CLEAN DEVELOPMENT MECHANISM

CDM-EB103-A04

Large-scale methodology

AM0117: Introduction of a new district cooling system

Version 02.0

Sectoral scope(s): 01

United Nations
Framework Convention on
Climate Change

TABLE OF CONTENTS **Page**

1. Introduction

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

Table 1. Methodology key elements

Typical projects	Introduction of a district cooling system supplying coolant from a new cooling plant(s). It replaces baseline cooling technologies.
Type of GHG emissions mitigation action	Energy efficiency: Reduction of energy consumption by utilization of more efficient centralized cooling technologies.

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology applies to project activities that provide district cooling to residential and commercial consumers through a dedicated cooling distribution network.

2.2. Applicability

3. The methodology is applicable to project activities that reduce CO_2 emissions by means of one, or a combination, of the following measures:

   (a) Introduction of new district cooling system(s) that supply cooling to residential and commercial consumers through a new dedicated distribution network;

   (b) Introduction of new district cooling system(s) that supply cooling to residential and commercial consumers through an existing dedicated distribution network;

   (c) Expansion of the existing district cooling system(s) by adding a new district cooling plant(s) with or without expanding a dedicated distribution network.

4. Emission reductions that are gained due to the switch of the energy sources shall not be claimed by applying this methodology alone. Therefore, emission reductions due to displacement of the baseline power source can be claimed by the means of the application of this methodology in combination with another relevant approved methodology. In doing so, interactive effects shall be considered as per the "Guidelines for the consideration of interactive effects for the application of multiple CDM methodologies for a programme of activities". For example, if the project district cooling plant is powered partially or completely by a dedicated renewable energy power plant, a project proponent may wish to consider small scale methodology 'AMS-I.F: Renewable electricity generation for captive use and mini-grid' to account for emission reductions due to shift of the power source. Otherwise, the most conservative electricity emission factor should be applied to determine emission reductions.

2.3. Entry into force

5. The date of entry into force of the methodology is the date of the publication of the EB 103 meeting report on 14 June 2019.

2.4. Applicability of sectoral scopes

6. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology application of sectoral scope 01 is mandatory.

3. Normative references

7. This methodology is based on the proposed new methodology "CDM-NM0373: Introduction of a new district cooling system" prepared by Emirates Central Cooling Systems Corporation and Dubai Carbon Centre of Excellence and is based on elements from the following approved baseline and monitoring methodologies:

   (a) AM0058 "Introduction of a new primary district heating system" version 03.1.

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

   (a) "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation";

   (b) "TOOL07: Tool to calculate the emission factor for an electricity system";

   (c) "TOOL11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period";

   (d) Standard: Sampling and surveys for CDM project activities and programmes of activities;

   (e) "TOOL03: Tool to calculate project or leakage CO2 emissions from fossil fuel combustion";

   (f) "Guidelines for the consideration of interactive effects for the application of multiple CDM methodologies for a programme of activities";

   (g) "TOOL01: Tool for the demonstration and assessment of additionality";

   (h) "TOOL23: Additionality of first-of-its-kind project activities".

9. For more information regarding the proposed new methodologies and the tools as well as their consideration by the Executive Board please refer to <http://cdm.unfccc.int/goto/MPappmeth>.

4. Definitions

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

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

   (a) **Building** - individual construction that is either a residential or commercial consumer of district cooling;

(b) **Existing buildings** (sub-area) - buildings within the project boundary that were connected to a baseline cooling technology before the start of the project activity and are supplied district cooling by the project activity;

(c) **New buildings** (sub-area) - buildings within the project boundary that are constructed after the implementation of the project activity and are supplied district cooling by the project activity;

(d) **Baseline cooling technology** - cooling technologies that are designed to provide coolant to a building or a part of the building (e.g. apartment) and are identified to be utilized in the baseline;

(e) **Coolant** - a fluid that draws off heat by circulating through a cooling system;

(f) **District cooling system** - a system for distributing centrally generated coolant (e.g. cooled water) to existing and/or new buildings. A district cooling system supplies coolant to an area of several buildings, i.e. a neighbourhood or a city. It includes the district cooling plants and cooling distribution network;

(g) **Gross floor area (GFA)** - area of a building unit including internal walls and partitions. 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.

5. Baseline methodology

5.1. Project boundary

12. The spatial extent of the project boundary includes:

(a) The district cooling system, including district cooling plant(s) pipes, sub-stations and buildings, existing and new, that are or will be connected to the district cooling system;

(b) The captive power plant/unit and/or all power plants/units connected physically to the electricity system[1] that the CDM project activity is connected to.

