CLEAN DEVELOPMENT MECHANISM

CDM-MP73-A01

Draft Methodological tool

TOOLXX: Calculation of baseline, project and leakage emissions from the use of refrigerants

Version 01.0

DRAFT

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The Executive Board of the clean development mechanism (CDM) (hereinafter referred to as the Board) at its eighty-fifth meeting requested the clean development mechanism (CDM) Methodologies Panel (MP) and the Small-Scale Working Group (SSC WG) to analyse the requirements in methodologies regarding consideration of baseline and/or project emissions from refrigerants used in refrigeration and air conditioning equipment and to propose any revisions, if necessary, while being compliant with all requirements stipulated in paragraph 17 of the EB 34 meeting report as shown in the extract below:

   (a) "The project boundary shall encompass all anthropogenic emissions by sources of greenhouse gases, as defined in article 1, paragraph 5 of the Convention but not included in Annex A of the Kyoto Protocol, under the control of the project participants that are significant and reasonably attributable to the CDM project activity;

   (b) The leakage emissions from greenhouse gases, as defined in article 1, paragraph 5 of the Convention but not included in Annex A of the Kyoto Protocol, should be accounted, if the CDM project activity results in an increase of such emissions;

   (c) The global warming potentials used to calculate the carbon dioxide equivalence of anthropogenic emissions by sources of greenhouse gasses not listed in Annex A shall be those accepted by the Intergovernmental Panel on Climate Change in its third[1] assessment report."

2. The Board also requested the secretariat to consider the outcomes of recently held, on-going and upcoming meetings of working groups of Parties to the Montreal Protocol as well as committees set up by them with the view to exploring opportunities to collaborate with the relevant bodies of the Montreal Protocol.

3. In response to the Board's request above, the MP70 and SSC WG51 jointly considered the analysis related to the requirements in methodologies regarding the baseline, project and leakage emissions from refrigerants used in refrigeration and air conditioning. The MP and SSC WG jointly agreed to develop a new tool with an aim to provide consistent procedures across the applicable CDM methodologies to calculate baseline, project and/or leakage emissions due to the use of refrigerants in CDM projects and PoAs involving refrigeration equipment such as air-conditioners and refrigerators.

4. The MP 72 and SSC WG 53 jointly agreed to launch the draft methodological tool for public input. No input was received.

[1] Note: All emission reductions and removals achieved by CDM project activities and PoAs in the second commitment period of the Kyoto Protocol shall be calculated using the global warming potentials (GWPs) adopted by the Conference of the Parties serving as the meeting of the Parties at its seventh session, in accordance with decision 4/CMP.7. This requirement applies from 1 January 2013 (EB 69, Annex 3).

2. Purpose

5. The methodological tool aims to streamline provisions across CDM methodologies to account emissions (BE, PE and LE) due to the use of refrigerants.

6. Further, to ensure consistency of approaches, the tool includes:

   (a) Guidance on the 'timing' for consideration of project emissions due to leakage of refrigerant charge in the project and baseline Refrigeration or Air Conditioning (RAC) equipment;

   (b) Clarifies which refrigerants are eligible;

   (c) Requirements related to destruction and/or recovery of refrigerants in the baseline equipment.

3. Key issues and proposed solutions

7. The approaches across CDM methodologies to account emissions (BE, PE, and LE) due to the use of refrigerants are diverse:

   (a) AM0060 considers project emissions due to i) refrigerant charge in the new chiller at its start of operation; ii) physical leakage; and iii) quantity of refrigerant used by existing baseline chiller before implementation of project activity and iv) leakage due to production of HFC-23 during manufacturing of HCFC-22;

   (b) AM0070 and AM0071 consider the manufacturing and servicing of domestic refrigeration appliances. Under AM0070 emission reductions cannot be claimed for reducing refrigerant emissions by switching from a refrigerant or a foam blowing agent with a higher GWP to a substance with a lower GWP;

   (c) AMS-II.K, while uses a similar approach like in AM0060, further adds conservativeness (for simplification) by assuming emissions due to leakage of refrigerants in the baseline as zero. It also provides an option to consider 35% of the initial refrigerant charge (as default) that would leak every single year during the crediting period;

   (d) AMS-II.C and AMS-III.X considered emissions due to physical leakage of refrigerants and calculated using IPCC values (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);

   (e) All small-scale CDM methodologies require refrigerants in project equipment with "No" ODP and also require project refrigerants with "No GWP" or "Low/negligible GWP," except in the case of AMS-II.C and AMS-II.K (See Table 1, Appendix). AM0060 is silent on this aspect (i.e. regarding ODP and GWP);

   (f) AMS-II.H and II.K require that if the displaced refrigerant is a GHG defined in Annex A of the Kyoto Protocol or paragraph 5 of the Convention and is not destroyed, then leakage emission from its storage or usage shall be accounted for. AM0060 on the other hand does not account emissions due to leakage in existing equipment that is displaced; it assumes that sale of refrigerants is likely to offset refrigerants newly manufactured. Therefore, its effects are assumed to be neutral.

