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

THE DESTRUCTION OF OZONE DEPLETING SUBSTANCES AND HIGH-GWP FOAM

VERSION 2.0

February 2023

ACR
AT WINROCK INTERNATIONAL

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ABOUT ACR[SM]

ACR is a leading global carbon crediting program operating in regulated and voluntary carbon markets. Founded in 1996 as the first private voluntary greenhouse gas (GHG) registry in the world, ACR creates confidence in the integrity of carbon markets to catalyze transformational climate results. ACR ensures carbon credit quality through the development of environmentally rigorous, science-based standards and methodologies as well as oversight of carbon offset project verification, registration, and credit issuance and retirement reporting through its transparent registry system. ACR is governed by Environmental Resources Trust LLC, a wholly-owned nonprofit subsidiary of Winrock International.

Acronyms

A/C	Air conditioning
AHRI	Air-Conditioning, Heating and Refrigeration Institute
ANSI	American National Standards Institute
CAA	Clean Air Act
CEMS	Continuous Emission Monitoring System
CFC	Chlorofluorocarbon
CH_4	Methane
CO_2	Carbon dioxide
CPT	Comprehensive performance test
DOT	U.S. Department of Transportation
DRE	Destruction and removal efficiency
EoL	End of life
EPA	United States Environmental Protection Agency
FTIR	Fourier transform infrared spectroscopy
GWP	Global warming potential
HBFC	Hydrobromofluorocarbon
HBR	High boiling residue
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
HWC	Hazardous waste combustor

MT	Metric ton
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
ODS	Ozone depleting substances
PU	Polyurethane
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

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1 Introduction

1.1 Purpose

The purpose of the Methodology is to quantify greenhouse gas (GHG) emission reductions associated with the destruction of: 1) high global warming potential (GWP) ozone depleting substances (ODS) obtained from within the U.S. and Canada and destroyed at an eligible destruction facility that would have otherwise been released to the atmosphere; 2) high-GWP foam blowing agents that are extracted from insulation foam; and 3) insulation foam that contains blowing agent(s) with high GWP.

2 Eligible Activities

This Methodology defines a set of activities designed to reduce GHG emissions by the destruction of eligible ODS, high-GWP foam blowing agents, or high-GWP insulation foam at qualifying destruction facilities.

2.1 Eligible Destruction Facilities

I. The end fate of the ODS, high-GWP foam blowing agent, or high-GWP insulation foam must be destruction 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% (95% for ODS and High GWP HFCs destroyed from intact foam); or
   B. A destruction facility that meets or exceeds the Montreal Protocol's TEAP standards provided in the *Report of the Task Force on Destruction Technologies*.
      i. A facility must demonstrate DRE of 99.99% (95% for ODS and High GWP HFCs destroyed from intact foam) and emission levels consistent with the guidelines set forth in the TEAP report. Evidence of meeting this requirement, along with all applicable national regulatory requirements (including permits), should be demonstrated as part of project validation and verification.

II. A destruction facility in the U.S. must meet all applicable monitoring and operational requirements under CAA and NESHAP standards, as well as all applicable federal, state, and local laws that apply directly to ODS, high-GWP foam blowing agent, and high-GWP insulation foam destruction activities during the time the ODS, high-GWP foam blowing agent or high-GWP foam destruction occurs.

III. A destruction facility in Canada must meet all applicable monitoring and operational requirements under Canadian Environmental Protection Act (CEPA) at the Federal level, as well as all other applicable federal, provincial, and local laws that apply directly to ODS, high-GWP foam blowing agent, and high-GWP insulation foam destruction activities during the time the ODS, high-GWP foam blowing agent or high-GWP foam destruction occurs.

IV. A destruction facility in countries other than U.S. and Canada must meet all applicable monitoring and operational requirements as well as all other applicable federal, state, provincial, and local laws that apply directly to ODS, high-GWP foam blowing agent, and high-GWP insulation foam destruction activities during the time the ODS, high-GWP foam blowing agent or high-GWP foam destruction occurs.

V. At the time of ODS, high-GWP foam blowing agent, or high-GWP insulation foam destruction, the destruction facility must have a valid Title V air permit (in the U.S.), equivalent permit required by CEPA (in Canada), equivalent permit (in other countries), if applicable, and any other air or water permits required by local, provincial, state or federal law to destroy ODS, high-GWP foam blowing agent, and/or high-GWP insulation foam and document compliance with all monitoring and operational requirements that apply to ODS, high-GWP foam blowing agent, and high-GWP insulation foam destruction project activities.

VI. For RCRA permitted HWCs in the U.S., any upsets or exceedances must be managed in accordance with an authorized SSMP.

VII. Any post-destruction hazardous waste must be managed as required by RCRA in the U.S, CEPA in Canada, and applicable/equivalent legislations in other countries.

2.2 Eligible ODS, High-GWP Foam Blowing Agents and High-GWP Insulation Foam

I. ODS, high-GWP foam blowing agents and high-GWP insulation foam destroyed under this Methodology must be from one or more of the eligible sources listed in subchapters 2.2.1, 2.2.2, 2.2.3, 2.2.4 or 2.2.5 of this Methodology.

II. ODS produced exclusively for other applications not listed in Sections 2.2.1, 2.2.2, 2.2.3, 2.2.4 or 2.2.5 are not eligible.

III. A single offset project may incorporate ODS, high-GWP foam blowing agents, or high-GWP insulation foam obtained from one or more of the source categories listed in subchapters 2.2.1, 2.2.2, 2.2.3, 2.2.4 or 2.2.5 of this Methodology.

IV. Destruction activity must take place under one or more Certificates of Destruction.

V. 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, high-GWP foam blowing agents, or high-GWP insulation foam destroyed; and

   B. The destruction activities must occur during one reporting period.

VI. A Certificate of Destruction may be used for only one offset project.

VII. 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. If applicable, serial, tracking or ID number of all containers for which high-GWP insulation foam destruction occurred;
F. For ODS, extracted high-GWP foam blowing agent, and high-GWP insulation foam in containers, mass and type of material destroyed from each container;
G. For high-GWP foam blowing agent extracted and destroyed in an enclosed equipment de-manufacturing system, mass of each high-GWP foam blowing agent destroyed.
H. Start and end destruction times and dates.

VIII. The ODS destroyed may originate from a single source or from numerous sources.
IX. The high-GWP foam blowing agents may originate from a single source or from numerous sources.
X. The high-GWP insulation foam may originate from a single source or from numerous sources.
XI. The handling, recovery, and disposal of ODS refrigerants must be performed by technicians certified by the U.S. EPA under CAA, sections 608 and 609, as applicable in the U.S., as required by CEPA in Canada, and by equivalent/appropriate authority/legislation in other countries that require such certification. Technicians may only service the equipment they are certified to service. Technician name and certification type(s) 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, systems, or other supplies legally sold for use in the United States or Canada.
II. Refrigerants from government inventories or stockpiles are only eligible if they are not required to be destroyed or converted.
III. Only destruction of the following ODS refrigerants is eligible to generate ACR Emission Reduction Tonnes (ERTs) under this Methodology:

A. CFC-11;
B. CFC-12;
C. CFC-13;
D. CFC-113;

E. CFC-114;
F. CFC-115;
G. HCFC-22;
H. HCFC-123

IV. ODS extracted from a foam source for use in refrigeration equipment is not considered part of this source category and must instead be considered as a high-GWP insulation foam source.