13. The emission sources included in the project boundary are described in Table 2 below.

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

Source		Gas	Included	Justification/Explanation
Baseline	Electricity and/or thermal energy consumed by baseline cooling technologies	CO_2	Yes	Main source of emissions
		CH_4	No	Excluded for simplification, this is conservative

[1] Refer to the latest approved version of the "TOOL07: Tool to calculate the emission factor for an electricity system" for definition of an electricity system.

Source		Gas	Included	Justification/Explanation
		N_2O	No	Excluded for simplification, this is conservative
Project activity	Electricity and/or thermal energy consumed by the district cooling system	CO_2	Yes	Main source of emissions
		CH_4	No	Excluded for simplification
		N_2O	No	Excluded for simplification

5.2. Procedure for the selection of the most plausible baseline scenario and demonstration of additionality

14. The methodology assumes that the baseline scenario is the continuation of the cooling energy production by the baseline cooling technologies.

15. District cooling projects implemented in least developed countries (LDCs) are deemed to be automatically additional.

16. If district cooling projects are implemented in non-LDCs and face the first-if-its-kind barrier, the latest approved version of the "Additionality of first-of-its-kind project activities" shall be followed to demonstrate the additionality of these project activities.

17. For district cooling projects, which are implemented in non-LDCs and which are not the first-of-its-kind, the procedure described below shall be applied.

5.2.1. Step 1: Penetration and performance assessment

18. This step aims to determine whether the proposed project activity is common practice in the city where the proposed CDM project activity is intended to be implemented.

19. The project activity is deemed to be additional if:

    (a) The seasonal energy efficiency ratio (SEER) of the district cooling plant involved in the project activity (determined as per section 5.2.3.2) is higher than a benchmark SEER (determined as per section 5.2.3.3); and

    (b) The share of the district cooling technologies at the moment of the project registration is less than 20 per cent of all cooling technologies within the benchmark boundary in terms of cooling output. The share of technologies can be derived from official country reports, third party surveys and/or credible international sources (e.g. International Energy Agency).

20. If any of two conditions above is not met, the project proponent should proceed to Step 2.

5.2.2. Step 2: Investment analysis

21. The aim of this analysis is to determine whether the proposed project activity is not economically or financially feasible using "Option III: Benchmark analysis", including the sensitivity analysis, provided in the "TOOL01: Tool for the demonstration and assessment of additionality".

22. The investment analysis should be undertaken from the perspective of the operator/investor of the district cooling system, reflecting the costs and revenues from the perspective of the operator/investor. If the project is subsidized through public authorities

and institutions (e.g. local or central government, international donor organizations), for example through grants which do not need to be repaid, soft loans or contributions to operating and maintenance costs, or deficit guarantees, the financial assessment is made, taking into account these subsidies, including as investment the total system costs minus any such public subsidies. Any capital that needs to be repaid should be included in the calculations, for example loans by the municipality or city authority should be considered as a capital investment by the project operator and not be subtracted from the total system costs.

23. In applying the investment analysis, the investment analysis may consider cost overruns of former investments in district cooling systems or reduced revenues of former district cooling systems investments compared to original projections, which make new investments less viable and riskier. In this case, project participants should evaluate the cost overruns or reduced revenues of former district cooling systems that were implemented in the same host country in the past. Information on originally projected and actually observed costs/revenues should be based on official and public data. As a conservative approach, the lower end of the range of cost-overruns or reduced revenues observed over this period should be assumed for the project system.

24. If the sensitivity analysis is not conclusive, then the project activity is not additional. If the sensitivity analysis confirms the proposed project activity is not economically attractive, then the proposed project activity is additional.

5.2.3. Benchmark determination procedure

25. The benchmark value serves for two purposes: (a) additionality demonstration and (b) baseline emissions determination.

5.2.3.1. Benchmark boundary

26. By default, a benchmark boundary is a city where the project activity is located. In addition to the cooling installation ~~that~~ to be replaced by the project activity, the benchmark boundary shall cover the cooling installations that would continue providing cooling after the project implementation. The cooling output of the cooling installations that would continue providing cooling after the project implementation shall be at least equal to the cooling output of the project activity. To meet this requirement, the benchmark boundary can be expanded to another city with the similar climatic conditions. For example, in case the project activity is to supply coolant to a greenfield settlement, where no existing cooling installation could be identified, the expansion of the boundary is deemed required. The expansion of the benchmark boundary shall be justified in the CDM-PDD and validated. New buildings shall be included in the benchmark determination. For this purpose, new buildings are assumed to be existent before the start of the project and use the best available technology (BAT) in a host country.

5.2.3.2. Data vintage and data source

27. Benchmark SEER shall be determined using SEERs values and cooling output of the installations used within the benchmark boundary.

28. In case of the existing buildings, actual data on SEER and cooling output shall be collected. Where the sampling is used to collect data, the latest version of the ‘Standard: Sampling and surveys for CDM project activities and programmes of activities’ shall be

applied. While collecting data through the sampling, existing cooling installations shall be grouped based on technology, capacity and the function of the building.