8. As discussed above, methodologies AM0060 (Chiller), and AMS-II.K (Co/tri-gen) assume that all refrigerants would leak during the crediting period and therefore accounted under PE. Moreover, the initial charge of refrigerant (before starting the operation of the new Chiller) is accounted in the first year of the first crediting period which may potentially lead to negative emission reductions in the first year creating impediments for project implementation in the area as actual emissions may occur over a much longer period of time.

9. There are 6 projects (3 PAs and 3 PoAs) currently in the pipeline using AMS-II.K, which has provisions similar to that of AM0060. No negative emissions reductions in the first year of the first crediting period are identified. This is because baseline of AMS-II.K constitutes heat, electricity and cooling components and hence results into the high baseline to project emission ratio as compared to projects potentially covered under AM0060.

10. There are 2 PoAs in the pipeline involving replacement of Chillers applying AMS-II.C. These projects could also potentially qualify under AM0060. There is no negative emissions reductions outcome in the first year of the first crediting period. In AMS-II.C, the initial charge of refrigerant (before starting the operation of the new Chiller) is not accounted in the first year of the first crediting period while emissions due to physical leakage of refrigerants are calculated using IPCC default values. AMS-II.C accounts only project refrigerant emissions that are incremental to baseline emissions, i.e. emission reductions cannot be accrued for switching from high GWP to low GWP refrigerants while emissions will be accounted if switching from low to high GWP refrigerants.

11. CDM project pipeline shows only one project (registered in 2008) using ODP refrigerant (HCFC-123) in project equipment. Other projects used HFC-134a (significant GWP, no/negligible ODP), R600 (HC- no GWP, no ODP) and Li Br (no GWP, no ODP) as project refrigerants.

12. In the case of accounting leakage emissions (occurring outside the project boundary), AM0060 requires that if HCFC-22 is used as refrigerant under the project activity and/or in the baseline, then HFC-23 emissions occurring as a by-product from the production of HCFC-22 shall be accounted as leakage emissions. It is noted that Kigali amendments to Montreal Protocol, once ratified, will require all producers of HCFC-22 to burn HFC-23 by product and therefore accounting such emissions under the CDM will be redundant.

13. Considering the issues identified above, the methodological tool is developed to provide consistent procedures among the CDM methodologies to calculate baseline, project and/or leakage emissions due to the use of refrigerants gases.

4. Impacts

14. This methodological tool, if approved by the Board, will harmonize the approach across CDM methodologies for accounting of emissions due to use of refrigerants.

5. Subsequent work and timelines

15. The draft methodological tool is recommended by the MP for consideration by the Board at its ninety-sixth meeting. If this draft tool is approved by the Board, the existing methodologies for demand side refrigerators and air-conditioners/chillers discussed above would need revisions to replace the current provisions, as applicable, by referring to this tool to account emissions due to use of refrigerants.

6. Recommendations to the Board

16. The MP and SSC WG jointly recommends the Board adopt this final draft methodological tool, to be made effective at the time of the Board's approval.

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1. Introduction

1. The methodological tool provides procedures to consider emissions due to the use of refrigerants in clean development mechanism (CDM) projects and PoAs involving refrigeration and air-conditioning systems (RAC).

2. Scope, applicability, and entry into force

2.1. Scope and applicability

2. This tool provides methods to estimate the baseline, project and leakage emissions associated with the use of refrigerant gases in refrigeration and air-conditioning systems. The methods build on experience gained with the provisions in CDM methodologies and are consistent with the guidance from the Board as summarised below (EB 34, paragraph 17).