2.2.2 HIGH-GWP INSULATION FOAM SOURCES[1]

I. Eligible high-GWP insulation foam must originate from appliance foam, building foam, or other foam legally sold for use in the U.S. or Canada.

II. Only destruction of the following high-GWP insulation foam blowing agents is eligible to generate ACR ERTs under this Methodology:

A. CFC-11;
B. CFC-12;
C. CFC-114
D. HCFC-22;
E. HCFC-141b;
F. HCFC-142b;
G. HFC-134a;
H. HFC-245fa.
I. HFC-365mfc

III. To be eligible, the high-GWP blowing agent must be destroyed in one of three ways:

A. If high-GWP blowing agent is extracted from insulation foam and subsequently destroyed at a separate destruction facility, the blowing agent must be extracted from the insulation foam under negative pressure and collected, stored, and transported in hermetically sealed containers;

B. If high-GWP blowing agent is extracted from foam and destroyed within an enclosed equipment de-manufacturing system, the blowing agent must be extracted from the foam and destroyed under negative pressure; or

C. If high-GWP insulation foam is destroyed, the intact foam (i.e., foam that is not shredded or compacted prior to destruction) must be separated from the application from which it

[1] Inclusive of high-GWP blowing agents extracted from insulation foam.

originated (i.e., those applications cited in subchapter 2.2.2 I) and must be stored, transported, and destroyed in sealed containers (see section 6.6 I).

2.2.3 MEDICAL AEROSOL SOURCES

I. Eligible medical aerosols must:
   A. Originate from domestic U.S. or Canada stockpiles of ODS originally produced in the U.S. or Canada prior to January 1, 2012 under an essential use exemption; and
   B. Be eligible for sale for use in medical products that are listed as essential uses by the U.S. Food and Drug Administration in the U.S. and Canadian Department of Health in Canada.

II. Only destruction of the following ODS medical aerosols is eligible to generate ACR ERTs under this Methodology:
   A. CFC-11;
   B. CFC-12;
   C. CFC-114;
   D. HCFC-22;
   E. HCFC-142b

2.2.4 FIRE SUPPRESSANT SOURCES

I. Eligible fire suppressants must originate from equipment or systems in the United States or Canada. Imported (except from U.S. or Canada) ODS fire suppressants are not eligible under this Methodology.

II. Only destruction of the following fire suppressants is eligible under this Methodology:
   A. Halon 1211;
   B. Halon 1301.

III. Halon 1301 originating in strategic stockpiles (strategic reserves that are being maintained for fire suppression systems in aviation, military use, shipping, oil and gas, computer rooms, and other critical applications) is not eligible under this Methodology.

2.2.5 SOLVENT SOURCES

I. Eligible solvents must be unused and in virgin condition. Unused solvents listed as hazardous waste by EPA under 40 CFR 261, subpart D are not eligible for destruction under this

methodology. Imported (except from U.S. or Canada) ODS solvents are not eligible under this Methodology. See Appendix D.5 for further details on additionality.

II. Only destruction of the following ODS solvents is eligible under this Methodology:
   A. CFC-11
   B. CFC-113
   C. HCFC-123
   D. HCFC-141b
   E. HCFC-225ca
   F. HCFC-225cb

3 Eligibility

ODS and high-GWP insulation foam (intact foam or extracted blowing agents) 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 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, high-GWP foam blowing agents, or high-GWP insulation foam that would otherwise be emitted to the atmosphere;
   B. Destroy the recovered ODS, high-GWP foam blowing agents, or high-GWP insulation foam through an eligible end-use management option pursuant to subchapter 2.1 of this Methodology;
   C. Conform with the point of origin 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 ANAB-accredited offset verification body approved by ACR.

3.2 Location

I. All ODS and high-GWP insulation foam must be obtained from equipment, systems, and other eligible supplies in the United States or its territories or Canada.

II. All ODS, high-GWP foam blowing agents, and high-GWP insulation foam must be destroyed at RCRA permitted destruction facilities in the U.S. (and its territories) or TEAP compliant destruction facilities outside the U.S. See section 2.1 for additional details.

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 Regulatory Surplus Test in subchapter 3.3.1 and the Performance Standard Evaluation in subchapter 3.3.2 of this Methodology.

3.3.1 REGULATORY SURPLUS 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 regulatory surplus test applies to all ODS and high-GWP insulation foam projects:

   A. If no law, regulation, or legally binding mandate requires the destruction of ODS stocks, high-GWP foam blowing agent, or high-GWP insulation foam, all emission reductions resulting from the recovery and destruction of ODS and high-GWP insulation foam are considered to be surplus to regulatory requirements, and therefore eligible for crediting under this Methodology.

   B. If any law, regulation, or legally binding mandate requires the destruction of ODS stocks, high-GWP foam blowing agent, or high-GWP insulation foam, only emission reductions resulting from the recovery and destruction of ODS, high-GWP foam blowing agent, and high-GWP insulation foam 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 destruction of halon 1301 obtained from strategic stockpiles or sources other than those recovered from fire suppression equipment is ineligible for crediting under this Methodology.

III. The performance standard evaluation is satisfied if the ODS or high-GWP insulation foam 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 (i.e., collection of ODS or high-GWP insulation foam, transportation of ODS or high-GWP insulation foam, etc.) will occur prior to offset project commencement.

3.5 Reporting Periods

I. An ODS or high-GWP insulation foam 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 V 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 equal to the reporting period. It cannot be renewed.

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, high-GWP foam blowing agents, or high-GWP insulation foam, 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.

3.8 Re-quantification of Emission Reductions for Previously Validated and Verified Projects

Version 2.0 of this methodology allows use of 100% emission rates for all eligible ODSs and High-GWP HFCs and removes the substitute emissions deduction requirement in the quantification of emission reductions. Projects validated and verified with previous versions of this methodology with start dates within past two (2) years of the publication of version 2.0 of this methodology, are eligible for re-quantification of emission reductions using the updated quantification equations included in the version 2.0 of this methodology.

To claim additional Emission Reduction Tonnes (ERTs) for these projects, the Project Proponent and/or Validation and Verification Body (VVB) shall submit the following within six (6) months of publication of this methodology.