29. The values of SEER for the existing installations included in the benchmark boundary shall be determined using any of the three options below. Options are ranked in terms of preference. SEER for the greenfield buildings included in the benchmark boundary shall be determined using only option 2.

Option 1: Directly from manufacturer of the baseline cooling technology;

Option 2: SEER of the (BAT) in a host country for a building with the same function (e.g. office, apartments) and similar GFA, i.e. in the range from 50 per cent to 150 per cent of the baseline building GFA.

Option 3: Calculated based on cooling output ~~energy~~ and energy input. If the cooling output of baseline technology *i* ($OPC_{B,i}$) and the thermal energy input of baseline technology *i* ($IPT_{B,i}$) are provided in GJ, apply equation 1; if provided in MWh, apply equation 2:

$$SEER_{B,i} = \frac{OPC_{B,i}}{\left(IPE_{B,i} \times 3.6 \text{~~0.000278~~} + IPT_{B,i}\right)}$$ Equation (1)

Where:

$SEER_{B,i}$ = Seasonal Energy Efficiency Ratio of the baseline cooling technology *i*, defined as energy output divided by energy input (GJ/GJ). If different units are used for the $SEER_{B,i}$ (e.g. BTU/Wh instead of GJ/GJ), ~~the~~ appropriate conversion factors shall be applied.

$OPC_{B,i}$ = ~~Output cooling energy~~ Cooling output of baseline technology *i* (~~kJ~~GJ)

$IPE_{B,i}$ = ~~Input e~~Electrical energy input of baseline technology *i* (M~~k~~Wh)

$IPT_{B,i}$ = ~~Input t~~Thermal energy input of baseline technology *i* (~~kJ~~GJ)

$$SEER_{B,i} = \frac{OPC_{B,i}}{\left(IPE_{B,i} + IPT_{B,i}\right)}$$ Equation (2)

Where:

$SEER_{B,i}$ = Seasonal Energy Efficiency Ratio of the baseline cooling technology *i*, defined as energy output divided by energy input (MWh/MWh). If different units are used for the $SEER_{B,i}$ (e.g. BTU/Wh instead of MWh/MWh), appropriate conversion factors shall be applied.

$OPC_{B,i}$ = Cooling output of baseline technology *i* (MWh)

$IPE_{B,i}$ = Electrical energy input of baseline technology *i* (MWh)

$IPT_{B,i}$ = Thermal energy input of baseline technology *i* (MWh)

30. The parameter $IPT_{iB,i}$ is to account for thermal energy input in an absorption-based baseline technology and is determined based in one of the following approaches:

(a) Applying equation 3 below if $IPT_{B,i}$ is in GJ~~and shall be determined as follows:~~

$$IPT_{B,i} = FF_{B,i} \times NCV_{B,i} \times \frac{10}{6} \times 0.2778$$

Equation (3)

Where:

$IPT_{B,i}$	=	~~Input t~~Thermal energy input of baseline technology i (~~MWhk~~JGJ)
$FF_{B,i}$	=	Fossil fuel consumption used in the baseline technology i (~~mass unit~~mass or volume unit)
$NCV_{B,i}$	=	Net calorific value of the fossil fuel used in the baseline technology i (GJ/mass or volume unit ~~per mass unit~~)

(b) Applying equation 4 below if $IPT_{B,i}$ is in MWh

$$IPT_{B,i} = FF_{B,i} \times NCV_{B,i} \times 0.2778$$

Equation (4)

Where:

$IPT_{B,i}$	=	Thermal energy input of baseline technology i (MWh)
$FF_{B,i}$	=	Fossil fuel consumption used in the baseline technology *i* (mass or volume unit)
$NCV_{B,i}$	=	Net calorific value of the fossil fuel used in the baseline technology i (GJ/mass or volume unit)

31. When determining the parameter $IPT_{iB,i}$ for an installation where more than one type of the fossil fuel used in the baseline technology, the least carbon intensive type shall be used. In case renewable energy (e.g. solar) is used or waste energy is used, ~~$SEEB_{ib}$~~$SEER_{B,i}$ is considered as one.

32. In case a baseline technology is electricity driven (e.g. water cooled electric driven centrifugal chillers), $IPT_{iB,i}$ becomes zero.

33. Data for the most recent three years should be used to determine the values of SEER for the existing installations included in the benchmark boundary.

34. The values of cooling output for the existing installations included in the benchmark boundary shall be determined as a sum of cooling output provided over the most recent

three years. For the installation with less than three years of historical data~~y~~, all available data shall be used.