3. The emissions from refrigerant gases not included in Annex A of the Kyoto Protocol, but defined in article 1 of the United Nations Framework Convention on Climate Change (the Convention) (e.g. HCFCs) shall be accounted and deducted from emission reduction calculations, if the CDM project activity results in an increase of such emissions. However, if the CDM project activity results in a decrease of such emissions as compared to the baseline, it shall not be accounted as emission reductions. This is because emission reductions due to avoided emissions from refrigerants which are not KP gases (e.g. HCFC), are ineligible under CDM. However, avoided emissions of refrigerant gases under the Kyoto Protocol (i.e. HFCs under the baseline)[1] due to the introduction of lower global warming potential (GWP) refrigerants[2] in appliances and the introduction of appliances with low leakages (either because the charge is smaller or the leak rate is lower) are eligible.

4. This tool is not applicable to quantify greenhouse gas (GHG) emission reductions associated with recycling and recovery of refrigerants.

5. The tool shall be applied in conjunction with the relevant CDM methodologies in which this tool is referred for the purpose of calculating baseline/project/leakage emissions.

2.2. Entry into force

6. The date of entry into force is the date of the publication of the EB 96 meeting report on 22 September 2017.

3. Definitions

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

[1] HFC-134a refrigerant in refrigerators and R410a, HFC-134a and HFC-32 in air conditioners.

[2] Hydrocarbons and Hydrofluorolefins have GWP values smaller by a factor ~100 compared to HFCs.

8. For the purpose of this tool, the following definitions shall apply:

(a) **Refrigerant** - chemicals circulating in a thermodynamic process in refrigeration or air conditioning equipment. An average air conditioner contains about one litre (>1 kg) of refrigerant and an average refrigerator contains about 0.1 litre (>100 g)[3].

(b) **Charge volume** - the amount of refrigerant filled in an appliance during manufacturing. Smaller units can be hermetically sealed (with optimized brazing technology and automatic leak detection by the manufacturer), while larger units and air conditioners need to be refilled with refrigerants periodically, up to 30% of initial charge per year.

4. Procedure to calculate baseline emissions

9. Baseline emissions[4] from physical leakage of refrigerants are calculated as follows:

$$BE_y = Q_{ref,BL} \times GWP_{ref,BL} \qquad \text{Equation (1)}$$

Where:

BE_y	=	Baseline emissions from physical leakage of refrigerant from the baseline equipment in year *y* (tCO2e/y)
$Q_{ref,BL}$	=	Average annual quantity of refrigerant used in the baseline to replace the refrigerant that has leaked, as per data/parameter Table 1 (tonnes/year).
$GWP_{ref,BL}$	=	Global Warming Potential valid for the commitment period of the baseline refrigerant (tCO2e/t refrigerant)

5. Procedure to calculate project emissions

10. Project emissions[5] from physical leakage of refrigerants are calculated as follows:

$$PE_y = Q_{ref,PJ,y} \times GWP_{ref,PJ} \qquad \text{Equation (2)}$$

Where:

PE_y	=	Project emissions from physical leakage of refrigerant from the project equipment in year *y* (tCO2e/y)

[3] Refrigerants leak slowly out of the appliance therefore it needs to be refilled periodically. Air conditioners need this maintenance every one or two years, while refrigerators leak very little that they do not need frequent refilling

[4] All GHGs as defined per Article 1, paragraph 5, the Convention should be considered only in case the baseline as well as the project uses non-KP refrigerant gases. This is for the purpose of accounting because if the CDM project activity results in an increase of emissions in the project as compared to baseline, it shall be deducted from the emission reduction calculation.

[5] See footnote 4

$Q_{ref,PJ,y}$ = Average annual quantity of refrigerant used in year *y* to replace refrigerant that has leaked in the same year determined as per data/parameter Table 3 (tonnes/year).

$GWP_{ref,PJ}$ = Global Warming Potential valid for the commitment period of the refrigerant that is used in the project equipment (t CO2e/t refrigerant)

5.1. Leakage refrigerant emissions

11. The leakage emissions from energy used in production of refrigerants are ignored, as they occur both in the baseline and the project activity and are expected to be of the same order of magnitude.

12. In case the displaced refrigerant as defined in Annex A of the Kyoto Protocol or in Article 1, paragraph 5 of the Convention is destroyed, no leakage emissions are accounted. Any displaced baseline refrigeration and air conditioning unit containing refrigerants with significant ODP and GWP shall be scrapped to ensure that it is not sold and reutilized. The destruction of the refrigerant contained therein should be undertaken in line with the "Code of Good Housekeeping" in the *Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer - 9th Edition*, UNEP Ozone Secretariat (2012).