I. Updated GHG Project Plan and Monitoring reports showing new equations and calculations.

II. Addendum to the original Validation and Verification (VV) Report that shows the new calculated baseline emissions, project emissions, and ERTs. This should also show the outstanding ERTs to

be issued (New ERTs – Original ERTs). The addendum shall state that eligibility and all other required checks of the VV audit remain unchanged since the first VV audit.

III. Addendum to the original Verification Statement that shows the New ERTs, Original ERTs, and the Outstanding ERTs.

4 Offset Project Boundary

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 and high-GWP insulation foam.

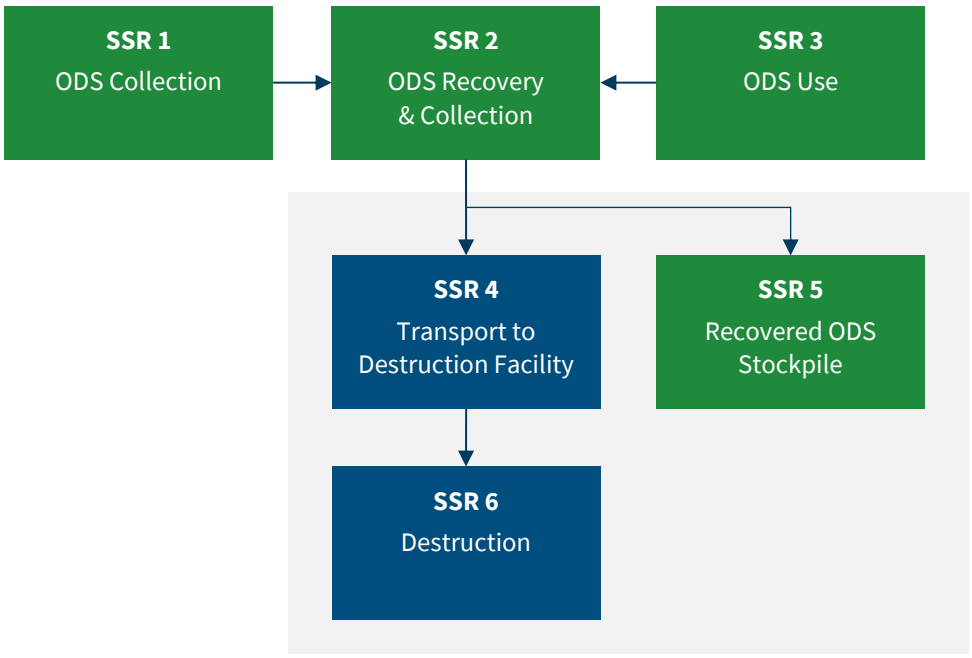
II. Figure 1 illustrates the GHG assessment boundary for refrigerant ODS, medical aerosol ODS, solvent ODS and fire suppressant ODS projects.

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 Refrigerant, Medical Aerosol, Solvent, and Fire Suppressant ODS Projects



III. Table 1 lists the SSRs for refrigerant, medical aerosol, solvent, and fire suppressant ODS projects indicating which gases are included or excluded from the offset project boundary.

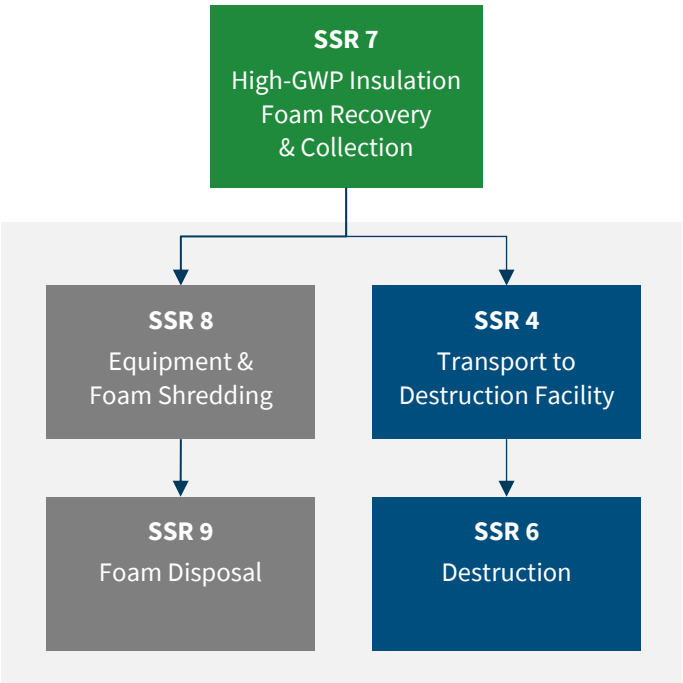
Table 1: List of Identified SSRs for Refrigerant, Medical Aerosol, Solvent, and Fire Suppressant ODS Projects

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 ODS 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 and fire suppressant systems	CO_2	E
		CH_4	E
		N_2O	E
4 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
	Emissions of ODS from recovered ODS stockpiles and EOL equipment (If not sent for destruction)	ODS	I

SSR	SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EXCLUDED (E)
5 Recovered ODS Stockpile	Indirect emissions from grid-delivered electricity	CO_2	E
		CH_4	E
		N_2O	E
6 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
		N_2O	E

IV. Figure 2 illustrates the GHG assessment boundary for high-GWP insulation foam projects.
   A. All SSRs inside the grey box are included and must be accounted for under this Methodology.
   B. SSRs in dark grey boxes are relevant only to baseline emissions.
   C. SSRs in blue boxes are relevant only to project emissions.
   D. SSRs in green boxes are relevant to the baseline and project emissions.

Figure 2: Illustration of the Offset Project Boundary for High-GWP Insulation Foam Projects



V. Table 2 lists the SSRs for high-GWP insulation foam projects indicating which gases are included or excluded from the offset project boundary.

Table 2: List of Identified SSRs for High-GWP Insulation Foam Projects

SSR	SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EXCLUDED (E)
4 ODS Collection	Fossil fuel emissions from the vehicular transport of high-GWP insulation foam or extracted blowing agent from aggregation point to final destruction facility	CO_2	I
		CH_4	E
		N_2O	E
6 Destruction	Emissions from incomplete destruction at destruction facility	ODS/HFC	I
	Emissions from the oxidation of carbon contained in destroyed foam or blowing agent	CO_2	I
	Fossil fuel emissions from the destruction of foam or blowing agent 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
		N_2O	E
7 High-GWP Insulation Foam Recovery and Collection	Emissions of ODS/HFC from demolition, deconstruction, or other damage to foam sources	ODS/HFC	E
	Fossil fuel emissions from demolition or deconstruction of foam sources	CO_2	E
		CH_4	

SSR	SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EXCLUDED (E)
		N_2O	
	Fossil fuel emissions from the collection and transport of high-GWP foam sources	CO_2	E
		CH_4	
		N_2O	
8 Equipment and Foam Shredding[2]	Emissions of ODS/HFC from the removal of foam from equipment for materials recovery, releasing ODS/HFC from foam	ODS/HFC	I
9 Foam Disposal	Emissions of ODS/HFC released from foam disposed of in landfills	ODS/HFC	I
	Fossil fuel emissions from the transport and placement of shredded foam waste in landfill	CO_2	E
		CH_4	E
		N_2O	E

[2] SSR 8 is only relevant to projects that manually remove foam in a non-enclosed equipment de-manufacturing system. For projects that destroy extracted high-GWP blowing agent from foam in an enclosed equipment de-manufacturing system, quantification of project emissions from foam removal is not required.