5.2.3.3. Benchmark determination

35. The following steps apply:

(a) Rank all installations included in the benchmark boundary in order of decreasing SEER;

(b) Plot the SEER values (y axis) as a function of the cumulative cooling output (x-axis);

(c) Identify the benchmark installation that corresponds to at least 80 per cent of the cumulative cooling output;

(d) Match the value of the benchmark SEER that corresponds to at least 80 per cent of the cumulative cooling output determined in step (c) above.

5.2.3.4. Validity of the benchmark

36. The first benchmark value shall be identified before the start of the validation process for the purpose of additionality demonstration and ex-ante emission reduction calculations. The benchmark value for baseline emissions estimation is valid for three years.

5.3. Baseline emissions

37. Baseline emissions are estimated using one of the two approaches below. The choice of the approach is dictated by the technology used by the benchmark installation.

(a) **Approach 1**. The benchmark installation is using electricity driven technology. Baseline emissions (BE_y) shall be determined by applying equation 2 of the methodological tool "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation". When applying the tool, parameter $Q_{B,y}$ shall correspond to parameter $EC_{BL,k,y}$, whereas parameter BE_y to parameter $BE_{EC,y}$. The quantity of energy consumed by baseline cooling technologies is determined by equation 7~~4~~ below, and therefore requirements for $EC_{BL,k,y}$ from the tool shall not apply.

(b) **Approach 2**. The benchmark installation is using absorption technology. Baseline emissions shall be determined based on equation 5 below if $Q_{B,y}$ is in MWh, or based on equation 6 if $Q_{B,y}$ is in GJ. ~~as follows:~~

$$BE_y = Q_{B,y} \frac{Q_{B,y}}{3600} \times EF_{BFF,y} \times 3.6 \qquad \text{Equation (5)}$$

Where:

BE_y = Baseline emissions in year *y* (tCO_2e)

$Q_{B,y}$ = ~~Quantity of e~~Energy consumed in baseline by baseline cooling technologies in year *y* (MWh~~/yr~~)

$EF_{EL,y}$ = ~~CO_2 emission factor for electricity source used in baseline (tCO_2e/MWh)~~

$EF_{BFF,y}$ = CO_2 emission factor of the least carbon intensive energy source used in the absorption baseline technology (tCO_2e/GJ)

$$BE_y = Q_{B,y} \times EF_{B,y}$$ Equation (6)

Where:

BE_y = Baseline emissions in year *y* (tCO_2e)

$Q_{B,y}$ = Energy consumed in baseline by baseline cooling technologies in year *y* (GJ)

$EF_{B,y}$ = CO_2 emission factor of the least carbon intensive energy source used in the absorption baseline technology (tCO_2e/GJ)

38. The quantity of energy consumption of baseline cooling technologies is determined as follows:

(a) Based on equation 7 below if $OPC_{r,y}$ is in MWh and $SEER_{B,i}$ is in MWh/MWh

$$Q_{B,y} = \sum_r \frac{OPC_{r,y}}{SEER_{B,i}} \text{ ~~} C_{P,r,y} \times SEER_B \text{~~}$$ Equation (7)

Where:

$Q_{B,y}$ = ~~Quantity of e~~Energy consumed in baseline by baseline cooling technologies in year *y* (MWh~~/yr~~)

$OPC_{P,r,y}$ = Cooling output of new district cooling plant *r* in year *y* (MWh~~/yr~~)

$SEER_{B,i}$ = ~~The b~~Benchmark Seasonal Energy Efficiency Ratio of the baseline cooling technology *i*, defined as energy output divided by energy input (MWh/MWh)

(b) Based on equation 8 below if $OPC_{r,y}$ is in GJ and $SEER_{B,i}$ is in GJ/GJ

$$Q_{B,y} = \sum_r \frac{OPC_{r,y}}{SEER_{B,i}}$$ Equation (8)

Where:

$Q_{B,y}$ = Energy consumed in baseline by baseline cooling technologies in year *y* (GJ)

$OPC_{r,y}$ = Cooling output of new district cooling plant *r* in year *y* (GJ)

$SEER_{B,i}$	=	Benchmark Seasonal Energy Efficiency Ratio of the baseline cooling technology *i*, defined as energy output divided by energy input (GJ/GJ)

39. The cooling output of the new district cooling plant can be obtained as follows:

Option 1: Direct measurement of the cooling energy (e.g. MWh or GJ), or

Option 2: Calculated based on measurements of temperature differences, flow rate of chilled water and system operating hours per year:

(a) If $OPC_{r,y}$ is determined in MWh, equation 9 below shall be applied

$$OPC_{\boldsymbol{P}r,y} = c_P \times F_{\boldsymbol{P},r,y} \times \Delta T_{r,y} \times h_{r,y} \times \text{~~3.6~~}2.77 \times 10^{\boldsymbol{-10}} \quad \text{Equation (9)}$$