13. In case the displaced refrigerant is a GHG as defined in Annex A of the Kyoto Protocol or in Article 1, paragraph 5 of the Convention and is not destroyed, leakage emission from its storage or usage in other equipment shall be considered and deducted from the emission reductions. The quantity of refrigerant that would leak shall be estimated based on the values specified in the Appendix (columns j, y and z). It is assumed that all the refrigerant charge in the project refrigerators is released to the atmosphere during the crediting period.

5.1.1. Data and parameters not monitored

Data / Parameter table 1.

Data / Parameter:	$Q_{ref,BL,}$
Data unit:	Tonnes/year
Description:	Average annual quantity of refrigerant used in the baseline to replace the refrigerant that has leaked
Source of data:	Baseline data of existing RAC unit
Measurement procedures (if any):	Use one of the following options (in preferential order): 1. Manufacturers data and/or as printed on appliance label and documented in technical specifications. 2. The historical specific leakage of the baseline equipment based on historical charging records from at least the three most recent years. Aggregated data at country or provincial level may also be used. For example, national reports submitted under the requirement of multilateral fund for the implementation of the

	Montreal Protocol as part of HCFC phase out management plan[6] (HPMP) together with the number of RAC equipment in the same region. IPCC guidelines (2006) chapter 7.5 guidance on combining Tier 1 and Tier 2 data on RAC maintenance may be applied. 3. Default Values as specified in the Appendix of this document
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	$GWP_{ref,BL}$; $GWP_{ref,PJ}$
Data unit:	t CO_2e/t refrigerant
Description:	Global Warming Potential, valid for the commitment period, of the refrigerant that is used in the RAC unit
Source of data:	IPCC
Measurement procedures (if any):	-
Any comment:	-

5.1.2. Data and parameters monitored

Data / Parameter table 3.

Data / Parameter:	$Q_{ref,PJ,y}$
Data unit:	Tonne/year
Description:	Average annual quantity of refrigerant used in year *y* to replace refrigerant that has leaked during the year
Source of data:	In order of preference: 1. Inventory data by the project participants of refrigerant cylinders consumed in year *y*. 2. Manufacturers data and/or as printed on appliance label and documented in technical specifications. 3. The value specified in the Appendix of this document
Measurement procedures (if any):	In case monitoring is applied, the inventory data should be based on inventory of refrigerant cylinders consumed in year *y*, e.g. the total annual amount of refrigerant ordered as indicated in purchase orders cross checked against invoices
Monitoring frequency:	Annually
QA/QC procedures:	Cross-check the quantities of refrigerants consumed with typical leakage rates of the RAC unit
Any comment:	-

[6] HPMPs have been approved by the Multilateral Fund for 143 countries and these HPMPs contain many activities in the „refrigeration serciving sector“, to improve maintenance and decrease refrigerant leakage. In the preparation of these HPMPs, surveys on the servicing sector are produced including estimates of the number or cylinders or volume of refrigerants used for maintenance. These allow accurate monitoring of actual maintenance practices and leakage emissions.

Appendix. Default parameters for Refrigeration/Air Conditioning Equipment

Table. Default parameters for Refrigeration/Air Conditioning Equipment

Type of Equipment	Charge Capacity[1] (kg) j	Installation Emission Factor k (% of capacity)	Operating Emissions x (% of capacity/yr)	Refrigerant Remaining at Disposal y (% of capacity)	Recovery Efficiency z (% of remaining)
Domestic Refrigeration	0.05 – 0.5	0.2	0.1	80	70
Stand-alone Commercial Applications	0.2 – 6	0.5	1	80	70
Medium & Large Commercial Refrigeration	50 – 2,000	0.5	10	100	70
Transport Refrigeration	3 – 8	0.2	15	50	70
Industrial Refrigeration including Food Processing and Cold Storage	10 – 10,000	0.5	7	100	90
Chillers	10 – 2,000	0.2	2	100	95
Residential and Commercial A/C including Heat Pumps	0.5 – 100	0.2	5	80	80
Mobile Air Conditioning	0.5 – 1.5	0.2	10	50	50

Source: Based on Chapter 7, Volume 3, Table 7.9: Emissions of Fluorinated Substitutes for Ozone Depleting Substances, 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

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[1] The project proponents shall choose the capacity based on the actual data from the baseline equipment. If such data is not available, use the minimum value from the capacity range

Document information

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01.0	28 July 2017	MP 73, Annex 1 To be considered by the Board at EB96. The draft version of this document (CDM-MP72-A04) was available for public input from 7 April to 5 May 2017. It received no inputs.

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