

T-VER-P-METH-15-01

Collection of Used Refrigerants for Reclamation and Utilization or Decomposition of Refrigerants

Version 01

**Scope: 11 - Fugitive emissions from production and consumption of
halocarbons and sulphur hexafluoride
Entry into force on 24 September 2025**

1. Methodology	Collection of Used Refrigerants for Reclamation and Utilization or Decomposition of Refrigerants
2. Project Type	Other
3. Scope	11 - Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride
4. Project Outline	This project aims to reduce greenhouse gas emissions by utilizing reclaimed refrigerants as an alternative to the release or incineration of used refrigerants
5. Applicability	Eligible project activities must fall under one of the following categories 1) Production and use of reclaimed refrigerants to replace the use of virgin refrigerants in cooling equipment such as air conditioning systems, refrigerators, water chillers, refrigerated vehicles, airconditioned public transport buses, and cold storage facilities, among others, in accordance with IPCC guidelines 2) Destruction by incineration of used refrigerants
6. Project Conditions	1) The used refrigerants under the project activities must be of the HFC type 2) The used refrigerants must undergo a reclamation process and be certified to meet the latest AHRI Standard 700, equivalent to virgin refrigerants, or other equivalent standards. 3) Used refrigerants sourced from industrial facilities licensed to operate as factories may only undergo reclamation activities. 4) Used refrigerants not originating from industrial facilities such as those from residential buildings, shopping malls, hospitals, etc. may undergo reclamation and/or destruction activities. 5) The project developer must provide evidence that the used refrigerants involved in the project activities originate solely from decommissioned refrigeration and air-conditioning systems or from maintenance of such systems. 6) The locations where refrigeration and air-conditioning systems are used and where used refrigerants are collected must be situated within Thailand.

	7) The facilities for refrigerant reclamation or destruction must be located within Thailand. 8) Reclaimed refrigerants must be used to replace virgin refrigerants (either for charging new products or for maintenance purposes), and the locations where reclaimed refrigerants are used must be situated within Thailand.
7. Project Starting Date	The date on which the project owner (employer) and the contractor jointly signed the construction or installation agreement for the greenhouse gas reduction project to be developed as a T-VER project
8. Definition	Industrial factory refers to a factory that has been granted permission to operate as an industrial facility, either by the Department of Industrial Works or the Industrial Estate Authority of Thailand HFC-type refrigerants refer to hydrofluorocarbon (HFC) refrigerants, which are composed of hydrogen, fluorine, and carbon, without chlorine. As a result, they do not deplete the ozone layer. Examples include HFC-134a and HFC-32 Cooling and Air Conditioning Systems refer to systems that extract heat from objects or air to reduce or maintain the desired temperature. Specifically, air conditioning systems are designed to lower and stabilize temperatures to create thermal comfort. Both cooling and air conditioning processes require the use of refrigerants as a medium to transfer heat from the interior to the exterior. Examples include air conditioners, refrigerators, water chillers, refrigerated trucks, air-conditioned public buses, and cold storage rooms Decommissioned refrigeration and air conditioning systems refer to systems that have reached the end of their functional lifespan or are no longer economically viable to repair, maintain, or continue using. These systems are permanently retired from service and are not reused. Proper evidence of disposal must be provided, demonstrating that the systems have been dismantled appropriately and that refrigerants have not been recovered for reuse Maintenance refers to the maintenance of refrigeration and air conditioning systems carried out by qualified technicians. This includes preventive maintenance, repairs, and performance assessments

	conducted while the equipment remains in operational condition. Related activities may involve inspection, fault diagnosis, component repair, cleaning, and testing. During such routine procedures, refrigerant releases may occur as part of normal operations.
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**Details of voluntary emission reductions program for
Collection of Used Refrigerants for Reclamation and Utilization
or Decomposition of Refrigerants**