Where:

$OPC_{r,y}$	=	Cooling output of new district cooling plant *r* in year *y* (MWh)
$F_{\boldsymbol{P},r,y}$	=	Average mass flow rate (integrated over the year) of new district cooling plant *r* in year *y* (g/hour)
$\Delta T_{r,y}$	=	Temperature difference between supply and return of chilled water from/to new district cooling plant *r* in year *y* (°C)
$h_{r,y}$	=	Number of the operating hours of the new district cooling plant r in year *y* (hours)
c_P	=	Specific heat capacity of coolant (J/g.°C)

(b) If $OPC_{r,y}$ is determined in GJ, equation 10 below shall be applied

$$OPC_{r,y} = c_P \times F_{P,r,y} \times \Delta T_{r,y} \times h_{r,y} \times 10^{-9} \quad \text{Equation (10)}$$

Where:

$OPC_{r,y}$	=	Cooling output of new district cooling plant *r* in year *y* (GJ)
$F_{P,r,y}$	=	Average mass flow rate (integrated over the year) of new district cooling plant *r* in year *y* (g/hour)
$\Delta T_{r,y}$	=	Temperature difference between supply and return of chilled water from/to new district cooling plant *r* in year *y* (°C)
$h_{r,y}$	=	Number of the operating hours of the new district cooling plant r in year *y* (hours)
c_P	=	Specific heat capacity of coolant (J/g.°C)

5.4. Project emissions

40. Project emissions (PE_y) include emissions from energy consumption associated with the generation of cooling output in the new district cooling plant(s).

$$PE_y = PE_{EC,y} + PE_{FC,j,y}$$ Equation (11)

Where:

PE_y	=	Project emissions in year *y* (tCO_2e/yr)
$PE_{EC,y}$	=	Emissions from electricity consumption associated with the generation of cooling output in the new district cooling plant(s) (tCO_2e/yr)
$PE_{FC,j,y}$	=	CO_2 emissions from fossil fuel combustion associated with the generation of cooling output in the new district cooling plant(s) (tCO_2e/yr)

41. The project emissions from consumption of electricity by the project activity ($PE_{EC,y}$) shall be calculated using the "TOOL05: Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

42. The project emissions from fossil fuel combustion by the project activity ($PE_{FC,j,y}$) shall be calculated using the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

5.5. Leakage emissions

43. Leakage emissions are calculated as follows:

$$LE_y = LE_{Ref,y} + LE_{Ref,sc} + LE_{water}$$ Equation (12)

Where:

LE_y	=	Leakage emissions in year *y* (tCO_2e/yr)
$LE_{Ref,y}$	=	Refrigerant leakage emissions from the project in year *y* (tCO_2e)
$LE_{Ref,sc}$	=	Refrigerant leakage emissions from the baseline cooling equipment that is scrapped as a result of the project activity (only accounted in the first year of the crediting period) (tCO_2e)
$LE_{water,y}$	=	Emissions due to the freshwater usage in the project system in year *y* (tCO_2e)

44. Emissions due to the refrigerants leakage during the project activity is calculated as:

$$LE_{Ref,y} = \sum_k R_{k,y} \times GWP_k$$ Equation (13)

Where:

$LE_{Ref,y}$	=	Refrigerant leakage emissions from the project in year *y* (tCO_2)
$R_{k,y}$	=	Quantity of refrigerant k filled in the district cooling system year *y* (tonnes)

GWP_k = Global Warming Potential of the refrigerant k

45. Emissions due to the refrigerant leakage from the baseline cooling equipment that is scrapped as a result of the project activity[2] are calculated (only for the first year of the crediting period) as below:

$$LE_{Ref,SC} = \sum_z R_z \times GWP_z \quad \text{Equation (14)}$$

Where:

$LE_{Ref,SC}$ = Refrigerant leakage emissions from the baseline individual cooling equipment that is scrapped as a result of the project activity (tCO_2e)

R_z = Quantity of refrigerant z leaked from the baseline individual cooling equipment that is scrapped as a result of the project activity (t~~onnes~~)

GWP_z = Global Warming Potential of the refrigerant z

46. Emissions due to use of freshwater shall be considered in sites where freshwater is produced through the desalination. As emissions associated with the production of make-up water are considered negligible, this source of leakage shall be considered once, i.e. at the first monitoring and calculated as below:

$$LE_{water} = Q_{water} \times EF_{water} \quad \text{Equation (15)}$$

Where:

LE_{water} = Emissions due to the freshwater usage in the project system (tCO_2e)

Q_{water} = Maximum designed quantity of freshwater to be used in the project system (t)

EF_{water} = Emission factor associated with the production of freshwater (tCO_2e/t)

