction of new buildings

17. For new construction, two options are available to demonstrate additionality and identify the baseline scenario depending on the chosen approaches to estimate baseline, project emissions and emission reductions.

18. **Option A**. Under this option a benchmark approach is applied to establish the baseline scenario using Option 1 and Option 2.1 in paragraph 32 are used to estimate baseline and project emissions. The calculation of the benchmark is outlined in the section "Baseline emissions" below. The baseline scenario for new construction is building units constructed and then occupied in the last five years in circumstances similar to the building units constructed and then occupied in the project activity, differentiated by building unit category.

19. Additionality of the project activity dealing with new construction shall be demonstrated only for fuel switching measures employed in the project activity, if less carbon-intensive fuels used in the project building units were not commercially available within the project boundary in the last five years.

20. If the less carbon-intensive fuels were commercially available in the project boundary in the last five years, separate additionality demonstration of the fuel switching measures is not required because it is assumed that the top 20 per cent benchmark will capture the autonomous fuel switching effect in the baseline. Based on the above, the following procedures shall be followed for the demonstration of additionality for fuel switching:

21. **Step 1.** Identify the less carbon-intensive fuel used in the project building units and check commercial availability of the fuel within the project boundary in the last five years. If the fuel has been commercially available in the last five years, it is not required to demonstrate additionality of the fuel switching measures. Otherwise, proceed to Step 2.

22. **Step 2**. Additionality of the fuel switching measures shall be demonstrated comparing the historical average retail price of the fuel used in the project building units since the fuel became commercially available within the project boundary ($P_{PJ,Fuel}$), with the fuel that was the most commonly used within the baseline building units for the same period

[13] This includes GHGs listed in Annex A of the Kyoto Protocol as well as GHGs controlled under the Montreal Protocol.

($P_{BL,Fuel}$). Retail prices per unit of energy (local currency unit/GJ) shall be used for the comparison. If the average retail price of the project fuel is higher than the one of the baseline fuel, the fuel switching measures are considered additional.

23. If the fuel switching measures are demonstrated to be additional or separate additionality demonstration of the fuel switching measures is not required,[14] the project is deemed additional as long as the total emissions level from the building units constructed in the project activity is lower than the baseline emissions level calculated by the benchmark analysis during each year of the crediting period.

24. If the fuel switching measures are not demonstrated additional or the project activity does not claim CERs for emission reductions from the fuel switching measures, emission reductions from the fuel switching measures cannot be claimed for CERs. In such a case, the project emission calculation requires the carbon intensity of fuel energy used in the project building units to be the same as the one in the baseline. With this adjustment, however, emission reductions from energy efficiency measures can still be deemed additional as long as the total emissions level from the building units constructed in the project activity is lower than the baseline emissions level calculated by the benchmark analysis.

25. **Option B.** This approach to demonstrate additionality and identify the baseline scenario is applied when Option 2.2 in paragraph 32 for estimating baseline and project emissions is used. This approach requires using the latest approved version of the “Tool for the demonstration and assessment of additionality”. The alternatives for the assessment of the baseline scenario shall, at least, include the proposed project activity implemented without CDM and an alternative design of the project building that would have been built considering the building characteristics obtained from surveys of construction companies or experts as described in Option 2.2 in paragraph 32 below. Guidance on applying the “Tool for the demonstration and assessment of additionality” as provided in Section 5.2.2 shall be applied.

26. Option B shall be used to demonstrate additionality and identify baseline scenario, if modelling based on surveys is used for estimating emission reductions.

5.2.2. Retrofitting existing buildings

27. For retrofitting existing buildings, relevant existing pre-retrofit building characteristics are assumed to be the baseline scenario. The approach to estimate baseline emissions of existing buildings prior to their retrofit is described in the section “Baseline emissions” below.

28. Additionality of the project activity dealing with retrofitting of existing buildings shall be demonstrated with the use of the latest approved version of the “Tool for the demonstration and assessment of additionality”. When Step 2. Investment analysis. Option II. Investment comparison analysis is applied; the analysis shall be conducted for the entire set of measures (not for an individual measure) planned to be implemented in a specific building type in the course of the project activity. When investment analysis is conducted for measures aimed at replacing existing equipment with new equipment or

[14] Either because the less carbon-intensive fuel used in the project building units was commercially available in the project boundary in the last five years, or there is no fuel switching measure involved in the project activity.

retrofitting existing equipment, the remaining lifetime of the baseline equipment shall be determined using the latest approved version of the “Tool to determine the remaining lifetime of equipment”. For measures targeted at retrofitting individual building envelop components the following lifetime can be applied:

(a) Windows – 30 years;

(b) Doors – 30 years;

(c) Insulation materials -30 years;

29. **Step 4**. Common practice analysis of the latest approved version of the “Tool for the demonstration and assessment of additionality” shall be conducted for each individual measure in the set of measures planned to be implemented in each building unit category *i*. If, as the outcome of the common practice analysis, a particular measure is regarded to be common practice, then the characteristics of this measure need to be included in the baseline model.

5.3. Baseline emissions

30. Depending on whether baseline emissions are estimated for new construction or retrofitting existing buildings, the following approaches are available.

31. For new construction, baseline emissions can be estimated:

(a) **Option 1.** Calculation of baseline emissions based on the monitoring during the crediting period of a control group based on the top 20 per cent benchmark of best performing buildings. Steps to calculate baseline emissions are described in Figure 1;

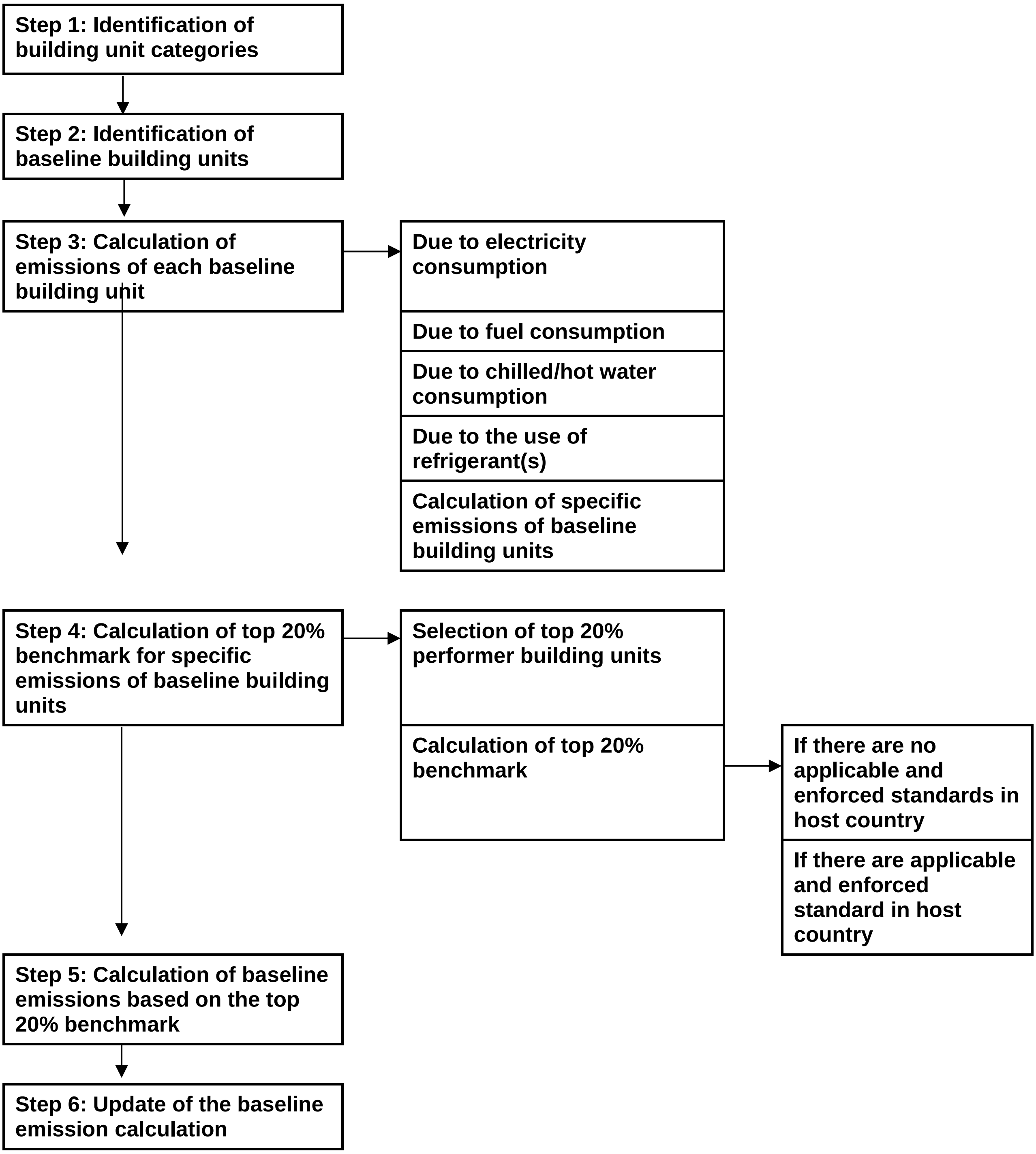
(b) **Option 2.** Modelling baseline emissions. Input data in the model can come from the following sources:

(i) **Option 2.1.** Building characteristics of the top 20 per cent benchmark of best performing buildings. To obtain these data, Step 1 to Step 4 described in Figure 1 shall be followed to identify the top 20 per cent best performing buildings and their baseline energy consumption and characteristics that should be used for the calibration of the baseline model;

(ii) **Option 2.2.** Building characteristics are obtained from interviews with five construction companies or experts (such as a third party architect or Chartered Engineer).

32. For retrofits, the only option available to estimate baseline emissions is modelling. Building characteristics of the building before retrofit shall be used as inputs in the model and its historical energy consumption shall be used for the calibration of the baseline model.

Figure 1. Steps to calculate baseline emissions for new construction using the top 20 per cent performance benchmark



5.3.1. Step 1. Identification of building unit categories

33. In the project activity, building units can be categorized into different categories. Building unit categories represent a wide range of uses and are very specific to the project circumstances. This methodology provides a mandatory list of building unit categories for use in appendix 1. The chosen categories shall be clearly presented in the PDD, and remain the same for the entire crediting period(s) unless a request for approval of changes is made in accordance with applicable requirements under changes to registered CDM project activity or programme of activities in the CDM project cycle procedure.

5.3.2. Step 2. Identification of baseline building units

34. Baseline building units shall be identified for each building unit category *i* defined in Step 1.The baseline building units are identified as building units in circumstances similar to the building units constructed in the project activity (project building units). In order to ensure similarity between the baseline and the project building units, the baseline building units shall consist of building units in building unit category *i*:

(a) That do not belong to a registered CDM project activity using this methodology;

(b) That are located in the same municipality as the project building units. If the minimum sample size of baseline building units cannot be obtained within the municipality, the project boundary should be extended to cover all neighbouring municipalities. If the minimum sample size cannot still be obtained, the project boundary should be extended by including the geographical area of the next higher level of administrative boundary (e.g. state, province, prefecture, county). If the sample size still remains below the minimum size, the building unit category should be excluded;

(c) That have been built and then occupied within the five years prior to the start of the project activity;

(d) That are located in a region with annual heating degree days (HDD) and cooling degree days (CDD) in a range from 80 per cent to 120 per cent of the average value of the region that the project building units are located in;[15]

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

(i) Acceptable data sources on the socio-economic conditions include: (a) income level information collected from a survey; (b) government records on income levels (e.g. for tax purposes); (c) relevant studies or publications on income levels; and/or (d) property prices per square metre as a proxy for income levels.[16] If no data or only limited data is publicly available on the socio-economic conditions, a survey can be

[15] This requirement is assumed to be determined, ex ante, by observation or review of public records but not by baseline building occupant surveys.

[16] The project participants applying the methodology may submit a request for revision if the criteria for socio-economic conditions do not work for the project-specific situation.

conducted. The survey may limit its scope to building units that have been built in the project boundary within the five years prior to the start of the project activity.[17] A minimum of three socio-economic classes should be defined based on the level of income or property price (e.g. low, middle, and high income/property price groups). The approaches and underlying assumptions used to distinguish the socio-economic classes shall be transparently documented in the PDD;

(ii) In case building units of a specific socio-economic class are concentrated in distinct areas, the baseline building units shall be chosen from areas with the same socio-economic class(es) as the project building units;

(iii) In case building units with two or more socio-economic classes are located in the same area, individual building units need to be surveyed and building units of the same socio-economic class as the project building units shall be chosen. Alternatively, such an area with mixed socio-economic classes may be excluded from the baseline building unit selection as long as the minimum sample size can be obtained from other areas with a distinct socio-economic class;

(f) That have a comparable size to the project building units, defined as the GFA of a baseline building unit being in the range from 50 per cent to 150 per cent of the average GFA of the project building units in building unit category *i*; similar height or number of floors (low-rise or high-rise), window-to-wall ratio and front façade orientation that can be demonstrated as typical of the project location;

(g) That are occupied, and used as a primary, year-round residence (applicable only to residential building units, either in a low-rise or high-rise building);

(h) That are operated on annual average at least 30 hours/week (applicable only to commercial and institutional building units, either in a low-rise or high-rise building).[18]

35. The project participants may either choose to identify the baseline building units from all the building units in the project boundary or use a randomly selected sample of the building units in the project boundary.

36. If the random sampling approach is used, emission reductions can be claimed only if the sample size is larger than the minimum sample size as determined below ($n_{BL,min,i,y}$). However, if the project has fewer building units than the minimum sample size in the corresponding building unit category *i*, then the equivalent number of baseline building units can be used. This minimum number refers to the number of baseline building units, for which useful monitoring data are available in a particular monitoring time interval.

[17] If income level information is to be collected, a building unit needs to be occupied at the time of conducting the survey. If property price information is to be collected, it is not necessary for a building unit to be occupied.

[18] A building unit is considered to be in operation for the amount of hours the building unit is utilized for its main purpose (e.g. office work for an office building unit). The building unit might as well consume energy in other hours (e.g. standby energy consumption in the building unit during night time). However, those hours are not counted towards the operating hours.

Therefore, to compensate for any possible dropouts from the sample group during the monitoring period, it will be necessary to select an initial sample size. This minimum sample size should be the minimum value between project building units in building unit category *i* or 20. Project participants may choose any larger sample than the minimum sample size, taking into account the risk of dropouts from the sample group, the overhead costs for monitoring and the effect of reduced statistical errors on account of a larger sample size in calculating emission reductions. Different sample sizes may be selected for each vintage year as long as the sample sizes are larger than the minimum size.

$$n_{BL,min,i,y} = \frac{{cv_{SE,BL,i,y}}^2 \times {t_{0.05}}^2 \times N_{BL,i}}{{P_{10\%}}^2 \times N_{BL,i} + {cv_{SE,BL,i,y}}^2 \times {t_{0.05}}^2}$$ Equation (1)

Where:

$n_{BL,min,i,y}$	=	Minimum sample size of baseline building units in building unit category *i* in year *y*. Round up to the next integer if it is decimal
$cv_{SE,BL,i,y}$	=	Coefficient of variation of specific emissions of baseline building units in building unit category *i* in year *y*
$t_{0.05}$	=	t-value for a 90 per cent statistical significance level (1.645)
$P_{10\%}$	=	10 per cent precision requirement for a sample estimate (0.10)
$N_{BL,i}$	=	Total number of baseline building units in the population for building unit category *i* at the start of the project activity

$$cv_{SE,BL,i,y} = \frac{\sigma_{POP,SE,BL,i,y}}{\mu_{POP,SE,BL,i,y}}$$ Equation (2)

Where:

$cv_{SE,BL,i,y}$	=	Coefficient of variation of specific emissions of baseline building units in building unit category *i* in year *y*
$\sigma_{POP,SE,BL,i,y}$	=	Expected population standard deviation of specific emissions of baseline building units in building unit category *i* in year *y* (t CO_2/m^2)
$\mu_{POP,SE,BL,i,y}$	=	Expected population mean of specific emissions of baseline building units in building unit category *i* in year *y* (t CO_2/m^2)

37. $cv_{SE,BL,i,y}$ is a measure of the expected variation in specific emissions of the population of baseline building units in building unit category *i*. For the first year, $cv_{SE,BL,i,y}$ can be derived from officially published documents or own non-representative survey, accounting for the same emission sources as ones for the emission reduction calculation of the project activity. However, as necessary information may not be readily available, a default factor of 0.5 is allowed to be used for the first year. For the second year and onwards, $cv_{SE,BL,i,y}$ needs to be replaced by the coefficient of variation of specific emissions of baseline building units calculated for the first year ($cv_{SE,PJ,i,1}$).

38. For the baseline building units in building unit category *i*, the baseline emissions have to be calculated separately for each building unit category *i* for each crediting period year. If the random sampling approach is pursued, project participants shall first establish a list of all building units in the project boundary that meet all the relevant criteria for baseline building unit identification. If a complete list of building units cannot be established, project participants shall explain in the PDD reasons for non-availability of certain building units and justify why the available building units are considered representative of all building units in the project boundary. Then, a unique identifier is to be assigned to each building unit on the list for a random selection of building units. For example, such a random selection can be performed with common spread sheet software. The collection of the energy consumption data from the baseline building units may require apportionment of the energy consumption if it is monitored only at a whole building level.[19] In this case, such energy consumption has to be apportioned following the procedure existent for the building, showing documented evidence of the procedure and the proof that the procedure has been applied consistently in the last three years. If such procedure is not available, apportion the energy consumption by the GFA that each tenant/owner in the building occupies. Also, the use of a refrigerant(s) monitored only at a whole building level[20] shall also be apportioned by the GFA of the building unit. Such apportionment can be mathematically expressed as follows:

$$X_{BL,i,j,y} = X_{BL-Bldg,i,j,y} \times \frac{GFA_{BL,i,j,y}}{GFA_{BL-Bldg,i,j,y}}$$ Equation (3)

Where:

$X_{BL,i,j,y}$	=	Baseline energy consumption (electricity, fossil fuel, or chilled water) or baseline emissions related to the use of a refrigerant(s) in baseline building unit *j* in building unit category *i* in year *y* (MWh, mass or volume unit, GJ, or t refrigerant/yr)
$X_{BL-Bldg,i,j,y}$	=	Baseline energy consumption (electricity, fossil fuel, or chilled water) or baseline emissions related to the use of a refrigerant(s) in the whole building, which baseline building unit *j* in building unit category *i* belongs to, in year *y* (MWh, mass or volume unit, GJ, or t refrigerant/yr)
$GFA_{BL,i,j,y}$	=	GFA of baseline building unit *j* in building unit category *i* in year *y* (m^2)
$GFA_{BL-Bldg,i,j,y}$	=	GFA of the whole building, which baseline building unit *j* in building unit category *i* belongs to, in year *y*. Account for GFA of each building unit in the building, but not GFA of the common service areas outside the physical boundaries of the building units (m^2)

[19] For example, energy consumption for the operation of a central air conditioning system for a whole building may be metered only at a whole building level. In this case, the building manager (e.g. facility manager, landlord) may simply include the energy bill in the rent without providing energy consumption data to each tenant/owner.

[20] For example, the refrigerant use in a central air conditioner supplying the entire building.

5.3.3. Step 3. Calculation of emissions of each baseline building unit

39. First, calculate the annual emissions of each baseline building unit *j* in building unit category *i* identified in Step 2. For the sake of simplification and conservativeness, the relevant emissions source(s) can be excluded from the calculation of the baseline emissions during the time period for which relevant data is not available.

$$BE_{i,j,y} = BE_{EC,i,j,y} + BE_{FC,i,j,y} + BE_{WC,i,j,y} + BE_{ref,i,j,y} \quad \text{Equation (4)}$$

Where:

$BE_{i,j,y}$	=	Baseline emissions of baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/yr)
$BE_{EC,i,j,y}$	=	Baseline emissions from electricity consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$BE_{FC,i,j,y}$	=	Baseline emissions from fossil fuel consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$BE_{WC,i,j,y}$	=	Baseline emissions from chilled/hot water consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$BE_{ref,i,j,y}$	=	Baseline emissions from the use of a refrigerant(s) in baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/yr)

40. If it is justified that the CDM project activity does not result in an increase of emissions from the use of refrigerant(s) in buildings and the project emissions from the use of a refrigerant(s) is omitted from the calculation of the project emissions, $BE_{ref,i,j,y}$ shall be excluded.

5.3.3.1. Sub-step 3.1. Calculation of baseline emissions from electricity consumption ($BE_{EC,i,j,y}$)

41. The baseline emissions from electricity consumption of baseline building unit *j* in building unit category *i* ($BE_{EC,i,j,y}$) are further divided into the following two components:

$$BE_{EC,i,j,y} = BE_{EC,non-REcaptive,i,j,y} + BE_{EC,REcaptive,i,j,y} \quad \text{Equation (5)}$$

Where:

$BE_{EC,i,j,y}$	=	Baseline emissions from electricity consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$BE_{EC,non-REcaptive,i,j,y}$	=	Baseline emissions from electricity consumption of baseline building unit *j* in building unit category *i* in year *y*, which is supplied by the grid and/or an off-grid fossil-fuel-fired captive power plant(s) (t CO_2/yr)
$BE_{EC,REcaptive,i,j,y}$	=	Baseline emissions from electricity consumption of baseline building unit *j* in building unit category *i* in year *y*, which is supplied by an off-grid renewable captive power plant(s) (t CO_2/yr)

42. $BE_{EC,non-REcaptive,i,j,y}$ shall be calculated using the latest approved version of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.

43. $BE_{EC,REcaptive,i,j,y}$ equals 0 (t CO_2/yr) as a conservative simplification.

5.3.3.2. Sub-step 3.2. Calculation of baseline emissions from fuel consumption (*$BE_{FC,i,j,y}$*)

44. The baseline emissions from fossil fuel consumption of baseline building unit *j* in building unit category *i* in year *y* ($BE_{FC,i,j,y}$) shall be calculated as follows:

$$BE_{FC,i,j,y} = \sum_{k} FC_{BL,i,j,k,y} \times COEF_{k,y} \quad \text{Equation (6)}$$

Where:

$BE_{FC,i,j,y}$	=	Baseline emissions from fossil fuel consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$FC_{BL,i,j,k,y}$	=	Annual consumption of fossil fuel type *k* of baseline building unit *j* in building unit category *i* in year *y*. The amount of fuel used for the electricity generation by the captive power plant(s) in the building that baseline building unit *j* belongs to shall not be included in the parameter (mass or volume unit/yr)
$COEF_{k,y}$	=	CO_2 emission coefficient of fuel type *k* in year *y* (t CO_2/mass or volume unit)

45. The CO_2 emission coefficient $COEF_{k,y}$ can be calculated using one of the following two options. Option A should be the preferred approach, if the necessary data is available.

5.3.3.2.1. Option A. The CO_2 emission coefficient *$COEF_{k,y}$* is calculated based on the ultimate analysis of the fossil fuel type *k*, using the following approach:

46. If $FC_{BL,i,j,k,y}$ is measured in a mass unit:

$$COEF_{k,y} = w_{C,k,y} \times {}^{44}/_{12} \quad \text{Equation (7)}$$

47. If $FC_{BL,i,j,k,y}$ is measured in a volume unit:

$$COEF_{k,y} = w_{C,k,y} \times \rho_{k,y} \times {}^{44}/_{12} \quad \text{Equation (8)}$$

Where:

$COEF_{k,y}$	=	CO_2 emission coefficient of fuel type *k* in year *y* (t CO_2/mass or volume unit)
$w_{C,k,y}$	=	Mass fraction of carbon in fuel type *k* in year *y* (t C/mass unit of the fuel)
$\rho_{k,y}$	=	Density of fuel type *k* in year *y* (mass unit/volume unit of the fuel)

5.3.3.2.2. Option B. The CO_2 emission coefficient $COEF_{k,y}$ is calculated based on the net calorific value and CO_2 emission factor of the fuel type *k*, using the following approach:

$$COEF_{k,y} = NCV_{k,y} \times EF_{CO2,k,y} \quad \text{Equation (9)}$$

Where:

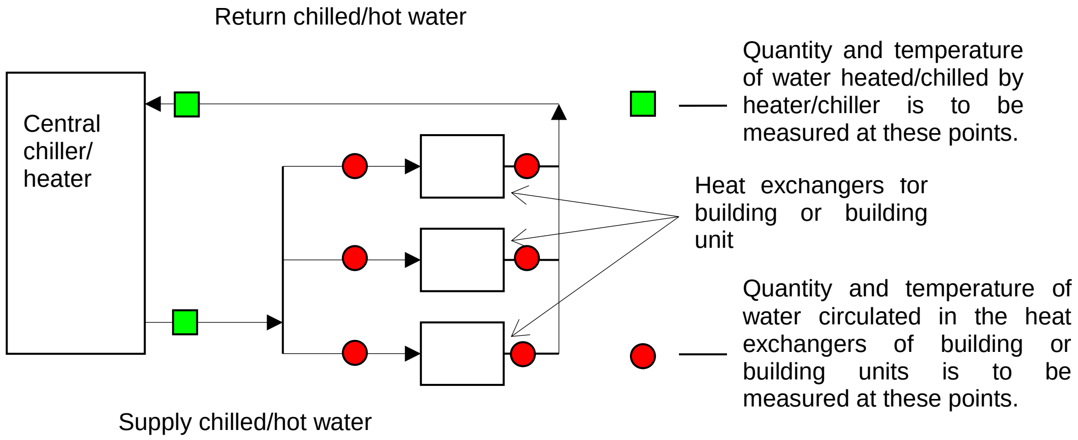
$COEF_{k,y}$	=	CO_2 emission coefficient of fuel type *k* in year *y* (t CO_2/mass or volume unit)
$NCV_{k,y}$	=	Average net calorific value of fossil fuel type *k* used in year *y* (GJ/mass or volume unit)
$EF_{CO2,k,y}$	=	CO_2 emission factor of fossil fuel type *k* in year *y* (GJ/mass or volume unit)

5.3.3.3. Sub-step 3.3. Calculation of baseline emissions from chilled/hot water consumption ($BE_{WC,i,j,y}$)

48. The chilled/hot water systems for baseline building units applicable under this methodology should have following configuration. The equations are derived considering this configuration in account.[21]

[21] Project participants willing to allow different configuration of chilled/hot water systems for baseline building units should submit the request for revision to this methodology.