1. Emission reductions activities used in the calculations

Table 1: Sources and Types of Greenhouse Gases

Greenhouse gas emission	Source	Greenhouse Gas	Details of activities that emit greenhouse gas emissions
Baseline Emission	Refrigerants sourced from industrial facilities	CO ₂	Destruction of refrigerants originating from industrial sources
	Refrigerants from non-industrial sources	HFC	Emission of pure refrigerants into the atmosphere during use
Project Emission	Electricity consumption	CO ₂	Procurement of electricity from the grid for use in remediation and conditioning processes
	Use of fossil fuels	CO ₂	Combustion of fossil fuels in remediation and conditioning processes
	Decomposition of used refrigerants	HFC	Residual refrigerants due to incomplete destruction
Leakage Emission	Decomposition of residual refrigerants from the project	HFC	Destruction of residual refrigerants from system conversion processes, which were sent for disposal at legally authorized facilities
	Transportation of refrigerants	CO ₂	Combustion of fossil fuels from transportation activities, including 1) Transport of used refrigerants to the project site 2) Transport of residual refrigerants from the project site to destruction facilities

2. Scope of Project

A project involving activities to reduce greenhouse gas emissions through the use of reclaimed refrigerants, which have undergone reconditioning and are reused as substitutes for virgin refrigerants in cooling equipment. The properties of the reclaimed refrigerants comply with AHRI Standard 700 or an equivalent standard. Alternatively, the project may involve the destruction of used refrigerants

The project boundary includes the collection of used refrigerants, the reconditioning process, the destruction of used refrigerants, as well as the distribution and utilization activities, all of which take place within Thailand. The refrigerants that are either reconditioned or destroyed are collected from two sources as follows

- 1) Non-industrial sources, such as residential buildings, shopping malls, hospitals, commercial buildings, small businesses, or any other entities not registered as industrial facilities
- 2) Industrial sources, including facilities that are officially licensed to operate as industrial factories or those located within industrial estates authorized by the Industrial Estate Authority of Thailand

3. Additionality

The project must undergo further proof of operation from normal operations. (Additionality) by using the "Proof of Operations Guidelines in addition to normal operations (Additionality) under the Thailand Voluntary Emission Reduction Program (T-VER)" standard equivalent to the international standards prescribed by the TGO.

4. Baseline Scenario

In accordance with the approach for establishing baseline data below Business as Usual (Below BAU), greenhouse gas emissions resulting from the use of refrigerants replaced by reclaimed refrigerants or from the destruction of refrigerants shall be considered in conjunction with the reduction targets for the production and consumption of refrigerants. Therefore, the project's baseline data refers to greenhouse gas emissions from the use of reclaimed refrigerants or from refrigerant destruction, combined with the reduction targets for the consumption and production of HFC-type refrigerants in Thailand under the Kigali Amendment to the Montreal Protocol, which sets a target to reduce the consumption and production of HFC refrigerants by 80% from the 2024 baseline by the year 2045

5. Baseline Emission

Baseline emissions are considered under two distinct cases 1) emissions resulting from the use of reclaimed refrigerants as substitutes for virgin refrigerants in refrigeration and air-conditioning systems originating from non-industrial sources and 2) emissions resulting from the incineration of used refrigerants sourced from industrial facilities. The details are as follows:

5.1 Baseline emissions from the use of reprocessed refrigerants that replace virgin refrigerants in refrigeration and air conditioning systems originating from non-industrial sources

Baseline emissions from the use of reclaimed refrigerants as substitutes for virgin refrigerants in refrigeration and air-conditioning systems originating from non-industrial sources, shall be calculated based on the quantity of reclaimed refrigerants used to replace virgin refrigerants and the Global Warming Potential (GWP) values of the respective refrigerants, as follows:

$$BE_y = \sum_i (Q_{\text{product},i,y} \times f) \times GWP_{\text{refrigerant},i} \times (1-DR) \quad \text{Equation (1)}$$