5 Quantifying GHG Emission Reductions

I. GHG emission reductions from an ODS or high-GWP insulation foam[3] project are quantified by comparing actual project emissions to calculated project baseline emissions.

II. A project proponent must use the calculation methods provided in this methodology to determine baseline and project GHG emissions.

III. GHG emissions must be quantified using the GWP values in Table 4.

IV. 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

$$ER_t = BE_t - PE_t$$

WHERE		UNITS
ER_t	Total quantity of GHG emission reductions during the reporting period	MT CO_2e
BE_t	Total quantity of project baseline emissions 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 by using Equation 2 and by summing the baseline emissions for all SSRs identified as included in the baseline in Tables 1 and 2.

[3] Whether intact high-GWP insulation foam or blowing agent extracted from high-GWP insulation foam

Equation 2: Total Baseline Emissions

$$\mathbf{BE_t = BE_{refr} + BE_{foam} + BE_{aer} + BE_{fs} + BE_{sol}}$$

WHERE		UNITS
BE_t	Total quantity of project baseline emissions during the reporting period	MT CO_2e
BE_{refr}	Total quantity of project baseline emissions from refrigerant ODS	MT CO_2e
BE_{foam}	Total quantity of project baseline emissions from high-GWP blowing agent	MT CO_2e
BE_{aer}	Total quantity of project baseline emissions from medical aerosol ODS	MT CO_2e
BE_{fs}	Total quantity of project baseline emissions from fire suppressant ODS	MT CO_2e
BE_{sol}	Total quantity of project baseline emissions from solvent ODS	MT CO_2e

II. Baseline emissions from refrigerant ODS (BE_{refr}) must be quantified using Equation 3.

III. BE_{refr} must include the estimated CO_2e emissions that would have occurred if the total quantity of recovered ODS ($Q_{refr,i}$) would not have been sent for destruction (remained in stockpile or inside EOL equipment) and would have eventually leaked into the atmosphere.

IV. 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 C.

V. The GWP values for ODS (GWP_i) must be taken from Table 4.

VI. If the project did not destroy any refrigerant ODS, then $BE_{refr} = 0$.

Equation 3: Baseline Emissions from Refrigerant ODS

$$\mathbf{BE_{refr} = \sum_i (Q_{refr,i} \times GWP_i)}$$

WHERE		UNITS
BE_{refr}	Total quantity of refrigerant project baseline emissions during the reporting period	MT CO_2e

$Q_{refr,i}$	Total quantity of refrigerant ODS **i** sent for destruction by the offset_project	MT ODS
GWP_i	Global warming potential of ODS **i** (see Table 4)	MT CO_2e/ MT ODS

VII. Baseline emissions from high-GWP foam blowing agents (BE_{foam}) (blowing agent extracted from foam or intact foam) must be quantified using Equation 4.

VIII. BE_{foam} must include the estimated CO_2e emissions that would have occurred as the result of foam disposal and eventual emission of all blowing agent contained in the foam product.

IX. The mass and composition of extracted blowing agent from high-GWP foam (EBA_i) must be calculated per the procedures in Appendix C.

X. The mass of intact high-GWP foam ($Q_{intf,i}$) must be calculated using the scales of the eligible destruction facility as specified in Appendix B

XI. The mass fraction of intact high-GWP blowing agent ($BA\%_{intf,i}$) must be calculated per Appendix B II or alternatively as described in section 6.1.IX.C

XII. If the project did not destroy any high-GWP blowing agent, then $BE_{foam} = 0$

Equation 4: Baseline Emissions from High-GWP Insulation Foam

$$\mathbf{BE_{foam}} = \sum_{i,j} [(\mathbf{EBA_i} + \mathbf{BA_{intf,i}}) \times \mathbf{GWP_i}]$$

WHERE		UNITS
BE_{foam}	Total quantity of high-GWP blowing agent project baseline emissions	MT CO_2e
EBA_i	Total quantity of high-GWP blowing agent **i** extracted from foam and destroyed (as determined through the procedures provided in Appendix C)	MT BA
$BA_{intf,i}$	Total quantity of high-GWP blowing agent **i** in intact foam sent for destruction (as determined through Equation 5)	MT BA
GWP_i	Global warming potential of high GWP blowing agent **i** (see Table 4)	MT CO_2e/ MT BA

Equation 5: Quantity of high-GWP blowing agent from intact foam

$$BA_{intf,i} = Q_{intf,i} \times BA\%_{intf,i}$$

WHERE		UNITS
$BA_{intf,i}$	Total quantity of high-GWP blowing agent **i** from intact foam sent for destruction	MT BA
$Q_{intf,i}$	Total mass of intact foam, **i**, with entrained high-GWP blowing agent sent for destruction (as determined through procedures in Appendix B I)	MT
$BA\%_{intf,i}$	Mass ratio of high-GWP blowing agent, **i**, entrained in intact foam (as determined per the procedures in Appendix B II or 6.1.IX.C and D)	% (0-1)

XIII. Baseline emissions from medical aerosol ODS (BE_{aer}) must be quantified using Equation 6.

XIV. BE_{aer} must include the estimated CO_2e emissions that would have occurred if the total quantity of recovered ODS ($Q_{aer,i}$) would not have been sent for destruction (remained in stockpile or inside medical aerosol devices) and would have eventually leaked.

XV. The total mass of medical aerosol ODS sent for destruction ($Q_{aer,i}$) includes eligible ODS and excludes the mass of HBR, moisture, ineligible ODS, and other ineligible material. Mass and composition of medical aerosol ODS are determined per Appendix C.

XVI. The GWP values for medical aerosol ODS (GWP_i) must be taken from Table 4.

XVII. If the project did not destroy any medical aerosol ODS, then $BE_{aer} = 0$.

Equation 6: Baseline Emissions from Medical Aerosol ODS

$$BE_{aer} = \sum_{i} (Q_{aer,i} \times GWP_i)$$

WHERE		UNITS
BE_{aer}	Total quantity of medical aerosol project baseline emissions during the reporting period	MT CO_2e
$Q_{aer,i}$	Total quantity of medical aerosol ODS **i** sent for destruction by the project	MT ODS
GWP_i	Global warming potential of ODS **i** (see Table 4)	MT CO_2e/ MT ODS

XVIII. Baseline emissions from fire suppressant ODS (BE_{fs}) must be quantified using Equation 7.

XIX. BE_{fs} must include the estimated CO_2e emissions that would have occurred if the total quantity of recovered ODS ($Q_{fs,i}$) would not have been sent for destruction (remained in stockpile or inside fire suppression equipment or systems) and would have eventually leaked into the atmosphere.

