American Carbon Registry
AT WINROCK INTERNATIONAL

METHODOLOGY FOR THE QUANTIFICATION, MONITORING, REPORTING AND VERIFICATION OF GREENHOUSE GAS EMISSIONS REDUCTIONS AND REMOVALS FROM

THE DESTRUCTION OF OZONE DEPLETING SUBSTANCES FROM INTERNATIONAL SOURCES

VERSION 1.0

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ABOUT AMERICAN CARBON REGISTRY® (ACR)

A leading carbon offset program founded in 1996 as the first private voluntary GHG registry in the world, ACR operates in the voluntary and regulated carbon markets. ACR has unparalleled experience in the development of environmentally rigorous, science-based offset methodologies as well as operational experience in the oversight of offset project verification, registration, offset issuance and retirement reporting through its online registry system.

ACRONYMS

A/C	Air conditioning
AHRI	Air-Conditioning, Heating and Refrigeration Institute
CFC	Chlorofluorocarbon
CH_4	Methane
CO_2	Carbon dioxide
DRE	Destruction and removal efficiency
EPA	United States Environmental Protection Agency
GWP	Global warming potential
HBR	High Boiling Residue
HWC	Hazardous waste combustor
ISO	International Organization for Standardization
MT	Metric ton
ODS	Ozone depleting substances
RCRA	Resource Conservation and Recovery Act
SSR	GHG Sources, GHG Sinks, and GHG Reservoirs
TEAP	Technology and Economic Assessment Panel to the Montreal Protocol Parties

CONTENTS

FIGURES

TABLES

EQUATIONS

1 INTRODUCTION

1.1 PURPOSE

The purpose of the Methodology is to quantify greenhouse gas (GHG) emission reductions associated with the destruction of ozone depleting substances (ODS) that would have otherwise been released to the atmosphere; All eligible ODS must be obtained from sources outside of the United States and its territories.

2 ELIGIBLE ACTIVITIES: QUANTIFICATION METHODOLOGY

This Methodology defines a set of activities designed to reduce GHG emissions by the destruction of eligible ODS at a single qualifying destruction facility.

2.1 ELIGIBLE DESTRUCTION FACILITIES

I. ODS must be destroyed at either:
   A. An approved HWC subject to the RCRA and with a RCRA permit for the ODS destruction facility stating an ODS destruction efficiency of at least 99.99% (only applicable to destruction facilities located in the United States); or
   B. A transformation or destruction facility that meets or exceeds the Montreal Protocol's TEAP standards provided in the *Report of the Task Force on Destruction Technologies,* including DRE of 99.99% and emission levels consistent with the guidelines set forth in the TEAP report. Compliance can be demonstrated through the existence of appropriate permits or other regulatory documentation issued by a party to the Montreal Protocol documenting compliance with DRE and facility operational requirements.

II. A destruction facility must meet all applicable monitoring and operational requirements under relevant environmental laws, as well as all applicable regulatory requirements that apply directly to ODS destruction activities during the time the ODS destruction occurs.

2.2 ELIGIBLE ODS

I. ODS destroyed under this Methodology must be from one or more of the eligible sources listed in subchapter 2.2.1 of this Methodology.
II. Eligible ODS may not be combined within the same container.
III. ODS produced exclusively for use as solvents or other applications not listed in subchapter 2.2.1, are not eligible.
IV. A single offset project may incorporate ODS obtained from one or more of the source categories listed in subchapter 2.2.1 of this Methodology.

V. Destruction activity must take place under one or more Certificates of Destruction.
VI. All the following conditions must be met for multiple Certificates of Destruction to be eligible as a single project:
    A. The project proponent is the same for all ODS destroyed;
    B. All ODS must be destroyed at the same eligible destruction facility; and
    C. The destruction activities must occur during one reporting period.
VII. A Certificate of Destruction may be used for only one offset project.
VIII. Each Certificate of Destruction must be issued by the qualifying destruction facility and must include the following information:
    A. Project Proponent;
    B. Destruction facility;
    C. Certificate of Destruction ID number;
    D. If applicable, serial, tracking, or ID number of all containers for which ODS destruction occurred;
    E. Mass and type of material destroyed from each container;
    F. Start and end destruction dates.
IX. The ODS destroyed may originate from a single source or from numerous sources.
X. The handling, recovery, and disposal of ODS refrigerants must be performed by qualified technicians. Qualified technicians may only service refrigeration or air conditioning equipment they are certified to service if a refrigerant handling, recovery, and disposal certification program exists in the ODS source country. Technician name and certification type(s) (if applicable) must be retained as part of the documentation retention requirements of this Methodology.

2.2.1 ODS Refrigerant Sources

I. Eligible refrigerants must originate from equipment, refrigeration systems, or other supplies, including but not limited to cans, cylinders, and other containers of recovered, reclaimed or unused ODS.
II. Only destruction of the following ODS refrigerants is eligible to generate ACR Emission Reduction Tonnes (ERTs) under this Methodology:
    A. CFCs:
        i. CFC-11;
        ii. CFC-12;
        iii. CFC-13;

iv. CFC-113;
v. CFC-114;
vi. CFC-115;

3 ELIGIBILITY

ODS offset projects must adhere to the eligibility requirements below as well as general ACR program requirements included in the ACR Standard.

ACR may require revisions to this Methodology to ensure that monitoring, reporting, and verification systems adequately reflect changes to project activities. This Methodology may also be periodically updated to reflect regulatory changes, emission factor revisions, or expanded applicability criteria. Before beginning a project, the project proponent should ensure that they are using the latest version of the Methodology.

3.1 GENERAL ELIGIBILITY REQUIREMENTS

I. Offset projects that use this Methodology must:
   A. Collect and destroy ODS that meet the eligibility requirements set forth in Section 2.2.1;
   B. Destroy the recovered ODS pursuant to subchapter 2.1 of this Methodology;
   C. Conform with the source documentation requirements, as specified in chapter 6 of this Methodology; and
   D. Conform to the chain of custody documentation requirements, as specified in chapter 6 of this Methodology.