Where

BE_y	=	Baseline emissions in year y (tCO ₂ e/year)
$Q_{\text{product},i,y}$	=	Quantity of used refrigerant that has been reclaimed to replace new refrigerant type i in year y (t refrigerant/year)
f	=	Purity correction factor of refrigerants according to AHRI Standard 700 (The value is 0.995)
$GWP_{\text{refrigerant},i}$	=	Global warming potential of refrigerant i (tCO ₂ e/t refrigerant)
DR	=	Deduction rate based on the refrigerant production and consumption phase-down targets under the Kigali Amendment (%)

5.2 Baseline emission from the thermal destruction of used refrigerants collected from industrial sources

Baseline emission from the thermal destruction of used refrigerants collected from industrial sources are calculated based on the quantity of used refrigerants destroyed and the emission factor associated with the destruction process, as follows:

$$BE_y = \sum_i Q_{\text{destruction},i,y} \times \eta \times EF_{\text{CO}_2,\text{refrigerant},i} \times (1-DR) \quad \text{Equation (2)}$$

Where

BE_y	=	Baseline emissions in year y (tCO ₂ e/year)
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$Q_{\text{destruction},i,y}$	=	Quantity of refrigerant type i destroyed under project implementation in year y (t refrigerant)
η	=	Destruction efficiency of used refrigerant disposal system (%) (A destruction efficiency value of 0.9999 is applied, based on the requirement set by the Department of Industrial Works (DIW), which mandates that the destruction efficiency for refrigerants must not be less than 99.99%)
$EF_{\text{CO}_2, \text{refrigerant}, i}$	=	Emission factor from destruction of refrigerant i (tCO ₂ / t refrigerant)
DR	=	Deduction rate based on the refrigerant production and consumption phase-down targets under the Kigali Amendment (%)

6. Project Emission

Project emissions are calculated based on the following components: project emissions from electricity consumption sourced from the grid during the refrigerant reconditioning and/or destruction processes, project emissions from fossil fuel combustion during the refrigerant reconditioning and/or destruction processes and project emissions from the thermal destruction of used refrigerants carried out. The details are as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{\text{destruction},y} \quad \text{Equation (4)}$$

Where

PE_y	=	Project emissions in year y (tCO ₂ /year)
$PE_{EC,y}$	=	Project emissions from electricity consumption sourced from the grid during the refrigerant reconditioning and/or destruction processes in year y (tCO ₂ /year)
$PE_{FC,y}$	=	Project emissions from fossil fuel combustion during the refrigerant reconditioning and/or destruction processes in year y (tCO ₂ /year)
$PE_{\text{destruction},y}$	=	Project emissions from the thermal destruction of used refrigerants carried out in year y (tCO ₂ /year)

6.1 Project emissions from electricity consumption sourced from the grid during the refrigerant reconditioning and/or destruction processes ($PE_{EC,y}$)

Project emissions from electricity consumption sourced from the grid during the refrigerant reconditioning and/or destruction processes can be calculated based on the amount of electricity consumed, the emission factor of electricity generation, and transmission and distribution losses in the grid, as follows

$$PE_{EC,y} = EC_{PJ,y} \times EF_{Elec,y} \times (1 + TDL_y) \quad \text{Equation (5)}$$

Where

- $PE_{EC,y}$ = Project emissions from the use of grid electricity in the process of reclaiming used refrigerants and/or destruction in year y (tCO₂/year)
- $EC_{PJ,y}$ = Electricity consumption of the project in year y (MWh/year)
- $EF_{Elec,y}$ = Emission factor for electricity generation/consumption in year y (tCO₂/MWh)
- TDL_y = Average technical transmission and distribution losses for providing electricity in year y

6.2 Project emissions from fossil fuel combustion during the refrigerant reconditioning and/or destruction processes ($PE_{FC,y}$)

Project emissions from fossil fuel combustion during the refrigerant reconditioning and/or destruction processes shall be calculated using the latest version of the T-VER-P-TOOL-02-01: Tool to Calculate Project or Leakage CO₂ Emissions from Fossil Fuel Combustion