47. In cases where the emission factor is not available directly from the supplier, but amount of energy used for freshwater production and total amount of freshwater supplied within the project boundary are known, the emission factor shall be calculated as per equation

[2] Emissions due to the possible refrigerant leakage from the baseline individual cooling equipment that is scrapped as a result of the project activity are accounted taking into consideration the decision taken by the Board at its 34th meeting, Paragraph 17 of the meeting report.

below. The data for the most recent year prior to the start of the project activity shall be used:

$$EF_{water} = \frac{\sum_l FC_l \times NCV_l \times EF_{CO2,l}}{WP}$$ Equation (16)

Where:

EF_{water}	=	Emission factor associated with the production of freshwater (tCO_2e/t)
FC_{i}	=	Amount of fuel type ~~i~~ l consumed to produce freshwater (~~mass~~ ~~unitt~~)
NCV_{i}	=	Net calorific value (energy content) of fuel type ~~i~~ l (GJ/~~mass unitt~~)
$EF_{CO2,i}$	=	CO_2 emission factor of fuel type l~~i~~ (tCO_2/GJ)
WP	=	Net amount of freshwater produced and supplied within the project boundary (t)
l~~i~~	=	All fuel types combusted for freshwater production

48. Where total net leakage effects are negative (LE_y), project participants should assume LE_y=0.

5.6. Emission reductions

$$ER_y = BE_y - PE_y - LE_y$$ Equation (17)

Where:

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

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

49. Consistent with guidance by the Board, project participants shall use the latest version of the "TOOL11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

5.8. Project activity under a programme of activities

5.9. Data and parameters not monitored

50. In addition to the data and parameters listed below, the guidance on "Data and parameters not monitored" in all tools to which this methodology refers applies.

Data / Parameter table 1.

Data / Parameter:	Building type
Data unit:	-
Description:	Categories grouped by type of buildings (new/existing). For each category, all connected buildings should be clearly identified.
Source of data:	Maps or schematic plan diagrams of the district cooling system and the area where project is implemented obtained from the district cooling company
Value to be applied:	-
Any comment:	Shall be stored in a database and checked during verification

Data / Parameter table 2.

Data / Parameter:	Baseline cooling technologies
Data unit:	-
Description:	Categories grouped by type of Baseline cooling technologies used in the absence of the project. The following needs to be clearly documented for each technology for the last 3 years. If the age of the building is less than 3 years, document the information from the start of the building's commissioning: Number of buildings in the project boundary supported by the technology Annual cooling output from the technology
Source of data:	
Value to be applied:	-
Any comment:	Shall be stored in a database and checked during verification

Data / Parameter table 3.

Data / Parameter:	$c_{P,r,y}$
Data unit:	J/g°C
Description:	Specific heat capacity of coolant
Source of data:	Coolant provider
Value to be applied:	-
Any comment:	

Data / Parameter table 4.

Data / Parameter:	EF_{water}
Data unit:	tCO_2e/t
Description:	Emission factor associated with the production of freshwater
Source of data:	Calculated based on Equation 16~~Freshwater producer~~
Value to be applied:	-
Any comment:	This requirement applies if the emission factor available directly from the freshwater producer

Data / Parameter table 5.

Data / Parameter:	FC_l
Data unit:	mass or volume unit
Description:	Amount of fuel type l~~i~~ consumed to produce freshwater
Source of data:	Information from freshwater producer or official statistics.~~Fresh water producer~~
Value to be applied:	-
Any comment:	This requirement applies if the emission factor associated with the production of freshwater is calculated by the project participant

Data / Parameter table 6.

Data / Parameter:	NCV_l
Data unit:	GJ/mass or volume unit
Description:	Net calorific value (energy content) of fuel type *i*
Source of data:	Information from freshwater producer or official statistics.~~Fresh water producer~~
Value to be applied:	-
Any comment:	This requirement applies if the emission factor associated with the production of freshwater is calculated by the project participant

Data / Parameter table ~~74.~~

Data / Parameter:	$EF_{CO2,l}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fuel type *l*
Source of data:	Information from freshwater producer or official statistics.~~Fresh water producer~~
Value to be applied:	-
Any comment:	This requirement applies if the emission factor associated with the production of freshwater is calculated by the project participant

Data / Parameter table ~~84.~~

Data / Parameter:	*WP*
Data unit:	t
Description:	Net amount of freshwater produced and supplied within the project boundary
Source of data:	Information from freshwater producer or official statistics.~~Fresh water producer~~
Value to be applied:	-
Any comment:	This requirement applies if the emission factor associated with the production of freshwater is calculated by the project participant

Data / Parameter table ~~7~~9.