II. A project proponent that uses this Methodology must:
   A. Monitor SSRs within the GHG Assessment Boundary as delineated in chapter 4 pursuant to the requirements of chapter 6 in this Methodology;
   B. Quantify GHG emission reductions pursuant to chapter 5 of this Methodology;
   C. Prepare and submit a GHG Project Plan in accordance with ACR Standard requirements; and
   D. Obtain validation and verification services from an accredited offset verification body approved by ACR.

3.2 LOCATION

I. All ODS must be obtained from eligible sources located outside the United States and its territories.
II. Destruction of ODS must occur at an eligible destruction facility per the requirements found in Section 2.1.

3.3 ADDITIONALITY

Offset projects must meet the additionality requirements included below. Eligible offsets must be generated by projects that yield additional GHG reductions that exceed any GHG reductions otherwise required by law or regulation or any GHG reduction that would otherwise occur in a conservative business-as-usual scenario. These requirements are assessed through the Legal Requirement Test in subchapter 3.3.1 and the Performance Standard Evaluation in subchapter 3.3.2 of this Methodology.

3.3.1 Legal Requirement Test

I. Emission reductions achieved by a project using this Methodology must exceed those required by any law, regulation, or legally binding mandate.

II. The following legal requirement test applies to all ODS destruction projects:

A. If no law, regulation, or legally binding mandate requires the destruction of ODS stocks, all emission reductions resulting from the recovery and destruction of ODS are considered to not be legally required, and therefore eligible for crediting under this Methodology.

B. If any law, regulation, or legally binding mandate requires the destruction of ODS stocks, only emission reductions resulting from the recovery and destruction of ODS that are in excess of what is required to comply with those laws, regulations, and legally binding mandates are eligible for crediting under this Methodology.

3.3.2 Performance Standard Evaluation

I. Emission reductions achieved by a project using this Methodology must exceed those likely to occur in a conservative business-as-usual scenario.

II. The performance standard evaluation is satisfied if the ODS project activities meet the project definition and all other eligibility requirements in the Methodology.

3.4 START DATE

I. An offset project must meet the start date requirements set forth in the ACR Standard.

II. For this Methodology, the project start date is defined as the date on which the earliest destruction activity of a project commences, as documented on a Certificate of Destruction.

III. Offset project activities (e.g., collection of ODS or transportation of ODS) will occur prior to offset project commencement.

3.5 REPORTING PERIODS

I. An ODS destruction project can only have a single reporting period.

II. Multiple destruction events may be combined within a single reporting period subject to the requirements in subchapter 2.2.VI of this Methodology.

III. The reporting period must not exceed 12 consecutive months. The project proponent may choose a reporting period shorter than 12 consecutive months.

IV. The project reporting period begins on the project start date.

3.6 CREDITING PERIODS

I. The project crediting period is the period of time over which emission reductions are quantified for the purpose of determining creditable GHG reductions.

II. The project crediting period for this Methodology is ten years.

III. The project crediting period begins on the project start date.

3.7 REGULATORY COMPLIANCE

I. An offset project must meet the regulatory compliance requirements set forth in the ACR Standard.

II. The regulatory compliance requirements for a project apply to the collection, recovery, storage, transportation, mixing, and destruction of ODS, including disposal of the post-destruction waste products that are directly applicable to the destruction activities. The regulatory compliance requirements in this section apply to the incinerator and any other unit or operation at the destruction facility, directly related to the destruction activities, during the time destruction occurs.

III. Any instances of non-compliance resulting from administrative or other issues not related to the project (those specific activities stated in Section 3.7 II) shall not be considered in a determination of project-related regulatory compliance. Further, in order to be deemed out of compliance, a regulatory body must have issued a notice of violation (or similar notification) stating specifically that a violation has occurred.

4 OFFSET PROJECT BOUNDARY: QUANTIFICATION METHODOLOGY

I. The GHG assessment boundary, or offset project boundary, delineates the SSRs that must be included or excluded when quantifying the net changes in emissions associated with the recovery and destruction ODS.

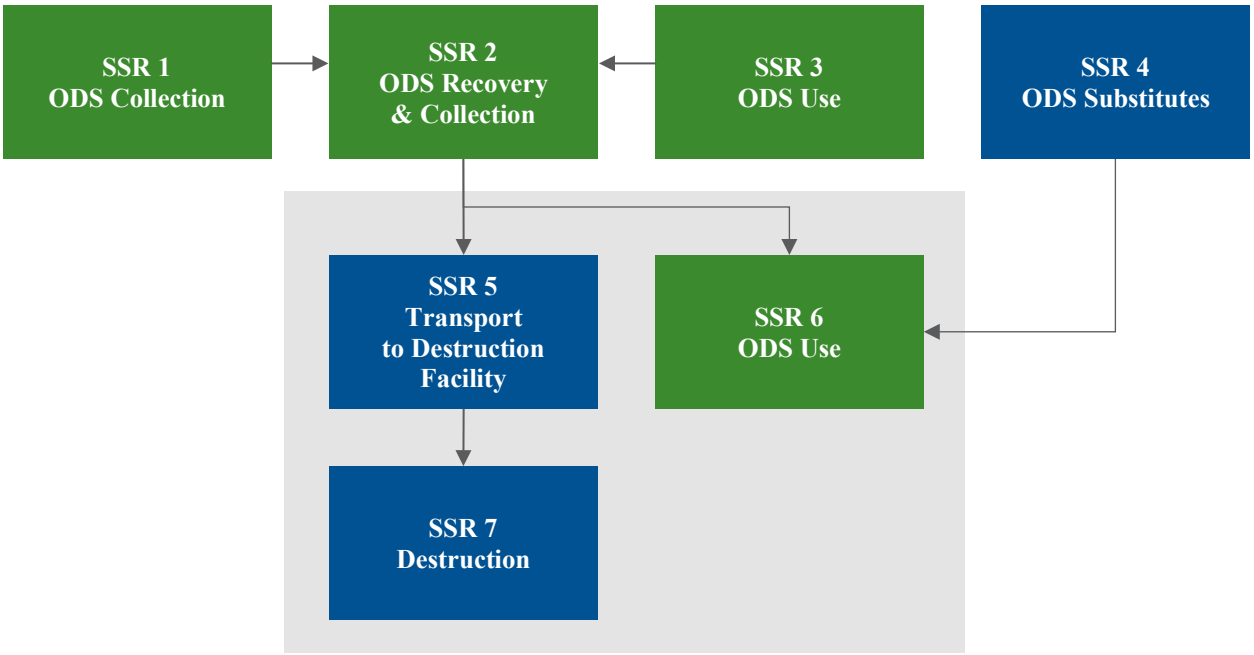
II. Figure 1 illustrates the GHG assessment boundary for ODS projects.