6.3 Project emissions from the thermal destruction of used refrigerants carried out ($PE_{destruction,y}$)

Project emissions from the thermal destruction of used refrigerants carried out can be calculated as follow

$$PE_{destruction,y} = Q_{destruction,i,y} \times (1-\eta) \times GWP_{refrigerant,i} \quad \text{Equation (6)}$$

Where

- $PE_{destruction,y}$ = Project emissions from the destruction of used refrigerants in year y (tCO₂/year)
- $Q_{destruction,i,y}$ = Quantity of refrigerant type i destroyed under project implementation in year y (t refrigerant/year)
- η = Destruction efficiency of used refrigerant disposal system (%) (A destruction efficiency value of 0.9999 is applied, based on the requirement set by the Department of Industrial Works (DIW), which mandates that the destruction efficiency for refrigerants must not be less than 99.99%)
- $GWP_{refrigerant,i}$ = Global warming potential of refrigerant type i (t CO₂e/t refrigerant)

7. Leakage Emission

Leakage Emission are considered only in terms of carbon dioxide (CO₂) emissions resulting from the use of fossil fuels for the transportation of used refrigerants to the project site, the transportation of residues, and the transportation of refrigerants from the project site to destruction facilities. The total transportation distance shall be taken into account. Additionally, the destruction of residual used refrigerants from project activities occurring outside the project boundary shall also be included

$$LE_y = LE_{TR,y} + LE_{destruction,y} \quad \text{Equation (7)}$$

Where

- LE_y = Leakage emission in year y (tCO₂/year)
- $LE_{TR,y}$ = Leakage emission from the transportation of used refrigerants to the project site, transportation of residues, and transportation of refrigerants from the project site to destruction facilities in year y (tCO₂/year)
- $LE_{destruction,y}$ = Leakage emission from the off-site thermal destruction of residual used refrigerants in year y (tCO₂/year)

7.1 Leakage emission from the transportation of used refrigerants to the project site, transportation of residues, and transportation of refrigerants from the project site to destruction facilities (LE_{TR,y})

Leakage emission from the transportation of used refrigerants to the project site, transportation of residues, and transportation of refrigerants from the project site to destruction facilities can be calculated as follow

$$LE_{TR,y} = \sum_f D_{f,y} \times Q_{refrigerant,y} \times EF_{CO_2,f} \times 10^{-6} \quad \text{Equation (8)}$$

Where

- $LE_{TR,y}$ = Leakage emission from the transportation of used refrigerants to the project site, transportation of residues, and transportation of refrigerants from the project site to destruction facilities in year y (tCO₂/year)
- $D_{f,y}$ = Round-trip distance between the origin and destination for the transportation activity of refrigerant type f in year y (km)
- $Q_{refrigerant,y}$ = Quantity of refrigerants transported in year y (kg refrigerant)
- $EF_{CO_2,f}$ = Emission factor from fossil fuel consumption for the transportation of refrigerant

type f (g CO₂/kg refrigerant-km)
f = Type of refrigerant

7.2 Leakage emission from the off-site thermal destruction of residual used refrigerants (LE_{destruction,y})

Leakage emission from the off-site thermal destruction of residual used refrigerants shall include the destruction of collected refrigerants that cannot be reclaimed. The calculation formula is as follows:

$$LE_{destruction,y} = Q_{residue,i,y} \times (1-\eta) \times GWP_{refrigerant,i} \quad \text{Equation (9)}$$

Where

LE_{destruction,y} = Leakage emission from the off-site thermal destruction of residual used refrigerants in year y (tCO₂/year)

Q_{residue,i,y} = Quantity of residual refrigerant of type i destroyed outside the project boundary in year y (t refrigerant/year)

η = Destruction efficiency of used refrigerant disposal system (%) (A destruction efficiency value of 0.9999 is applied, based on the requirement set by the Department of Industrial Works (DIW), which mandates that the destruction efficiency for refrigerants must not be less than 99.99%)

GWP_{refrigerant,i} = Global warming potential of refrigerant type i (tCO₂e/t refrigerant)