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

XXI. The GWP values for fire suppressant ODS (GWP_i) must be taken from Table 4.

XXII. If the project did not destroy any fire suppressant ODS, then $BE_{fs} = 0$.

Equation 7: Baseline Emissions from Fire Suppressant ODS

$$\mathbf{BE_{fs} = \sum_{i} Q_{fs} \times GWP_i}$$

WHERE		UNITS
BE_{fs}	Total quantity of fire suppressant project baseline emissions during the reporting period	MT CO_2e
$Q_{fs,i}$	Total quantity of fire suppressant ODS **i** sent for destruction by the project	MT ODS
GWP_i	Global warming potential of ODS **i** (see Table 4)	MT CO_2e/ MT ODS

XXIII. Baseline emissions from solvent ODS (BE_{sol}) must be quantified using Equation 8.

XXIV. BE_{sol} must include the estimated CO_2e emissions that would have occurred if the total quantity of recovered unused solvent ODS ($Q_{sol,i}$) would not have been sent for destruction (remained in stockpile or inside solvent containers) and would have eventually leaked into the atmosphere.

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

XXVI. The GWP values for solvent ODS (GWP_i) must be taken from Table 4.

XXVII. If the project did not destroy any solvent ODS, then $BE_{fs} = 0$.

Equation 8: Baseline Emissions from Solvent ODS

$$BE_{sol} = \sum_{i} Q_{sol} \times GWP_i$$

WHERE		UNITS
BE_{sol}	Total quantity of solvent project baseline emissions during the reporting period	MT CO_2e
$Q_{sol,i}$	Total quantity of solvent ODS i sent for destruction by the project	MT ODS
GWP_i	Global warming potential of ODS i (see Table 4)	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 Tables 1 and 2 using Equation 9.

Equation 9: Total Project Emissions

$$PE_t = Rem_f + Tr\&Dest$$

WHERE		UNITS
PE_t	Total quantity of project emissions during the reporting period	MT CO_2e
Rem_f	Total GHG emissions from removal of high GWP foam in a non-enclosed equipment de-manufacturing system	MT CO_2e
$Tr\&Dest$	Total GHG emissions from transportation and destruction of ODS and high-GWP insulation foam/blowing agents	MT CO_2e

II. If high-GWP foam is manually removed in a non-enclosed equipment de-manufacturing system, project emissions from removal of the foam (Rem_f) must be quantified using Equation 10.

A. The default percentage of blowing agent that is lost when foam is removed from appliances in a non-enclosed manufacturing facility is 10% (Lfr).

III. If the project did not destroy any high-GWP blowing agent, then $\mathrm{Rem_f} = 0$.

Equation 10: Project Emissions from Removal of Foam in a Non-Enclosed Equipment De-Manufacturing System

$$\mathbf{Rem_f = (BE_{foam} \times Lfr)}$$

WHERE		UNITS
$\mathrm{Rem_f}$	Total GHG emissions from removal of high GWP foam in a non-enclosed equipment de-manufacturing system	MT CO_2e
$\mathrm{BE_{foam}}$	Total quantity of high-GWP blowing agent project baseline emissions (as determined through Equation 4)[4]	MT CO_2e
Lfr	Default percentage of blowing agent that is lost in removal of foam from appliances in a non-enclosed equipment de-manufacturing system	10%

IV. Project emission from the transportation and destruction of ODS and high-GWP insulation foam/blowing agent shall be quantified using default emission factors in Equation 11.

A. The default emission factor for ODS transportation and destruction is 7.5 MT CO_2e per MT ODS for refrigerant, medical aerosol, fire suppressant, solvent, or blowing agent extracted from high-GWP foam.

B. The default emission factor for transportation and destruction is 75 MT CO_2e per MT of high-GWP foam for intact foam projects.

C. Q_{ODS} and Q_{BA} include the mass of all eligible and ineligible ODS and high-GWP blowing agent, moisture, HBR, and other accompanying material.

Equation 11: Project Emissions from Transportation and Destruction Using the Default Emission Factors

$$\mathbf{Tr\&Dest = (Q_{ODS} \times EF) + (Q_{BA} \times EF) + (Q_{intf} \times EF)}$$

[4] Note that, for purposes of quantifying project foam removal emissions, project baseline emissions used in this equation shall only include the proportion of emissions associated with foam that is manually removed in a non-enclosed manufacturing facility.

WHERE		UNITS
$Tr\&Dest$	Total GHG emissions from ODS and high-GWP insulation foam/blowing agent transportation and destruction, as calculated using default emission factors	MT CO_2e
Q_{ODS}	Total quantity of refrigerant, medical aerosol, solvent, and/or fire suppressant ODS sent for destruction in the project	MT ODS
Q_{BA}	Total quantity of high-GWP blowing agent extracted from insulation foam and sent for destruction in the project	MT BA
Q_{intf}	Total mass of intact foam with entrained high-GWP blowing agent sent for destruction	MT
EF	Default emission factor for transportation and destruction of ODS or High-GWP Blowing Agent foam (7.5 for refrigerant, medical aerosol, solvent, fire suppressant or extracted blowing agent projects, 75 for intact high-GWP foam projects)	MT CO_2e/ MT ODS/ MT BA or MT

5.3 Accounting for Disqualified ODS Material and High-GWP Foam After Destruction

ERTs may only be generated for the destruction of eligible ODS, high-GWP foam blowing agents, and high-GWP insulation foam that meet the point of origin and chain of custody requirements specified in chapter 6 of this Methodology. Any disqualified ODS, high-GWP foam blowing agents, or high-GWP insulation foam must be removed from baseline emission calculations using the following method to determine the mass and species of the disqualified ODS, high-GWP foam blowing agents, or high-GWP insulation foam:

I. The total mass of each container of disqualified ODS (from refrigerant, medical aerosol, solvent, or fire suppressant ODS or high-GWP blowing agent) or high-GWP insulation foam shall be considered as the original container when the ODS or high-GWP foam was acquired. Documentation of the acquired ODS, high-GWP blowing agent, or high-GWP insulation foam must identify the capacity of the disqualified ODS, high-GWP blowing agent or high-GWP

insulation foam 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 5 must be used to convert the volume to mass.

A. For refrigerant, medical aerosol, solvent, or fire suppressant ODS or high-GWP foam blowing agent: If converting between mass and volume, the ODS or blowing agent must be in a liquid state.

II. The species of each disqualified ODS or high-GWP blowing agent shall be the species with the highest GWP of the destruction event.

III. The determined mass of disqualified ODS or high-GWP blowing agent shall be subtracted from the total mass of that ODS or high-GWP blowing agent species destroyed.