Data / Parameter:	Q_{water}
Data unit:	t~~onne~~
Description:	Maximum designed quantity of freshwater to be used in the project system
Source of data:	District cooling plant design documentation
Value to be applied:	-
Any comment:	

6. Monitoring methodology

51. Describe and specify in the CDM-PDD all monitoring procedures, including the type of measurement instrumentation used, the responsibilities for monitoring and QA/QC procedures that will be applied. Where the methodology provides different options (e.g. use of default values or on-site measurements), specify which option will be used. All meters and instruments should be calibrated regularly as per industry practices.

52. 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 differently in the comments in the tables below.

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

6.1. Data and parameters monitored

Data / Parameter table ~~8~~10.

Data / Parameter:	$OPC_{~~P~~,r,y}$
Data unit:	MWh or GJ
Description:	Cooling output of new district cooling plant r in year *y*
Source of data:	~~Meter~~Calculated based on Equation (9)
Measurement procedures (if any):	~~Based on integrated measurements by project participants based on: (a) Differential temperature of supply and return chilled water, and Chilled water flow~~ Measurement procedures of parameters included in ~~from~~ Equation (9) as specified in this section (i.e. section 6.1)
Monitoring frequency:	Monitoring frequency of parameters included in Equation (9) as specified in this section (i.e. section 6.1) ~~Continuous~~
QA/QC procedures:	QA/QC procedures of parameters included in Equation (9) as specified in this section (i.e. section 6.1) ~~Meter should be subject to regular maintenance and calibrations in order to ensure measurements with low degree of uncertainty. Data is to be stored electronically~~
Any comment:	This parameter has to be monitored if the option 1 is chosen to determine the cooling output of the new district cooling plant

Data / Parameter table ~~9~~11.

Data / Parameter:	$F_{r,y}$

Data unit:	g/hour
Description:	Average mass flow rate (integrated over the year) of new district cooling plant r in year y
Source of data:	Flow-~~M~~meter
Measurement procedures (if any):	
Monitoring frequency:	Continuous
QA/QC procedures:	Meter should be subject to regular maintenance and calibrations in order to ensure measurements with low degree of uncertainty. Data is to be stored electronically
Any comment:	This parameter has to be monitored if the option 2 is chosen to determine the cooling output of the new district cooling plant

Data / Parameter table ~~10~~12.

Data / Parameter:	$\Delta T_{r,y}$
Data unit:	°C
Description:	Temperature difference between supply and return of chilled water from/to new district cooling plant r in year y
Source of data:	~~Meters~~Thermometers
Measurement procedures (if any):	
Monitoring frequency:	Continuous
QA/QC procedures:	Meter should be subject to regular maintenance and calibrations in accordance with the requirements of the CDM Project Standard Data is to be stored electronically
Any comment:	This parameter has to be monitored if the option 2 is chosen to determine the cooling output of the new district cooling plant

Data / Parameter table 13~~11~~.

Data / Parameter:	$h_{r,y}$
Data unit:	hours
Description:	Number of the operating hours of the new district cooling plant r in year y
Source of data:	Plant records
Measurement procedures (if any):	
Monitoring frequency:	Continuous
QA/QC procedures:	
Any comment:	This parameter has to be monitored if the option 2 is chosen to determine the cooling output of the new district cooling plant

~~**Data / Parameter table 12.**~~

~~Data / Parameter:~~	~~$F_{r,y}$~~
~~Data unit:~~	~~g/sec~~

~~Description:~~	~~Average flow rate (integrated over the year) of coolant new district cooling plant r in year y~~
~~Source of data:~~	~~Flow Meter~~
~~Measurement procedures (if any):~~	~~Yearly average~~
~~Monitoring frequency:~~	~~Continuous~~
~~QA/QC procedures:~~	~~Meters should be subject to regular maintenance and calibrations in order to ensure measurements with low degree of uncertainty. Data is to be stored electronically~~
~~Any comment:~~	

Data / Parameter table ~~13~~14.

Data / Parameter:	$SEER_{B,i}$
Data unit:	MWh/MWh or GJ/GJ
Description:	Benchmark Seasonal Energy Efficiency Ratio of the baseline cooling technology *i*
Source of data:	From manufacturers of the baseline cooling technology
Measurement procedures (if any):	-
Monitoring frequency:	Every 3 years
QA/QC procedures:	-
Any comment:	This requirement applies if option 1 or option 2 is chosen to determine the value of SEER for the existing installation. If option 3 is chosen, the value of $SEER_{B~~b~~,i~~t~~}$ shall be determined by applying ~~e~~Equation 1

Data / Parameter table 15~~14~~.

Data / Parameter:	$OPC_{iB,i}$
Data unit:	~~kJ~~MWh or GJ
Description:	Output cooling energy of baseline technology i
Source of data:	Meter
Measurement procedures (if any):	Based on direct measurements of: (a) Differential temperature of supply and return chilled water, and (b) Chilled water flow
Monitoring frequency:	Continuous
QA/QC procedures:	Meter should be subject to regular maintenance and calibrations in order to ensure measurements with low degree of uncertainty. Data is to be stored electronically
Any comment:	These requirements apply if option 3 is chosen to determine the value of SEER for the existing installation

Data / Parameter table 16~~15~~.