Figure 2. The applicable configuration of chilled/hot water system



49. The baseline emissions from chilled/hot water consumption of baseline building unit *j* in building unit category *i* in year *y* ($BE_{WC,i,j,y}$) shall be calculated as follows:

$$BE_{WC,i,j,y} = \frac{WC_{BL,i,j,y} \times EF_{BL,WP,i,j,y}}{1 - \eta_{BL,dist,l,y}}$$ Equation (10)

Where:

$BE_{WC,i,j,y}$	=	Baseline emissions from chilled/hot water consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$WC_{BL,i,j,y}$	=	Energy content of annual chilled/hot water consumption in baseline building unit *j* in building unit category *i* in year *y* (GJ/yr)
$EF_{BL,WP,i,j,y}$	=	Emission factor for production of chilled/hot water that is supplied to baseline building unit *j* in building unit category *i* in year *y* (t CO_2/GJ)
$\eta_{BL,dist,l,y}$	=	Average technical distribution losses of the chilled/hot water system / network serving baseline building unit *j* in building unit category *i* in year *y* (GJ of technical thermal energy losses in the chilled/hot water distribution network divided by GJ of thermal energy supplied to the building units)

50. If a heat meter(s) is installed for monitoring of the energy content of chilled/hot water consumed in the baseline building unit *j* (or centrally in the building that the baseline building unit belongs to), $WC_{BL,i,j,y}$ can be derived directly from the meter reading. If only a mass or volume flow meter(s) and temperature indicators are installed, $WC_{BL,i,j,y}$ is calculated according to the following equations:

$$WC_{BL,i,j,y} = m_{BL,i,j,y} \times \Delta t_{BL,i,j,y} \times C_m$$ Equation (11)

Where:

$WC_{BL,i,j,y}$	=	Energy content of annual chilled/hot water consumption in baseline building unit *j* in building unit category *i* in year *y* (GJ/yr)
$m_{BL,i,j,y}$	=	Annual chilled/hot water consumption (in mass) of baseline building unit *j* in building unit category *i* in year *y* (kg/yr)
$\Delta t_{BL,i,j,y}$	=	Average temperature difference between the outlet and inlet of the heat exchanger used for the cooling/heating of building unit *j* in building unit category *i* in year *y* (K)
C_m	=	Specific heat capacity of the chilled/hot water (GJ/(kg·K))

51. In case a volumetric flow meter, and not a mass flow meter, is installed, $m_{BL,i,j,y}$ is calculated using the following equation:

$$m_{BL,i,j,y} = v_{BL,i,j,y} \times \rho_{H2O} \qquad \text{Equation (12)}$$

Where:

$m_{BL,i,j,y}$	=	Annual chilled/hot water consumption (in mass) of baseline building unit *j* in building unit category *i* in year *y* (kg/yr)
$v_{BL,i,j,y}$	=	Annual chilled/hot water consumption (in volume) of baseline building unit *j* in building unit category *i* in year *y* (m^3/yr)
ρ_{H2O}	=	Density of the chilled/hot water (kg/m^3)

52. The emission factor for chilled/hot water production ($EF_{BL,WP,i,j,y}$) shall be calculated for each centralised chilled/hot water system *l* that supplies the chilled/hot water to the respective building unit *j* in building unit category *i* in year *y*, according to the following equation:

$$EF_{BL,WP,i,j,y} = \frac{BE_{WP,EC,l,y} + BE_{WP,FC,l,y} + BE_{WP,FE,l,y}}{WP_{BL,l,y}} \qquad \text{Equation (13)}$$

Where:

$EF_{BL,WP,i,j,y}$	=	Emission factor for production of chilled/hot water that is supplied to baseline building unit *j* in building unit category *i* in year *y* (t CO_2/GJ)
$BE_{WP,EC,l,y}$	=	Baseline emissions from electricity consumption of chilled/hot water system *l* in year *y* (t CO_2/yr)
$BE_{WP,FC,l,y}$	=	Baseline emissions from fuel consumption of chilled/hot water system *l* in year *y* (t CO_2/yr) (In case all or part of the heat consumed in chilled/hot water system *l* is supplied by fossil fuel)

$BE_{WP,FE,l,y}$	=	Baseline fugitive emissions of CO_2 and methane due to release of non-condensable gases from geothermal sources in chilled/hot water production in chilled/hot water system *l* in year *y* (t CO_2/yr) (In case all or part of the heat consumed in chilled/hot water system *l* is supplied by a geothermal source)
$WP_{BL,l,y}$	=	Energy content of annual chilled/hot water produced by chilled/hot water system *l* in year *y* (GJ/yr)

53. If a heat meter(s) is/are installed for monitoring of the energy content of chilled/hot water production in the chilled/hot water cooling system *l*, $WP_{BL,l,y}$ can be derived directly from the meter reading. If only a mass or volume flow meter(s) is installed, $WP_{BL,l,y}$ is calculated according to the following equations:

$$WP_{BL,l,y} = m_{BL,l,y} \times \Delta t_{BL,l,y} \times C_m \quad \text{Equation (14)}$$

Where:

$WP_{BL,l,y}$	=	Energy content of annual chilled/hot water production of chilled/hot water system *l* in year *y* (GJ/yr)
$m_{BL,l,y}$	=	Annual chilled/hot water production (in mass) of chilled/hot water system *l* in year *y* (kg/yr)
$\Delta t_{BL,l,y}$	=	Average temperature difference between the outlet and inlet of the heat exchanger used for the chilled/hot water production in chilled/hot water system *l* in year *y* (K)
C_m	=	Specific heat capacity of the chilled/hot water (GJ/(kg·K))

54. In case a volumetric flow meter, and not a mass flow meter, is installed, $m_{BL,l,y}$ is calculated using the following equation:

$$m_{BL,l,y} = v_{BL,l,y} \times \rho_{H2O} \quad \text{Equation (15)}$$

Where:

$m_{BL,l,y}$	=	Annual chilled/hot water production (in mass) of chilled/hot water system *l* in year *y* (kg/yr)
$v_{BL,l,y}$	=	Annual chilled/hot water production (in volume) of chilled/hot water system *l* in year *y* (m^3/yr)
ρ_{H2O}	=	Density of the chilled/hot water (kg/m^3)

55. The baseline emissions from electricity consumption of chilled/hot water system *l* in year *y* ($BE_{WP,EC,l,y}$) shall be calculated using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". The electricity consumption includes the consumption all electrical equipment as a part of central chilled/hot water system for example compressor, pumps etc.

56. The baseline emissions from fossil fuel consumption of chilled/hot water system *l* in year *y* ($BE_{WP,FC,l,y}$) are calculated as follows:

$$BE_{WP,FC,l,y} = \sum_{k} FC_{BL,l,k,y} \times COEF_{k,y} \qquad \text{Equation (16)}$$

Where:

$BE_{WP,FC,l,y}$	=	Baseline emissions from fossil fuel consumption of chilled/hot water system *l* in year *y* (t CO_2/yr)
$FC_{BL,l,k,y}$	=	Quantity of fossil fuel type *k* fired in chilled/hot water system *l* in year *y* (mass or volume unit/yr)
$COEF_{k,y}$	=	CO_2 emission coefficient of fuel type *k* in year *y* (t CO_2/mass or volume unit)

57. The CO_2 emission coefficient $COEF_{k,y}$ shall be calculated following the same procedures as in the calculation of $BE_{FC,i,j,y}$ above using either Option A or B (equations (7) to (9)).

58. In case all or part of the heat consumed in chilled/hot water system *l* is supplied by a geothermal source, the fugitive emissions from these sources are calculated as follows:

$$BE_{WP,FE,l,y} = \left(w_{BL,steam,CO2,l,y} + w_{BL,steam,CH4,l,y} \times GWP_{CH4}\right) \times M_{BL,steam,l,y} \qquad \text{Equation (17)}$$

Where:

$BE_{WP,FE,l,y}$	=	Baseline fugitive emissions of CO_2 and methane due to release of non-condensable gases from geothermal sources in chilled/hot water production in chilled/hot water system *l* in year *y* (t CO_2/yr)
$w_{BL,steam,CO2,l,y}$	=	Average mass fractions of carbon dioxide in the produced steam for the use in chilled/hot water system *l* in year *y* (t CO_2/t steam)
$w_{BL,steam,CH4,l,y}$	=	Average mass fractions of methane in the produced geothermal steam for the use in chilled/hot water system *l* in year *y* (t CH_4/t steam)
GWP_{CH4}	=	Global Warming Potential of methane valid for the relevant commitment period (t CO_2e/t CH_4)
$M_{BL,steam,l,y}$	=	Quantity of geothermal steam produced for the use in chilled/hot water cooling system *l* in year *y* (t/yr)

5.3.3.4. Sub-step 3.4. Calculation of baseline emissions from the use of a refrigerant(s) (*$BE_{ref,i,j,y}$*)

59. The emissions from the use of a refrigerant(s) in baseline building unit *j* in building unit category *i* in year *y* ($BE_{ref,i,j,y}$) shall be calculated as follows:

$$BE_{ref,i,j,y} = \sum_{m} Q_{BL,ref,i,j,m,y} \times GWP_{BL,ref,i,j,m,y} + BE_{WP,ref,l,y} \times \frac{WC_{BL,i,j,y}}{\left(1 - \eta_{BL,dist,l,y}\right) \times WP_{BL,l,y}}$$ Equation (18)

Where:

$BE_{ref,i,j,y}$	=	Baseline emissions from the use of a refrigerant(s) in baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/yr)
$Q_{BL,ref,i,j,m,y}$	=	Annual quantity of refrigerant type *m* used to replace the refrigerant(s) that has leaked in baseline building unit *j* in building unit category *i* in year *y*, excluding refrigerant leakage from chilled water system (t refrigerant/yr)
$GWP_{BL,ref,i,j,m,y}$	=	Global Warming Potential of refrigerant type *m* used in baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/t refrigerant)
$WC_{BL,i,j,y}$	=	Energy content of annual chilled water consumption in baseline building unit *j* in building unit category *i* in year *y* (GJ/yr)
$BE_{WP,ref,l,y}$	=	Baseline emissions from the use of a refrigerant in chilled water system *l* in year *y* (t CO_2/yr)
$\eta_{BL,dist,l,y}$	=	Average technical distribution losses of the chilled water system *l* in year *y* (GJ of technical thermal energy losses in the chilled water distribution network divided by GJ of thermal energy supplied to the building units)
$WP_{BL,l,y}$	=	Energy content of annual chilled water produced by chilled water system *l* in year *y* (GJ/yr)

60. The baseline emissions from the use of a refrigerant in chilled water system *l* in year *y* ($BE_{WP,ref,l,y}$) are calculated as follows:

$$BE_{WP,ref,l,y} = Q_{BL,ref,l,y} \times GWP_{BL,ref,l,y}$$ Equation (19)

Where:

$BE_{WP,ref,l,y}$	=	Baseline emissions from the use of a refrigerant in chilled water system *l* in year *y* (t CO_2/yr)
$Q_{BL,ref,l,y}$	=	Average annual quantity of the refrigerant used to replace the refrigerant that has leaked in chilled water system *l* in year *y* (t refrigerant/yr)
$GWP_{BL,ref,l,y}$	=	Global Warming Potential of the refrigerant used in chilled water system *l* in year *y* (t CO_2e/t refrigerant)

5.3.3.5. Sub-step 3.5. Calculation of specific emissions of baseline building units

61. Calculate the specific emissions (*SE*) of baseline building unit *j* in building unit category *i* in year *y*, defined as emissions per *GFA* in square metre per year:

$$SE_{BL,i,j,y} = \frac{BE_{i,j,y}}{GFA_{BL,i,j,y}} \quad \text{Equation (20)}$$

Where:

$SE_{BL,i,j,y}$	=	Specific emissions of baseline building unit *j* in building unit category *i* in year *y*, defined as emissions per GFA in square metre per year (t CO_2e/(m^2·yr))
$BE_{i,j,y}$	=	Baseline emissions of baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/yr)
$GFA_{BL,i,j,y}$	=	GFA of baseline building unit *j* in building unit category *i* in year *y* (m^2)

5.3.4. Step 4. Calculation of the top 20 per cent benchmark for specific emissions of baseline building units

5.3.4.1. Sub-step 4.1. Selection of the top 20 per cent performer building units

62. Sort the group of the baseline building units from the lowest to the highest specific energy consumption (*SE*). Identify the top 20 per cent performer building units *j* as the building units with the 1^{st} to *J*th lowest *SE*, where *J* (the total number of top 20 per cent performer building units *j*) is calculated as the product of the number of baseline building units monitored and 20 per cent, rounded down to the next integer if it is decimal.

5.3.4.2. Sub-step 4.2. Calculation of top 20 per cent benchmark

5.3.4.2.1. Sub-step 4.2.a. Follow this step if there are no applicable and enforced standards on building energy efficiency in the host country

63. *SE*s of the top 20 per cent performer building units ($SE_{Top20\%,i,j,y}$) is averaged to determine the top 20 per cent benchmark level of *SE* for baseline building units in building unit category *i* in year *y* ($SE_{Top20\%,i,y}$).

$$SE_{Top20\%,i,y} = \frac{\sum_j SE_{Top20\%,i,j,y}}{J_{i,y}}$$ Equation (21)

Where:

$SE_{Top20\%,i,y}$	=	Specific emissions of the top 20 per cent performer building units in building unit category *i* in year *y*, defined as emissions per *GFA* in square meter per year (t $CO_2e/(m^2 \cdot yr)$)
$SE_{Top20\%,i,j,y}$	=	Specific emissions of top 20 per cent performer building unit *j* in building unit category *i* in year *y*, defined as emissions per *GFA* in square meter per year (t $CO_2e/(m^2 \cdot yr)$)
$J_{i,y}$	=	Total number of the top 20 per cent performer building units in building unit category *i* in year *y*. It is calculated as the product of the number of baseline building units monitored in building category *i* and 20 per cent, rounded down to the next integer if it is decimal

64. If sampling of the baseline building units is involved in the calculation of *SE* of the baseline building units, the calculated $SE_{Top20\%,i,y}$ shall be calculated as simple average of specific emissions of building units included in top 20 per cent best performing building units in building unit category *i*.

5.3.4.2.2. Sub-step 4.2.b. Follow this step if there is an applicable and enforced standard on building energy efficiency in the host country

65. The building energy efficiency levels stipulated in the standard shall be the basis of the calculation of $SE_{Top20\%,i,y}$. For this purpose, $SE_{Top20\%,i,y}$ is divided into the following components:

$$SE_{Top20\%,i,y} = EI_{Standard,i,y} \times CI_{Top20\%,i,y} + REFI_{Top20\%,i,y}$$ Equation (22)

Where:

$SE_{Top20\%,i,y}$	=	Specific emissions of top 20 per cent performer building units in building unit category *i* in year *y*, defined as emissions per *GFA* in square metre per year (t $CO_2e/(m^2 \cdot yr)$)
$EI_{Standard,i,y}$	=	Energy efficiency of building units in building unit category *i* stipulated in an applicable and enforced standard on building energy efficiency in the host country ($MWh/(m^2 \cdot yr)$)
$CI_{Top20\%,i,y}$	=	Average carbon intensity of energy used in the top 20 per cent performer building units in building unit category *i* in year *y* (t CO_2e/MWh)
$REFI_{Top20\%,i,y}$	=	Specific emissions from the use of a refrigerant(s) in the top 20 per cent performer building units in building unit category *i* in year *y* (t $CO_2e/(m^2 \cdot yr)$)

66. Note: The minimum between the value of $SE_{Top20\%,i,y}$ calculated using equations (21) and (22) should be used under this option.

67. The average carbon intensity of energy used in the top 20 per cent performer building units ($CI_{Top20\%,i,y}$) is calculated as follows:

$$CI_{Top20\%,i,y} = \frac{\sum_j CI_{Top20\%,i,j,y}}{J_{i,y}}$$ Equation (23)

Where:

$CI_{Top20\%,i,y}$	=	Average carbon intensity of energy used in the top 20 per cent performer building units in building unit category *i* in year *y* (t CO_2e/MWh)
$CI_{Top20\%,i,j,y}$	=	Carbon intensity of energy used in top 20 per cent performer building unit *j* in building unit category *i* in year *y* (t CO_2e/MWh)
$J_{i,y}$	=	Total number of top 20 per cent performer building units in building unit category *i* in year *y* (t CO_2e/yr). It is calculated as the product of the number of baseline building units monitored in building category *i* and 20 per cent, rounded down to the next integer if it is decimal

68. $CI_{Top20\%,i,j,y}$ is a subset of carbon intensity of energy used in baseline building unit *j* in building unit category *i* in year *y* ($CI_{BL,i,j,y}$), which is calculated as follows:

$$CI_{BL,i,j,y} = \frac{BE_{EC,i,j,y} + BE_{FC,i,j,y} + BE_{WC,i,j,y}}{EC_{BL,i,j,y} + \left(\sum_k FC_{BL,i,j,k,y} \times NCV_{k,y} + WC_{BL,i,j,y}\right) \times 0.2778}$$ Equation (24)

Where:

$CI_{BL,i,j,y}$	=	Carbon intensity of energy used in baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/MWh)
$BE_{EC,i,j,y}$	=	Baseline emissions from electricity consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$BE_{FC,i,j,y}$	=	Baseline emissions from fossil fuel consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$BE_{WC,i,j,y}$	=	Baseline emissions from chilled/hot water consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$EC_{BL,i,j,y}$	=	Electricity consumption of baseline building unit *j* in building unit category *i* in year *y* (MWh/yr)
$FC_{BL,i,j,k,y}$	=	Annual consumption of fossil fuel type *k* of baseline building unit *j* in building unit category *i* in year *y*. The amount of fuel used for the electricity generation by the captive power plant(s) in the building that project building unit *j* belongs to shall not be included in the parameter (mass or volume unit/yr)

$NCV_{k,y}$	=	Average net calorific value of fossil fuel type k used in year *y* (GJ/mass or volume unit)
$WC_{BL,i,j,y}$	=	Energy content of annual chilled/hot water consumption in baseline building unit *j* in building unit category *i* in year *y* (GJ/yr)
0.2778	=	A multiplication factor used to convert GJ to MWh

69. The average specific emissions from the use of a refrigerant(s) in the top 20 per cent performer building units ($REFI_{Top20\%,i,y}$) is calculated as follows:

$$REFI_{Top20\%,i,y} = \frac{\sum_j REFI_{Top20\%,i,j,y}}{J_{i,y}}$$ Equation (25)

Where:

$REFI_{Top20\%,i,y}$	=	Average specific emissions from the use of a refrigerant(s) in the top 20 per cent performer building units in building unit category *i* in year *y* (t $CO_2e/(m^2 \cdot yr)$)
$REFI_{Top20\%,i,j,y}$	=	Specific emissions from the use of a refrigerant(s) in top 20 per cent performer building unit *j* in building unit category *i* in year *y* (t $CO_2e/(m^2 \cdot yr)$)
$J_{i,y}$	=	Total number of top 20 per cent performer building units in building unit category *i* in year *y* (t CO_2e/yr). It is calculated as the product of the number of baseline building units monitored in building category *i* and 20 per cent, rounded down to the next integer if it is decimal

70. $REFI_{Top20\%,i,j,y}$ is a subset of specific emissions from the use of a refrigerant(s) in baseline building unit *j* in building unit category *i* in year *y* ($REFI_{BL,i,j,y}$), which is calculated as follows:

$$REFI_{BL,i,j,y} = \frac{BE_{ref,i,j,y}}{GFA_{BL,i,j,y}}$$ Equation (26)

Where:

$REFI_{BL,i,j,y}$	=	Specific emissions from the use of a refrigerant(s) in baseline building unit *j* in building unit category *i* in year *y* (t $CO_2e/(m^2 \cdot yr)$)
$BE_{ref,i,j,y}$	=	Baseline emissions from the use of a refrigerant(s) in baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/yr)
$GFA_{BL,i,j,y}$	=	GFA of baseline building unit *j* in building unit category *i* in year *y* (m^2)

71. If a sample of building units in the project boundary is monitored as baseline building units, the calculated $CI_{Top20\%,i,y}$ and $REFI_{Top20\%,i,y}$ shall be conservatively adjusted for the sampling error. Namely, the adjustment requires $CI_{Top20\%,i,y}$ and $REFI_{Top20\%,i,y}$ to be the lower-bound value of the confidence interval established around the average *CI* and *REFI* of the top 20 per cent performer building units at a 90 per cent significance level.

This sample error adjustment is performed by a bootstrap method.[22] First, create resamples of $CI_{BL,i,j,y}$ and $REFI_{BL,i,j,y}$ by repeatedly sampling at random and with replacement[23] from the original sample of $CI_{BL,i,j,y}$ and $REFI_{BL,i,j,y}$. Each resample is the same size as the original sample and the minimum size of the resamples is 1,000. Second, create bootstrap distributions calculating $CI_{Top20\%,i,y}$ and $REFI_{Top20\%,i,y}$ for each resample according to the equations (23) and (25). Lastly, the sample-error-adjusted $CI_{Top20\%,i,y}$ and $REFI_{Top20\%,i,y}$ are the values of $CI_{Top20\%,i,y}$ and $REFI_{Top20\%,i,y}$ at the 5th percentile of the corresponding bootstrap distribution.

5.3.5. Step 5a. Calculation of baseline emissions based on the top 20 per cent benchmark

72. Based on the top 20 per cent benchmark *SE* determined above, the baseline emissions are calculated by multiplying the top 20 per cent benchmark *SE* by the total *GFA* of the project building units in the corresponding building unit category *i*. Accordingly, the total baseline emissions are calculated as follows:

$$BE_y = \sum_i SE_{Top20\%,i,y} \times GFA_{PJ,i,y} \times CF_{BL,i,y} \times DISC_{i,y}$$ Equation (27)

Where:

BE_y	=	Baseline emissions of baseline building units in year *y* (t CO_2e/yr)
$SE_{Top20\%,i,y}$	=	Specific emissions of top 20 per cent performer building units in building unit category *i* in year *y*, defined as emissions per unit *GFA* (in square meter) per year (t CO_2e/(m^2·yr))
$GFA_{PJ,i,y}$	=	Total *GFA* of project building units in building unit category *i* in year *y* (m^2)
$CF_{BL,i,y}$	=	Baseline correction factor for occupancy of project building units in building unit category *i* in year *y*
$DISC_{i,y}$	=	Discount factor for double-counting of emissions reductions due to overlapping use of efficient appliances in building unit category *i* in year *y*

[22] Refer to Hesterberg et al. (2005) for more details of the bootstrap method.

[23] Sampling with replacement means that after randomly drawing an observation from the original sample, it is put back before drawing the next observation.

73. The discount factor ($DISC_{i,y}$) is calculated as follows:

$$DISC_{i,y} = 1 - \sum_{n} \frac{APPL_{CDM,n,y}}{APPL_{Host,n,y}} \times ESHARE_{i,n}$$ Equation (28)

Where:

$DISC_{i,y}$	=	Discount factor for double-counting of emissions reductions due to overlapping use of efficient appliances *in* building unit category *i* in year *y*
$APPL_{CDM,n,y}$	=	Total number of efficient appliances of type *n* that are used in registered CDM project(s) in the host country in year *y*
$APPL_{Host,n,y}$	=	Total number of efficient appliances of type *n* that are sold in the host country in year *y*
$ESHARE_{i,n}$	=	Default share of energy use of efficient appliances of type *n* in the total building energy consumption in building unit category *i* in year *y*

74. The baseline correction factor for occupancy of project building units ($CF_{BL,i,y}$) is set to one if all the building units in the project boundary are monitored as project building units. If a sample of building units in the project boundary is monitored as project building units, $CF_{BL,i,y}$ shall be calculated as follows:

$$CF_{BL,i,y} = 1 - \lambda_{PJ,i,y}$$ Equation (29)

Where:

$CF_{BL,i,y}$	=	Baseline correction factor for occupancy of project building units in building unit category *i* in year *y*
$\lambda_{PJ,i,y}$	=	Share of building units not meeting the occupancy criterion for project building units in building unit category *i* in year *y*

$$\lambda_{PJ,i,y} = \frac{n_{PJ,UNO,i,y}}{n_{PJ,i,y}}$$ Equation (30)

Where:

$\lambda_{PJ,i,y}$	=	Share of building units not meeting the occupancy criterion for project building units in building unit category *i* in year *y*
$n_{PJ,UNO,i,y}$	=	Total number of project building units not satisfying the occupancy criterion in the sample for building unit category *i* in year *y*. See Step 2 "Identification of project building units" for the occupancy criterion
$n_{PJ,i,y}$	=	Total number of project building units included in the sample for building unit category *i* in year *y*

5.3.6. Step 5b. Modelling baseline emissions

75. For each building category, the baseline emissions of new construction can also be determined using a whole building computerized simulation tool to generate energy use using weather data and building occupancy of the project buildings, which are monitored during each year of the crediting period.

76. Baseline emissions associated with the use of a refrigerant(s) shall be accounted for using calculation procedures described in Section 5.4.3.4 Sub-step 3.4. Calculation of baseline emissions from the use of a refrigerant(s) above.

77. The model base building settings shall exclude all measures that have not been deemed to be common practice (such as improved physical characteristics and properties of subject building units, improved efficiency of equipment and appliances).The model's tenancy-related settings (T-settings) related to operating pattern (e.g. hours of operation), building control strategies and occupancy (e.g. number of occupants) of baseline building units as well as weather data shall match those in the calibrated model of the project building units.