A. All SSRs inside the grey box are included and must be accounted for under this Methodology.

B. SSRs in green boxes are relevant to the baseline and project emissions.

C. SSRs in blue boxes are relevant only to project emissions.

Figure 1: Illustration of the Offset Project Boundary for ODS Projects



III. Table 1 lists the SSRs for ODS projects indicating which gases are included or excluded from the offset project boundary.

Table 1: List of Identified SSRs for ODS Projects

SSR	SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EXCLUDED (E)
1 ODS Collection	Fossil fuel emissions from the collection and transport of ODS sources	CO_2	E
		CH_4	E
		N_2O	E
2 ODS Recovery and Collection	Emissions of ODS from the recovery and collection of ODS at end-of-life or servicing	ODS	E
	Fossil fuel emissions from the recovery and collection of refrigerant at end-of-life or servicing	CO_2	E
		CH_4	E
		N_2O	E
3 ODS Use	Emissions of ODS from equipment use, leaks, and servicing	ODS	E
	Fossil fuel emissions from the operation of refrigeration and A/C equipment	CO_2	E
		CH_4	E
		N_2O	E
4 Substitute Refrigerant Production	Emissions of substitute refrigerant production	CO_2e	E
	Fossil fuel emissions from the production of substitute refrigerant	CO_2	E
		CH_4	E

SSR	SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EXCLUDED (E)
		N_2O	E
5 Transport to Destruction Facility	Fossil fuel emissions from the vehicular transport of ODS from aggregation point to final destruction facility	CO_2	I
		CH_4	E
		N_2O	E
6 ODS Use	Emissions of ODS from use, leaks and servicing through continued operation of equipment	ODS	I
	Emissions of substitute from use, leaks and servicing through continued operation of equipment	CO_2e	I
	Indirect emissions from grid-delivered electricity	CO_2	E
		CH_4	E
		N_2O	E
7 Destruction	Emissions of ODS from incomplete destruction at destruction facility	ODS	I
	Emissions from the oxidation of carbon contained in destroyed ODS	CO_2	I
	Fossil fuel emissions from the destruction of ODS at destruction facility	CO_2	I
		CH_4	E
		N_2O	E
	Indirect emissions from the use of grid-delivered electricity	CO_2	I
		CH_4	E

SSR	SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EXCLUDED (E)
		N_2O	E

5 QUANTIFYING GHG EMISSION REDUCTIONS: QUANTIFICATION METHODOLOGY

I. A project proponent must use the calculation methods provided in this methodology to determine baseline and project GHG emissions.
II. GHG emissions must be quantified using the GWP values in Table 3.
III. GHG emission reductions (ER) must be quantified by subtracting the project emissions (PE) from the baseline emissions (BE) using Equation 1.

Equation 1: Total Emission Reductions

$$\mathbf{ER_t = BE_{refr,t} - PE_t}$$

WHERE		UNITS
ER_t	Total quantity of GHG emission reductions during the reporting period	MT CO_2e
$BE_{refr,t}$	Total quantity of project baseline emissions from ODS during the reporting period	MT CO_2e
PE_t	Total quantity of project emissions during the reporting period	MT CO_2e

5.1 QUANTIFYING BASELINE EMISSIONS

I. Baseline emissions (BE) must be estimated using Equation 2 and by summing the baseline emissions for all SSRs identified as included in the baseline in Table 1.

II. Baseline emissions from refrigerant ODS ($BE_{refr,t}$) must include the estimated CO_2e emissions that would have occurred over the ten-year crediting period had the destroyed ODS been used in existing refrigeration or air conditioning equipment.

III. The total mass of refrigerant ODS sent for destruction ($Q_{refr,i}$) includes eligible ODS and excludes the mass of HBR, moisture, ineligible ODS, and other ineligible material. Mass and composition of refrigerant ODS are determined per the procedures provided in Appendix B.

IV. The GWP values for refrigerant ODS (GWP_i) must be taken from Table 3.

V. The 10-year cumulative emission rate for refrigerant ODS ($ER_{refr,i}$) must be taken from Table 3.

Equation 2: Total Baseline Emissions from ODS

$$\mathbf{BE_{refr,t}} = \sum_{\mathbf{i}} (\mathbf{Q_{refr,i}} \times \mathbf{ER_{refr,i}} \times \mathbf{GWP_i})$$

WHERE		UNITS
$BE_{refr,t}$	Total quantity of project baseline emissions from ODS during the reporting period	MT CO_2e
$Q_{refr,i}$	Total quantity of refrigerant ODS **i** sent for destruction	MT ODS
$ER_{refr,i}$	10-year cumulative emission rate of refrigerant ODS **i** (see Table 3)	%
GWP_i	Global warming potential of ODS **i** (see Table 3)	MT CO_2e/ MT ODS

5.2 QUANTIFYING PROJECT EMISSIONS

I. Project emissions (PE) must be quantified by summing the emissions for all SSRs identified as included in the project in Table 1 using Equation 3.