Data / Parameter:	$IPE_{iB,i}$
Data unit:	~~k~~MWh

Description:	Input electrical energy of the baseline technology i
Source of data:	Electricity Meter
Measurement procedures (if any):	-
Monitoring frequency:	Continuous
QA/QC procedures:	Meters should be subject to regular maintenance and calibrations in order to ensure measurements with low degree of uncertainty. Data is to be stored electronically
Any comment:	These requirements apply if option 3 is chosen to determine the value of SEER for the existing installation

Data / Parameter table 1716.

Data / Parameter:	$FF_{iB,i}$
Data unit:	mass or volume unit
Description:	Fossil fuel consumption used in the baseline technology i
Source of data:	~~Meter~~As per the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Measurement procedures (if any):	As per the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Monitoring frequency:	As per the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"~~Continuous~~
QA/QC procedures:	As per the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"~~Meters should be subject to regular maintenance and calibrations in order to ensure measurements with low degree of uncertainty.~~ ~~Data is to be stored electronically~~
Any comment:	As per the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". These requirements apply if option 3 is chosen to determine the value of SEER for the existing installation.

Data / Parameter table 1718.

Data / Parameter:	NCV_i
Data unit:	GJ/~~per~~ mass or volume unit
Description:	Net calorific value of the fossil fuel used in the baseline technology
Source of data:	As per the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". If the parameter is sourced from the 2006 IPCC Guidelines on National GHG Inventories, the lower limit of the uncertainty at a 95% confidence interval, as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy), shall be selected. ~~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 if the carbon fraction of the fuel is not provided (Option A) b) Measurements by the project participants — If a) is not available c) Regional or national default values — If a) and (b) are 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 a 95% 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), (b) and (c) are not available
Measurement procedures (if any):	As per the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency:	As per the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures:	As per the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"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:	As per the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". These requirements apply if option 3 is chosen to determine the value of SEER for the existing installation

Data / Parameter table 1819.

Data / Parameter:	$R_{k,y}$
Data unit:	tonnes
Description:	Quantity of refrigerant k used in the project in year *y*

Source of data:	Records from the plant operator
Measurement procedures (if any):	Metering will rely on the simple counting of cylinders
Monitoring frequency:	continuously
QA/QC procedures:	Crosschecked with purchase records. All meters and scales will be calibrated as per manufacturers' recommendations
Any comment:	-

Data / Parameter table 20~~19~~.

Data / Parameter:	R_z
Data unit:	t~~onnes~~
Description:	Quantity of refrigerant z leaked from the baseline individual cooling equipment that is scrapped as a result of the project activity
Source of data:	
Measurement procedures (if any):	-
Monitoring frequency:	Only for the first year of the crediting period
QA/QC procedures:	
Any comment:	The DOE should validate this data

Data / Parameter table ~~20~~21.

Data / Parameter:	$Q_{water,y}$
Data unit:	T~~onnes~~
Description:	Quantity of freshwater used in the project system in year *y*
Source of data:	Records from the plant operator
Measurement procedures (if any):	-
Monitoring frequency:	
QA/QC procedures:	-
Any comment:	-

Data / Parameter table ~~21~~22.

Data / Parameter:	GWP_k, GWP_z
Data unit:	-
Description:	Global Warming Potential of the refrigerant k and z
Source of data:	Records from the plant operator
Measurement procedures (if any):	Intergovernmental Panel of Climate Change (IPCC)'s latest reports or any other relevant scientific body's assessment
Monitoring frequency:	
QA/QC procedures:	-
Any comment:	Shall be updated according to any future COP/MOP decisions

Data / Parameter table ~~22~~23.

Data / Parameter:	$EF_{~~BFF~~,y}$
Data unit:	tCO_2e/GJ
Description:	CO_2 emission factor of the least carbon intensive energy source used in the absorption baseline technology
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 participants — If a) is not available c) Regional or national default values — If a) and (b) are 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 a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories — If a), (b) and (c) are not available
Measurement procedures (if any):	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency:	For a) and b): The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures:	-
Any comment:	

- - - - -

Document information

Version	*Date*	*Description*
02.0	14 June 2019	EB 103, Annex 4. Revision, done in response to request AM_REV_0259, to correct errors and inconsistencies in equations 1 to 5.
01.0	4 November 2016	EB 92, Annex 3. Initial adoption.

Decision Class: Regulatory
Document Type: Standard
Business Function: Methodology
Keywords: chiller, energy efficiency, residential consumer