A. The total mass of refrigerant ODS sent for destruction ($Q_{refr,i}$) shall be adjusted in Equation 3.

B. The total quantity of blowing agent extracted from high-GWP foam and sent for destruction ($EBA_{,i}$) shall be adjusted in Equation 4.

C. The total mass of high-GWP blowing agent from intact high-GWP foam sent for destruction ($BA_{intf,i}$) shall be adjusted in Equation 5.

D. The total mass of medical aerosol ODS sent for destruction ($Q_{aer,i}$) shall be adjusted in Equation 6.

E. The total mass of fire suppressant ODS sent for destruction ($Q_{fs,i}$) shall be adjusted in Equation 7.

F. The total mass of solvent ODS sent for destruction ($Q_{sol,i}$) shall be adjusted in Equation 8.

5.4 Conversion Factors and Rounding Practices

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

II. The following rounding practices shall be applied for the purpose of this Methodology:

A. At least five significant digits shall be maintained.

B. There shall be no rounding to the left side of the decimal.

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 point of origin of all ODS and high-GWP foam must be documented. The project proponent must collect and maintain documentation showing regulatory compliance back to all points of origin.

III. Documentation of the point of origin must be generated at the time of collection from the point of origin and must include all the following:

   A. Facility name and physical address;

   B. Point of origin zip code; and

   C. Serial or ID number of containers used for storage and transport.

IV. For refrigerant ODS, medical aerosol ODS, solvent ODS, and fire suppressant ODS, the project proponent must collect and maintain documentation on the chain of custody and ownership of the ODS beginning at the point of origin until 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.

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

VI. For projects destroying medical aerosol ODS, the project proponent must maintain documentation that the ODS is eligible to be sold for use in a medical product that is listed as an essential use by the Food and Drug Administration (FDA) in the U.S. or Department of Health in Canada.

VII. For projects recovering and destroying Halon 1301 fire suppressant, the project proponent must obtain a signed attestation from a representative at the point of origin facility regarding the source of the Halon 1301. Specifically, this attestation must state that the source of Halon 1301 is not a strategic stockpile. The attestation shall be supplied to the ACR and to the validation and verification body for assessment.

VIII. For projects destroying solvent ODS, the project proponent must maintain documentation that the ODS was marketed as solvent but was never used. The ODS solvent should not be a hazardous waste as per 40 CFR 261, subpart D in the U.S. and as per CEPA in Canada.

IX. For intact high-GWP foam sources (i.e., those where blowing agent is not extracted prior to destruction), the project proponent must collect and maintain all the following information:

A. For intact high-GWP foams:

i. Total quantity of foam that is the source of the high-GWP blowing agent in the project;

ii. Type and amount of blowing agent in the foam determined through procedures in Appendix B.II or Sections 6.1 IX C and D, as applicable; and

B. For intact appliance high-GWP foams:

i. Numbers of units containing high-GWP foam that are processed;

ii. Type and amount of blowing agent(s) in the foam, determined through the procedures in Appendix B II or Sections 6.1 IX C and D, as applicable.

C. Type and amount of blowing agent(s) in the intact foam may also be determined based on manufacturer specifications (for appliances) and bill of materials (for buildings) that show the type(s) and quantities of blowing agent(s) originally used. The amount of blowing agent(s) remaining in the intact foam shall be determined using the applicable default emission (loss) rate at disposal published by US EPA in the most recent U.S. Inventory of Greenhouse Gas Emissions and Sinks.

D. For high-GWP intact foams in existing stockpiles, the type and amount of blowing agent(s) may be determined following 6.1.IX.C based on the original source of recovered foam materials. If the foam stockpile is older than a year, the amount of remaining blowing agent in the stockpiled foam shall be determined by deducting the default annual leakage rate (for each 12-month year the foam remained in the stockpile) from the emission (loss) rate at disposal. The leakage and emission rates shall be based on most recent U.S. Inventory of Greenhouse Gas Emissions and Sinks published by the US EPA. The stockpile of intact foam should be stored in dry and covered space from the date it was discontinued to be used. Excessively damaged or torn intact foams are ineligible.

X. For refrigerant ODS, medical aerosol ODS, solvent ODS, and fire suppressant ODS and extracted high-GWP foam blowing agent that is not destroyed in an enclosed equipment de-manufacturing process, the project proponent must collect and maintain all 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. Size of each sample in pounds;
F. Volume of container from which sample was extracted;
G. Ambient air temperature at time of sampling; and
H. Chain of custody for each sample from the point of sampling to the eligible lab.

XI. For refrigerant ODS, medical aerosol ODS, solvent ODS, and fire suppressant ODS and extracted high-GWP foam blowing agent, 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;
   D. Data on the emissions of carbon monoxide during destruction; and
   E. If applicable, for an enclosed equipment de-manufacturing system:
      i. Mass and composition of ODS and high-GWP blowing agent(s) entering the destruction unit,
      ii. Time and date(s) of chemical analyses,
      iii. Number of appliances that are de-manufactured in the system, and
      iv. Date(s) appliances enter equipment de-manufacturing system.

XII. For intact high-GWP insulation foam, the destruction facility must track 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 of the following information from the destruction facility:
   A. Mass of high-GWP foam fed into the destruction unit;
   B. Operating temperature and pressure of the destruction unit during foam destruction;
   C. Effluent discharges measured in terms of water and pH levels; and
   D. Data on the emissions of carbon monoxide during foam destruction.

6.2 Point of Origin Determination

I. The project proponent must collect and maintain data on the point of origin of each refrigerant ODS, medical aerosol ODS, solvent ODS, or fire suppressant ODS, high-GWP foam blowing

agent, and high-GWP insulation foam as part of tracking chain of custody. Data must be generated at the time of collection from the point of origin.

II. Point of origin is defined as follows:

A. For refrigerant ODS, medical aerosol ODS, solvent ODS, or fire suppressant ODS:

i. The point of origin for all ODS not recovered at an equipment de-manufacturing facility is the location of the ODS prior to acquisition by the project proponent.[5]

ii. The point of origin for all ODS recovered at an equipment de-manufacturing facility is the equipment de-manufacturing facility.

iii. The point of origin for all ODS stored in a stockpile, as of the publication date of this methodology, is the location of the stockpile.

B. For blowing agent extracted from high-GWP foam, the point of origin is the facility where the blowing agent is extracted.

C. For blowing agent in intact appliance or intact other high-GWP foam, the point of origin is the location at which the foam is removed.

D. For blowing agent in intact building high-GWP foam, the point of origin is the location at which the building high-GWP foam was taken.