Equation 3: Total Project Emissions

$$PE_t = Sub_{refr} + Tr\&Dest$$

WHERE		UNITS
PE_t	Total quantity of project emissions during the reporting period	MT CO_2e
Sub_{refr}	Total GHG emissions from substitute refrigerant	MT CO_2e
$Tr\&Dest$	Total GHG emissions from transportation and destruction of ODS	MT CO_2e

II. Project emissions from substitute refrigerants (Sub_{refr}) must be quantified using Equation 4.

III. Sub_{refr} must include the estimated CO_2e emissions over a ten-year period from non-ODS substitute refrigerants that are used. The emission factors for substitute refrigerants in Table 3 must be used.

IV. The total mass of refrigerant ODS sent for destruction ($Q_{ref,i}$) excludes the mass of HBR, moisture, and ineligible ODS. Mass and composition of refrigerant ODS are determined per the procedures provided in Appendix B.

Equation 4: Project Emissions from the Use of Non-ODS Refrigerants

$$Sub_{refr} = \sum_i Q_{refr,i} \times SE_i$$

WHERE		UNITS
Sub_{refr}	Total quantity of refrigerant substitute emissions	MT CO_2e
$Q_{refr,i}$	Total quantity of refrigerant ODS i sent for destruction	MT ODS

SE_i	Emission factor for substitute(s) for refrigerant i, per Table 3	MT CO_2e/ MT ODS destroyed

V. Project emissions from the transportation and destruction of ODS shall be quantified using default emission factors in Equation 5.

A. The default emission factor for ODS transportation and destruction is 7.5 MT CO_2e per MT ODS.

B. Q_{ODS} includes the mass of all eligible and ineligible ODS, moisture, HBR, and other accompanying material.

Equation 5: Project Emissions from Transportation and Destruction Using the Default Emission Factors

$$Tr\&Dest = (Q_{ODS} \times EF)$$

WHERE		UNITS
$Tr\&Dest$	Total GHG emissions from ODS transportation and destruction, as calculated using default emission factors	MT CO_2e
Q_{ODS}	Total quantity of ODS sent for destruction in the project	MT ODS
EF	Default emission factor for transportation and destruction of ODS (7.5)	MT CO_2e/ MT ODS

5.3 ACCOUNTING FOR DISQUALIFIED ODS

ERTs may only be generated for the destruction of eligible ODS that meets the sourcing and chain of custody requirements specified in chapter 6 of this Methodology. Any disqualified ODS must be removed from baseline emission calculations using the following method to determine the mass and species of the disqualified ODS:

I. The total mass of each container of disqualified ODS shall be considered as the original container when the ODS was acquired. Documentation of the acquired ODS must identify the capacity of the disqualified ODS container or the entire destruction event is not eligible for crediting. If a container's capacity is labelled in volume rather than in mass, the densities in Table 4 must be used to convert the volume to mass.
   A. If converting between mass and volume, the ODS must be in a liquid state.
II. The species of each disqualified ODS shall be the species with the highest GWP of the destruction event.
III. The determined mass of disqualified ODS shall be subtracted from the total mass of that ODS species destroyed in the project.
   A. The total mass of refrigerant ODS sent for destruction ($Q_{refr,i}$) shall be adjusted in Equation 2.

5.4 CONVERSION FACTORS

I. For the purpose of this Methodology, 1 pound (lb) equals 0.45359 kilogram (Kg).

6 MONITORING

6.1 GENERAL MONITORING REQUIREMENTS

I. The project proponent is responsible for monitoring all project activities to ensure compliance with this Methodology.

II. The source of all ODS must be documented. Source documentation must include all of the following:

- A. Owner of the ODS prior to acquisition by the project proponent;
- B. Physical address of the ODS prior to acquisition by the project proponent and facility name (if applicable);
- C. Additional information as follows:
  - i. If sourced from equipment or refrigeration system: identification of any refrigeration or air conditioning equipment or system by serial number; or
  - ii. If sourced from other supplies: an affidavit, certification, or attestation by the prior owner asserting the date the owner transferred title of the ODS to the project proponent, whether the prior owner is a manufacturer of refrigerant, importer of refrigerant, or wholesale distributor of refrigerant.;
- D. Serial or ID number of any containers used for storage and transport.

III. The project proponent must collect and maintain documentation on the chain of custody and ownership of the ODS beginning at the location it is first acquired by the project proponent through destruction, including all the following:

- A. Names, addresses, and contact information of all entities buying and selling ODS for destruction; and
- B. The mass of ODS, including ineligible ODS and contaminants, at each transaction.

IV. For projects destroying ODS sourced from government stockpiles or inventories, the project proponent must maintain documentation that the ODS is not required to be destroyed or converted.

V. The project proponent must collect and maintain all of the following information from the composition and mass analysis:

- A. Time and date of sample;
- B. Name of project proponent;
- C. Name of technician taking sample;
- D. Employer of technician taking sample;

E. Volume of container from which sample was extracted;
F. Ambient air temperature at time of sampling; and
G. Chain of custody for each sample from the point of sampling to the laboratory conducting sample analysis.

VI. The destruction facility must track continuously during the destruction process the following parameters and provide the data about these parameters to the project proponent. The project proponent must collect and maintain all the following information from the destruction facility:
A. The feed rate;
B. Operating temperature and pressure of the destruction unit during destruction;
C. Effluent discharges measured in terms of water and pH levels (if applicable);
D. Destruction system monitoring data on the emissions of carbon monoxide during destruction (if applicable); and

VII. Projects must follow the procedures in Appendix B. The project proponent must collect and maintain information showing conformance with the procedures in Appendix B.