8. Emission Reduction

Emission reduction can be calculated as follow

$$ER_y = BE_y - PE_y - LE_y \quad \text{Equation (10)}$$

Where

ER_y = Emission reductions in year y (tCO₂e/year)

BE_y = Baseline emissions in year y (tCO₂e/year)

PE_y = Project emissions in year y (tCO₂e/year)

LE_y = Leakage emissions in year y (tCO₂e/year)

9. Monitoring Plan

9.1 Monitoring approach

- 1) The project developer explains and specifies the steps for monitoring the project activity data (Activity data) or verify all measurement results in the project proposal document. including the type of measuring instruments used Person responsible for monitoring results and verifying information Calibration of measuring instruments (if any) and procedures for warranty and quality control Where methods have different options, such as using default values or on-site measurements The project developer must specify which option to use. In addition, the installation, maintenance and calibration of measuring instruments should be carried out in accordance with the instructions of the equipment manufacturer and in accordance with national standards. or international standards such as IEC, ISO
- (2) All data collected as part of the greenhouse gas reduction monitoring. The data should be stored in electronic file format, and the retention period is in accordance with the guidelines set by the Administrative Organization or the organization's quality system, but the period of time is not less than that specified by the TGO. Must follow the follow-up methods specified in the follow-up parameters specified in Table 9.2.

9.2 Data and parameters monitored

Parameter	$Q_{\text{product},i,y}$
Unit	t refrigerant/ year
Description	Quantity of used refrigerant that has been reclaimed to replace new refrigerant type i in year y
Source	Report or data record
Measurement procedures	Quantity of refrigerants sold, as specified in purchase orders and verified against invoices, summarized annually
Monitoring frequency	Continuous monitoring is conducted, and data is recorded at least on a monthly basis

Parameter	$Q_{\text{destruction},i,y}$
Unit	t refrigerant
Description	Quantity of refrigerant type i destroyed under project implementation in year y
Source	Reports or data records

Measurement procedures	Measurement of the quantity of refrigerant destroyed by incineration
Monitoring frequency	Continuous monitoring and data recording at least annually

Parameter	$GWP_{HFC-134a}$
Unit	t CO ₂ e/t refrigerant
Description	Global warming potential of refrigerant HFC-134a
Source	IPCC, Fifth Assessment Report
Measurement procedures	-
Monitoring frequency	Continuous monitoring and data recording at least annually

Parameter	$GWP_{refrigerant,i}$
Unit	t CO ₂ e/t refrigerant
Description	Global warming potential of refrigerant type i
Source	IPCC Global Warming Potential Values latest version
Measurement procedures	-
Monitoring frequency	Continuous monitoring and data recording at least annually

Parameter	$Q_{LUB,y}$
Unit	kg
Description	Quantity of lubricant contained in reclaimed refrigerant during year y
Source	Report or data record
Measurement procedures	Quantity of refrigerant lubricant sold, as specified in purchase orders and verified against invoices, summarized annually
Monitoring frequency	Continuous monitoring is conducted, and data is recorded at least on a monthly basis

Parameter	$EC_{PJ,y}$
Unit	MWh/year
Description	Electricity consumption of the project in year y
Source	Report or data record
Measurement procedures	Measurement from the project's electricity meter
Monitoring frequency	Continuous monitoring is conducted, and data is recorded at least on a monthly basis

Parameter	$EF_{Elec,y}$
Unit	tCO ₂ /MWh
Description	Emission factor for electricity generation/consumption in year y

Source	Report on greenhouse gas emissions (Emission Factor) from electricity generation/consumption for projects and activities of greenhouse gas reduction published by TGO.
Measurement procedures	<u>For the preparation of project proposal documents</u> Use the latest $EF_{Elec,y}$ announced by TGO <u>For monitoring the results of reducing greenhouse gas emissions</u> Use the $EF_{Elec,y}$ values announced by TGO according to the year of the carbon creditCertification period. However, in the case that the year of the Carbon CreditCertification period does not have $EF_{Elec,y}$ values announced by TGO, use the latest $EF_{Elec,y}$ values announced by TGO in that year instead.
Monitoring frequency	-