E. For blowing agent in intact high-GWP foam in a stockpile, the point of origin is the location of the stockpile.

6.3 Instrument QA/QC

I. For a destruction facility that is not part of an enclosed equipment de-manufacturing system, the scales used to determine the mass of ODS, high-GWP foam blowing agent, or high-GWP insulation foam used in calculating emission reductions must be:

A. Properly calibrated and inspected per the destruction facility's RCRA permit, or for non-RCRA facilities, calibrated and inspected as required by the governing permit and at least within six months prior to project start date to 5% or better accuracy. RCRA facilities that do not have calibration requirements defined in their RCRA permits must calibrate and inspect scales at least within six months prior to project start date to 5% or better accuracy.

II. For a destruction facility that is part of an enclosed equipment de-manufacturing system, the following requirements apply:

A. FTIR must be used to determine the mass and composition of ODS or high-GWP blowing agent and:

[5] Per Section 3.3.2, strategically stockpiled Halon 1301 is ineligible for crediting.

i. No more than one day prior to the commencement of the destruction event, conduct a check for calibration accuracy using a gas of known quality:
    a. This check must demonstrate that the FTIR equipment is accurate to within +/- 1% relative to the reference gas;
ii. Conduct and record a daily zero validation of the FTIR equipment output;
iii. No more than one day prior to the end of the destruction event, conduct a check for calibration accuracy using a gas of known quality:
    a. This check must demonstrate that the FTIR equipment is accurate to within +/- 1% relative to the reference gas
iv. The FTIR equipment must be calibrated by the manufacturer or a certified calibration service per manufacturer's specifications or every 5 years, whichever is more frequent. Instruments are exempted from calibration requirements if the manufacturer's specifications state that no calibration is required.
v. If a check on the FTIR equipment reveals accuracy less than +/- 1% threshold (reading relative to the reference gas), corrective action such as calibration by the manufacturer or a certified service provider is required for the FTIR equipment.
vi. If the check on the FTIR equipment reveals accuracy less than +/- 1% threshold during the check stipulated in Section 6.3 II A i, the destruction event may not commence until corrective action is performed and a subsequent check reveals accuracy within a +/-1% threshold
vii. If the check on the FTIR equipment reveals accuracy less than +/- 1% of threshold during the check stipulated in Section 6.3 II A iii, the mass and composition data from the FTIR equipment must be scaled per the following procedure. These adjustments must be made for the entire period from the check required in Section 6.3 II A i through to the end of the reporting period.
    a. The project proponent shall calculate total emission reductions using:
        1. The monitored values without correction; and
        2. The monitored values adjusted based on the calibration drift recorded at the time of the check as required in Section 6.3 II A iii.
    b. The lower of the two emission reduction estimates shall be reported as the emission reductions claimed for the reporting period.

B. If a catalyst is used in the destruction process, maintenance procedures related to catalyst replacement, carbon filter cleaning or other system controls needed to ensure the required

99.99% destruction efficiency is maintained must be implemented in accordance with manufacturer's guidance and specifications.

6.4 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 permits, Notices of Violations (NOVs) for facilities in the U.S., Notices or letters of non-compliances for facilities outside the U.S., and any relevant administrative or legal consent orders dating back at least 3 years prior to the project commencement date;

C. Destruction facility monitoring and maintenance information (Continuous emissions 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 point of origin documentation; and

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

6.5 Monitoring Parameters

The project proponent must monitor the parameters described in Table 3.

Table 3: Project Monitoring Parameters

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

EQUATION #	PARAMETER	DESCRIPTION	DATA UNIT	MEASUREMENT FREQUENCY	CALCULATED (C) MEASURED (M) REFERENCE (R) OPERATING RECORDS (O)	COMMENT
						for each project
		Mass of ODS (or ODS mixture) or HFC in each container	Mass of mixture	Per container	M	Must be determined for each container
		Concentration of ODS (or ODS mixture) or HFC in each container	Mass ODS or HFC/ Mass of mixture	Per container	M	Must be determined for each container
		Mass of ODS or HFC destroyed in an enclosed equipment de-manufacturing system	Mass of mixture	Continuous	M	Readings taken and recorded every two minutes
		Concentration of ODS or HFC destroyed in an enclosed equipment de-manufacturing system	Concentration of ODS or HFC	Continuous	M	Readings taken and recorded every two minutes
		Mass of building foam used as source of ODS and high GWP blowing agent	Mass of building foam	For each offset project	M	Must be monitored for each project

EQUATION #	PARAMETER	DESCRIPTION	DATA UNIT	MEASUREMENT FREQUENCY	CALCULATED (C) MEASURED (M) REFERENCE (R) OPERATING RECORDS (O)	COMMENT
1	ER_t	Total quantity of GHG emission reductions during the reporting period	MT CO_2e	For each offset project	C	
12	BE_t	Total quantity of baseline emissions during the reporting period	MT CO_2e	For each offset project	C	
19	PE_t	Total quantity of project emissions during the reporting period	MT CO_2e	For each offset project	C	
23	BE_{refr}	Total quantity of baseline emissions from refrigerant ODS	MT CO_2e	For each offset project	C	
24	BE_{foam}	Total quantity of baseline emissions from high-GWP blowing agent	MT CO_2e	For each offset project	C	
26	BE_{aer}	Total quantity of medical aerosol ODS baseline emissions	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
27	BE_{fs}	Total quantity of fire suppressant ODS baseline emissions	MT CO_2e	For each offset project	C	
28	BE_{sol}	Total quantity of solvent ODS baseline emissions	MT CO_2e	For each offset project	C	
3	$Q_{refr,i}$	Total quantity of refrigerant ODS **i** sent for destruction	MT ODS	For each offset project	M	
3 4 6 7	GWP_i	Global warming potential of ODS or HFC **i**	MT CO_2e/ MT ODS or MT BA	N/A	R	See Table 4
4	$EBA_{,i}$	Total quantity of high-GWP blowing agent **i** extracted from foam and destroyed	MT BA	For each offset project	C	
4 5	$BA_{intf,i}$	Total quantity of high-GWP blowing agent **i** in intact foam sent for destruction	MT BA	For each offset project	C	

EQUATION #	PARAMETER	DESCRIPTION	DATA UNIT	MEASUREMENT FREQUENCY	CALCULATED (C) MEASURED (M) REFERENCE (R) OPERATING RECORDS (O)	COMMENT
5	$Q_{intf,i}$	Total mass of intact foam **i**, with entrained high-GWP blowing agent sent for destruction	MT	For each offset project	M	
5	$BA\%_{intf,i}$	Mass ratio of high-GWP blowing agent, **i**, entrained in intact foam	% (0-1)	For each offset project	M	
6	$Q_{aer,i}$	Total quantity of medical aerosol ODS, **i**, sent for destruction	MT ODS	For each offset project	M	
7	$Q_{fs,i}$	Total quantity of fire suppressant ODS, **i**, sent for destruction	MT ODS	For each offset project	M	
8	$Q_{sol,i}$	Total quantity of solvent ODS, **i**, sent for destruction	MT ODS	For each offset project	M	
10	Rem_f	Total quantity of high-GWP blowing agent project baseline emissions from destruction of intact foam	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
		manually removed in a non-enclosed equipment de-manufacturing system				
10	Lfr	Default percentage of blowing agent that is lost in manual removal of intact foam in a non-enclosed equipment de-manufacturing system	% (0-1)	For each offset project	R	Equal to 10% for foam removed in a non-enclosed equipment de-manufacturing system
11	Tr&Dest	Total GHG emissions from ODS and high-GWP insulation foam/blowing agent transportation and destruction	MT CO_2e	For each offset project	C	
11	Q_{ODS}	Total quantity of refrigerant, medical aerosol, solvent, and/or fire suppressant ODS sent for destruction	MT ODS	For each offset project	M/C	