VIII. For ODS destroyed in a country other than the country from which it was sourced, the project proponent must collect and maintain:
A. Records establishing a right to export the ODS from the source country and the name, department, regulatory body, and contact information of the governmental authority granting permission to export; and
B. Records establishing a right to import the ODS to the country of destruction and the name, department, regulatory body, and contact information of the governmental authority granting permission to import.

6.2 INSTRUMENT QA/QC

I. The scales used to determine the mass of ODS used in calculating emission reductions must be:
A. Inspected at least quarterly; and
B. Properly calibrated per the destruction facility's RCRA permit, or for non-RCRA facilities, calibrated at least quarterly to 5% or better accuracy. RCRA facilities that do not have calibration requirements defined in their RCRA permits must calibrate scales quarterly to 5% or better accuracy.

6.3 DOCUMENT RETENTION

I. The project proponent is required to keep all documentation and information outlined in this Methodology.

II. Information that must be retained by the project proponent includes:

A. All data inputs for the calculation of the offset project emission reductions, including all required sampled data;

B. Copies of all regulatory permits, for project related collection, recovery, transportation, and destruction activities;

C. Destruction facility monitoring and maintenance information (destruction system monitoring data, DRE documentation, scale readings, calibration procedures, calibration checks and daily zero validations (if applicable), manufacturer guidance pertaining to facility or technology maintenance, and permits);

D. Chain of custody and sourcing documentation; and

E. ODS composition and mass determinations (i.e., from laboratory reports or other procedures included in this Methodology).

6.4 MONITORING PARAMETERS: QUANTIFICATION METHODOLOGY

The project proponent must monitor the parameters described in Table 2.

Table 2: Project Monitoring Parameters – Quantification Methodology

EQUATION #	PARAMETER	DESCRIPTION	DATA UNIT	MEASUREMENT FREQUENCY	CALCULATED (C) MEASURED (M) REFERENCE (R) OPERATING RECORDS (O)	COMMENT
		Legal Requirement Test	N/A	For each offset project		Must be monitored and determined for each project
		Mass of ODS (or ODS mixture) in each container	Mass of mixture	Per container	M	Must be determined for each container

EQUATION #	PARAMETER	DESCRIPTION	DATA UNIT	MEASUREMENT FREQUENCY	CALCULATED (C) MEASURED (M) REFERENCE (R) OPERATING RECORDS (O)	COMMENT
		Concentration of ODS (or ODS mixture) in each container	Mass ODS / Mass of mixture	Per container	M	Must be determined for each container
1	ER_t	Total quantity of GHG emission reductions during the reporting period	MT CO_2e	For each offset project	C	
1 3	PE_t	Total quantity of project emissions during the reporting period	MT CO_2e	For each offset project	C	
1 2	$BE_{refr,t}$	Total quantity of baseline emissions from refrigerant ODS	MT CO_2e	For each offset project	C	
2 4	$Q_{refr,i}$	Total quantity of refrigerant ODS *i* sent for destruction	MT ODS	For each offset project	M	
2	$ER_{refr,i}$	10-year cumulative emission rate of refrigerant ODS *i*	0 – 100%	N/A	R	See Table 3
2	GWP_i	Global warming potential of ODS *i*	MT CO_2e/ MT ODS	N/A	R	See Table 3
3	Sub_{refr}	Total GHG emissions from substitute refrigerant	MT CO_2e	For each offset project	C	

EQUATION #	PARAMETER	DESCRIPTION	DATA UNIT	MEASUREMENT FREQUENCY	CALCULATED (C) MEASURED (M) REFERENCE (R) OPERATING RECORDS (O)	COMMENT
3 5	Tr&Dest	Total GHG emissions from ODS transportation and destruction	MT CO_2e	For each offset project	C	
4	SE_i	Emission factor for substitute emissions of refrigerant *i*	MT CO_2e/ MT ODS destroyed	Per container	R	See Table 3
5	Q_{ODS}	Total quantity of refrigerant ODS sent for destruction	MT ODS	For each offset project	M/C	
5	EF	Default emission factor for transportation and destruction of ODS		N/A	R	Equal to 7.5 MT CO_2e per MT

7 VERIFICATION REQUIREMENTS

I. See the ACR Standard for guidance on project validation and verification requirements.

II. An ODS offset project requires only one site visit regardless of the number of destruction events within that reporting period.

III. For the purpose of this Methodology, the site visit must include a visit to the destruction facility. The site visit may also include a visit to the project proponent's office(s) where all project-related documents and data were produced, managed, and retained. The site visit may also include a visit to any facility in the chain of custody, such as an aggregation facility or other source from which refrigerant was obtained.

DEFINITIONS

If not explicitly defined here, the current definitions in the most recent version of the American Carbon Registry (ACR) Standard apply.

Aggregation	The grouping together of multiple containers of ODS into a single shipment or single container. Aggregation does not require the collected ODS to be combined into a single container. Multiple containers shipped together are considered an aggregate.
Certificate of Destruction	An official document provided by the destruction facility certifying the date, mass, and species of ODS destroyed.
Container	An air-tight and water-tight unit for storing or transporting ODS material without leakage or escape. Containers used in transporting project material must meet relevant ISO container standard requirements.
Destruction	The destruction of ODS by qualified destruction, transformation or conversion plants achieving greater than 99.99% destruction and removal efficiency (DRE), so that the destroyed ODS are not emitted to the atmosphere. Destruction may be performed using any technology, including transformation, that results in the complete breakdown of ODS into a waste product, a usable by-product, or end product.
Destruction facility	A facility that destroys, transforms, or converts ODS and conforms with the description in either subchapter 2.1 I A or 2.1 I B in this Methodology.
Disqualified ODS	ODS that does not conform, or cannot be determined to conform, to the sourcing or chain of custody documentation requirements specified in chapter 6 of this Methodology and must be removed from baseline emission calculations pursuant to subchapter 5.3 in this Methodology.