Parameter	TDL_y
Unit	-
Description	Average technical transmission and distribution losses for providing electricity in year y
Source	Option 1: Measurement report in case data are available for electricity output from the producer and electricity received by the consumer. Option 2: Use the latest value announced by TGO (equal to 0.0596), based on the Energy Balance of Thailand 2023 published by the Department of Alternative Energy Development and Efficiency (DEDE)
Measurement procedures	1) If Option 1 is selected, the project developer shall monitor the said value annually throughout the monitoring of greenhouse gas emission reductions. 2) If Option 2 is selected, the project developer shall apply this value throughout the monitoring of greenhouse gas emission reductions.
Monitoring frequency	To be determined once during the first year of the carbon crediting period

Parameter	$D_{f,y}$
Unit	km
Description	Round-trip distance between the origin and destination for the transportation activity of refrigerant type f in year y
Source	Report on the project developer's information
Measurement procedures	Record of the round-trip distance between the origin and the destination
Monitoring frequency	Continuous monitoring is conducted, and data is recorded at least on a monthly basis

Parameter	$Q_{refrigerant,y}$
Unit	t refrigerant/year
Description	Quantity of refrigerants transported in year y

Source	Report on the project developer's information
Measurement procedures	Record of the quantity of refrigerant transported
Monitoring frequency	Continuous monitoring is conducted, and data is recorded at least on a monthly basis

Parameter	$Q_{\text{residue},i,y}$
Unit	t refrigerant/year
Description	Quantity of residual refrigerant of type i destroyed outside the project boundary in year y
Source	Report on the project developer's information
Measurement procedures	Record of the quantity of residual refrigerant sent for destruction
Monitoring frequency	Continuous monitoring is conducted, and data is recorded at least on a monthly basis

9.3 Data and parameters not monitored

Parameter	$EF_{\text{CO}_2,\text{refrigerant},i}$
Unit	tCO ₂ e/ t refrigerant
Description	Emission factor from destruction of refrigerant i
Source	1) Option 1: Based on documents related to research studies. 2) Option 2: Destruction of refrigerants carried out by an incineration facility.
Applicable value	-

Parameter	$EF_{\text{CO}_2,f}$
Unit	tCO ₂ /tkm
Description	Emission factor from fossil fuel consumption for the transportation of refrigerant type f
Source	1) Measurement based on fossil fuel consumption. 2) Use of a constant value.
Applicable value	In case Source Option 2 is selected, apply the following values: 1) For transportation by small vehicle, use a value of 0.245 g CO ₂ /kg refrigerant-km 2) For transportation by large vehicle, use a value of 0.129 g CO ₂ /kg refrigerant-km

Parameter	DR
Unit	%
Description	Deduction rate based on the refrigerant production and consumption phase-down targets under the Kigali Amendment
Source	United Nations Environment Programme (UNEP)

Applicable value

The Deduction rate based on the Kigali Amendment targets for the consumption and production of refrigerants shall be applied according to the values specified in the table corresponding to the Thai calendar year in which the project proposal document is finalized and validated by an external assessor

No.	Year	Deduction rate (%)
1	2024	0
2	2025	2
3	2026	4
4	2027	6
5	2028	8
6	2029	10
7	2030	15

10. Reference

- 1) Clean Development Mechanism (CDM) : AMS-III.X.: Energy Efficiency and HFC-134a Recovery in Residential Refrigerators Version 2.0
- 2) ACR methodologies: Certified reclaimed HFC refrigerants, propellants, and fire suppressants version 2.0
- 3) 2006 IPCC Guidelines for National Greenhouse Gas Inventories Chapter 7.5.1.
- 4) Tool 12 Project and leakage emissions from transportation of freight

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Version	Amendment	Entry into force	Description
01	-	24 September 2025	Initial adoption