78. To model baseline emissions, two options are available to project participants:

5.3.6.1. **Option 1**. Modelling baseline emissions based on the top 20 per cent benchmark

79. Baseline emissions of the building units in building category *i* are calculated using a calibrated whole building model of the subject baseline building units in building category *i*. The B-settings of the model shall refer to physical characteristics of top 20 per cent best performing buildings selected as baseline buildings following Step 1 and 2, described above.

80. If there are no applicable and enforced standards on building energy efficiency for new construction in the host country, respective energy consumption based on the top 20 per cent benchmark calculated in Step 5a shall be used as input parameters in the whole building model of the baseline building units in building category *i*.

81. If there is an applicable and enforced standard on building energy efficiency for new construction in the host country, energy performance requirements stipulated in the standard shall be taken into account when energy consumption and associated baseline emissions based on the top 20 per cent benchmark are calculated in Step 5a and these shall be used as input parameters in the whole building model of the baseline building units in building category *i*.

82. The baseline model's weather, and T-settings shall match those in the calibrated model of the project activity building(s) (See section "Project emissions" below).

5.3.6.2. **Option 2.** Modelling baseline emissions based on baseline building characteristics obtained through interviews of experts

83. Baseline emissions of the building units in building category *i* are calculated using a calibrated whole building model of the subject baseline building units in building category *i*. The B-settings of the model shall refer to physical characteristics of baseline building units in building category *i*. Physical characteristics can be obtained from interviews with five construction companies or experts (such as a third party architect or Chartered Engineer) that shall provide information on construction materials and their

physical characteristics (such as U-values), construction practices, types of insulation, windows, doors, etc., that were most commonly used in the last five years. This information shall be supported by evidence (such as studies conducted by third party or construction documentation). If different construction companies or experts provide different quotes of most commonly used materials and construction practices, the most conservative option shall be selected as the baseline characteristic.

5.3.7. Step 6. Update of the baseline emission calculation

84. The total *GFA* of project building units in building unit category *i* in year *y* ($GFA_{PJ,i,y}$) has to be updated at least every third year (e.g. year 4, 7, 10), or more frequently, in order to reflect the change in the scale of the project activity over time.

85. In order to reflect the changes in the energy consumption patterns of the baseline building units over time, baseline emissions shall be updated annually during project implementation, for which the following options are available:

5.3.7.1. **Option 1.** Annual monitoring of electricity consumption, fuel consumption and energy content of annual chilled/hot water consumption of baseline building unit j in building unit category *i*

86. This option is applicable when project participants selected to follow Step 5a. Calculation of baseline emissions based on the top 20 per cent benchmark.

87. The relevant data ($EC_{BL,i,j,y}$, $FC_{BL,i,j,k,y}$ and $WC_{BL,i,j,y}$) shall be collected every year from the same baseline building units which are included in top 20 per cent performers identified from the first year after project implementation. If a baseline building unit in the group of top 20 per cent is destroyed or its function is changed, it can be replaced by another building unit in the same building unit category that is randomly sampled.

88. The calculation of the baseline emissions from the use of a refrigerant(s) ($BE_{ref,i,j,y}$) shall be updated annually for the building units which are included in the top 20 per cent performers identified from the first year after project implementation. Alternatively, it can be updated for the first three years of the corresponding crediting period, and for any subsequent year in the crediting period, the minimum annual value of the three-year monitoring period can be used.

89. All the other baseline-related data need to be updated every third year (e.g. year 4, 7, 10) for the baseline building units that are included in the 20 per cent performers identified from the first year after project implementation.

90. Based on the above data, the baseline emissions shall be updated annually during project implementation for the baseline building units which are included in the top 20 per cent performers identified from the first year after project implementation.

91. All the steps should be documented transparently, including a list of the baseline building units identified, with information to clearly identify the building units, as well as the relevant data used for the calculation of the baseline emissions.

5.3.7.1. **Option 2**. Annual update of baseline emissions using a whole building computerized simulation tool

92. The baseline emissions from new construction are updated annually using a whole building computerized simulation tool to generate energy use using weather data and building occupancy patterns experienced by the project buildings, which are monitored during each year of the crediting period. Physical characteristics of baseline building units in building category *i* (the B-settings of the model) should not be updated annually and are fixed for the crediting period.

5.3.8. Retrofitting existing buildings

93. The baseline emissions of existing buildings are determined using a whole building computerized simulation model calibrated taking into account relevant building characteristics (B-settings) and energy consumption and of the existing building(s) experienced over the recent 12 months prior to their retrofit as well as its operating, building control strategies and occupancy (T-settings) that together with the weather data are experienced during the above period.

94. Baseline emissions associated with the use of a refrigerant(s) shall be accounted for using calculation procedures described in Section 5.4.3.4 Sub-step 3.4. Calculation of baseline emissions from the use of a refrigerant(s) above.

95. Baseline emissions are calculated using a calibrated whole building model of the subject baseline building units in building category *i*. The model base building settings (B-settings) refer to physical characteristics of existing buildings prior to their retrofit. The model base building settings shall exclude all the project activity measures (such as improved physical characteristics and properties of subject building units, improved efficiency of equipment and appliances).The model tenancy-related settings (T-settings) related to operating pattern (e.g. hours of operation), building control strategies and occupancy (e.g. number of occupants) of subject building units as well as weather data shall match those in the calibrated model of the project building units

96. If there is an applicable and enforced standard on building energy efficiency for retrofits in the host country, energy performance requirements stipulated in the standard shall be used as input parameters in the whole building model of the subject baseline building units in building category *i* when respective energy consumption and associated baseline emissions of existing buildings prior to retrofit are modelled.

97. The baseline model's weather, and T-settings shall match those in the calibrated model of the project activity building(s) (See section "Project emissions" below).

5.4. Project emissions

98. Depending on whether project emissions are estimated for new construction or retrofitting existing buildings, the following approaches are available.

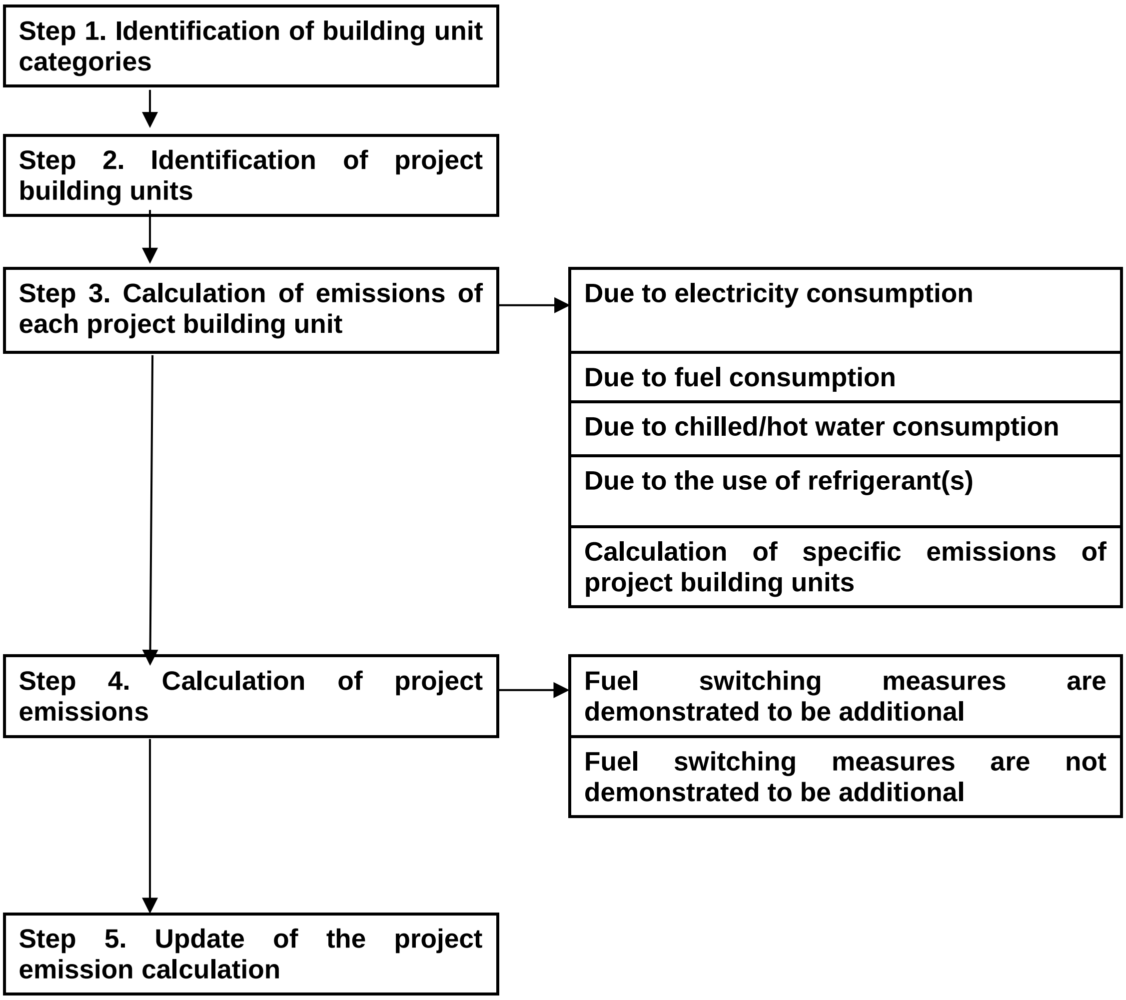
99. For new construction, project emissions can be estimated:

   (a) **Option 1.** Calculation of project emissions based on monitoring of energy consumption. Steps to calculate baseline emissions are described in Figure 2;

   (b) **Option 2.** Modelling project emissions.

100. For retrofits, the only option available is modelling.

Figure 2. Flow chart of estimating project emissions



5.4.1. Step 1. Identification of building unit categories

101. The same building unit categories as the ones identified in Step 1 of the baseline emissions section shall be used. The definitions shall be clearly presented in the PDD, and remain the same for the entire crediting period(s) unless a request for approval of changes is made in accordance with applicable requirements under changes to registered CDM project activity or programme of activities in the CDM project cycle procedure.

5.4.2. Step 2. Identification of project building units

102. Project building units shall be identified for each building unit category *i* defined in Step 1. The project building units shall consist of building units in building unit category *i*, which satisfy the following occupancy criterion:

(a) That are occupied, and used as a primary, year-round residence (applicable only to residential building units, either in a low-rise or high-rise building);

(b) That are operated on annual average at least 30 hours/week (applicable only to commercial and institutional building units, either in a low-rise or high-rise building).[24]

103. The compliance with the occupancy criterion needs to be monitored ex post, and project building units failing to satisfy the occupancy criterion shall be excluded from the pool of project building units ($N_{PJ,UNO,i,y}$ or $n_{PJ,UNO,i,y}$, whether the population or sample is monitored). If all the building units in the project boundary are monitored as project building units, the ex post monitoring assures that the non-compliant project building units are not considered in the emission reduction calculation. If a sample of building units in the project boundary is monitored as project building units, excluding the non-compliant project building units does not ensure that there is no non-compliant project building unit in the population. Thus, the project and baseline emissions need to be corrected for the share of non-compliant project building units. For this purpose, the number of project building units not satisfying the occupancy criterion ($n_{PJ,UNO,i,y}$) is monitored ex post.

104. The project participants may either choose to identify the project building units as all the building units in the project boundary or use a randomly selected sample of the building units in the project boundary.

105. If the random sampling approach is used, emission reductions can be claimed only if the sample size is larger than the minimum sample size as determined below ($n_{PJ,min,i,y}$). This minimum number refers to the number of project building units, for which useful monitoring data are available in a particular monitoring interval. Therefore, to compensate for any possible dropouts from the sample group during the monitoring period, it will be necessary to initially select a sample size. Project participants may choose any size larger than the minimum sample size, taking into account the risk of

[24] A building unit is considered to be in operation for the amount of hours the building unit is utilized for its main purpose (e.g. office work for an office building unit). The building unit might as well consume energy in other hours (e.g. standby energy consumption in the building unit during night time). However, those hours are not counted towards the operating hours.

dropouts from the sample group, the overhead costs for monitoring and the effect from reduced statistical errors on account of a larger sample size in calculating emission reductions. The minimum sample size needs to be updated every year because the total number of project building units for building unit category *i* may change over time. Different sample sizes may be chosen for each vintage year as long as the sample sizes are larger than the minimum size.

$$n_{PJ,min,i,y} = \frac{{cv_{SE,Pj,i,y}}^2 \times {t_{0.05}}^2 \times N_{PJ,i,y}}{{P_{10\%}}^2 \times N_{PJ,i,y} + {cv_{SE,PJ,i,y}}^2 \times {t_{0.05}}^2}$$ Equation (31)

Where:

$n_{PJ,min,i,y}$	=	Minimum sample size of project building units in building unit category *i* in year *y.* Round up to the next integer if it is decimal
$cv_{SE,Pj,i,y}$	=	Coefficient of variation of specific emissions of project building units in building unit category *i* in year *y*
$t_{0.05}$	=	t-value for a 90 per cent statistical significance level (1.645)
$P_{10\%}$	=	10 per cent precision requirement for a sample estimate (0.10)
$N_{PJ,i,y}$	=	Total number of project building units for building unit category *i* in year *y*

$$cv_{SE,PJ,i,y} = \frac{\sigma_{POP,SE,PJ,i,y}}{\mu_{POP,SE,PJ,i,y}}$$ Equation (32)

Where:

$cv_{SE,PJ,i,y}$	=	Coefficient of variation of specific emissions of project building units in building unit category *i* in year *y*
$\sigma_{POP,SE,PJ,i,y}$	=	Expected population standard deviation of specific emissions of project building units in building unit category *i* in year *y* (t CO_2/m^2)
$\mu_{POP,SE,PJ,i,y}$	=	Expected population mean of specific emissions of project building units in building unit category *i* in year *y* (t CO_2/m^2)

106. $cv_{PJ,SE,i,y}$ is a measure of the expected variation in specific emissions of the population of project building units in building unit category *i* in year *y*. For the first year, $cv_{SE,PJ,i,y}$ can be derived from officially published documents or own non-representative survey, accounting for the same emission sources as ones for the emission reduction calculation of the project activity. However, as necessary there may not be information readily available, a default factor of 0.5 is allowed to be used for the first year. For the second year, $cv_{SE,PJ,i,y}$ needs to be calculated based on the expected population mean and standard deviation of specific emissions of project building units in building unit category *i* in year *y* ($\mu_{POP,SE,PJ,i,y}$ and $\sigma_{POP,SE,PJ,i,y}$). The sample mean and standard deviation of the same for the first year ($\mu_{SE,PJ,i,1}$ and $\sigma_{SE,PJ,i,1}$), calculated with the equations (48) and (49), may be used as proxies for $\mu_{POP,SE,PJ,i,y}$ and $\sigma_{POP,SE,PJ,i,y}$.[25] In

[25] Regardless of additionality or existence of the fuel switching measures, these equations may be used for the sample size determination purpose.

case all the building units in the project boundary are monitored as project building units, replace $n_{PJ,i,y}$ by $N_{PJ,i,y}$ in using the equations (48) and (49).

107. For the project building units in building unit category *i*, the project emissions have to be calculated separately for each building unit category *i* for each crediting period year. If the random sampling approach is pursued, the same procedures as the baseline building units sampling shall be followed.

108. The collection of the energy consumption data from the project building units may require apportionment of the energy consumption if it is monitored only at a whole building level.[26] In this case, apportion the energy consumption by the *GFA* that each tenant/owner in the building occupies. Also, the use of a refrigerant(s) monitored only at a whole building level[27] shall also be apportioned by the *GFA* of the building unit. Such apportionment can be mathematically expressed as follows:

$$X_{PJ,i,j,y} = X_{PJ-Bldg,i,j,y} \times \frac{GFA_{PJ,i,j,y}}{GFA_{PJ-Bldg,i,j,y}}$$ Equation (33)

Where:

$X_{PJ,i,j,y}$	=	Project energy consumption (electricity, fossil fuel, or chilled water) or project emissions related to use of a refrigerant(s) in project building unit *j* in building unit category *i* in year *y* (MWh, mass or volume unit, GJ, or t refrigerant/yr)
$X_{PJ-Bldg,i,j,y}$	=	Project energy consumption (electricity, fossil fuel, or chilled water) or project emissions related to the use of a refrigerant(s) in the whole building, which project building unit *j* in building unit category *i* belongs to, in year *y* (MWh, mass or volume unit, GJ, or t refrigerant/yr)
$GFA_{PJ,i,j,y}$	=	*GFA* of project building unit *j* in building unit category *i* in year *y* (m^2)
$GFA_{PJ-Bldg,i,j,y}$	=	*GFA* of the whole building, which project building unit *j* in building unit category *i* belongs to, in year *y*. Account for *GFA* of each building unit in the building, but not *GFA* of the common service areas outside the physical boundaries of the building units (m^2)

5.4.3. Step 3. Calculation of emissions of each project building unit

109. First, calculate the annual emissions of each project building unit *j* in building unit category *i* identified in Step 2.

$$PE_{i,j,y} = PE_{EC,i,j,y} + PE_{FC,i,j,y} + PE_{WC,i,j,y} + PE_{ref,i,j,y}$$ Equation (34)

[26] For example, energy consumption for the operation of a central air conditioning system for a whole building may be metered only at a whole building level. In this case, the building manager (e.g. facility manager, landlord) may simply include the energy bill in the rent without providing energy consumption data to each tenant.

[27] For example the refrigerant use in a central air conditioner supplying the entire building.

Where:

$PE_{i,j,y}$	=	Project emissions of project building unit *j* in building unit category *i* in year *y* (t CO_2e/yr)
$PE_{EC,i,j,y}$	=	Project emissions from electricity consumption of project building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$PE_{FC,i,j,y}$	=	Project emissions from fossil fuel consumption of project building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$PE_{WC,i,j,y}$	=	Project emissions from chilled/hot water consumption of project building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$PE_{ref,i,j,y}$	=	Project emissions from the use of a refrigerant(s) in project building unit *j* in building unit category *i* in year *y* (t CO_2e/yr)

110. If it is justified that the CDM project activity does not result in an increase of emissions from the use of a refrigerant(s) in buildings as compared to the baseline, $PE_{ref,i,j,y}$ may be excluded.

5.4.3.1. Sub-step 3.1. Calculation of project emissions from electricity consumption ($PE_{EC,i,j,y}$)

111. The project emissions from electricity consumption of project building unit *j* in building unit category *i* ($PE_{EC,i,j,y}$) are further divided into the following two components:

$$PE_{EC,i,j,y} = PE_{EC,non-REcaptive,i,j,y} + PE_{EC,REcaptive,i,j,y} \quad \text{Equation (35)}$$

Where:

$PE_{EC,i,j,y}$	=	Project emissions from electricity consumption of project building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$PE_{EC,non-REcaptive,i,j,y}$	=	Project emissions from electricity consumption of project building unit *j* in building unit category *i* in year *y*, which is supplied by the grid and/or an off-grid fossil-fuel-fired captive power plant(s) (t CO_2/yr)
$PE_{EC,REcaptive,i,j,y}$	=	Project emissions from electricity consumption of project building unit *j* in building unit category *i* in year *y*, which is supplied by an off-grid renewable captive power plant(s) (t CO_2/yr)

112. $PE_{EC,non-REcaptive,i,j,y}$ shall be calculated using the latest approved version of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.

113. $PE_{EC,REcaptive,i,j,y}$ equals 0 (t CO_2/yr) as the methodology excludes the use of biogas or biomass systems.

5.4.3.2. Sub-step 3.2. Calculation of project emissions from fuel consumption ($PE_{FC,i,j,y}$)

114. The project emissions from fossil fuel consumption of project building unit *j* in building unit category *i* in year *y* ($PE_{FC,i,j,y}$) shall be calculated using the latest approved version of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.

5.4.3.3. Sub-step 3.3. Calculation of project emissions from chilled/hot water consumption (*$PE_{WC,i,j,y}$*)

115. The chilled/hot water systems installed in project building units applicable under this methodology should have configuration as depicted in Figure 2. The equations are derived considering this configuration in account.[28]

116. The project emissions from chilled/hot water consumption of project building unit *j* in building unit category *i* in year *y* ($PE_{WC,i,j,y}$) shall be calculated as follows:

$$PE_{WC,i,j,y} = \frac{WC_{PJ,i,j,y} \times EF_{PJ,WP,i,j,y}}{1 - \eta_{PJ,dist,l,y}} \quad \text{Equation (36)}$$

Where:

$PE_{WC,i,j,y}$	=	Project emissions from chilled/hot water consumption of project building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$WC_{PJ,i,j,y}$	=	Energy content of annual chilled/hot water consumed in project building unit *j* in building unit category *i* in year *y* (GJ/yr)
$EF_{PJ,WP,i,j,y}$	=	Emission factor for production of chilled/hot water that is supplied to project unit *j* in building unit category *i* in year *y* (t CO_2/GJ)
$\eta_{PJ,dist,l,y}$	=	Average technical distribution losses of the chilled/hot water system *l* in year *y* (GJ of thermal energy losses in the chilled/hot water distribution network divided by GJ of thermal energy supplied to the building units)

117. If a heat meter(s) is installed for monitoring of the energy content of chilled/hot water consumed in the project building unit *j* (or centrally in the building that the project building unit belongs to), $WC_{PJ,i,j,y}$ can be derived directly from the meter reading. If only a mass or volume flow meter(s) and temperature indicators are installed, $WC_{PJ,i,j,y}$ is calculated according to the following equations:

$$WC_{PJ,i,j,y} = m_{PJ,i,j,y} \times \Delta t_{PJ,i,j,y} \times C_m \quad \text{Equation (37)}$$

Where:

$WC_{PJ,i,j,y}$	=	Energy content of annual chilled/hot water consumption in project building unit *j* in building unit category *i* in year *y* (GJ/yr)
$m_{PJ,i,j,y}$	=	Annual chilled/hot water consumption (in mass) of project building unit *j* in building unit category *i* in year *y* (kg/yr)
$\Delta t_{PJ,i,j,y}$	=	Average temperature difference between the outlet and inlet of the heat exchanger used for the cooling and heating of building unit *j* in building unit category *i* in year *y* (K)
C_m	=	Specific heat capacity of the chilled water (GJ/(kg·K))

[28] Project participants willing to use a different configuration of chilled/hot water systems in project buildings should submit the request for revision to this methodology.

118. In case the volumetric flow meter, and not mass flow meter, is installed, $m_{PJ,i,j,y}$ is calculated using the following equation:

$$m_{PJ,i,j,y} = v_{PJ,i,j,y} \times \rho_{H20} \quad \text{Equation (38)}$$

Where:

$m_{PJ,i,j,y}$	=	Annual chilled/hot water consumption (in mass) of project building unit *j* in building unit category *i* in year *y* (kg/yr)
$v_{PJ,i,j,y}$	=	Annual chilled/hot water consumption (in volume) of project building unit *j* in building unit category *i* in year *y* (m^3/yr)
ρ_{H20}	=	Density of the chilled/hot water (kg/m^3)

119. The emission factor for chilled/hot water production ($EF_{PJ,WP,i,j,y}$) shall be calculated for each centralised chilled/hot water system *l* that supplies the chilled/hot water to the respective building unit *j* in building unit category *i* in year *y*, according to the following equation. If the supply of chilled/hot water is claimed for CERs in any other registered CDM project, $EF_{PJ,WP,i,j,y}$ shall be equal to the baseline emission factor of the chilled/hot water supply calculated according to the methodology applied to the registered CDM project. Such treatment is necessary to avoid double counting of emission reductions.

$$EF_{PJ,WP,i,j,y} = \frac{PE_{WP,EC,l,y} + PE_{WP,FC,l,y} + PE_{WP,FE,l,y}}{WP_{PJ,l,y}} \quad \text{Equation (39)}$$

Where:

$EF_{PJ,WP,i,j,y}$	=	Emission factor for production of chilled/hot water that is supplied to project building unit *j* in building unit category *i* in year *y* (t CO_2/GJ)
$PE_{WP,EC,l,y}$	=	Project emissions from electricity consumption of chilled/hot water system *l* in year *y* (t CO_2/yr)
$PE_{WP,FC,l,y}$	=	Project emissions from fuel consumption of chilled/hot water system *l* in year *y* (t CO_2/yr)
$PE_{WP,FE,l,y}$	=	Project fugitive emissions of CO_2 and methane due to release of non-condensable gases from geothermal sources in chilled/hot water production in chilled/hot water system *l* in year *y* (t CO_2/yr)
$WP_{PJ,l,y}$	=	Energy content of annual chilled/hot water production of chilled/hot water system *l* in year *y* (GJ/yr)

120. If a heat meter(s) is installed for monitoring of the chilled/hot water production in the chilled/hot water system *l*, $WP_{PJ,l,y}$ can be derived directly from the meter reading. If only a mass or volume flow meter(s) is installed, $WP_{PJ,l,y}$ is calculated according to the following equations:

$$WP_{PJ,l,y} = m_{PJ,l,y} \times \Delta t_{PJ,l,y} \times C_m \quad \text{Equation (40)}$$

Where:

$WP_{PJ,l,y}$	=	Energy content of annual chilled/hot water production of chilled/hot water system *l* in year *y* (GJ/yr)
$m_{PJ,l,y}$	=	Annual chilled/hot water production (in mass) of chilled/hot water system *l* in year *y* (kg/yr)
$\Delta t_{PJ,l,y}$	=	Average temperature difference between the outlet and inlet of the heat exchanger used for the chilled/hot water production in chilled/hot water system *l* in year *y* (K)
C_m	=	Specific heat capacity of the chilled/hot water (GJ/(kg·K))

121. In case a volumetric flow meter, and not a mass flow meter, is installed, $m_{PJ,l,y}$ is calculated using the following equation:

$$m_{PJ,l,y} = v_{PJ,l,y} \times \rho_{H2O} \quad \text{Equation (41)}$$

Where:

$m_{PJ,l,y}$	=	Annual chilled/hot water production (in mass) of chilled water system *l* in year *y* (kg/yr)
$v_{PJ,l,y}$	=	Annual chilled/hot water production (in volume) of chilled water system *l* in year *y* (m^3/yr)
ρ_{H2O}	=	Density of the chilled water (kg/m^3)

122. The project emissions from electricity consumption of chilled/hot water system *l* in year *y* ($PE_{WP,EC,l,y}$) shall be calculated using the latest approved version of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. The electricity consumption includes the consumption all electrical equipment as a part of central chilled/ hot water system for example compressor, pumps etc.