Eligible ODS	Those ODS included in subchapter 2.2.1. in this Methodology.
Emission rate	The rate at which refrigerant is released to the atmosphere.
Ineligible ODS	Those ODS not included in subchapter 2.2.1 in this Methodology.
Mixed ODS	Less than or equal to 90% composition of a single ODS species.
Non-mixed ODS	Greater than 90% composition of a single ODS species.
Ozone Depleting Substances (ODS)	Substances known to deplete the stratospheric ozone layer. The ODS controlled under the Montreal Protocol and its Amendments are chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), halons, methyl bromide (CH3Br), carbon tetrachloride (CCl4), methyl chloroform (CH3CCl3), hydrobromofluorocarbons (HBFC) and bromochloromethane (CHBrCl).
ODS	Any individual type of ODS (e.g., CFC-11, CFC-113)).
Refrigeration or air conditioning equipment	A refrigeration or air conditioning appliance or system used in any sector (including commercial, industrial, or residential).
Stockpile	ODS stored for future use or disposal in bulk quantities at a single facility. The ODS may be stored in multiple containers or a single container.
Substitute refrigerant	Those refrigerants that will be used to fulfill the function that would have been filled by the destroyed ODS refrigerants. These refrigerants may be drop-in replacements or may be used in new equipment or devices that fulfill the same market function.
Substitute emissions	GHG emitted from the use of substitute refrigerants in technologies that are used to replace the ODS destroyed in a project.
Transformation or Conversion	The breakdown of a substance into a waste product, a usable by-product, or end-product.

APPENDIX A: EMISSION FACTOR TABLES – QUANTIFICATION METHODOLOGY

Table 3: Parameters for ODS Refrigerants[1]

ODS	100-YR GLOBAL WARMING POTENTIAL (MT CO_2E/MT ODS) (GWP_I)	10-YEAR CUMULATIVE EMISSION RATE (%/10 YEARS) ($ER_{REFR,I}$)	SUBSTITUTE EMISSIONS (MT CO_2E/MT ODS) (SE_I)
CFC-11	4,750	89%	223
CFC-12	10,900	95%	686
CFC-13	14,400	61%	7,144
CFC-113	6,130	89%	220
CFC-114	10,000	78%	659
CFC-115	7,370	61%	1,139

[1] Note that, for purposes of conservatism, emission rates found in this table are set equal to those in ACR's U.S. ODS Destruction Methodology.

Table 4: ODS Carbon Ratio and Density

ODS	CARBON RATIO (CR_I)	DENSITY (G/CM^3)
CFC-11	12/137	1.494
CFC-12	12/121	1.486
CFC-13	12/104	1.526
CFC-113	24/187	1.560
CFC-114	24/171	1.455
CFC-115	24/154	1.568

APPENDIX B: ODS MASS AND COMPOSITION – QUANTIFICATION METHODOLOGY

Prior to destruction, the precise mass and composition of ODS must be determined.

I. For ODS extracted into containers prior to destruction, the following analysis must be conducted:
   A. Mass must be determined by individually measuring the mass of each container first when it is full prior to destruction and then after destruction is complete. The mass of ODS and any contaminants is equal to the difference between the full and empty mass, as measured. To be eligible to receive ERTs, all the following requirements must be met when weighing the containers:
      i. A single scale conforming with the requirements in (subchapter 6.3) of this Methodology must be used for generating both the full and empty mass tickets at the destruction facility;
      ii. The full mass must be measured no more than 48 hours prior to commencement of destruction per the destruction system monitoring data, if available, or the Certificate of Destruction;
      iii. The empty mass must be measured no more than 48 hours after the conclusion of destruction per the destruction system monitoring data, if available, or, the Certificate of Destruction; and
      iv. Each single compartment, cylinder, drum, or any other eligible ODS container that has been identified and destined for destruction must be weighed separately, sampled separately, and treated as a separate destruction event.
      v. Recovery, collection, and aggregation activities may occur until the container has been identified and destined for destruction. After the ODS container has been identified and destined for destruction, ODS must not be added or removed, except for the purpose of sampling and analysis.
   B. The following procedures must be applied for the full and empty masses required within 48 hours of both the commencement and conclusion of destruction, pursuant to subsections I A ii and I A iii in Appendix B of this Methodology:

i. For containers permanently affixed to a detachable trailer:
   a. The trailer must be detached from its transportation vehicle, and the trailer must be weighed separately from its transportation vehicle;
   b. Any accessories, such as spare tires or tire chains, or any part of the trailer's load other than the ODS which are included in the trailer's full mass prior to ODS destruction must be included in the trailer's empty mass after destruction; and
   c. A container with a capacity over 1,000 pounds must be placed on the scale motionless for at least 3 minutes to allow the mass to stabilize before the mass measurement is recorded.

ii. For containers not permanently affixed to a truck or detachable trailer:
   a. Each container may be weighed by placing it individually on the scale prescribed in subsection I A i in Appendix B of this Methodology; and;
   b. A container with a capacity over 1,000 pounds must be placed on the scale motionless for at least 3 minutes to allow the mass to stabilize before the mass measurement is recorded.

iii. For containers weighed with the transportation vehicle included:
   a. The driver and any other passengers must exit the vehicle such that their mass is not included;
   b. Any accessories, such as spare tires or tire chains, or any part of the truck's load other than the ODS which are included in the truck's full mass prior to ODS destruction must be included in the truck's empty mass after destruction;
   c. If more than 1,000 pounds of ODS is being transported for destruction, then the truck must be situated motionless on the scale for at least 3 minutes to allow the mass to stabilize before the mass measurement is recorded.
   d. The transportation vehicle's weight classification and load rating must be recorded;
   e. The transportation vehicle's fuel capacity must be recorded. Its fuel level at the time of each scale recording must also be recorded. Fuel level must be recorded in an increment of one eighth of the fuel tank capacity. If the fuel level is in between two increments, the fuel level prior to ODS destruction must be rounded down and the fuel level after ODS destruction must be rounded up;

f. If the transportation vehicle's fuel level is lower after destruction than the fuel level before destruction, the difference in fuel mass must be subtracted from $Q_{refr,i}$ in Equation 2, and Q_{ODS} in Equation 5. The following fuel densities shall be used to adjust for mass:

   7.0851 lb/gal for diesel; or

   6.0023 lb/gal for gasoline; and

g. If different transportation vehicles are used to transport containers to a destruction facility and to pick up the empty containers after destruction, each transport vehicle shall be weighed both upon its arrival and departure from the destruction facility. If the vehicle transporting the full ODS containers to the destruction facility weighs more than the vehicle carrying the empty ODS containers from the facility, the mass discrepancy must be subtracted, as applicable from $Q_{refr,i}$ in Equation 2, and Q_{ODS} in Equation 5

C. Composition and concentration of ODS must be established for each individual container by taking a sample from each container of ODS and having it analyzed for composition and concentration at an AHRI-certified laboratory, a laboratory accredited to ISO/IEC 17025, or a laboratory licensed and regulated by the federal government, and using the AHRI Standard 700 – Specifications for Refrigerants (AHRI 700). The laboratory performing the composition analysis must not be affiliated with the project proponent. All the following requirements must be met for each sample:

i. The sample must be taken while ODS is in the possession of the company that will destroy the ODS;

ii. Samples must be taken by a technician unaffiliated with the project proponent; if the destruction facility is the project proponent, an outside technician must perform this task;

iii. Samples must be taken with a clean, fully evacuated sample bottle that meets applicable DOT requirements with a minimum capacity of one pound;

iv. Each sample must be taken in liquid state;

v. A minimum sample size of one pound must be drawn for each sample;

vi. Each sample must be individually labeled and tracked according to the container from which it was taken, and all the following information recorded:

   a. Time and date of sample;

   b. Name of project proponent;

   c. Name of technician taking sample;

   d. Employer of technician taking sample;

   e. Volume of container from which sample was extracted; and

f. Ambient air temperature at time of sampling; and

g. Chain of custody for each sample from the point of sampling to the laboratory conducting the analysis must be documented by paper bills of lading or electronic, third-party tracking that includes proof of delivery.

D. All project samples shall be analyzed using AHRI 700 to confirm the mass percentage and identification of each component of the sample. The analysis shall provide:

i. Identification of the ODS;

ii. Purity (%) of the ODS mixture by mass using gas chromatography;

iii. Moisture level in parts per million. The moisture content of each sample must be less than 75% of the saturation point for the ODS based on the temperature recorded at the time the sample was taken;

a. For non-mixed ODS, the saturation point is the saturation point of the major ODS species;

b. For mixed ODS, the saturation point is the lowest saturation value of any species that makes up at least 10% of the composition;

iv. Analysis of HBR, which must be less than 10% by mass; and

v. Analysis of other ODS in the case of mixtures of ODS, and their percentage by mass.

E. If any of the requirements in sections I A through I C of this Appendix are not met, no GHG reductions may be verified for ODS destruction associated with that container.

F. If a container holds non-mixed ODS, no further information or sampling is required to determine the mass and composition of the ODS. For non-mixed ODS, the analysis conducted for the sample taken at the destruction facility must be used for quantifying GHG emissions.

G. If the container holds mixed ODS, the project proponent must meet all the following additional requirements:

i. The required sampling may be conducted at the final destruction facility or prior to delivery to the destruction facility;

ii. Circulation and sampling activities must be conducted by a contracted third-party and by individuals who have been properly trained for the functions they perform;

iii. The offset project documentation must specify the procedures by which mixed ODS are analyzed;

iv. Prior to sampling, the ODS mixture must be circulated in a single container or two connected containers that meet all the following criteria:

a. The containers have no solid interior obstructions;
b. The containers were fully evacuated prior to filling;
c. The containers must have sampling ports to sample liquid and gas phase ODS;
d. The sampling ports must be located in the middle third of all of the containers (i.e., not at one end or the other); and
e. The containers and associated equipment can circulate the mixture via a closed loop system from the bottom to top for a single container, or from the bottom of one tank to the top of another tank if two connected containers are used.

v. If the original mixed ODS container or two connected containers do not meet these requirements, the mixed ODS must be transferred into a temporary holding tank or container or two connected containers that meet all the above criteria. The mass of the contents placed into the temporary container or two connected containers shall be calculated and recorded. During transfer of ODS into and out of the temporary container or two connected containers, ODS shall be recovered to the vacuum levels required by the U.S. EPA for that ODS (see 40 CFR 82.156);

vi. Once the mixed ODS is in a container, two connected containers, or temporary storage unit that meets the criteria above, circulation of mixed ODS must be conducted as follows:

a. Liquid mixture shall be circulated from the liquid port to the vapor port for a single container, or from the liquid port of one tank into the vapor port for another tank if two connected containers are used;
b. A volume of the mixture equal to two times the volume in the container shall be circulated;
c. Calculations converting between mass and volume shall use the densities provided in Table 4; if converting between mass and volume, the mixed ODS must be in a liquid state;
d. Circulation must occur at a rate of at least 30 gallons/minute; and
e. Start and end times shall be recorded;

vii. Within 30 minutes of the completion of circulation, a minimum of two samples shall be taken from the bottom liquid port for a single container, or minimum of two samples must be taken from the liquid port of each tank if two connected tanks are used and both samples must be analyzed at a laboratory, per the requirements in Section 1. C of this Appendix; and

viii. The project proponent must calculate the project GHG emission reductions using both sample results, and choose the sample resulting in the lower project emission reductions.

