CLEAN DEVELOPMENT MECHANISM

TOOL28

Methodological tool

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

Version 01.0

United Nations
Framework Convention on
Climate Change

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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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