123. The project emissions from fossil fuel consumption of chilled/hot water system *l* in year *y* ($PE_{WP,FC,l,y}$) shall be calculated using the latest approved version of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.

124. In case all or part of the heat consumed in chilled/hot water system *l* is supplied by a geothermal source, the fugitive emissions from these sources are calculated as follows:

$$PE_{WP,FE,l,y} = \left(w_{PJ,steam,CO2,l,y} + w_{PJ,steam,CH4,l,y} \times GWP_{CH4}\right) \times M_{PJ,steam,l,y} \quad \text{Equation (42)}$$

Where:

$PE_{WP,FE,l,y}$	=	Project fugitive emissions of CO_2 and methane due to release of non-condensable gases from geothermal sources in chilled/hot water production in chilled/hot water system *l* in year *y* (t CO_2/yr)
$w_{PJ,steam,CO2,l,y}$	=	Average mass fractions of carbon dioxide in the produced steam for the use in chilled/hot water system *l* in year *y* (t CO_2/t steam)

$w_{PJ,steam,CH4,l,y}$ = Average mass fractions of methane in the produced geothermal steam for the use in chilled/hot water system *l* in year *y* (t CH_4/t steam)

GWP_{CH4} = Global Warming Potential of methane valid for the relevant commitment period (t CO_2e/t CH_4)

$M_{PJ,steam,l,y}$ = Quantity of geothermal steam produced for the use in chilled/hot water system *l* in year *y* (t/yr)

5.4.3.4. Sub-step 3.4. Calculation of project emissions from the use of a refrigerant(s) ($PE_{ref,i,j,y}$)

125. The project emissions from the use of a refrigerant(s) in project building unit *j* in building unit category *i* in year *y* ($PE_{ref,i,j,y}$) shall be calculated as follows:

$$PE_{ref,i,j,y} = \sum_{m}\left(Q_{PJ,ref,i,j,m,y} + Q_{PJ,ref,i,j,m,Start} - Q_{PJ,ref,i,j,m,End}\right) \times GWP_{PJ,ref,i,j,m,y} + PE_{WP,ref,l,y} \times \frac{WC_{PJ,i,j,y}}{\left(1 - \eta_{PJ,dist,l,y}\right) \times WP_{PJ,l,y}}$$ Equation (43)

Where:

$PE_{ref,i,j,y}$ = Project emissions from the use of a refrigerant(s) in project building unit *j* in building unit category *i* in year *y* (t CO_2e/yr)

$Q_{PJ,ref,i,j,m,y}$ = Annual quantity of refrigerant type *m* used to replace the refrigerant(s) that has leaked in project building unit *j* in building unit category *i* in year *y*, excluding refrigerant leakage from chilled water system (t refrigerant/yr)

$Q_{PJ,ref,i,j,m,Start}$ = Quantity of the initial charge of refrigerant type *m* in chiller(s) used in project building unit *j* in building unit category *i* in year *y*, excluding refrigerant leakage from chilled water system (t refrigerant/yr)

$Q_{PJ,ref,i,j,m,End}$ = Quantity of refrigerant type *m* in chiller(s) used in project building unit *j* in building unit category *i* that is recovered and destroyed or re-used in year *y*, excluding refrigerant leakage from chilled water system (t refrigerant/yr)

$GWP_{PJ,ref,i,j,m,y}$ = Global Warming Potential of refrigerant type *m* used in project building unit *j* in building unit category *i* in year *y* (t CO_2e/t refrigerant)

$WC_{PJ,i,j,y}$ = Energy content of annual chilled water consumption in project building unit *j* in building unit category *i* in year *y* (GJ/yr)

$PE_{WP,ref,l,y}$	=	Project emissions from the use of a refrigerant in chilled water system *l* in year *y* (t CO_2/yr)
$\eta_{PJ,dist,l,y}$	=	Average technical distribution losses of the chilled/hot water system *l* in year *y* (GJ of technical thermal energy losses in the chilled/hot water distribution network divided by GJ of thermal energy supplied to the building units)
$WP_{PJ,l,y}$	=	Energy content of annual chilled/hot water production of chilled/hot water system *l* in year *y* (GJ/yr)

126. The project emissions from the use of a refrigerant in chilled/hot water system *l* in year *y* ($PE_{WP,ref,l,y}$) are calculated as follows:

$$PE_{WP,ref,l,y} = \left(Q_{PJ,ref,l,y} + Q_{PJ,ref,l,Start} - Q_{PJ,ref,l,End}\right) \times GWP_{PJ,ref,l,y} \qquad \text{Equation (44)}$$

Where:

$PE_{WP,ref,l,y}$	=	Project emissions from the use of a refrigerant in chilled water system *l* in year *y* (t CO_2/yr)
$Q_{PJ,ref,l,y}$	=	Average annual quantity of the refrigerant used to replace the refrigerant that has leaked in chilled water system *l* in year *y* (t refrigerant/yr)
$Q_{PJ,ref,l,Start}$	=	Quantity of the initial charge of the refrigerant in chilled water system *l* in year *y* (t refrigerant/yr)
$Q_{PJ,ref,l,End}$	=	Quantity of the refrigerant in chilled water system *l* that is recovered and destroyed or re-used in year *y* (t refrigerant/yr)
$GWP_{PJ,ref,l,y}$	=	Global Warming Potential of the refrigerant used in chilled water system *l* in year *y* (t CO_2e/t refrigerant)

5.4.4. Step 4a. Calculation of project emissions

5.4.4.1. Sub-step 4.a.1 Follow this step if fuel switching measures of the project activity are demonstrated additional or separate additionality demonstration of the fuel switching measures is not required

127. If all the building units in the project boundary are monitored as project building units, the project emission shall be calculated as follows:

$$PE_y = \sum_i \sum_j PE_{i,j,y} \times DISC_{i,y} \qquad \text{Equation (45)}$$

Where:

PE_y	=	Project emissions from project building units in year *y* (t CO_2e/yr)
$PE_{i,j,y}$	=	Project emissions from project building unit *j* in building unit category *i* in year *y* (t CO_2e/yr)

$DISC_{i,y}$	=	Discount factor for double-counting of emissions reductions due to overlapping use of efficient appliances in building unit category *i* in year *y*. The discount factor is to be calculated using equation provided in the section on baseline emissions

128. If a sample of building units in the project boundary is monitored as project building units, calculate the *SE* of project building unit *j* in building unit category *i* in year *y*, defined as emissions per *GFA* in square metre per year:

$$SE_{PJ,i,j,y} = \frac{PE_{i,j,y}}{GFA_{PJ,i,j,y}} \quad \text{Equation (46)}$$

Where:

$SE_{PJ,i,j,y}$	=	Specific emissions of project building unit *j* in building unit category *i* in year *y*, defined as emissions per *GFA* in square metre per year (t CO_2e/(m^2·yr))
$PE_{i,j,y}$	=	Project emissions of project building unit *j* in building unit category *i* in year *y* (t CO_2e/yr)
$GFA_{PJ,i,j,y}$	=	*GFA* of project building unit *j* in building unit category *i* in year *y* (m^2)

129. Then, calculate the average *SE* of the project building units in building unit category *i* in year *y* ($SE_{PJ,i,y}$), adjusting for the sample error as follows:

$$SE_{PJ,i,y} = \mu_{SE,PJ,i,y} + t_{0.05} \times \frac{\sigma_{SE,PJ,i,y}}{\sqrt{n_{PJ,i,y}}} \quad \text{Equation (47)}$$

Where:

$SE_{PJ,i,y}$	=	Mean of specific emissions of project building units in building unit category *i* in year *y*, defined as emissions per *GFA* in square meter per year (t CO_2e/(m^2·yr))
$\mu_{SE,PJ,i,y}$	=	Sample mean of specific emissions of project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$t_{0.05}$	=	t-value for a 90 per cent statistical significance level (1.645)
$\sigma_{SE,PJ,i,y}$	=	Standard deviation of specific emissions of project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$n_{PJ,i,y}$	=	Total number of project building units included in the sample for building unit category *i* in year *y*

$$\mu_{SE,PJ,i,y} = \frac{\sum_j SE_{PJ,i,j,y}}{n_{PJ,i,y}} \quad \text{Equation (48)}$$

Where:

$\mu_{SE,PJ,i,y}$	=	Sample mean of specific emissions of project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$SE_{PJ,i,j,y}$	=	Specific emissions of project building unit *j* in building unit category *i* in year *y*, defined as emissions per *GFA* in square meter per year (t CO_2e/(m^2·yr))
$n_{PJ,i,y}$	=	Total number of project building units included in the sample for building unit category *i* in year *y*

$$\sigma_{SE,PJ,i,y} = \sqrt{\frac{\sum_j \left(SE_{PJ,i,j,y} - \mu_{SE,PJ,i,y}\right)^2}{n_{PJ,i,y} - 1}}$$ Equation (49)

Where:

$\sigma_{SE,PJ,i,y}$	=	Standard deviation of specific emissions of project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$SE_{PJ,i,j,y}$	=	Specific emissions of project building unit *j* in building unit category *i* in year *y*, defined as emissions per *GFA* in square metre per year (t CO_2e/(m^2·yr))
$\mu_{SE,PJ,i,y}$	=	Sample mean of specific emissions of project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$n_{PJ,i,y}$	=	Total number of project building units included in the sample for building unit category *i* in year *y*

130. Based on $SE_{PJ,i,y}$ determined above, the project emissions are calculated by multiplying $SE_{PJ,i,y}$ by the total *GFA* of the project building units in the corresponding building unit category *i*. Accordingly, the total project emissions are calculated as follows:

$$PE_y = \sum_i SE_{PJ,i,y} \times GFA_{PJ,i,y} \times CF_{PJ,i,y} \times DISC_{i,y}$$ Equation (50)

Where:

PE_y	=	Project emissions of project building units in year *y* (t CO_2e/yr)
$SE_{PJ,i,y}$	=	Mean of specific emissions of project building units in building unit category *i* in year *y*, defined as emissions per *GFA* in square metre per year (t CO_2e/(m^2·yr))
$GFA_{PJ,i,y}$	=	Total GFA of project building units in building unit category *i* in year *y* (m^2)
$CF_{PJ,i,y}$	=	Correction factor for occupancy of project building units in building unit category *i* in year *y*

$DISC_{i,y}$	=	Discount factor for double-counting of emissions reductions due to overlapping use of efficient appliances in building unit category *i* in year *y*. The discount factor is to be calculated using equation provided in the section on baseline emissions

131. Project correction factor for occupancy $CF_{PJ,i,y}$ shall be calculated as follows:

Where:

PE_y	=	Project emissions of project building units in year *y* (t CO_2e/yr)
$SE_{PJ,i,y}$	=	Mean of specific emissions of project building units in building unit category *i* in year *y*, defined as emissions per *GFA* in square metre per year (t $CO_2e/(m^2\cdot yr)$)
$GFA_{PJ,i,y}$	=	Total *GFA* of project building units in building unit category *i* in year *y* (m^2)
$CF_{PJ,i,y}$	=	Correction factor for occupancy of project building units in building unit category *i* in year *y*

132. The project correction factor for occupancy of project building units ($CF_{PJ,i,y}$) is set to one if all the building units in the project boundary are monitored as project building units. If a sample of building units in the project boundary is monitored as project building units, $CF_{PJ,i,y}$ shall be calculated as follows:

$$CF_{PJ,i,y} = 1 - \left(\lambda_{PJ,i,y} - t_{0.05} \times \sqrt{\frac{\lambda_{Pj,i,y} \times \left(1 - \lambda_{PJ,i,y}\right)}{n_{PJ,i,y}}}\right)$$ Equation (51)

Where:

$CF_{PJ,i,y}$	=	Project correction factor for occupancy of project building units in building unit category *i* in year *y*
$\lambda_{PJ,i,y}$	=	Share of building units not meeting the occupancy criterion for project building units in building unit category *i* in year *y*
$t_{0.05}$	=	t-value for a 90 per cent statistical significance level (1.645)
$n_{PJ,i,y}$	=	Total number of project building units included in the sample for building unit category *i* in year *y*

$$\lambda_{PJ,i,y} = \frac{n_{PJ,UNO,i,y}}{n_{PJ,i,y}}$$ Equation (52)

Where:

$\lambda_{PJ,i,y}$	=	Share of building units not meeting the occupancy criterion for project building units in building unit category *i* in year *y*
$n_{PJ,UNO,i,y}$	=	Total number of project building units not satisfying the occupancy criterion in the sample for building unit category *i* in year *y*. See Step 2 “Identification of project building units” for the occupancy criterion
$n_{PJ,i,y}$	=	Total number of project building units included in the sample for building unit category *i* in year *y*

5.4.4.2. Sub-step 4.a.2. Follow this step if fuel switching measures of the project activity are not demonstrated additional or the project activity does not claim CERs for emission reductions from the fuel switching measures

133. The project emissions shall be calculated as follows:[29]

$$PE_y = \sum_i \{(ECI_{PJ,i,y} \times CI_{Top20\%,EC,i,y} + FCI_{PJ,i,k,y} \times CI_{Top20\%,FC,i,y} + WCI_{PJ,i,y} \times CI_{Top20\%,WC,i,y} + REFI_{PJ,i,y}) \times GFA_{PJ,i,y} \times CF_{PJ,i,y} \times DISC_{i,y}\} \quad \text{Equation (53)}$$

Where:

PE_y	=	Project emissions from project building units in year *y* (t CO_2e/yr)
$ECI_{PJ,i,y}$	=	Average specific electricity consumption of project building units in building unit category *i* in year *y* (MWh/(m^2·yr))
$CI_{Top20\%,EC,i,y}$	=	Average carbon intensity of electricity used in the top 20 per cent performer baseline building units in building unit category *i* in year *y* (t CO_2e/MWh)
$FCI_{PJ,i,k,y}$	=	Average specific consumption of energy of fossil fuel type *k* of project building units in building unit category *i* in year *y* (MWh/(m^2·yr))
$CI_{Top20\%,FC,i,y}$	=	Average carbon intensity of fossil fuel used in the top 20 per cent performer baseline building units in building unit category *i* in year *y* (t CO_2e/MWh)
$WCI_{PJ,i,y}$	=	Average specific chilled/hot water consumption of project building units in building unit category *i* in year *y* (GJ/(m^2·yr))

[29] In this equation, the carbon intensity of energy sources is derived from the parameters used for the baseline emission calculation in order to exclude emission reductions from fuel switching measures.

$CI_{Top20\%,WC,i,y}$	=	Average carbon intensity of chilled/hot water used in the top 20 per cent performer baseline building units in building unit category *i* in year *y* (t CO_2e/GJ)
$REFI_{PJ,i,y}$	=	Average specific emissions from the use of a refrigerant(s) in project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$GFA_{PJ,i,y}$	=	Total GFA of project building units in building unit category *i* in year *y* (m^2)
$CF_{PJ,i,y}$	=	Project correction factor for occupancy of project building units in building unit category *i* in year *y*, calculated applying the equations (51) and (52)
$DISC_{i,y}$	=	Discount factor for double-counting of emissions reductions due to overlapping use of efficient appliances in building unit category *i* in year *y*. The discount factor is to be calculated using equation provided in the section on baseline emissions

5.4.4.2.1. Calculation of average carbon intensity of energy sources

134. Using the same set of top 20 per cent performer building units identified in Sub-step 4.1 of the baseline emission calculation, the average carbon intensity of different energy sources ($CI_{Top20\%,EC,i,y}$, $CI_{Top20\%,FC,i,y}$ and $CI_{Top20\%,WC,i,y}$) shall be calculated.

135. The average carbon intensity of electricity used in the top 20 per cent performer building units ($CI_{Top20\%,EC,i,y}$) is calculated as follows:

$$CI_{Top20\%,EC,i,y} = \frac{\sum_j CI_{Top20\%,EC,i,j,y}}{J_{i,y}} \quad \text{Equation (54)}$$

Where:

$CI_{Top20\%,EC,i,y}$	=	Average carbon intensity of electricity used in the top 20 per cent performer building units in building unit category *i* in year *y* (t CO_2e/MWh)
$CI_{Top20\%,EC,i,j,y}$	=	Carbon intensity of electricity used in top 20 per cent performer baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/MWh)
$J_{i,y}$	=	Total number of top 20 per cent performer baseline building units in building unit category *i* in year *y* (t CO_2e/yr). It is calculated as the product of the number of baseline building units monitored in building category *i* and 20 per cent, rounded down to the next integer if it is decimal

136. $CI_{Top20\%,EC,i,j,y}$ is the carbon intensity of electricity used in baseline building unit *j* in building unit category *i* in year *y* ($CI_{BL,EC,,i,j,y}$), which is calculated as follows:

$$CI_{BL,EC,i,j,y} = \frac{BE_{EC,i,j,y}}{EC_{BL,i,j,y}} \quad \text{Equation (55)}$$

Where:

$CI_{BL,EC,i,j,y}$	=	Carbon intensity of electricity used in baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/MWh)
$BE_{EC,i,j,y}$	=	Baseline emissions from electricity consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$EC_{BL,i,j,y}$	=	Electricity consumption of baseline building unit *j* in building unit category *i* in year *y* (MWh/yr)

137. The average carbon intensity of fuel used in the top 20 per cent performer building units ($CI_{Top20\%,FC,i,y}$) is calculated as follows:

$$CI_{Top20\%,FC,i,y} = \frac{\sum_j CI_{Top20\%,FC,i,j,y}}{J_{i,y}}$$ Equation (56)

Where:

$CI_{Top20\%,FC,i,y}$	=	Average carbon intensity of fuel used in the top 20 per cent performer baseline building units in building unit category *i* in year *y* (t CO_2e/MWh)
$CI_{Top20\%,FC,i,j,y}$	=	Carbon intensity of fuel used in top 20 per cent performer baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/MWh)
$J_{i,y}$	=	Total number of top 20 per cent performer baseline building units in building unit category *i* in year *y* (t CO_2e/yr). It is calculated as the product of the number of baseline building units monitored in building category *i* and 20 per cent, rounded down to the next integer if it is decimal

138. $CI_{Top20\%,FC,i,j,y}$ is the carbon intensity of fuel used in baseline building unit *j* in building unit category *i* in year *y* ($CI_{BL,FC,,i,j,y}$), which is calculated as follows:

$$CI_{BL,FC,i,j,y} = \frac{BE_{FC,i,j,y}}{FC_{BL,i,j,y}}$$ Equation (57)

Where:

$CI_{BL,FC,i,j,y}$	=	Carbon intensity of fuel used in baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/MWh)
$BE_{FC,i,j,y}$	=	Baseline emissions from fuel consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$FC_{BL,i,j,y}$	=	Fuel consumption of baseline building unit *j* in building unit category *i* in year *y* (MWh/yr)

139. The average carbon intensity of chilled/hot water used in the top 20 per cent performer building units ($CI_{Top20\%,WC,i,y}$) is calculated as follows:

$$CI_{Top20\%,WC,i,y} = \frac{\sum_j CI_{Top20\%,WC,i,j,y}}{J_{i,y}} \quad \text{Equation (58)}$$

Where:

$CI_{Top20\%,WC,i,y}$	=	Average carbon intensity of chilled/hot water used in the top 20 per cent performer building units in building unit category *i* in year *y* (t CO_2e/GJ)
$CI_{Top20\%,WC,i,j,y}$	=	Carbon intensity of chilled/hot water used in top 20 per cent performer baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/GJ)
$J_{i,y}$	=	Total number of top 20 per cent performer building units in baseline building unit category *i* in year *y* (t CO_2e/yr). It is calculated as the product of the number of baseline building units monitored in building category *i* and 20 per cent, rounded down to the next integer if it is decimal

140. $CI_{Top20\%,WC,i,j,y}$ is a subset of carbon intensity of chilled/hot water used in baseline building unit *j* in building unit category *i* in year *y* ($CI_{BLWC,i,j,y}$), which is calculated as follows:

$$CI_{BL,WC,i,j,y} = \frac{BE_{WC,i,j,y}}{WC_{BL,i,j,y}} \quad \text{Equation (59)}$$

Where:

$CI_{BL,WC,i,j,y}$	=	Carbon intensity of chilled/hot water used in baseline building unit *j* in building unit category *i* in year *y* (t CO_2e/GJ)
$BE_{WC,i,j,y}$	=	Baseline emissions from chilled/hot water consumption of baseline building unit *j* in building unit category *i* in year *y* (t CO_2/yr)
$WC_{BL,i,j,y}$	=	Energy content of annual chilled/hot water consumption in baseline building unit *j* in building unit category *i* in year *y* (GJ/yr)

5.4.4.2.2. Calculation of average specific energy consumption and refrigerant leakage

141. If all the building units in the project boundary are monitored as project building units, the average specific electricity consumption of the project building units ($ECI_{PJ,i,y}$) is calculated as follows:

$$ECI_{PJ,i,y} = \frac{\sum_j ECI_{PJ,i,j,y}}{N_{PJ,i,y}} \quad \text{Equation (60)}$$

Where:

$ECI_{PJ,i,y}$	=	Average specific electricity consumption of project building units in building unit category *i* in year *y* (MWh/(m^2·yr))
$ECI_{PJ,i,j,y}$	=	Specific electricity consumption of project building unit *j* in building unit category *i* in year *y* (MWh/(m^2·yr))
$N_{PJ,i,y}$	=	Total number of project building units in the population for building unit category *i* in year *y*

$$ECI_{PJ,i,j,y} = \frac{EC_{PJ,i,j,y}}{GFA_{PJ,i,j,y}}$$ Equation (61)

Where:

$ECI_{PJ,i,j,y}$	=	Specific electricity consumption of project building unit *j* in building unit category *i* in year *y* (MWh/(m^2·yr))
$EC_{PJ,i,j,y}$	=	Electricity consumption of baseline building unit *j* in building unit category *i* in year *y* (MWh/yr)
$GFA_{PJ,i,j,y}$	=	GFA of project building unit *j* in building unit category *i* in year *y* (m^2)

142. If all the building units in the project boundary are monitored as project building units, the average specific consumption fossil fuel type *k* of project building units ($FCI_{PJ,i,k,y}$) is calculated as follows:

$$FCI_{PJ,i,k,y} = \frac{\sum_j FCI_{PJ,i,j,k,y}}{N_{PJ,i,y}}$$ Equation (62)

Where:

$FCI_{PJ,i,k,y}$	=	Average specific consumption of fossil fuel type *k* of project building units in building unit category *i* in year *y* (mass or volume unit/(m^2·yr))
$FCI_{PJ,i,j,k,y}$	=	Specific consumption of fossil fuel type *k* of project building unit *j* in building unit category *i* in year *y* (mass or volume unit/(m^2·yr))
$N_{PJ,i,y}$	=	Total number of project building units in the population for building unit category *i* in year *y*

$$FCI_{PJ,i,j,k,y} = \frac{FC_{PJ,i,j,k,y}}{GFA_{PJ,i,j,y}}$$ Equation (63)

Where:

$FCI_{PJ,i,j,k,y}$	=	Specific consumption of fossil fuel type *k* of project building unit *j* in building unit category *i* in year *y* (mass or volume unit/(m^2·yr))
$FC_{PJ,i,j,k,y}$	=	Annual consumption of fossil fuel type *k* of project building unit *j* in building unit category *i* in year *y*. The amount of fuel used for the electricity generation by the captive power plant(s) in the building that project building unit *j* belongs to shall not be included in the parameter (mass or volume unit/yr)
$GFA_{PJ,i,j,y}$	=	*GFA* of project building unit *j* in building unit category *i* in year *y* (m^2)

143. If all the building units in the project boundary are monitored as project building units, the average specific chilled/hot water consumption of project building units ($WCI_{PJ,i,y}$) is calculated as follows:

$$WCI_{PJ,i,y} = \frac{\sum_j WCI_{PJ,i,j,y}}{N_{PJ,i,y}}$$ Equation (64)

Where:

$WCI_{PJ,i,y}$	=	Average specific chilled/hot water consumption of project building units in building unit category *i* in year *y* (GJ/(m^2·yr))
$WCI_{PJ,i,j,y}$	=	Specific chilled/hot water consumption of project building unit *j* in building unit category *i* in year *y* (GJ/(m^2·yr))
$N_{PJ,i,y}$	=	Total number of project building units in the population for building unit category *i* in year *y*

$$WCI_{PJ,i,j,y} = \frac{WC_{PJ,i,j,y}}{GFA_{PJ,i,j,y}}$$ Equation (65)

Where:

$WCI_{PJ,i,j,y}$	=	Specific chilled/hot water consumption of project building unit *j* in building unit category *i* in year *y* (GJ/(m^2·yr))
$WC_{PJ,i,j,y}$	=	Energy content of annual chilled/hot water consumption in project building unit *j* in building unit category *i* in year *y* (GJ/yr)
$GFA_{PJ,i,j,y}$	=	GFA of project building unit *j* in building unit category *i* in year *y* (m^2)

144. If all the building units in the project boundary are monitored as project building units, the average specific emissions from the use of a refrigerant(s) in project building units ($REFI_{PJ,i,y}$) is calculated as follows:

$$REFI_{PJ,i,y} = \frac{\sum_j REFI_{PJ,i,j,y}}{N_{PJ,i,y}}$$ Equation (66)

Where:

$REFI_{PJ,i,y}$	=	Average specific emissions from the use of a refrigerant(s) in project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$REFI_{PJ,i,j,y}$	=	Specific emissions from the use of a refrigerant(s) in project building unit *j* in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$N_{PJ,i,y}$	=	Total number of project building units in the population for building unit category *i* in year *y*

$$REFI_{PJ,i,j,y} = \frac{PE_{ref,i,j,y}}{GFA_{PJ,i,j,y}} \quad \text{Equation (67)}$$

Where:

$REFI_{PJ,i,j,y}$	=	Specific emissions from the use of a refrigerant(s) in project building unit *j* in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$PE_{ref,i,j,y}$	=	Project emissions from the use of a refrigerant(s) in project building unit *j* in building unit category *i* in year *y* (t CO_2e/yr)
$GFA_{PJ,i,j,y}$	=	GFA of project building unit *j* in building unit category *i* in year *y* (m^2)

145. If a sample of building units in the project boundary is monitored as project building units, the calculated $ECI_{PJ,i,y}$, $FCI_{PJ,i,k,y}$, $WCI_{PJ,i,y}$ and $REFI_{PJ,i,y}$ shall be conservatively adjusted for the sampling error. Namely, the adjustment requires $ECI_{PJ,i,y}$, $FCI_{PJ,i,k,y}$, $WCI_{PJ,i,y}$ and $REFI_{PJ,i,y}$ to be the higher-bound value of the confidence interval established around the average *EI* and *REFI* of the project building units at a 90 per cent significance level.

$$ECI_{PJ,i,y} = \mu_{ECI,PJ,i,y} + t_{0.05} \times \frac{\sigma_{ECI,PJ,i,y}}{\sqrt{n_{PJ,i,y}}} \quad \text{Equation (68)}$$

and

$$FCI_{PJ,i,k,y} = \mu_{FCI,PJ,i,k,y} + t_{0.05} \times \frac{\sigma_{FCI,PJ,i,k,y}}{\sqrt{n_{PJ,i,y}}} \quad \text{Equation (69)}$$

and

$$WCI_{PJ,i,y} = \mu_{WCI,PJ,i,y} + t_{0.05} \times \frac{\sigma_{WCI,PJ,i,y}}{\sqrt{n_{PJ,i,y}}} \quad \text{Equation (70)}$$

and

$$REFI_{PJ,i,y} = \mu_{REFI,PJ,i,y} + t_{0.05} \times \frac{\sigma_{REFI,PJ,i,y}}{\sqrt{n_{PJ,i,y}}} \quad \text{Equation (71)}$$

Where:

$ECI_{PJ,i,y}$	=	Average specific electricity consumption of project building units in building unit category *i* in year *y* (MWh/(m^2·yr))
$FCI_{PJ,i,k,y}$	=	Average specific consumption of fossil fuel type *k* of project building units in building unit category *i* in year *y* (mass or volume unit/(m^2·yr))
$WCI_{PJ,i,y}$	=	Average specific chilled/hot water consumption of project building units in building unit category *i* in year *y* (GJ/(m^2·yr))
$REFI_{PJ,i,y}$	=	Average specific emissions from the use of a refrigerant(s) in project building unit *j* in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$\mu_{ECI,PJ,i,y}$	=	Sample mean of specific electricity consumption of project building units in building unit category *i* in year *y* (MWh/(m^2·yr))
$\mu_{FCI,PJ,i,k,y}$	=	Sample mean of specific consumption of fossil fuel type *k* of project building units in building unit category *i* in year *y* (mass or volume unit/(m^2·yr))
$\mu_{WCI,PJ,i,y}$	=	Sample mean of specific chilled/hot water consumption of project building units in building unit category *i* in year *y* (GJ/(m^2·yr))
$\mu_{REFI,PJ,i,y}$	=	Sample mean of specific emissions from the use of a refrigerant(s) in project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$t_{0.05}$	=	t-value for a 90 per cent statistical significance level
$\sigma_{ECI,PJ,i,y}$	=	Standard deviation of specific electricity consumption of project building units in building unit category *i* in year *y* (MWh/(m^2·yr))
$\sigma_{FCI,PJ,i,k,y}$	=	Standard deviation of specific consumption of fossil fuel type *k* of project building units in building unit category *i* in year *y* (mass or volume unit/(m^2·yr))
$\sigma_{WCI,PJ,i,y}$	=	Standard deviation of specific chilled/hot water consumption of project building units in building unit category *i* in year *y* (GJ/(m^2·yr))
$\sigma_{REFI,PJ,i,y}$	=	Standard deviation of specific emissions from the use of a refrigerant(s) in project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$n_{PJ,i,y}$	=	Total number of project building units included in the sample for building unit category *i* in year *y*

$$\mu_{ECI,PJ,i,y} = \frac{\sum_j ECI_{PJ,i,j,y}}{n_{PJ,i,y}} \quad \text{Equation (72)}$$

and

$$\mu_{FCI,PJ,i,k,y} = \frac{\sum_j FCI_{PJ,i,j,k,y}}{n_{PJ,i,y}} \quad \text{Equation (73)}$$

and

$$\mu_{WCI,PJ,i,y} = \frac{\sum_j WCI_{PJ,i,j,y}}{n_{PJ,i,y}}$$ Equation (74)

and

$$\mu_{REFI,PJ,i,y} = \frac{\sum_j REFI_{PJ,i,j,y}}{n_{PJ,i,y}}$$ Equation (75)

Where:

$\mu_{ECI,PJ,i,y}$	=	Sample mean of specific electricity consumption of project building units in building unit category *i* in year *y* (MWh/(m^2·yr))
$\mu_{FCI,PJ,i,k,y}$	=	Sample mean of specific consumption of fossil fuel type *k* of project building units in building unit category *i* in year *y* (mass or volume unit/(m^2·yr))
$\mu_{WCI,PJ,i,y}$	=	Sample mean of specific chilled/hot water consumption of project building units in building unit category *i* in year *y* (GJ/(m^2·yr))
$\mu_{REFI,PJ,i,y}$	=	Sample mean of specific emissions from the use of a refrigerant(s) in project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$ECI_{PJ,i,j,y}$	=	Specific electricity consumption of project building unit *j* in building unit category *i* in year *y* (MWh/(m^2·yr))
$FCI_{PJ,i,j,k,y}$	=	Specific consumption of fossil fuel type *k* of project building unit *j* in building unit category *i* in year *y* (mass or volume unit/(m^2·yr))
$WCI_{PJ,i,j,y}$	=	Specific chilled/hot water consumption of project building unit *j* in building unit category *i* in year *y* (GJ/(m^2·yr))
$REFI_{PJ,i,j,y}$	=	Specific emissions from the use of a refrigerant(s) in project building unit *j* in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$n_{PJ,i,y}$	=	Total number of project building units included in the sample for building unit category *i* in year *y*

$$\sigma_{ECI,PJ,i,y} = \sqrt{\frac{\sum_j \left(ECI_{PJ,i,j,y} - \mu_{ECI,PJ,i,y}\right)^2}{n_{PJ,i,y} - 1}}$$ Equation (76)

and

$$\sigma_{FCI,PJ,i,k,y} = \sqrt{\frac{\sum_j \left(FCI_{PJ,i,j,k,y} - \mu_{FCI,PJ,i,k,y}\right)^2}{n_{PJ,i,y} - 1}}$$ Equation (77)

and

$$\sigma_{WCI,PJ,i,y} = \sqrt{\frac{\sum_j \left(WCI_{PJ,i,j,y} - \mu_{WCI,PJ,i,y}\right)^2}{n_{PJ,i,y} - 1}}$$ Equation (78)

and

$$\sigma_{REFI,PJ,i,y} = \sqrt{\frac{\sum_j \left(REFI_{PJ,i,j,y} - \mu_{REFI,PJ,i,y}\right)^2}{n_{PJ,i,y} - 1}}$$ Equation (79)

Where:

$\sigma_{ECI,PJ,i,y}$	=	Standard deviation of specific electricity consumption of project building units in building unit category *i* in year *y* (MWh/(m^2·yr))
$\sigma_{FCI,PJ,i,k,y}$	=	Standard deviation of specific consumption of fossil fuel type *k* of project building units in building unit category *i* in year *y* (mass or volume unit/(m^2·yr))
$\sigma_{WCI,PJ,i,y}$	=	Standard deviation of specific chilled/hot water consumption of project building units in building unit category *i* in year *y* (GJ/(m^2·yr))
$\sigma_{REFI,PJ,i,y}$	=	Standard deviation of specific emissions from the use of a refrigerant(s) in project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$ECI_{PJ,i,j,y}$	=	Specific electricity consumption of project building unit *j* in building unit category *i* in year *y* (MWh/(m^2·yr))
$FCI_{PJ,i,j,k,y}$	=	Specific consumption of fossil fuel type *k* of project building unit *j* in building unit category *i* in year *y* (mass or volume unit/(m^2·yr))
$WCI_{PJ,i,j,y}$	=	Specific chilled/hot water consumption of project building unit *j* in building unit category *i* in year *y* (GJ/(m^2·yr))
$REFI_{PJ,i,j,y}$	=	Specific emissions from the use of a refrigerant(s) in project building unit *j* in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$\mu_{ECI,PJ,i,y}$	=	Sample mean of specific electricity consumption of project building units in building unit category *i* in year *y* (MWh/(m^2·yr))
$\mu_{FCI,PJ,i,k,y}$	=	Sample mean of specific consumption of fossil fuel type *k* of project building units in building unit category *i* in year *y* (mass or volume unit/(m^2·yr))
$\mu_{WCI,PJ,i,y}$	=	Sample mean of specific chilled/hot water consumption of project building units in building unit category *i* in year *y* (GJ/(m^2·yr))
$\mu_{REFI,PJ,i,y}$	=	Sample mean of specific emissions from the use of a refrigerant(s) in project building units in building unit category *i* in year *y* (t CO_2e/(m^2·yr))
$n_{PJ,i,y}$	=	Total number of project building units included in the sample for building unit category *i* in year *y*

5.4.5. Step 4b. Modelling project emissions

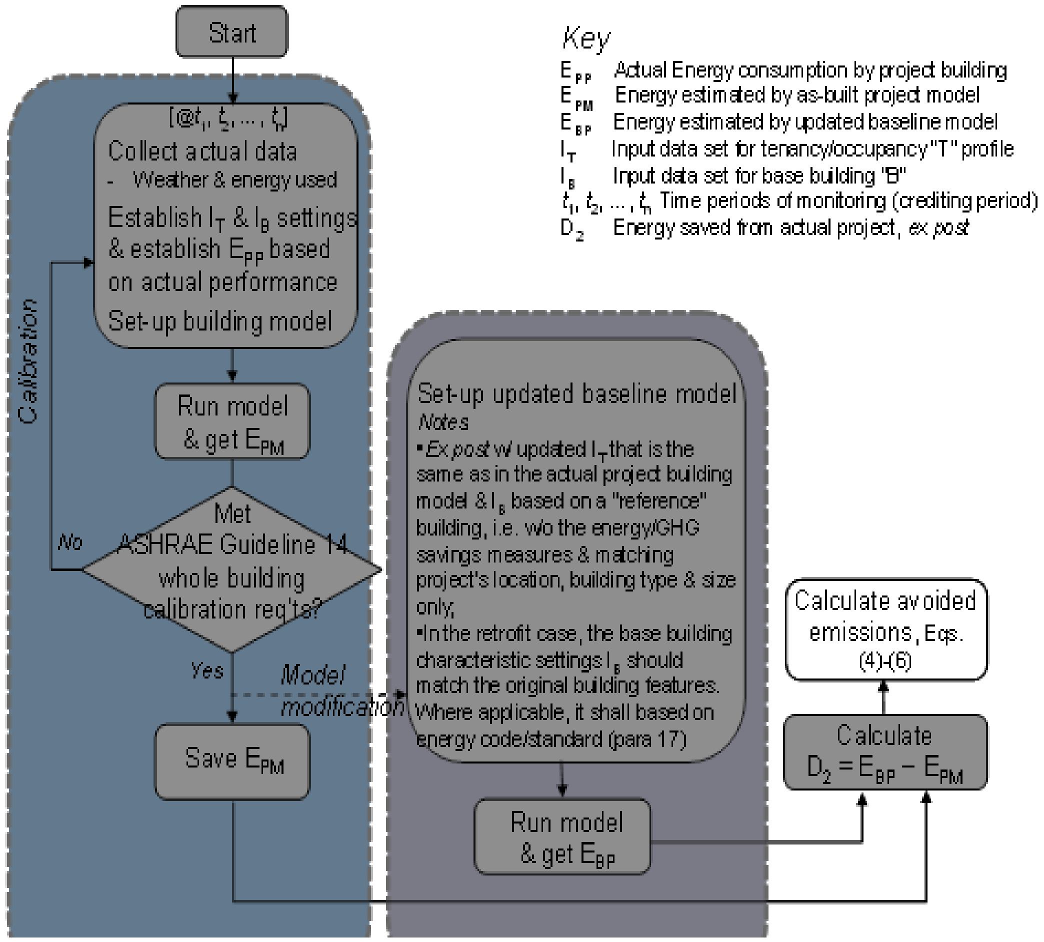
146. A calibrated building model of the subject building units in the building unit category *i* is developed to:

(a) Match (via calibration) the actual energy consumption of the project building;

(b) Estimate baseline building energy consumption;

(c) Determine the electrical and thermal energy savings between the project and baseline buildings, which are then multiplied by appropriate emissions factors.

Figure 3. Flowchart of whole building simulation



147. The calibrated building model is established after the end of the first year of project building operation and when 12 months of energy use data under expected ("full"[30]) operations are available for the project building.

[30] Expected or full operations means operated on annual average at least 30 hours/week for commercial and institutional buildings and used for year-round residence for residential buildings.

148. The model is established and calibrated using the:

(a) As-built project building characteristics;

(b) Weather, building operating characteristics, building control strategies and settings and building occupancy experienced during the same 12 month period for which energy use data under expected (full) operations are available;

(c) Actual annual energy used in the building during the first full year of project building operation.

149. The project building model is calibrated using actual energy data and the modelling process is conducted as described below:

150. **Step 1.** The following data are collected for the project building:[31]

(a) Physical base properties(B-settings) of the building;

(b) Specifications of the space conditioning system, including its performance.[32] Data collected may include such characteristics as quantities, capacities and operating characteristics of primary equipment (e.g. chillers and boilers), secondary equipment (e.g. air handling units, terminal boxes), fan sizes and types, motor sizes and efficiencies, system zoning, characteristics of duct systems and other major components;

(c) Control systems;

(d) Information about the tenancy-related characteristics (T-settings).

151. **Step 2.** Model calibration[33]

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

(b) The computer simulation results for the project building are compared to the actual energy consumption by fuel type during the same 12 month period for which energy use data under expected (full) operations are available, and whole building model is calibrated following the "Whole Building Calibrated Simulation" path in ASHRAE Guideline 14-2002.[34]

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[31] The specific data to collect vary widely depending upon the desired tolerances of the calibration and the individual building characteristics, therefore the determination of which data to collect is left to the modeler.

[32] For projects supplied by district heating or cooling, the overall thermal efficiency of the district system is included in the model. Although emission reductions from improvements to the district system are outside the scope of this methodology, its efficiency is necessary to derive the net emission reductions from measures applied to the buildings.

[33] 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.

[34] American Society of Heating, Air Conditioning, and Refrigeration Engineers Guideline 14-2002 Measurement of Energy and Demand Savings, or current version.

152. **Step 3.** Computer simulation

(a) After the project model calibration has been completed in Step 2, the calibrated model is representative of the project building units in building category *i*;

(b) The calibrated model is modified to represent the baseline building units in building unit category as described above;

(c) Calibrated models of the project building units and the baseline building units are completed for each crediting period year using weather, building operating characteristics, building control strategies and settings, and building occupancy settings, referred to as tenancy settings, for each year of the crediting period.

153. **Step 4.** Documentation. The following information is reported as part of the annual emission savings documentation:

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

(b) Steps 1 and 3 input files to define the project and baseline building models, ex ante and ex post, including: (i) building physical properties; (ii) characteristics of the space conditioning system; (iii) initial load and operating assumptions; (iv) typical year weather file; (v) occupancy schedules; (vi) HVAC and lighting control settings; and (vii) lighting schedules; and

(c) Step 2 information documenting the calibration process, including: (i) initial simulation results for baseline building; and (ii) accuracy with which the simulation results match the calibration energy data. Model development and calibration documentation (including input and weather files) shall be provided to allow for accurate recreation of the model;

(d) Physical base properties of the baseline and project building units, including, but not limited to: (i) building envelope (e.g. building geometry, location of building surfaces such as windows, building shades, relative position of the building thermal zones); and (ii) thermal properties (layer-by-layer description of the building materials with their conductivity, specific heat, and density);

(e) Specification of the space conditioning system of the project and baseline building units;

(f) Specification of the control systems and control settings of the project and baseline building units;

(g) Information about actual baseline and project buildings' tenancy-related settings: (i) internal loads (occupancy or average number of people per time period; lighting and equipment power density; internal load schedules); and (ii) building operations (control temperatures, window opening and related schedules, reflecting occupant behaviour);

(h) Weather files for the project location with hourly data of temperature, humidity, wind direction and speed, total and diffuse solar radiation;

(i) Name and qualifications of the person(s) involved in the computer simulation analyses and calibration.

5.4.5.1. Step 5. Update of the project emission calculation

154. In order to reflect the changes in the energy consumption patterns of the project building units over time, the relevant data ($EC_{PJ,i,j,y}$, $FC_{PJ,i,j,k,y}$ and $WC_{PJ,i,j,y}$) shall be collected every year from the same project building units. If a project building unit in a sample group is destroyed or its function is changed, it can be replaced by another building unit with the same function that is randomly sampled.

155. The calculation of the project emissions from the use of a refrigerant(s) ($PE_{ref,i,j,y}$) shall be updated annually. Alternatively, it can be updated for the first three years of the corresponding crediting period, and for any subsequent year in the crediting period, the maximum annual value of the three-year monitoring period can be used.

156. All the other project-related data need to be updated every third year (e.g. year 4, 7, 10). The *GFA* data in the project ($GFA_{PJ,i,j,y}$, $GFA_{PJ\text{-}Bldg,i,j,y}$ and $GFA_{PJ,i,y}$) may be updated more frequently in order to reflect the change in the scale of the project activity over time.

157. Based on the above data, the project emissions shall be updated annually after the project implementation.

158. All the steps should be documented transparently, including a list of the project building units identified, with information to clearly identify the building units, as well as the relevant data used for the calculation of the project emissions.

5.5. Leakage emissions

159. 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 ($SCRAP_{q,y}$). 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.

160. 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 leakage includes mainly fugitive CH_4 emissions and CO_2 emissions from associated fuel combustion and flaring. In this methodology, the following leakage emission sources shall be considered:

(a) Fugitive CH_4 emissions associated with fuel extraction, processing, of fossil fuels and liquefaction, transportation, re-gasification and distribution of natural gas used in the project plant In the case LNG is used in the project plant: CO_2 emissions from fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression into a natural gas transmission or distribution system.

161. Thus, leakage emissions are calculated as follows:

$$LE_y = LE_{CH4,y} + LE_{LNG,CO2,y} \qquad \text{Equation (80)}$$

Where:

LE_y	=	Leakage emissions during the year *y* (t CO_2e/yr)
$LE_{CH4,y}$	=	Leakage emissions due to fugitive upstream CH_4 in the year *y* (t CO_2e/yr)
$LE_{LNG,CO2,y}$	=	Leakage emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system during the year *y* (t CO_2e/yr)

162. Note that to the extent that upstream emissions occur in Annex I countries that have ratified the Kyoto Protocol, from 1 January 2008 onwards, these emissions should be excluded, if technically possible, in the leakage calculations.

5.5.1. Fugitive methane emissions

163. For the purpose of determining fugitive methane emissions associated with the production, and in case of natural gas, the transportation and distribution of the fuels, project participants should multiply the quantity of fossil fuels k consumed in all element processes *i* with a methane emission factor for these upstream emissions ($EF_{k,upstream,CH4}$), and subtract for all fuel types *k* which would be used in the absence of the project activity the fuel quantities multiplied with respective methane emission factors ($EF_{k,upstream,CH4}$), as follows:

$$LE_{CH4} = \left[\sum_k FF_{PJ,k,y} \times NCV_{k,y} \times EF_{k,upstream,CH4} - \sum_k FF_{BL,k,y} \times NCV_{k,y} \times EF_{k,upstream,CH4}\right] \times GWP_{CH4} \qquad \text{Equation (81)}$$

Where:

LE_{CH4}	=	Leakage emissions due to fugitive upstream CH_4 in the year *y* (t CO_2e/yr)
$FF_{PJ,k,y}$	=	Consumption of fossil fuel in all project building units in year *y* (m^3/yr)
$NCV_{k,y}$	=	Average net calorific value of the fuel type *k* consumed in year *y* (GJ/m^3)
$EF_{k,upstream,CH4}$	=	Emission factor for upstream fugitive methane emissions from production, transportation and distribution of fuel type *k* (t CH_4/GJ fuel supplied to final consumers)

$FF_{BL,k,y}$	=	Consumption of fossil fuel type *k* (a coal or petroleum fuel type) in all baseline building units in year *y* (volume or mass unit/yr)
GWP_{CH4}	=	Global Warming Potential of methane valid for the relevant commitment period

5.5.2. Determination of fossil fuel consumption in project building units

164. If all the building units in the project boundary are monitored as project building units, the total natural gas consumption ($FF_{PJ,k,y}$) shall be calculated as follows:

$$FF_{PJ,k,y} = \sum_i \sum_j FF_{PJ,i,j,y} \quad \text{Equation (82)}$$

Where:

$FF_{PJ,k,y}$	=	Consumption of fossil fuel *k* in all project building units in year *y* (m^3/yr)
$FF_{PJ,i,j,y}$	=	Consumption of fossil fuel *k* in project building unit *j* in building unit category *i* in year *y* (m^3/yr)

165. If a sample of building units in the project boundary is monitored as project building units, calculate $FF_{PJ,k,y}$ as follows:

$$FF_{PJ,k,y} = \sum_i FF_{PJ,k,i,y} \times N_{PJ,i,y} \quad \text{Equation (83)}$$

Where:

$FF_{PJ,k,y}$	=	Consumption of fossil fuel *k* in all project building units in year *y* (m^3/yr)
$FF_{PJ,k,i,y}$	=	Mean consumption of fossil fuel *k* in project building units in building unit category *i* in year *y* (m^3/yr)
$N_{PJ,i,y}$	=	Total number of project building units in the population for building unit category *i* in year *y*

$$FF_{PJ,k,i,y} = \mu_{FF,PJ,k,y} + t_{0.05} \times \frac{\sigma_{FF,PJ,k,i,y}}{\sqrt{n_{PJ,i,y}}} \quad \text{Equation (84)}$$

Where:

$FF_{PJ,k,i,y}$	=	Mean consumption of fossil fuel *k* in project building units in building unit category *i* in year *y* (m^3/yr)
$\mu_{FF,PJ,k,y}$	=	Sample mean consumption of fossil fuel *k* in project building units in building unit category *i* in year *y* (m^3/yr)
$t_{0.05}$	=	t-value for a 90% statistical significance level (1.645)

$\sigma_{FF,PJ,k,i,y}$ = Standard deviation of consumption of fossil fuel *k* in project building units in building unit category *i* in year *y* (m^3/yr)

$n_{PJ,i,y}$ = Total number of project building units included in the sample for building unit category *i* in year *y*

$$\mu_{FF,PJ,k,i,y} = \frac{\sum_j FF_{PJ,k,i,j,y}}{n_{PJ,i,y}}$$ Equation (85)

Where:

$\mu_{FF,PJ,k,i,y}$ = Sample mean of consumption of fossil fuel *k* in project building units in building unit category *i* in year *y* (m^3/yr)

$FF_{PJ,k,i,j,y}$ = Consumption of fossil fuel *k* in project building unit *j* in building unit category *i* in year *y* (m^3/yr)

$n_{PJ,i,y}$ = Total number of project building units included in the sample for building unit category *i* in year *y*

$$\sigma_{FF,PJ,k,i,y} = \sqrt{\frac{\sum_j \left(FF_{PJ,k,i,j,y} - \mu_{FF,PJ,k,i,y}\right)^2}{n_{PJ,i,y} - 1}}$$ Equation (86)

Where:

$\sigma_{FF,PJ,k,i,y}$ = Standard deviation of consumption of fossil fuel *k* in project building units in building unit category *i* in year *y* (m^3/yr)

$FF_{PJ,k,i,j,y}$ = Consumption of fossil fuel *k* in project building unit *j* in building unit category *i* in year *y* (m^3/yr)

$\mu_{FF,PJ,k,i,y}$ = Sample mean of consumption of fossil fuel *k* in project building units in building unit category *i* in year *y* (m^3/yr)

$n_{PJ,i,y}$ = Total number of project building units included in the sample for building unit category *i* in year *y*

5.5.3. Determination of fossil fuel consumption in baseline building units

166. Consumption of fossil fuel type *k* in all baseline building units in year *y* ($FF_{BL,k,y}$) is calculated as follows:

$$FF_{BL,k,y} = \sum_i FF_{Top20\%,i,k,y} \times N_{PJ,i,y}$$ Equation (87)

Where:

$FF_{BL,k,y}$	=	Consumption of fossil fuel type *k* (a coal or petroleum fuel type) in all baseline building units in year *y* (volume or mass unit/yr)
$FF_{Top20\%,i,k,y}$	=	Mean consumption of fossil fuel type *k* (a coal or petroleum fuel type) in top 20 per cent performer building units in building unit category *i* in year *y* (volume or mass unit/yr)
$N_{PJ,i,y}$	=	Total number of project building units in the population for building unit category *i* in year *y*

$$FF_{Top20\%,i,k,y} = \frac{\sum_j FF_{Top20\%,i,j,k,y}}{J_{i,y}}$$ Equation (88)

Where:

$FF_{Top20\%,i,k,y}$	=	Mean consumption of fossil fuel type *k* (a coal or petroleum fuel type) in top 20 per cent performer building units in building unit category *i* in year *y* (volume or mass unit/yr)
$FF_{Top20\%,i,j,k,y}$	=	Consumption of fossil fuel type *k* (a coal or petroleum fuel type) in top 20 per cent performer building unit *j* in building unit category *i* in year *y* (volume or mass unit/yr)
$J_{i,y}$	=	Total number of top 20 per cent performer building units in building unit category *i* in year *y*. It is calculated as the product of the number of baseline building units monitored in building category *i* and 20 per cent, rounded down to the next integer if it is decimal

167. If sampling of the baseline building units is involved in the calculation of $FF_{Top20\%,i,k,y}$, the calculated $FF_{Top20\%,i,k,y}$ shall be conservatively adjusted for the sampling error. Namely, the adjustment requires $FF_{Top20\%,i,k,y}$ to be the lower-bound value of the confidence interval established around the average consumption of fossil fuel type *k* of the top 20 per cent performer building units at a 90 per cent significance level. This sample error adjustment is performed by a bootstrap method.[35] First, create resamples of $FF_{BL,i,j,k,y}$ by repeatedly sampling at random and with replacement[36] from the original sample of $FF_{BL,i,j,k,y}$. Each resample is the same size as the original sample and the minimum size of the resamples is 1,000. Second, create a bootstrap distribution calculating $FF_{Top20\%,i,k,y}$ for each resample according to equation (88). Lastly, the sample-error-adjusted $FF_{Top20\%,i,k,y}$ is the value of $FF_{Top20\%,i,k,y}$ at the five per cent percentile of the bootstrap distribution.