APPENDIX C: INTERNATIONAL ODS DESTRUCTION

The destruction of ODS refrigerant is an important strategy to combat climate change. In the United States, incentive programs for the destruction of ODS have been in existence for over 10 years in various forms. Currently, most of the ODS destruction that is eligible for carbon offset credits in the United States occurs under the California cap and trade program where ODS destruction credits are eligible. However, the California ODS destruction methodology and the ACR ODS destruction methodology (for use in ACR's voluntary offset program) both restrict the source eligibility to the United States and its territories.

Moving forward, the majority of recoverable ODS refrigerant is likely to originate in countries other than the United States. In fact, in its recent report on ODS destruction, ICF concludes that the majority of recoverable ODS refrigerant will originate from Montreal Protocol Article 5 countries[2].

This methodology includes the requirements that must be followed in order to earn carbon offset credits for destruction of ODS refrigerant that is recovered from non-U.S. sources. An important component of the methodology is the performance standard for additionality. This appendix provides additional information on ODS destruction in an international context.

A.1 INTERNATIONAL ODS DESTRUCTION

While the Montreal Protocol established a global ban on the production and manufacture of CFC refrigerants (except for some limited production for essential or critical uses otherwise approved by the Parties), it did not provide for the destruction or elimination of existing supplies of ODS refrigerants. ODS, for instance, may still be used in chillers, air conditioners, and other refrigeration systems and are still prevalent and randomly distributed throughout the world – both in operating equipment manufactured before deadlines to cease production, and on the shelves of repair contractors and others who own or operate older refrigeration or cooling equipment.

[2] ICF International. (2018). ODS Destruction in the United States and Abroad.

These ODS are at risk of being released into the atmosphere during operation and maintenance or at end of product life, or from untended, rusting or leaking cans, cylinders and other containers. Few if any mandates exist to destroy ODS refrigerants at end of life. Moreover, few if any incentive programs exist to encourage or help defray the otherwise prohibitive cost to aggregate, collect, and destroy these substances. Indeed, even if funds were available, in many parts of the world there is limited or no access to disposal options that prevent the release of ODS to the atmosphere, let alone provide for its destruction.

There are numerous reports identifying efforts to fund pilot projects or establish national product stewardship schemes, taxes and levies to incentivize the destruction of ODS refrigerants around the world. The small number of successful programs from among this list, and their limited reach, prove that business as usual is the release of ODS into the atmosphere. By way of example:

- Australia has a product stewardship scheme operated as a rebate program by the non-profit, Refrigerant Reclaim Australia (RRA) under a government mandate for the collection and destruction of unwanted ODS refrigerant. The program is open to all refrigeration and air conditioning sectors (e.g., commercial, industrial, automotive, household appliances however, the rebate offered by RRA inherently incentivizes the recovery of refrigerant from larger systems and there is a notable void in the responsible management of small quantities of ODS refrigerant recovered from household appliances and vehicle end-of-life (ICF, 2008, p67). RRA estimates based on 2014 – 2015 collection data (available on their website) that their program accepted between 15 – 20 percent of all refrigerants available for recovery from automotive, commercial, industrial, and household refrigeration and air conditioning equipment and appliances in Australia. The majority of the remaining refrigerant is recovered for reuse by the technicians and contractors servicing the equipment. There is no nationwide program for recovering ODS refrigerant from vehicles or household appliances at end-of-life. Additionally, the RRA program does not include sources of ODS refrigerant beyond what is recovered by service technicians and contractors in recovery cylinders, i.e., unused or otherwise saleable quantities of ODS refrigerant remain on the market or stored in stockpiles.
- The Canadian product stewardship scheme is operated by the Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) as a voluntary industry-led program. The program does not provide a rebate, but it does accept ODS refrigerant recovered from commercial/industrial stationary refrigeration and air conditioning equipment as well as household window air conditioners on a no-fee basis. Other recovered ODS refrigerant in small quantities from the household appliance and automotive sectors requires a disposal fee, and thus does not di-

rectly benefit from the incentive program. As such, program participation is primarily seen from the commercial/industrial stationary refrigeration and air conditioning industry. According to the 2008 ICF report, 95 percent of the commercial stationary refrigeration and air conditioning industry participates in the voluntary program. As in Australia, the HRAI program does not include ODS refrigerant beyond what is recovered by service technicians and contractors, i.e., unused or otherwise saleable quantities of ODS refrigerant remain on the market or stored in stockpiles.

- An industry-led program in Japan provides ODS refrigerant recovery, recycling, and/or destruction. ODS refrigerants are recovered from household appliances and vehicles at end-of-life as well as from the commercial refrigeration and air conditioning service sector. The costs associated with the program are shared by equipment manufacturers, importers, and consumers. In 2015 approximately 965 metric tonnes of ODS refrigerants were recycled and another 4,800 metric tonnes were destroyed (with ODS refrigerants making up a small portion of both) (OFCP, 2016).
- A voluntary product stewardship scheme is also in place in New Zealand. The program collects CFCs, HCFCs, HFCs, and other synthetic refrigerants from the refrigeration and air conditioning industries. The program is operated by a charitable trust that is funded through a wholesale levy placed on imported refrigerant and paid by participating companies. Unwanted refrigerant is collected from industry participants at no charge, aggregated at one of three collection depots, and shipped overseas for destruction. Since 1999 more than 347 metric tonnes of refrigerants have been collected and destroyed by the program. (Recovery, 2016)

There are essential distinctions between the project activities described in this methodology and the ODS refrigerant destruction programs established in Australia, Canada, Japan, and New Zealand. For one, few of these existing programs readily facilitate the collection of small quantity ODS refrigerants, such as that recovered from household appliances or vehicles, or widely dispersed in disposable cylinders and cans. Most importantly, none of the programs prevent the continued use and reuse of ODS refrigerant as an alternative to destruction.

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