168. Where reliable and accurate national data on fugitive CH_4 emissions associated with the production, and in case of natural gas, the transportation and distribution of the fuels is available, project participants should use this data to determine average emission factors by dividing the total quantity of CH_4 emissions by the quantity of fuel produced or

[35] Refer to Hesterberg et al. (2005) for more details of the bootstrap method.

[36] Sampling with replacement means that after randomly drawing an observation from the original sample, it is put back before drawing the next observation.

supplied respectively.[37] Where such data is not available, project participants may use the default values provided in Table 3 below. In this case, the natural gas emission factor for the location of the project should be used, except in cases where it can be shown that the relevant system element (gas production and/or processing/transmission/distribution) is predominantly of recent vintage and built and operated to international standards, in which case the US/Canada values may be used.

169. Note that the emission factor for fugitive upstream emissions for natural gas ($EF_{NG,upstream,CH4}$) should include fugitive emissions from production, processing, transport and distribution of natural gas, as indicated in the Table 3 below. Note further that in case of coal the emission factor is provided based on a mass unit and needs to be converted in an energy unit, taking into account the net calorific value of the coal.

Table 3. Default emission factor for fugitive CH_4 upstream emissions

Activity	Unit	Default emission factor	Reference for the underlying emission factor range in Volume 3 of the *1996 Revised IPCC Guidelines*
Coal			
Underground mining	t CH4 / kt coal	13.4	Equations 1 and 4, p. 1.105 and 1.110
Surface mining	t CH4 / kt coal	0.8	Equations 2 and 4, p.1.108 and 1.110
Oil			
Production	t CH4 / PJ	2.5	Tables 1-60 to 1-64, p. 1.129 - 1.131
Transport, refining and storage	t CH4 / PJ	1.6	Tables 1-60 to 1-64, p. 1.129 - 1.131
Total	t CH4 / PJ	4.1	
Natural gas			
USA and Canada			
Production	t CH4 / PJ	72	Table 1-60, p. 1.129
Processing, transport and distribution	t CH4 / PJ	88	Table 1-60, p. 1.129
Total	t CH4 / PJ	160	
Eastern Europe and former USSR			
Production	t CH4 / PJ	393	Table 1-61, p. 1.129
Processing, transport and distribution	t CH4 / PJ	528	Table 1-61, p. 1.129
Total	t CH4 / PJ	921	
Western Europe			
Production	t CH4 / PJ	21	Table 1-62, p. 1.130
Processing, transport and distribution	t CH4 / PJ	85	Table 1-62, p. 1.130
Total	t CH4 / PJ	105	
Other oil exporting countries / Rest of world			
Production	t CH4 / PJ	68	Table 1-63 and 1-64, p. 1.130 and 1.131
Processing, transport and distribution	t CH4 / PJ	228	Table 1-63 and 1-64, p. 1.130 and 1.131
Total	t CH4 / PJ	296	

Note: The emission factors in this table have been derived from IPCC default Tier 1 emission factors provided in Volume 3 of the 1996 Revised IPCC Guidelines, by calculating the average of the provided default emission factor range.

[37] GHG inventory data reported to the UNFCCC as part of national communications can be used where country-specific approaches (and not IPCC Tier 1 default values) have been used to estimate emissions.

5.5.4. CO_2 emissions from LNG

170. Where applicable, CO_2 emissions from fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system ($LE_{LNG,CO2,y}$) should be estimated by multiplying the quantity of natural gas combusted in the project with an appropriate emission factor, as follows:

$$LE_{LNG,CO2,y} = FF_{PJ,y} \times EF_{CO2,upstream,LNG} \qquad \text{Equation (89)}$$

Where:

$LE_{LNG,CO2,y}$	=	Leakage emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system in year *y* (t CO_2e/yr)
$FF_{PJ,y}$	=	Consumption of natural gas in all project building units in year *y* (m^3/yr)
$EF_{CO2,upstream,LNG}$	=	Emission factor for upstream CO_2 emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, regasification and compression of LNG into a natural gas transmission or distribution system (t CO_2e/m^3)

171. Where reliable and accurate data on upstream CO_2 emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system is available, project participants should use this data to determine an average emission factor. Where such data is not available, project participants may assume a default value of 6 t CO_2/TJ as a rough approximation.[38]

5.6. Emission reductions

172. Two options to calculate emissions reductions are available depending on whether suppressed demand for energy services[39] existed to project implementation.

173. **Option 1.** Emissions reductions calculations without considering suppressed demand scenario

174. If suppressed demand for energy services is deemed not to exist prior to project implementation, emissions reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \qquad \text{Equation (90)}$$

[38] This value has been derived from data published for North American LNG systems. “Barclay, M. and N. Denton, 2005. Selecting offshore LNG process. <http://www.fwc.com/publications/tech_papers/files/LNJ091105p34-36.pdf> (10th April 2006)”.

[39] A minimum living standard of adequate space heating, indoor air temperatures, and adequate access to energy (including electricity) to satisfy basic human needs.

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e/yr)
BE_y	=	Baseline emissions in year *y* (t CO_2e/yr)
PE_y	=	Project emissions in year *y* (t CO_2e/yr)
LE_y	=	Leakage emissions in year *y* (t CO_2e/yr)

175. When a whole building computerized simulation tool is used, emission reductions are determined as the differences in energy use and emissions between the baseline and project scenarios generated by calibrated models of the baseline buildings and project buildings using the weather and building occupancy experienced during each year of the crediting period and subtracting leakage emissions.

176. If the building computerized simulation tool allows estimating energy savings due to energy efficiency measures only, emission reductions from fuel switching (including renewables) shall be calculated using model outputs (i.e. estimated energy savings) that are multiplied with the respective emission factors.

177. **Option 2.** Emissions reductions calculations under suppressed demand scenario

178. Suppressed demand for energy services is deemed to exist prior to project implementation if one or more of the following conditions are observed:

(a) The project activity is implemented in rural areas of the country with the electrification rate being below 20 per cent;[40]

(b) Animal dung is the most common fuel used in the project area;

(c) The project activity is in Least Developed Countries (LDCs) or Small Island Developing States (SIDs);

(d) The conditions applicable for special underdeveloped zone (SUZ) provided in the "Guidelines for demonstrating additionality of microscale project activities".

179. If a suppressed demand scenario is determined to exist, two options to address it in emissions reductions calculations are available.

(a) Option 2a:

180. This option is applicable if emissions reductions are estimated based on the top 20 per cent benchmark of best performing buildings. Under this option, a suppressed demand factor of 1.20 can be used to make a suppressed demand correction in one of the following ways:

(a) In case measures implemented under the project activity are targeted at electricity consumption only, the electricity consumption of baseline buildings shall be multiplied by the suppressed demand factor to determine their baseline electricity consumption corrected for suppressed demand;

[40] The most recent available data on the electrification rates shall be used to demonstrate compliance with the 20 per cent threshold. In no case shall data be used if older than three years than the date of commencement of validation of the project activity.

(b) In case measures implemented under the project activity are targeted at space heating[41] and/or cooking only, the respective energy consumption (for heating, cooking or both, depending on which end-use the measures are targeted at) of baseline buildings shall be multiplied by the suppressed demand factor to determine their baseline energy consumption for heating and/or cooking corrected for suppressed demand;

(c) In case measures implemented under the project activity are targeted at all types of energy demand, i.e. electricity, space heating and cooking, the respective energy consumption of each type of energy demand of baseline buildings shall be multiplied by the suppressed demand factor to determine their baseline energy consumption for electricity, heating and cooking corrected for suppressed demand;

(b) Option 2b:

181. This option is applicable if emissions reductions are estimated using a whole building computer simulation model. Depending on whether emissions reductions are estimated for the project activity dealing with new construction or retrofitting existing buildings, the following options are available:

(a) For new construction, the calibrated whole building model needs to be run two times to generate baseline energy consumption in each year of the crediting period using the following inputs that are common for two runs:

(i) Baseline building characteristics (B-settings);

(ii) T-settings of the project activity buildings;

(iii) Actual weather conditions experienced by project buildings;

(iv) The generated baseline energy consumption shall be used for emissions reductions calculations;

(v) Run 1:

a. Temperature settings:

i. If relevant building code specifies indoors temperatures, these should be used as inputs;

ii. If there are no relevant buildings codes or building code does not specifies indoors temperature, then healthy indoor temperatures recommended by such organizations as the World Health Organization, using the most conservative temperature, shall be used as inputs and the source of data shall be specified in the PDD;

[41] Measures targeted at space heating may include building envelop improvements (such as improved building insulation, replacement of windows and doors) as well as improvements to space conditioning equipment (such as the refurbishment or deployment of boilers and HVAC equipment).

(vi) Run 2:

a. Temperature settings:

i. The same as in the project model observed in each relevant year of the crediting period;

(b) The baseline energy consumption that shall be used for calculations of emission reductions shall be the minimum energy consumption generated by the simulation model as a result of Run 1 and Run 2;

(c) For retrofitting existing buildings, the calibrated whole building model needs to be run two times to generate baseline energy consumption in each year of the crediting period using the following inputs that are common for two runs:

(i) Baseline building characteristics (B-settings);

(ii) The average energy consumption experienced by the baseline building(s) during the last three full years prior to its retrofit;

(iii) T-settings of the project activity buildings;

(iv) Actual weather conditions experienced by project buildings;

(v) The generated baseline energy consumption shall be used for emissions reductions calculations;

(vi) Run 1:

a. Temperature settings:

i. If relevant building code specifies indoors temperatures, these should be used as inputs;

ii. If there are no relevant buildings codes or building code does not specifies indoors temperature, then healthy indoor temperatures recommended by such organizations as the World Health Organization, using the most conservative temperature, shall be used as inputs and the source of data shall be specified in the PDD;

(vii) Run 2:

a. Temperature settings:

i. The same as in the project model observed in each relevant year of the crediting period;

(d) The baseline energy consumption used for calculations of emission reductions shall be the minimum energy consumption generated by the simulation model as a result of Run 1 and Run 2.

5.7. Changes required for methodology implementation in 2nd and 3rd crediting periods

182. Refer to the latest approved version of the tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

183. In applying the aforementioned tool, the following procedure specific to this methodology should be followed. For the parameters monitored ex post, there are parameters that require monitoring annually and at least every three years. For the latter parameters, the monitoring frequency does not necessarily coincide with the first year of the 2nd and the 3rd crediting periods (i.e. year 8 and 15). Therefore, updating of these parameters is not necessary at the renewal of the crediting period.

5.8. Data and parameters not monitored

Data / Parameter table 1.

Data / Parameter:	**$DISH_{PJ,ex\text{-}ante}$**
Data unit:	-
Description:	Existence of a district heating system(s) supplying space heating to project building units used for the calculation of project emissions, checked before the construction of the project building units
Source of data:	Project building construction plan
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	**$BIOG_{PJ,ex\text{-}ante}$**
Data unit:	-
Description:	Existence of a biogas systems(s) supplying electrical or thermal energy to project building units, used for the calculation of project emissions, and chilled/hot water systems, supplying to the project building units, checked before the construction of the project building units
Source of data:	Project building construction plan
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	**$BIOM_{PJ,ex\text{-}ante}$**
Data unit:	-

Description:	Existence of a biomass-fired boiler(s) supplying electrical or thermal energy to project building units, used for the calculation of project emissions, and chilled/hot water systems, supplying to the project building units, checked before the construction of the project building units
Source of data:	Project building construction plan
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	**$COGEN_{PJ,ex\text{-}ante}$**
Data unit:	-
Description:	Existence of a cogeneration system(s) supplying electrical or thermal energy to project building units, used for the calculation of project emissions, and chilled/hot water systems, supplying water to the project building units, checked before the construction of the project building units
Source of data:	Project building construction plan and, if relevant, a survey at chilled/hot water systems
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	**$CFC_{PJ,ex\text{-}ante}$**
Data unit:	-
Description:	Confirmation that none of the project building units used for the calculation of project emissions uses CFC as a refrigerant, checked before the construction of the project building units
Source of data:	Project building construction plan
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	**$OVERL_{PJ,ex\text{-}ante}$**
Data unit:	-
Description:	Confirmation that none of the project building units used for the calculation of project emissions claims CERs for emission reductions achieved by using efficient appliances being credited in other project activities registered as CDM projects, checked before the construction of the project building units
Source of data:	UNFCCC website <http://cdm.unfccc.int/index.html>

Measurement procedures (if any):	Check on the UNFCCC CDM website if there are registered CDM projects receiving CERs from the use of efficient appliances within the host country. If there is none, this applicability condition is deemed satisfied. If there is one or more registered CDM projects receiving CERs from the use of efficient appliances within the host country, a discount factor ($DISC_{i,y}$) shall be applied to the baseline and project emissions in order to satisfy this applicability condition
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	$COMP_{PJ,ex-ante}$
Data unit:	-
Description:	Compliance of project building units with all applicable energy standards, checked before the construction of the project building units
Source of data:	Certificate of compliance issued by an independent entity
Measurement procedures (if any):	First, check if there is an applicable energy standard that is assumed to be enforced in the project boundary. An energy standard is assumed to be enforced if more than 50 per cent of the building units regulated by the standard in the project boundary are in compliance with the standard. This requirement is assumed to be determined by observation or review of public records but not by building occupant surveys. If there is no inspection system in place to check the compliance of buildings, the energy standard can be assumed not enforced. If there is an applicable energy standard that is assumed to be enforced, an independent entity such as a governmental agency or sectoral expert shall check the compliance as per the host country regulation, based on the project building construction plan. The results shall be validated by a DOE
Any comment:	-

Data / Parameter table 8.

Data / Parameter:	$ESHARE_{i,n}$
Data unit:	-
Description:	Default share of energy use category of efficient appliances of type *n* in the total building energy consumption in building unit category *i* in year *y*
Source of data:	Official statistics, existing relevant study, or own survey
Measurement procedures (if any):	A default energy consumption profile for the relevant building unit category *i* shall be prescribed in the PDD (e.g. X% lighting, Y% air conditioning, Z% water heating, etc.). Such a default profile is to be established for a broad category of (i) residential building units, (ii) commercial building units, and/or (iii) institutional building units. If a building energy consumption profile is not readily available on the country level, a profile specific to the project boundary, or other comparable geographical areas within the host country may be used
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	$P_{BL,Fuel}$
Data unit:	Local currency unit/GJ
Description:	Historical average retail price of the fuel most commonly used in the baseline building units since the less carbon-intensive fuel used in the project building units became commercially available within the project boundary
Source of data:	Fuel retailers
Measurement procedures (if any):	Preferably published retail prices. If published retail prices are not available, offers from fuel retailers can be used as a substitute
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	$P_{PJ,Fuel}$
Data unit:	Local currency unit/GJ
Description:	Historical average retail price of the less carbon-intensive fuel used in the project building units since the fuel became commercially available within the project boundary
Source of data:	Fuel retailers
Measurement procedures (if any):	Preferably published retail prices. If published retail prices are not available, offers from fuel retailers can be used as a substitute
Any comment:	-

Data / Parameter table 11.

Data / Parameter:	$N_{BL,i}$
Data unit:	-
Description:	Total number of baseline building units in the population for building unit category *i* at the start of the project activity
Source of data:	Building survey
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 12.

Data / Parameter:	C_m
Data unit:	GJ/(kg·K)
Description:	Specific heat capacity of the chilled/hot water
Source of data:	E.g. "Water – Thermal Properties", <http://www.engineeringtoolbox.com/water-thermal-properties-d_162.html>
Measurement procedures (if any):	-
Any comment:	Applicable only if a mass or volume flow meter is installed for monitoring of chilled/hot water consumption

Data / Parameter table 13.

Data / Parameter:	ρ_{H2O}
Data unit:	kg/m^3
Description:	Density of the chilled/hot water
Source of data:	For example “Water – Thermal Properties”, <http://www.engineeringtoolbox.com/water-thermal-properties-d_162.html>
Measurement procedures (if any):	-
Any comment:	Applicable only if a volume flow meter is installed for monitoring of chilled/hot water consumption

Data / Parameter table 14.

Data / Parameter:	GWP_{CH4}
Data unit:	t CO_2e/t CH_4
Description:	Global warming potential of methane valid for the relevant commitment period
Source of data:	The latest version of the IPCC’s assessment report
Measurement procedures (if any):	Default value for the first commitment period: 21 t CO_2e/t CH_4
Any comment:	Applicable only if a geothermal source(s) supplies heat to the chilled/hot water cooling system

Data / Parameter table 15.

Data / Parameter:	$EF_{NG,upstream,CH4}$
Data unit:	t CH_4/GJ fuel supplied to final consumers
Description:	Emission factor for upstream fugitive methane emissions from production, transportation and distribution of natural gas
Source of data:	Default values provided in Table 3 “Default emission factor for fugitive CH_4 upstream emissions” in the leakage emissions section
Measurement procedures (if any):	-
Any comment:	Applicable only if the project activity is implemented under a programme of activities

Data / Parameter table 16.

Data / Parameter:	$EF_{k,upstream,CH4}$
Data unit:	t CH_4/GJ fuel produced
Description:	Emission factor for upstream fugitive methane emissions from production of the fuel type *k* (a coal or petroleum fuel type)
Source of data:	Default values provided in Table 3 “Default emission factor for fugitive CH_4 upstream emissions” in the leakage emissions section
Measurement procedures (if any):	-

Any comment:	Applicable only if the project activity is implemented under a programme of activities

Data / Parameter table 17.

Data / Parameter:	**$EF_{CO2,upstream,LNG}$**
Data unit:	t CO_2e/m^3
Description:	Emission factor for upstream CO_2 emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, regasification and compression of LNG into a natural gas transmission or distribution system
Source of data:	Where reliable and accurate data on upstream CO_2 emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system is available, project participants should use this data to determine an average emission factor. Where such data is not available, project participants may assume a default value of 6 t CO_2/TJ as a rough approximation
Measurement procedures (if any):	-
Any comment:	Applicable only if the project activity is implemented under a programme of activities

6. Monitoring methodology

184. All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred per cent of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

185. In addition, the monitoring provisions in the tools referred to in this methodology apply.

6.1. Data and parameters monitored

Data / Parameter table 18.

Data / Parameter:	**$BIOG_{PJ,y}$**
Data unit:	-
Description:	Existence of a biogas systems(s) supplying thermal or electrical energy to project building units, used for the calculation of project emissions, and chilled/hot water systems, supplying water to the project building units, year *y*
Source of data:	Building survey
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter

QA/QC procedures:	-
Any comment:	-

Data / Parameter table 19.

Data / Parameter:	**$BIOM_{PJ,y}$**
Data unit:	-
Description:	Existence of a biomass-fired boiler(s) supplying electrical or thermal energy to project building units, used for the calculation of project emissions, and chilled/hot water systems, supplying water to the project building units, in year *y*
Source of data:	Building survey
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 20.

Data / Parameter:	**$COGEN_{PJ,y}$**
Data unit:	-
Description:	Existence of a biomass-fired boiler(s) supplying electrical or thermal energy to project building units, used for the calculation of project emissions, and chilled/hot water systems, supplying water to the project building units, in year *y*
Source of data:	Building survey
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 21.

Data / Parameter:	**$CFC_{PJ,y}$**
Data unit:	-
Description:	Confirmation that none of the project building units used for the calculation of project emissions uses CFC as a refrigerant in year *y*
Source of data:	Building survey
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter

QA/QC procedures:	-
Any comment:	-

Data / Parameter table 22.

Data / Parameter:	**$OVERL_{PJ,y}$**
Data unit:	-
Description:	Confirmation that none of the project building units used for the calculation of project emissions claims CERs for emission reductions achieved by using efficient appliances being credited in other project activities registered as CDM projects in year *y*
Source of data:	UNFCCC website <http://cdm.unfccc.int/index.html>
Measurement procedures (if any):	Check on the UNFCCC CDM website if there are registered CDM projects receiving CERs from the use of efficient appliances within the host country. If there is none of such, this applicability condition is deemed satisfied. If there is registered CDM project(s) receiving CERs from the use of efficient appliances within the host country, a discount factor ($DISC_{i,y}$) shall be applied to the baseline and project emissions in order to satisfy this applicability condition
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 23.

Data / Parameter:	**$COMP_{PJ,y}$**
Data unit:	-
Description:	Compliance of project building units with all applicable energy standards, checked in year *y* after the construction of the project building units
Source of data:	Certificate of compliance issued by an independent entity
Measurement procedures (if any):	First, check if there is an applicable energy standard that is assumed to be enforced in the project boundary. An energy standard is assumed to be enforced if more than 50 per cent of the building units regulated by the standard in the project boundary are in compliance with the standard. This requirement is assumed to be determined by observation or review of public records but not by building occupant surveys. If there is no inspection system in place to check the compliance of buildings, the energy standard can be assumed not enforced. If there is an applicable energy standard that is assumed to be enforced, an independent entity such as a governmental agency or sectoral expert shall check the compliance as per the host country regulation. The results shall be verified by a DOE at the first verification of emission reductions achieved by the relevant project building unit(s)
Monitoring frequency:	Monitored only in the year in which the project building units are constructed

QA/QC procedures:	-
Any comment:	-

Data / Parameter table 24.

Data / Parameter:	$\mathbf{APPL_{CDM,n,y}}$
Data unit:	-
Description:	Total number of efficient appliances of type *n* that are used in registered CDM project(s) in the host country in year *y*
Source of data:	Monitoring reports of respective CDM projects available on UNFCCC website
Measurement procedures (if any):	If the registered CDM project(s) has not published a monitoring report(s), it is not necessary to account for this parameter
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 25.

Data / Parameter:	$\mathbf{APPL_{Host,n,y}}$
Data unit:	-
Description:	Total number of efficient appliances of type *n* that are sold in the host country in year *y*
Source of data:	Official statistics, existing relevant study, or own survey
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 26.

Data / Parameter:	$\boldsymbol{\sigma_{POP,SE,BL,i,y}}$
Data unit:	t CO_2/m^2
Description:	Expected population standard deviation of specific emissions of baseline building units in building unit category *i* in year *y*
Source of data:	For the first year: Derived from officially published documents or own non-representative building survey. If a default factor of 0.5 is used for $cv_{SE,BL,i,y}$, there is no need to derive this parameter. For the second year onwards: Use $\sigma_{SE,PJ,i,1}$ as a proxy
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and update the value in the second year for the rest of the crediting period(s)

QA/QC procedures:	-
Any comment:	-

Data / Parameter table 27.

Data / Parameter:	$\sigma_{POP,SE,PJ,i,y}$
Data unit:	t CO_2/m^2
Description:	Expected population standard deviation of specific emissions of project building units in building unit category *i* in year *y*
Source of data:	For the first year: Derived from officially published documents or own non-representative building survey. If a default factor of 0.5 is used for $cv_{SE,PJ,i,y}$, there is no need to derive this parameter. For the second year onwards: Use $\sigma_{SE,PJ,i,1}$ as a proxy
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and update the value in the second year for the rest of the crediting period(s)
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 28.

Data / Parameter:	$GFA_{BL,i,j,y}$ or $GFA_{BL-Bldg,i,j,y}$
Data unit:	m^2
Description:	(a) GFA of baseline building unit *j* in building unit category *i* in year *y*; or (b) GFA of the whole building, which baseline building unit *j* in building unit category *i* belongs to, in year *y*. Account for GFA of each building unit in the building, but not GFA of the common service areas
Source of data:	The following data sources may be used if the relevant conditions apply: **Data source** / **Conditions for using the data source** (a) Building plan — This is the preferred source (b) On-site measurement — If (a) is not available
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	(a) Confirm on-site that building geometry represented in the plan is accurate; (b) Not applicable
Any comment:	$GFA_{BL-Bldg,i,j,y}$ is applicable only if apportioning of baseline energy consumption and/or baseline emissions related to the use of a refrigerant(s) is required

Data / Parameter table 29.

Data / Parameter:	$BE_{EC,non-REcaptive,i,j,y}$
Data unit:	t CO_2/yr
Description:	Baseline emissions from electricity consumption of baseline building unit *j* in building unit category *i* in year *y*, which is supplied by the grid and/or an off-grid fossil-fuel-fired captive power plant(s)
Source of data:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Measurement procedures (if any):	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Monitoring frequency:	Annually
QA/QC procedures:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Any comment:	-

Data / Parameter table 30.

Data / Parameter:	$FC_{BL,i,j,k,y}$ or $FC_{BL-Bldg,i,j,y}$
Data unit:	Mass or volume unit/yr (e.g. tonne/yr or m^3/yr)
Description:	(a) Annual consumption of fossil fuel type *k* of baseline building unit *j* in building unit category *i* in year *y*; or (b) Annual consumption of fossil fuel type *k* of the whole building, which baseline building unit *j* in building unit category *i* belongs to, in year *y.* In both cases, the amount of fuel used for the electricity generation by the captive power plant(s) in the building that baseline building unit *j* belongs to shall not be included in the parameter
Source of data:	Choose among the following options: (a) Utility billing records; (b) On-site measurements
Measurement procedures (if any):	(a) As per the utility metering; (b) Use either mass or volume meters
Monitoring frequency:	(a) As per the utility metering; (b) Continuously, aggregated at least annually
QA/QC procedures:	Check consistency of the monitored records with the records from previous monitoring intervals
Any comment:	$FC_{BL-Bldg,i,j,k,y}$ is applicable only if the fuel consumption is monitored only at a whole building level

Data / Parameter table 31.

Data / Parameter:	$w_{C,k,y}$
Data unit:	t C/mass unit of the fuel
Description:	Weighted average mass fraction of carbon in fuel type *k* in year *y*

Source of data:	The following data sources may be used if the relevant conditions apply: **Data source** / **Conditions for using the data source** (a) Values provided by the fuel supplier in invoices — This is the preferred source (b) Measurements by the project participant — If () is not available
Measurement procedures (if any):	Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	Verify if the values under a) and b) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in b) should have ISO17025 accreditation or justify that they can comply with similar quality standards
Any comment:	Applicable only if Option A is used for the calculation of emissions from fossil fuel consumption in building unit or chilled/hot water system and the fuel consumption is measured in a mass unit

Data / Parameter table 32.

Data / Parameter:	$\rho_{k,y}$
Data unit:	Mass unit/volume unit of the fuel
Description:	Weighted average density of fuel type *k* in year *y*
Source of data:	The following data sources may be used if the relevant conditions apply: **Data source** / **Conditions for using the data source** (a) Values provided by the fuel supplier in invoices — This is the preferred source (b) Measurements by the project participant — If (a) is not available (c) Regional or national default value — If (a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)

Measurement procedures (if any):	Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if Option A is used for the calculation of emissions from fossil fuel consumption in building unit or chilled/hot water system and the fuel consumption is measured in a volume unit

Data / Parameter table 33.

<table>
<tr><td>Data / Parameter:</td><td>$NCV_{k,y}$</td></tr>
<tr><td>Data unit:</td><td>GJ/mass or volume unit</td></tr>
<tr><td>Description:</td><td>Average net calorific value of fossil fuel type k used in year y</td></tr>
<tr><td>Source of data:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><th colspan="2">Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>(a)</td><td>Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>(b)</td><td>Measurements by the project participant</td><td>If (a) is not available</td></tr>
<tr><td>(c)</td><td>Regional or national default value</td><td>If (a) is not available.
These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)</td></tr>
<tr><td>(d)</td><td>IPCC default values at the upper limit of the uncertainty at 95 per cent confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (a) is not available</td></tr>
</table>
</td></tr>
<tr><td>Measurement procedures (if any):</td><td>For (a) and (b): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency:</td><td>For (a), (b) and (c): For the first year of the project implementation, and every third year thereafter.
For (d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
</table>

QA/QC procedures:	Verify if the values under (a), (b) and (c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in (a), (b) or (c) should have ISO17025 accreditation or justify that they can comply with similar quality standards
Any comment:	Applicable only if Option B is used for the calculation of emissions from fossil fuel consumption in building unit or chilled/hot water system

Data / Parameter table 34.

<table>
<tr><td>Data / Parameter:</td><td>$EF_{CO2,k,y}$</td></tr>
<tr><td>Data unit:</td><td>t CO_2/GJ</td></tr>
<tr><td>Description:</td><td>Weighted average CO_2 emission factor of fossil fuel type k used in year y</td></tr>
<tr><td>Source of data:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><th colspan="2">Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>(a)</td><td>Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>(b)</td><td>Measurements by the project participant</td><td>If (a) is not available</td></tr>
<tr><td>(c)</td><td>Regional or national default value</td><td>If (a) is not available
These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)</td></tr>
<tr><td>(d)</td><td>IPCC default values at the upper limit of the uncertainty at 95 per cent confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (a) is not available</td></tr>
</table>
</td></tr>
<tr><td>Measurement procedures (if any):</td><td>For (a) and (b): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency:</td><td>For the first year of the project implementation, and every third year thereafter</td></tr>
</table>

QA/QC procedures:	-
Any comment:	Applicable only if Option B is used for the calculation of emissions from fossil fuel consumption in a building unit or chilled/hot water system. For (a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, options (b), (c) or (d) should be used

Data / Parameter table 35.

Data / Parameter:	$WC_{BL,i,j,y}$ **or** $WC_{BL\text{-}Bldg,i,j,y}$
Data unit:	GJ/yr
Description:	(a) Energy content of annual chilled/hot water consumption in baseline building unit *j* in building unit category *i* in year *y*; or (b) Energy content of annual chilled/hot water consumption in the whole building, which baseline building unit *j* in building unit category *i* belongs to, in year *y*
Source of data:	Choose among the following options: (a) Utility billing records; (b) On-site measurements
Measurement procedures (if any):	(a) As per the utility metering; (b) Use heat meters
Monitoring frequency:	(a) As per the utility metering; (b) Continuously, aggregated at least annually
QA/QC procedures:	Check consistency of the monitored records with the records from previous monitoring intervals
Any comment:	Applicable only if a heat meter is installed for monitoring of chilled/hot water consumption. $WC_{BL\text{-}Bldg,i,j,k,y}$ is applicable only if the chilled/hot water consumption is monitored only at a whole building level

Data / Parameter table 36.

Data / Parameter:	$\eta_{BL,dist,l,y}$
Data unit:	GJ of technical thermal energy losses in the chilled/hot water distribution network divided by GJ of thermal energy supplied to the building units
Description:	Average technical distribution losses of the chilled/hot water system *l* in year *y*
Source of data:	Monitoring records of thermal energy supply and demand or thermal energy loss measurement. A default value of 0 per cent may be used if no recent data are available or the data cannot be regarded accurate and reliable
Measurement procedures (if any):	(a) Based on monitoring of thermal energy supply and demand; or (b) Measurement and estimation of surface thermal energy losses. Follow authentic engineering handbooks/ publications or national or international standards for calculation of the surface thermal energy losses

Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 37.

Data / Parameter:	$\mathbf{m_{BL,i,j,y}}$
Data unit:	kg/yr
Description:	Annual chilled/hot water consumption (in mass) of baseline building unit *j* in building unit category *i* in year *y*
Source of data:	Choose among the following options: (a) Utility billing records; (b) On-site measurements
Measurement procedures (if any):	(a) As per the utility metering; (b) Use mass meters
Monitoring frequency:	(a) As per the utility metering; (b) Continuously, aggregated at least annually
QA/QC procedures:	Check consistency of the monitored records with the records from previous monitoring intervals
Any comment:	Applicable only if a mass flow meter is installed for monitoring of chilled/hot water consumption

Data / Parameter table 38.

Data / Parameter:	$\mathbf{v_{BL,i,j,y}}$
Data unit:	m^3/yr
Description:	Annual chilled/hot water consumption (in volume) of baseline building unit *j* in building unit category *i* in year *y*
Source of data:	Choose among the following options: (a) Utility billing records; (b) On-site measurements
Measurement procedures (if any):	(a) As per the utility metering; (b) Use volume meters
Monitoring frequency:	(a) As per the utility metering; (b) Continuously, aggregated at least annually
QA/QC procedures:	Check consistency of the monitored records with the records from previous monitoring intervals
Any comment:	Applicable only if a volume flow meter is installed for monitoring of chilled/hot water consumption

Data / Parameter table 39.

Data / Parameter:	$\mathbf{WP_{BL,l,y}}$
Data unit:	GJ/yr
Description:	Annual energy content of chilled/hot water production of chilled/hot water system *l* in year *y*
Source of data:	On-site measurements

Measurement procedures (if any):	Use heat meters
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a heat meter is installed for monitoring of chilled/hot water production

Data / Parameter table 40.

Data / Parameter:	$\mathbf{m_{BL,l,y}}$
Data unit:	kg/yr
Description:	Annual chilled/hot water production (in mass) of chilled/hot water system *l* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Use mass meters
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a mass flow meter is installed for monitoring of chilled/hot water production

Data / Parameter table 41.

<table>
<tr><th>Data / Parameter:</th><th>$\mathbf{\Delta t_{BL,l,y}}$</th></tr>
<tr><td>Data unit:</td><td>K</td></tr>
<tr><td>Description:</td><td>Average temperature difference between the outlet and inlet of the heat exchanger used for the chilled/hot water production in chilled/hot water system l in year y</td></tr>
<tr><td>Source of data:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>(a) Readings taken from temperature meters installed at pipeline of inlet and outlet of the heat exchanger used for the chilled/hot water supply</td><td>This is the preferred source</td></tr>
<tr><td>(b) Specification of the manufacturer of the chilled/hot water system</td><td>If (a) is not available</td></tr>
</table>
</td></tr>
</table>

Measurement procedures (if any):	(a) Readings taken from temperature meters installed at pipeline of inlet and outlet of the heat exchanger; (b) Not applicable
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a mass or volume flow meter is installed for monitoring of chilled/hot water production. The temperature meter readings should be installed at the immediate inlet and outlet point of the heat exchanger of the chilled/hot water system

Data / Parameter table 42.

Data / Parameter:	$\mathbf{v_{BL,l,y}}$
Data unit:	m^3/yr
Description:	Annual chilled/hot water production (in volume) of chilled/hot water system *l* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Use volume meters
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a volume flow meter is installed for monitoring of chilled/hot water production

Data / Parameter table 43.

Data / Parameter:	$\mathbf{BE_{WP,EC,l,y}}$
Data unit:	t CO_2/yr
Description:	Baseline emissions from electricity consumption of chilled/hot water system *l* in year *y*
Source of data:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Measurement procedures (if any):	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter.
QA/QC procedures:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Any comment:	-

Data / Parameter table 44.

Data / Parameter:	$\mathbf{FC_{BL,l,k,y}}$
Data unit:	Mass or volume unit/yr (e.g. tonne/yr or m^3/yr)
Description:	Quantity of fossil fuel type *k* fired in chilled/hot water system *l* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Use either mass or volume meters
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	Check consistency of the monitored records with the records from previous monitoring intervals
Any comment:	-

Data / Parameter table 45.

Data / Parameter:	$\mathbf{Q_{BL,ref,l,y}}$
Data unit:	t refrigerant/yr
Description:	Average annual quantity of the refrigerant used to replace the refrigerant that has leaked in chilled water system *l* in year *y*
Source of data:	Choose among the following options: (a) Inventory data of refrigerant cylinders consumed in the chilled/hot water system; (b) Assume the low-end default value from Chapter 7: Emissions of fluorinated substitutes for Ozone depleting substances, Volume 3, Industrial Processes and Product Use, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	Cross-check the quantities of refrigerants consumed with typical leakage rates of the refrigerants for the relevant application
Any comment:	-

Data / Parameter table 46.

Data / Parameter:	$\mathbf{GWP_{BL,ref,l,y}}$
Data unit:	t CO_2e/t refrigerant
Description:	Global Warming Potential of the refrigerant used in chilled water system *l* in year *y*
Source of data:	If the refrigerant used is listed in Annex A of the Kyoto Protocol, then values listed in IPCC's second assessment report shall be used, else values listed in the IPCC's fourth assessment report shall be used
Measurement procedures (if any):	-

Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 47.

Data / Parameter:	$w_{BL,steam,CO2,l,y}$
Data unit:	t CO_2/t steam
Description:	Average mass fractions of carbon dioxide in the produced steam for the use in chilled/hot water cooling system *l* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Non-condensable gases sampling should be carried out in production wells and at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The CO_2 and CH_4 sampling and analysis procedure consists of collecting non-condensable gases samples from the main steam line with glass flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation. Hydrogen sulphide (H_2S) and carbon dioxide (CO_2) dissolve in the solvent while the residual compounds remain in their gaseous phase. The gas portion is then analyzed using gas chromatography to determine the content of the residuals including CH_4. All alkane concentrations are reported in terms of methane
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a geothermal source(s) supplies heat to the chilled/hot water cooling system

Data / Parameter table 48.

Data / Parameter:	$w_{BL,steam,CH4,l,y}$
Data unit:	t CO_2/t steam
Description:	Average mass fractions of methane in the produced geothermal steam for the use in chilled/hot water cooling system *l* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	As per the procedures outlined for $w_{BL,steam,CO2,l,y}$
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a geothermal source(s) supplies heat to the chilled/hot water system

Data / Parameter table 49.

Data / Parameter:	$M_{BL,steam,l,y}$
Data unit:	t/yr
Description:	Quantity of geothermal gas produced for the use in chilled/hot water cooling system *l* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	The steam quantity discharged from the geothermal wells should be measured with a venturi flow meter (or other equipment with at least the same accuracy). Measurement of temperature and pressure upstream of the venturi meter is required to define the steam properties. The calculation of steam quantities should be conducted on a continuous basis and should be based on international standards. The measurement results should be summarized transparently in regular production reports
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a geothermal source(s) supplies heat to the chilled/hot water system

Data / Parameter table 50.

Data / Parameter:	$Q_{BL,ref,i,j,m,y}$ **or** $Q_{BL\text{-}Bldg,ref,i,j,m,y}$
Data unit:	t refrigerant/yr
Description:	(a) Annual quantity of refrigerant type *m* used to replace the refrigerant(s) that has leaked in baseline building unit *j* in building unit category *i* in year *y*, excluding refrigerant leakage from chilled water system; or (b) Annual quantity of refrigerant type *m* used to replace the refrigerant(s) that has leaked in the whole building, which baseline building unit *j* in building unit category *i* belongs to, in year *y*, excluding refrigerant leakage from chilled water system
Source of data:	Choose among the following options: (a) Inventory data of refrigerant cylinders consumed in the chilled/hot water system; (b) Assume the low-end default value from Chapter 7: Emissions of fluorinated substitutes for Ozone depleting substances, Volume 3, Industrial Processes and Product Use, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Measurement procedures (if any):	-
Monitoring frequency:	Annually. Alternatively, only for the first three years of the corresponding crediting period, if the minimum annual value of the three-year monitoring period is to be used for the subsequent years in the crediting period
QA/QC procedures:	Cross-check the quantities of refrigerants consumed with typical leakage rates of the refrigerants for the relevant application
Any comment:	$Q_{BL\text{-}Bldg,ref,i,j,m,y}$ is applicable only if the refrigerant leakage is monitored only at a whole building level

Data / Parameter table 51.

Data / Parameter:	$\mathbf{GWP_{BL,ref,i,j,m,y}}$
Data unit:	t CO_2e/t refrigerant
Description:	Global Warming Potential of refrigerant type *m* used in baseline building unit *j* in building unit category *i* in year *y*
Source of data:	If the refrigerant used is listed in Annex A of the Kyoto Protocol, then values listed in IPCC's second assessment report shall be used, else values listed in the IPCC's fourth assessment report shall be used
Measurement procedures (if any):	-
Monitoring frequency:	As per the monitoring frequency of $Q_{BL,ref,i,j,m,y}$ or $Q_{BL\text{-}Bldg,ref,i,j,m,y}$
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 52.

Data / Parameter:	$\mathbf{J_{i,y}}$
Data unit:	-
Description:	Total number of top 20 per cent performer building units in building unit category *i* in year *y*
Source of data:	Building survey
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 53.

Data / Parameter:	$\mathbf{EI_{Standard,i,y}}$
Data unit:	MWh/(m^2·yr)
Description:	Energy efficiency of building units in building unit category *i* stipulated in an applicable and enforced standard on building energy efficiency in the host country
Source of data:	Officially published standard on building energy efficiency
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	Applicable only if there is an applicable and enforced standard on building energy efficiency in the host country

Data / Parameter table 54.

Data / Parameter:	$EC_{BL,i,j,y}$ or $EC_{BL\text{-}Bldg,i,j,y}$
Data unit:	MWh/yr
Description:	(a) Electricity consumption of baseline building unit *j* in building unit category *i* in year *y*; or (b) Electricity consumption of the whole building, which baseline building unit *j* in building unit category *i* belongs to, in year *y*
Source of data:	Choose among the following options: (a) Utility billing records; (b) On-site measurements
Measurement procedures (if any):	(a) As per the utility metering; (b) Use electricity meters
Monitoring frequency:	(a) As per the utility metering; (b) Continuously, aggregated at least annually
QA/QC procedures:	Check consistency of the monitored records with the records from previous monitoring intervals
Any comment:	$EC_{BL\text{-}Bldg,i,j,y}$ is applicable only if the electricity consumption is monitored only at a whole building level

Data / Parameter table 55.

Data / Parameter:	$GFA_{PJ,i,y}$
Data unit:	m^2
Description:	Total GFA of project building units in building unit category *i* in year *y*
Source of data:	The following data sources may be used if the relevant conditions apply: <table><tr><th>Data source</th><th>Conditions for using the data source</th></tr><tr><td>(a) Building plan</td><td>This is the preferred source</td></tr><tr><td>(b) On-site measurement</td><td>If (a) is not available</td></tr></table>
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter, or more frequently
QA/QC procedures:	(a) Confirm on-site that building geometry represented in the plan is accurate; (b) Not applicable
Any comment:	-

Data / Parameter table 56.

Data / Parameter:	$n_{PJ,i,y}$
Data unit:	-
Description:	Total number of project building units included in the sample for building unit category *i* in year *y*

Source of data:	Project participants
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	The value of this parameter should always be larger than the minimum sample size

Data / Parameter table 57.

Data / Parameter:	$\mathbf{N_{PJ,UNO,i,y}}$ **or** $\mathbf{n_{PJ,UNO,i,y}}$
Data unit:	-
Description:	Total number of project building units not satisfying the occupancy criterion in the population ($N_{PJ,UNO,i,y}$) or sample ($n_{PJ,UNO,i,y}$) for building unit category *i* in year *y*. The occupancy criterion is as follows: (a) Residential building units, either in a low-rise or high-rise building, are occupied, and used as a primary, year-round residence; (b) Commercial and institutional building units, either in a low-rise or high-rise building, are operated on annual average at least 30 hours/week
Source of data:	Building survey
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter, or more frequently
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 58.

Data / Parameter:	$\mathbf{GFA_{PJ,i,j,y}}$ **or** $\mathbf{GFA_{PJ\text{-}Bldg,i,j,y}}$
Data unit:	m^2
Description:	(a) GFA of project building unit *j* in building unit category *i* in year *y*; or (b) GFA of the whole building, which project building unit *j* in building unit category *i* belongs to, in year *y*. Account for GFA of each building unit in the building, but not GFA of the common service areas
Source of data:	The following data sources may be used if the relevant conditions apply: **Data source** / **Conditions for using the data source** (a) Building plan — This is the preferred source (b) On-site measurement — If (a) is not available
Measurement procedures (if any):	-

Monitoring frequency:	For the first year of the project implementation, and every third year thereafter, or more frequently
QA/QC procedures:	(a) Confirm on-site that building geometry represented in the plan is accurate; (b) Not applicable
Any comment:	$GFA_{PJ\text{-}Bldg,i,j,y}$ is applicable only if apportioning of project energy consumption and/or project emissions from the use of a refrigerant(s) is required

Data / Parameter table 59.

Data / Parameter:	$\mathbf{PE_{EC,non\text{-}REcaptive,i,j,y}}$
Data unit:	t CO_2/yr
Description:	Project emissions from electricity consumption of project building unit *j* in building unit category *i* in year *y*, which is supplied by an off-grid renewable captive power plant(s)
Source of data:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Measurement procedures (if any):	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Monitoring frequency:	Annually
QA/QC procedures:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Any comment:	-

Data / Parameter table 60.

Data / Parameter:	$\mathbf{PE_{FC,i,j,y}}$
Data unit:	t CO_2/yr
Description:	Project emissions from fossil fuel consumption of project building unit *j* in building unit category *i* in year *y*
Source of data:	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Measurement procedures (if any):	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Monitoring frequency:	Annually
QA/QC procedures:	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Any comment:	-

Data / Parameter table 61.

Data / Parameter:	**$WC_{PJ,i,j,y}$ or $WC_{PJ\text{-}Bldg,i,j,y}$**
Data unit:	GJ/yr
Description:	Energy content of annual chilled/hot water consumption in project building unit *j* in building unit category *i* in year *y*; or Energy content of annual chilled/hot water consumption in the whole building, which baseline building unit *j* in building unit category *i* belongs to, in year *y*
Source of data:	Choose among the following options: (a) Utility billing records; (b) On-site measurements
Measurement procedures (if any):	(a) As per the utility metering; (b) Use heat meters
Monitoring frequency:	(a) As per the utility metering; (b) Continuously, aggregated at least annually
QA/QC procedures:	Check consistency of the monitored records with the records from previous monitoring intervals
Any comment:	Applicable only if a heat meter is installed for monitoring of chilled/hot water consumption. $WC_{PJ\text{-}Bldg,i,j,y}$ is applicable only if the fuel consumption is monitored only at a whole building level

Data / Parameter table 62.

Data / Parameter:	**$\eta_{PJ,dist,l,y}$**
Data unit:	GJ of technical thermal energy losses in the chilled/hot water distribution network divided by GJ of thermal energy supplied to the building units
Description:	Average technical distribution losses of the chilled/hot water system *l* in year *y*
Source of data:	Monitoring records of thermal energy supply and demand or thermal energy loss measurement
Measurement procedures (if any):	(a) Based on monitoring of thermal energy supply and demand; or (b) Measurement and estimation of surface thermal energy losses. Follow authentic engineering handbooks/ publications or national or international standards for calculation of the surface thermal energy losses
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 63.

Data / Parameter:	**$m_{PJ,i,j,y}$**
Data unit:	kg/yr
Description:	Annual chilled/hot water consumption (in mass) of project building unit *j* in building unit category *i* in year *y*

Source of data:	Choose among the following options: (a) Utility billing records; (b) On-site measurements
Measurement procedures (if any):	(a) As per the utility metering; (b) Use mass meters
Monitoring frequency:	(a) As per the utility metering; (b) Continuously, aggregated at least annually
QA/QC procedures:	Check consistency of the monitored records with the records from previous monitoring intervals
Any comment:	Applicable only if a mass flow meter is installed for monitoring of chilled/hot water consumption

Data / Parameter table 64.

Data / Parameter:	$v_{PJ,i,j,y}$
Data unit:	m^3/yr
Description:	Annual chilled/hot water consumption (in volume) of project building unit *j* in building unit category *i* in year *y*
Source of data:	Choose among the following options: (a) Utility billing records; (b) On-site measurements
Measurement procedures (if any):	(a) As per the utility metering; (b) Use volume meters
Monitoring frequency:	(a) As per the utility metering; (b) Continuously, aggregated at least annually
QA/QC procedures:	Check consistency of the monitored records with the records from previous monitoring intervals
Any comment:	Applicable only if a volume flow meter is installed for monitoring of chilled/hot water consumption

Data / Parameter table 65.

Data / Parameter:	$WP_{PJ,l,y}$
Data unit:	GJ/yr
Description:	Energy content of annual chilled/hot water production of chilled/hot water system *l* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Use heat meters
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a heat meter is installed for monitoring of chilled/hot water production

Data / Parameter table 66.

Data / Parameter:	$m_{PJ,l,y}$
Data unit:	kg/yr
Description:	Annual chilled/hot water production (in mass) of chilled/hot water system *l* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Use mass meters
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a mass flow meter is installed for monitoring of chilled/hot water production

Data / Parameter table 67.

<table>
<tr><td>Data / Parameter:</td><td>$\Delta t_{PJ,l,y}$</td></tr>
<tr><td>Data unit:</td><td>K</td></tr>
<tr><td>Description:</td><td>Average temperature difference between the outlet and inlet of the heat exchanger used for the chilled/hot water production in chilled/hot water system l in year y</td></tr>
<tr><td>Source of data:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>(a) Readings taken from temperature meters installed at pipeline of inlet and outlet of the heat exchanger used for the chilled/hot water supply</td><td>This is the preferred source</td></tr>
<tr><td>(b) Specification of the manufacturer of the chilled/hot water system</td><td>If (a) is not available</td></tr>
</table>
</td></tr>
<tr><td>Measurement procedures (if any):</td><td>(a) Readings taken from temperature meters installed at pipeline of inlet and outlet of the heat exchanger;
(b) Not applicable</td></tr>
<tr><td>Monitoring frequency:</td><td>For the first year of the project implementation, and every third year thereafter</td></tr>
<tr><td>QA/QC procedures:</td><td>-</td></tr>
<tr><td>Any comment:</td><td>Applicable only if a mass or volume flow meter is installed for monitoring of chilled/hot water consumption.
The temperature meter readings should be installed at the immediate inlet and outlet point of the heat exchanger of the chilled/hot water system</td></tr>
</table>

Data / Parameter table 68.

Data / Parameter:	$\Delta t_{PJ,i,j,y}$
Data unit:	K
Description:	Average temperature difference between the outlet and inlet of the heat exchanger used for the cooling and heating of building unit *j* in building unit category *i* in year *y* (K)
Source of data:	The following data sources may be used if the relevant conditions apply: **Data source** / **Conditions for using the data source** (a) Readings taken from temperature meters installed at pipeline of inlet and outlet of the heat exchanger used for the cooling and heating of building unit *j* /
Measurement procedures (if any):	Readings taken from temperature meters installed at pipeline of inlet and outlet of the heat exchanger
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a mass or volume flow meter is installed for monitoring of chilled/hot water consumption. The temperature meter readings should be installed at the immediate inlet and outlet point of the heat exchanger

Data / Parameter table 69.

Data / Parameter:	$v_{PJ,l,y}$
Data unit:	m^3/yr
Description:	Annual chilled/hot water production (in volume) of chilled/hot water cooling system *l* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Use volume meters
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a volume flow meter is installed for monitoring of chilled/hot water consumption

Data / Parameter table 70.

Data / Parameter:	$PE_{WP,EC,l,y}$
Data unit:	t CO_2/yr
Description:	Project emissions from electricity consumption of chilled/hot water system *l* in year *y*
Source of data:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Measurement procedures (if any):	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Any comment:	-

Data / Parameter table 71.

Data / Parameter:	$PE_{WP,FC,l,y}$
Data unit:	t CO_2/yr
Description:	Project emissions from fossil fuel consumption of chilled/hot water system *l* in year *y*
Source of data:	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Measurement procedures (if any):	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Any comment:	-

Data / Parameter table 72.

Data / Parameter:	$Q_{PJ,ref,l,y}$
Data unit:	t refrigerant/yr
Description:	Average annual quantity of the refrigerant used to replace the refrigerant that has leaked in chilled water system *l* in year *y*
Source of data:	Choose among the following options: (a) Inventory data of refrigerant cylinders consumed in the chilled/hot water system; (b) Assume the high-end default value from Chapter 7: Emissions of fluorinated substitutes for Ozone depleting substances, Volume 3, Industrial Processes and Product Use, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Measurement procedures (if any):	-

Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	Cross-check the quantities of refrigerants consumed with typical leakage rates of the refrigerants for the relevant application
Any comment:	-

Data / Parameter table 73.

Data / Parameter:	$\mathbf{Q_{PJ,ref,l,Start,y}}$
Data unit:	t refrigerant/yr
Description:	Quantity of the initial charge of the refrigerant in chilled water system *l* in year *y*
Source of data:	Manufacturer's data
Measurement procedures (if any):	-
Monitoring frequency:	Monitored only in the year in which the chilled water system started its operation
QA/QC procedures:	-
Any comment:	This emission source is accounted for only in the year in which the chilled water system started its operation

Data / Parameter table 74.

Data / Parameter:	$\mathbf{Q_{PJ,ref,l,End,y}}$
Data unit:	t refrigerant/yr
Description:	Quantity of the refrigerant in chilled water cooling system *l* that is recovered and destroyed or re-used in year *y*
Source of data:	Values provided by an entity responsible for the refrigerant destruction or re-use
Measurement procedures (if any):	As per a method approved under regulations by the host country and/or pursuant to international treaties signed by the host country under the Montreal Protocol, Kyoto Protocol or any other Protocol that may apply in the future
Monitoring frequency:	Monitored only in the year in which the refrigerant is destroyed or re-used
QA/QC procedures:	Cross-check the quantities of refrigerants destroyed or re-used with typical initial charge and leakage rates of the refrigerants for the relevant application
Any comment:	This emission source is accounted only in the year in which the refrigerant is destroyed or re-used. If the destruction or re-use takes place after the end of a crediting period(s) of the project activity, this emission source should not be accounted nor is it mandatory to monitor this parameter

Data / Parameter table 75.

Data / Parameter:	$\mathbf{GWP_{PJ,ref,l,y}}$
Data unit:	t CO_2e/t refrigerant
Description:	Global Warming Potential of the refrigerant used in chilled water system *l* in year *y*
Source of data:	If the refrigerant used is listed in Annex A of the Kyoto Protocol, then values listed in IPCC's second assessment report shall be used, else values listed in the IPCC's fourth assessment report shall be used
Measurement procedures (if any):	-
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 76.

Data / Parameter:	$\mathbf{w_{PJ,steam,CO2,l,y}}$
Data unit:	t CO_2/t steam
Description:	Average mass fractions of carbon dioxide in the produced steam for the use in chilled/hot water system *l* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Non-condensable gases sampling should be carried out in production wells and at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The CO_2 and CH_4 sampling and analysis procedure consists of collecting non-condensable gases samples from the main steam line with glass flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation. Hydrogen sulphide (H_2S) and carbon dioxide (CO_2) dissolve in the solvent while the residual compounds remain in their gaseous phase. The gas portion is then analyzed using gas chromatography to determine the content of the residuals including CH_4. All alkane concentrations are reported in terms of methane
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a geothermal source(s) supplies heat to the chilled/hot water system

Data / Parameter table 77.

Data / Parameter:	$\mathbf{w_{PJ,steam,CH4,l,y}}$
Data unit:	t CO_2/t steam
Description:	Average mass fractions of methane in the produced geothermal steam for the use in chilled/hot water system *l* in year *y*
Source of data:	On-site measurements

Measurement procedures (if any):	As per the procedures outlined for $w_{PJ,steam,CO2,l,y}$
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a geothermal source(s) supplies heat to the chilled/hot water system

Data / Parameter table 78.

Data / Parameter:	$M_{PJ,steam,l,y}$
Data unit:	t/yr
Description:	Quantity of geothermal gas produced for the use in chilled/hot water system *l* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	The steam quantity discharged from the geothermal wells should be measured with a venturi flow meter (or other equipment with at least the same accuracy). Measurement of temperature and pressure upstream of the venturi meter is required to define the steam properties. The calculation of steam quantities should be conducted on a continuous basis and should be based on international standards. The measurement results should be summarized transparently in regular production reports
Monitoring frequency:	For the first year of the project implementation, and every third year thereafter
QA/QC procedures:	-
Any comment:	Applicable only if a geothermal source(s) supplies heat to the chilled/hot water system

Data / Parameter table 79.

Data / Parameter:	$Q_{PJ,ref,i,j,m,y}$ **or** $Q_{PJ\text{-}Bldg,ref,i,j,m,y}$
Data unit:	t refrigerant/yr
Description:	(a) Annual quantity of refrigerant type *m* used to replace the refrigerant(s) that has leaked in project building unit *j* in building unit category *i* in year *y*, excluding refrigerant leakage from chilled water system; or (b) Annual quantity of refrigerant type *m* used to replace the refrigerant(s) that has leaked in the whole building, which project building unit *j* in building unit category *i* belongs to, in year *y*, excluding refrigerant leakage from chilled water system
Source of data:	Choose among the following options: (a) Inventory data of refrigerant cylinders consumed in the chilled water cooling system; (b) Assume the high-end default value from Chapter 7: Emissions of fluorinated substitutes for Ozone depleting substances, Volume 3, Industrial Processes and Product Use, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Measurement procedures (if any):	-

Monitoring frequency:	Annually. Alternatively, only for the first three years of the corresponding crediting period, if the maximum annual value of the three-year monitoring period is to be used for the subsequent years in the crediting period
QA/QC procedures:	Cross-check the quantities of refrigerants consumed with typical leakage rates of the refrigerants for the relevant application
Any comment:	$Q_{PJ\text{-}Bldg,ref,i,j,m,y}$ is applicable only if the refrigerant leakage is monitored only at a whole building level

Data / Parameter table 80.

Data / Parameter:	$\mathbf{Q_{PJ,ref,i,j,m,Start,y}}$ **or** $\mathbf{Q_{PJ\text{-}Bldg,ref,i,j,m,Start,y}}$
Data unit:	t refrigerant/yr
Description:	(a) Quantity of the initial charge of refrigerant type *m* in a cooling device(s) used in project building unit *j* in building unit category *i* in year *y*, excluding refrigerant leakage from chilled water system; or (b) Quantity of the initial charge of refrigerant type *m* in a cooling device(s) used in the whole building, which project building unit *j* in building unit category *i* belongs to, in year *y*, excluding refrigerant leakage from chilled water system
Source of data:	Manufacturer's data
Measurement procedures (if any):	-
Monitoring frequency:	Monitored only in the year in which the cooling device(s) started its operation
QA/QC procedures:	-
Any comment:	This emission source is accounted only in the year in which the cooling device(s) started its operation. $Q_{PJ\text{-}Bldg,ref,i,j,m,Start,y}$ is applicable only if the initial charge of the refrigerant consumption is monitored only at a whole building level

Data / Parameter table 81.

Data / Parameter:	$\mathbf{Q_{PJ,ref,i,j,m,End,y}}$ **or** $\mathbf{Q_{PJ\text{-}Bldg,ref,i,j,m,End,y}}$
Data unit:	t refrigerant/yr
Description:	(a) Quantity of refrigerant type *m* in a cooling device(s) used in project building unit *j* in building unit category *i* that is recovered and destroyed or re-used in year *y*, excluding refrigerant leakage from chilled water system; or (b) Quantity of refrigerant type *m* in a cooling device(s) used in the whole building, which project building unit *j* in building unit category *i* belongs to, that is recovered and destroyed or re-used in year *y*, excluding refrigerant leakage from chilled water system
Source of data:	Values provided by an entity responsible for the refrigerant destruction or re-use

Measurement procedures (if any):	As per a method approved under regulations by the host country and/or pursuant to international treaties signed by the host country under the Montreal Protocol, Kyoto Protocol or other Protocol that may apply in the future
Monitoring frequency:	Monitored only in the year in which the refrigerant is destroyed or re-used
QA/QC procedures:	Cross-check the quantities of refrigerants destroyed or re-used with typical initial charge and leakage rates of the refrigerants for the relevant application
Any comment:	This emission source is accounted only in the year in which the refrigerant is destroyed or re-used. If the destruction or re-use takes place after the end of a crediting period(s) of the project activity, this emission source should not be accounted nor is it mandatory to monitor this parameter. $Q_{PJ\text{-}Bldg,ref,i,j,m,End,y}$ is applicable only if the refrigerant destruction or re-use is monitored only at a whole building level

Data / Parameter table 82.

Data / Parameter:	$\mathbf{GWP_{PJ,ref,i,j,m,y}}$
Data unit:	t CO_2e/t refrigerant
Description:	Global Warming Potential of refrigerant type *m* used in project building unit *j* in building unit category *i* in year *y*
Source of data:	If the refrigerant used is listed in Annex A of the Kyoto Protocol, then values listed in IPCC's second assessment report shall be used, else values listed in the IPCC's fourth assessment report shall be used
Measurement procedures (if any):	-
Monitoring frequency:	As per the monitoring frequency of $Q_{PJ,ref,i,j,m,y}$ or $Q_{PJ\text{-}Bldg,ref,i,j,m,y}$
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 83.

Data / Parameter:	$\mathbf{N_{PJ,i,y}}$
Data unit:	-
Description:	Total number of project building units in the population for building unit category *i* in year *y*
Source of data:	Project participants
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 84.

Data / Parameter:	$EC_{PJ,i,j,y}$ **or** $EC_{PJ-Bldg,i,j,y}$
Data unit:	MWh/yr
Description:	(a) Electricity consumption of project building unit *j* in building unit category *i* in year *y*; or (b) Electricity consumption of the whole building, which project building unit *j* in building unit category *i* belongs to, in year *y*
Source of data:	Choose among the following options: (a) Utility billing records; (b) On-site measurements
Measurement procedures (if any):	(a) As per the utility metering; (b) Use electricity meters
Monitoring frequency:	(a) As per the utility metering; (b) Continuously, aggregated at least annually
QA/QC procedures:	Check consistency of the monitored records with the records from previous monitoring intervals
Any comment:	$EC_{PJ-Bldg,i,j,y}$ is applicable only if the electricity consumption is monitored only at a whole building level

Data / Parameter table 85.

Data / Parameter:	$FC_{PJ,i,j,k,y}$ **or** $FC_{PJ-Bldg,i,j,y}$
Data unit:	Mass or volume unit/yr (e.g. tonne/yr or m^3/yr)
Description:	(a) Annual consumption of fossil fuel type *k* of project building unit *j* in building unit category *i* in year *y*; or (b) Annual consumption of fossil fuel type *k* of the whole building, which project building unit *j* in building unit category *i* belongs to, in year *y*. In both cases, the amount of fuel used for the electricity generation by the captive power plant(s) in the building that project building unit *j* belongs to shall not be included in the parameter
Source of data:	Choose among the following options: (a) Utility billing records; (b) On-site measurements
Measurement procedures (if any):	(a) As per the utility metering; (b) Use either mass or volume meters
Monitoring frequency:	(a) As per the utility metering; (b) Continuously, aggregated at least annually
QA/QC procedures:	Check consistency of the monitored records with the records from previous monitoring intervals
Any comment:	$FC_{PJ-Bldg,i,j,y}$ is applicable only if the fuel consumption is monitored only at a whole building level

Data / Parameter table 86.

Data / Parameter:	$FF_{PJ,k,i,j,y}$
Data unit:	m^3/yr
Description:	Consumption of fossil fuel *k* in project building unit *j* in building unit category *i* in year *y*

Source of data:	On-site measurements
Measurement procedures (if any):	Use volume meters
Monitoring frequency:	Annually
QA/QC procedures:	The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be crosschecked with available purchase invoices from the financial records
Any comment:	Applicable only if the project activity is implemented under a programme of activities

Data / Parameter table 87.

Data / Parameter:	**$NCV_{k,y}$**
Data unit:	GJ/m^3
Description:	Average net calorific value of the fossil fuel *k* consumed in year *y*
Source of data:	The following data sources may be used if the relevant conditions apply:
Measurement procedures (if any):	For (a) and (b): measurements should be undertaken in line with national or international fuel standards

Data source		Conditions for using the data source
(a)	Values provided by the fuel supplier in invoices	This is the preferred source
(b)	Measurements by the project participant	If (a) is not available
(c)	Regional or national default value	If (a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)
(d)	IPCC default values at the upper limit of the uncertainty at 95 per cent confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If (a) is not available

Monitoring frequency:	For (a), (b) and (c): for the first year of the project implementation, and every third year thereafter. For (d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures:	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards
Any comment:	Applicable only if the project activity is implemented under a programme of activities Note that for the NCV the same basis (pressure and temperature) should be used as for the fuel consumption

Data / Parameter table 88.

Data / Parameter:	$\mathbf{FF_{Top20\%,i,j,k,y}}$
Data unit:	volume or mass unit/yr
Description:	Consumption of fossil fuel type *k* (a coal or petroleum fuel type) in top 20 per cent performer building unit *j* in building unit category *i* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Use volume or mass meters
Monitoring frequency:	Annually
QA/QC procedures:	The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be crosschecked with available purchase invoices from the financial records
Any comment:	Applicable only if the project activity is implemented under a programme of activities

Data / Parameter table 89.

Data / Parameter:	**$SCRAP_{q,y}$**
Data unit:	-
Description:	Confirmation of scrapping of equipment q replaced in year y in the project activity
Source of data:	Project participant
Measurement procedures (if any):	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
Monitoring frequency:	Upon scrapping of the replaced equipment
QA/QC procedures:	-
Any comment:	Applicable only if the project activity is implemented under a programme of activities

Appendix 1. List of building unit categories

1. This list provides building unit categories eligible under this methodology. The list categorizes building units based on two criteria: (i) type of a building unit; and (ii) height of a whole building that the building unit belongs to.

2. Definitions of building unit types eligible under this methodology are provided below. Further, a low-rise building is defined as a building with three stories or fewer above grade, and a high-rise building with more than three stories above grade.

    (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.

    (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, theaters, 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;

i. **Health care (low-rise or high-rise)** - this category includes the following:

- **Health care** - this category includes, for example, hospitals, clinics, and rehabilitation centers;
- **Nursing** - this category includes, for example, nursing homes, assisted living centers, or other residential care buildings;
- **Other health care** - this category includes health care building units that belong to none of the above categories;

ii. **Public order and safety (low-rise or high-rise)** - this category includes the following:

- **Stations** - this category includes, for example, police and fire stations, other public service stations for road and park maintenance, civil defence;
- **Prisons** - this category includes, for example, jails, reformatories, and penitentiaries;
- **Judiciary** - this category includes, for example, courthouses and probation offices;
- **Other public order and safety** - this category includes public order and safety building units that belong to none of the above categories;
    - **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.

Appendix 2. Sample format for baseline building survey questionnaire

1. Objective - establishment of emissions benchmark for buildings

2. Questionnaire - an objective questionnaire is designed as per guidance provided in this appendix

3. Methodology of conducting the baseline building survey:

(a) Definition of project region (administrative specification);

(b) Sampling frame: municipal/government cadastre;

(c) Sampling unit: building;

(d) Sampling method: systematic random sampling;

(e) Sample size: the sample size is determined as per equation (1) in the methodology;

(f) Sampling plan: the entire set of buildings found in the cadastre covering the project region is divided into different building categories (*i*). The stratification of building categories (*i*) is carried out as per appendix I of the methodology;

(g) Mode of data collection: Interview of building administrators of the selected buildings;

(h) Frequency of surveying: initial survey before project start, annual survey during crediting period.

I. Initial survey on baseline building units

1. Date of survey:__/__/_____ (day, month year)

2. Name of survey administrator:_____________

3. Contact details of interviewed building administrator:

a)______________________(name)

b)______________________(telephone)

c) ______________________(email)

4. Building location:

a) _______________ (municipality)

b)_________________________________ (street address) or ______ (GPS coordinates)

c) _______(unique baseline building identifier)

5. District heating is used for this building: ☐ No; ☐ Yes

6. Socio-economic conditions of neighbourhood: ______ (choose parameter as per methodology, provide source of information)

7. Building unit category: _____________ (select from Annex 1 of methodology)

8. Building height: ____ (number of floors above grade)

9. Number of building units in building: ____

____________________________________ (list unique baseline building unit identifiers)

10. GFA of building units (excluding common service areas outside the physical boundaries of the building units):

a) ___m^2 (in case of building unit and building being identical)

b) ___m^2 for building unit # ___________ (please add lines as necessary)

11. Start of building occupancy: __/_____ (month, year)

12. Occupancy / use status of each building unit:

a) In case of **residential** building units: ☐ Primary residence ☐ Secondary residence (add lines as necessary)

b) In case of **commercial** and **institutional** building units: ____ hours/week (annual average)

(add lines as necessary)

13. Energy and refrigerant consumption of building (list all fuel, refrigerant and energy types for three years prior to survey, specify measurement unit as appropriate, add lines as necessary, differentiate by building unit, if available)

a) _______m^3/ t of fossil fuel type ______________

b) _______MWh of electricity

c) _______GJ of chilled/hot water

d) _______t of refrigerant type _____________

e) _______________________________________Description of apportioning procedure to building units if energy consumption data are only available for the whole building

II. Annual ex-post monitoring of baseline building units during crediting period

1. Date of survey:__/__/_____ (day, month year)

2. Period covered by survey: from __/__/_____ to __/__/_____ (day, month year)

3. Name of survey administrator:_____________

4. Contact details of interviewed building administrator:

a)______________________(name)

b)______________________(telephone)

c) ______________________(email)

5. Building location:

a) ______________ (municipality)

b)_______________________________ (street address), or: ______ (GPS coordinates)

c) _______ (unique baseline building identifier)

6. District heating is used for this building: ☐ No; ☐ Yes

7. Building has ceased to exist: ☐

8. Building has changed its function: ☐

9. GFA of building units (excluding common service areas outside the physical boundaries of the building units, to be done every third year):

a) ___m^2 (in case of building unit and building being identical)

b) ___m^2 for building unit # ___________ (please add lines as necessary)

10. Occupancy / use status:

a) In case of **residential** building units: ☐ Primary residence ☐ Secondary residence

b) In case of **commercial** and **institutional** building units: ____ hours/week (annual average)

11. Energy and refrigerant consumption of building (list all fuel, refrigerant and energy types for past calendar year, specify measurement unit as appropriate, add lines as necessary, differentiate by building unit, if available)

a) _______t of fossil fuel type ______________

b) _______MWh of electricity

c) _______GJ of chilled/hot water

d) _______t of refrigerant type _____________ (as per frequency specified in the methodology)

e) _______________________________________Description of apportioning procedure to building units if energy consumption data are only available for the whole building

III. Initial survey on baseline district chilled/hot water systems[42]

1. Date of survey:__/__/_____ (day, month year)

2. Name of survey administrator:_____________

3. Contact details of interviewed chilled water production administrator:

a)______________________(name)

b)______________________(telephone)

c) ______________________ (email)

4. District served by the chilled water/hot production: _________________________

5. Chilled/hot water production: _______GJ of chilled/hot water

[42] In case chilled/hot water is supplied by a district system, the building administrator does not have access to data related to chilled/hot water production. Thus, it is necessary to fill a questionnaire separate from the one for the building administrator.

6. Energy and refrigerant consumption due to chilled water production (list all fuel, refrigerant and energy types for three years prior to survey, specify measurement unit as appropriate, add lines as necessary)

a) ______m^3/ t of fossil fuel type ______________

b) _______MWh of electricity

c) _______t of refrigerant type _____________

In case of using geothermal heat sources, please provide

d) _______t methane emitted

7. Energy losses due to chilled/hot water distribution

a) ___ %

<u>IV. Annual ex-post monitoring of baseline district chilled/hot water systems</u>

1. Date of survey:__/__/_____ (day, month year)

2. Period covered by survey: from __/__/_____ to __/__/_____ (day, month year)

3. Name of survey administrator:_____________

4. Contact details of interviewed chilled/hot water production administrator:

a)______________________(name)

b)______________________(telephone)

c) ______________________ (email)

5. District served by the chilled/hot water production: _________________________

6. Chilled water production: _______GJ of chilled/hot water

7. Energy and refrigerant consumption due to chilled/hot water production (list all fuel, refrigerant and energy types for past calendar year, specify measurement unit as appropriate, add lines as necessary)

a) ______m^3/ t of fossil fuel type ______________

b) _______MWh of electricity

c) _______t of refrigerant type _____________

In case of using geothermal heat sources, please provide

d) _______t methane emitted

8. Energy losses due to chilled/hot water distribution ___ %

Appendix 3. Sample format for project building survey questionnaire

1. Objective - enable calculation of project emissions for project buildings.

2. Questionnaire - an objective questionnaire is designed as per guidance provided in this appendix

3. Methodology of conducting the project building survey

(a) Sampling method: systematic random sampling;

(b) Sample size: the sample size is determined as per equation (31) in the methodology;

(c) Stratification: the entire set of project buildings is divided into different building categories (i) as per appendix 1 of the methodology;

(d) Mode of data collection: interview of building administrators of the buildings;

(e) Frequency of surveying: annual survey during crediting period.

I. Annual ex post monitoring of project building units

1. Date of survey:__/__/_____ (day, month year)

2. Period covered by survey: from __/__/_____ to __/__/_____ (day, month year)

3. Name of survey administrator:_____________

4. Contact details of interviewed building administrator:

a)______________________(name)

b)______________________(telephone)

c) ______________________ (email)

5. Building location:

a) ______________ (municipality)

b)_______________________________ (street address) or ______ (GPS coordinates)

c) _______ (unique project building identifier)

6. Confirmation of absence in the surveyed building of

a) district heating: ☐ (every third year of the crediting period)

b) cogeneration: ☐ (every third year of the crediting period)

c) use of CFCs as refrigerants: ☐ (every third year of the crediting period)

d) use of biogas: ☐ (every third year of the crediting period)

e) use of biomass use: ☐ (every third year of the crediting period)

7. Building unit category: _____________ (select from Annex 1 of methodology)

8. Building height: ____ (number of floors above grade)

9. Number of building units in building: ____

____________________________________ (list unique project building unit identifiers)

10. GFA of building units (excluding common service areas outside the physical boundaries of the building units):

a)____m^2 (in case of building unit and building being identical)

b) ___m^2 for building unit # ___________ (please add lines as necessary)

11. Start of building occupancy: __/_____ (month, year)

12. Occupancy / use status of each building unit:

a) In case of **residential** building units: ☐ Primary residence ☐ Secondary residence (add lines as necessary)

b) In case of **commercial** and **institutional** building units: ____ hours/week (annual average)

(add lines as necessary)

13. Energy and refrigerant consumption of building (list all fuel, refrigerant and energy types for past calendar year, specify measurement unit as appropriate, add lines as necessary, differentiate by building unit, if available)

a) _______t of fossil fuel type ______________

b) _______MWh of electricity

c) _______GJ of chilled/hot water

d) _______t of refrigerant type _____________ (as per frequency specified in the methodology)

e) _______________________________________Description of apportioning procedure to building units if energy consumption data are only available for the whole building

II. Annual ex post monitoring of project district chilled/hot water systems

1. Date of survey:__/__/_____ (day, month year)

2. Period covered by survey: from __/__/_____ to __/__/_____ (day, month year)

3. Name of survey administrator:_____________

4. Contact details of interviewed chilled water production administrator:

a)______________________(name)

b)______________________(telephone)

c) ______________________ (email)

5. District served by the chilled/hot water production: _________________________

6. Chilled water/hot production _______GJ of chilled/hot water

7. Energy and refrigerant consumption due to chilled/hot water production (list all fuel, refrigerant and energy types for past calendar year, specify measurement unit as appropriate, add lines as necessary)

a) ______m^3/ t of fossil fuel type ______________

b) _______MWh of electricity

c) _______t of refrigerant type _____________

In case of using geothermal heat sources, please provide

d) _______t methane emitted

8. Energy losses due to chilled/hot water distribution ___ %

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Document information

Version	*Date*	*Description*
02.0	21 February 2014	EB 77, Annex 7 Revision to: • Change the title from “Energy efficiency and fuel switching in new buildings” to “Energy efficiency and fuel switching in new and existing buildings”; • Expand the scope and applicability to cover retrofitting existing buildings; • Introduce approaches for additionality demonstration for project activities dealing with new construction and retrofitting existing buildings; • Reduce data intensity and simplify calculations in the existing approach for estimating emission reductions from new construction; • Provide an alternative approach for estimating emission reductions from new construction with the use of whole building computerized simulation tool; • Provide an approach for estimating emission reductions from retrofitting existing buildings with the use of whole building computerized simulation tool; • Introduce editorial changes.
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