EQUATION #	PARAMETER	DESCRIPTION	DATA UNIT	MEASUREMENT FREQUENCY	CALCULATED (C) MEASURED (M) REFERENCE (R) OPERATING RECORDS (O)	COMMENT
11	Q_{BA}	Total quantity of high-GWP blowing agent extracted from insulation foam and sent for destruction in the project	MT BA	For each offset project	M/C	
11	Q_{intf}	Total mass of intact foam, i, with entrained high-GWP blowing agent sent for destruction	MT	For each offset project	M/C	
11	EF	Default emission factor for transportation and destruction of ODS or High-GWP Blowing Agent foam	MT CO_2e/ MT ODS/ MT BA or MT	N/A	R	Equal to 7.5 MT CO_2e per MT for refrigerant, medical aerosol, or fire suppressant projects and blowing agent extracted from high-GWP foam Equal to 75 MT CO_2e per MT for intact foam projects

6.6 Other Monitoring Requirements

This subchapter provides monitoring requirements in addition to the general requirements in subchapter 6.1.

I. When transporting intact high-GWP insulation foam, all recovered foam pieces must be placed in air-tight and water-tight storage until arrival at the destruction facility.

II. Projects using this Methodology to quantify emission reductions from extracted high-GWP foam blowing agent must meet all the following requirements:

   A. The blowing agent must be extracted from the foam to a concentrated form prior to destruction.

   B. The extraction must occur under negative pressure.

   C. If the recovered blowing agent is not destroyed in an enclosed equipment de-manufacturing system, the recovered blowing agent must be collected, stored, and transported in containers meeting DOT standards (equivalent standards in Canada or another country) for refrigerants and analyzed prior to destruction as specified in Appendix C.

   D. The processes, training, QA/QC, and management systems relevant to the collection, storage, and transport of the blowing agent must be documented.

   E. If the recovered blowing agent is destroyed in a destruction unit that is within an enclosed equipment de-manufacturing system, the blowing agent must be analyzed prior to destruction as specified in Appendix C.

III. Projects destroying high-GWP blowing agent from intact foam must follow the procedures in Appendix B. The project proponent must collect and maintain documentation showing conformance with the procedures in Appendix B.

IV. Projects destroying refrigerant ODS, medical aerosol ODS, solvent ODS, fire suppressant ODS, or extracted high-GWP foam blowing agent must follow the procedures in Appendix C. The project proponent must collect and maintain information showing conformance with the procedures in Appendix C.

7 Verification Requirements

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

II. An ODS or high-GWP insulation foam offset project requires only one site visit for each destruction facility regardless of the number of destruction events within that reporting period.

III. For the purpose of this Methodology, the site visit must include one visit to each destruction facility included in the project. 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 point of origin.

Definitions

If not explicitly defined here, the current definitions in the most recent version of the *ACR Standard* apply.

Aggregation	The grouping together of multiple containers of ODS, high-GWP foam blowing agents, or high-GWP insulation foam 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.
Appliance Foam	Insulation foam in domestic appliances such as refrigerators and freezers, water heaters, and in commercial appliances such as refrigerator display cases and vending machines.
Building Foam	Insulation foam used in roofing, flooring, or walls.
Certificate of Destruction	An official document provided by the destruction facility certifying the date, mass, and species of ODS or high-GWP foam blowing agents destroyed.
Container	An air-tight and water-tight unit for storing or transporting ODS, high-GWP foam blowing agents, or high-GWP insulation foam material without leakage or escape. Containers used in transporting project material must comply with all applicable Department of Transportation (DOT) requirements in the U.S. and equivalent requirements in Canada and other countries.
Destruction	The destruction of ODS, high-GWP foam blowing agents, or high-GWP insulation foam by qualified destruction facilities achieving greater than 99.99% (95% for intact foam) destruction and removal efficiency (DRE), so that the destroyed ODS, high-GWP foam blowing agents, or high-GWP insulation foam are not emitted to the atmosphere. Destruction may be performed using any technology that results in the complete breakdown of ODS, high-GWP foam blowing agents, or high-GWP insulation foam into a waste product, a usable by-product, or end-product.

Destruction facility	A facility that destroys ODS, high-GWP foam blowing agents, or high-GWP insulation foam and conforms with the description in either subchapter 2.1 I A or 2.1 I B in this Methodology.
Disqualified ODS, high-GWP foam blowing agents, or high-GWP insulation foam	ODS, high-GWP foam blowing agents, or high-GWP insulation foam that does not conform, or cannot be determined to conform, to the point of origin 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, high-GWP foam blowing agents, or high-GWP insulation foam	Those ODS, high-GWP foam blowing agents, or high-GWP insulation foam included in subchapter 2.2.1, 2.2.2, 2.2.3, 2.2.4 and 2.2.5 in this Methodology.
Enclosed equipment de-manufacturing system	A system involving the disassembly and recycling of refrigerators and other appliances in which the cabinet, including insulation foam, is shredded and materials are recovered, measured, and destroyed in one or more enclosed, self-contained unit or units operating under negative pressure.
Essential Use Exemption	An exception, granted by the Parties to the Montreal Protocol, for continued production of medical aerosol ODS after the production prohibition for ODS used in other applications.
Fire suppression equipment/system	The equipment or system employed to control and extinguish fires used in any sector (including commercial, industrial, or residential).
Halons	A class of ODS that are powerful greenhouse gases and that contribute significantly to stratospheric ozone depletion. These substances are used in various fire suppression equipment and systems.
High-GWP Foam Blowing Agent	ODS or HFC entrained in insulation foam that was used in manufacture of the foam to provide insulation, structural and other performance properties. When reclaimed, ODS or HFC blowing agents have identical chemical properties as ODS or HFC refrigerants and may be sold and used as refrigerants. Unless they are reclaimed to virgin specifications, they cannot be sold on the market.

Ineligible ODS	Those ODS, high-GWP foam blowing agents, or high-GWP insulation foam not included in subchapter 2.2.1, 2.2.2, 2.2.3, 2.2.4 and 2.2.5 in this Methodology.
Intact foam	Insulation foam that is not shredded or compacted prior to destruction.
Medical aerosol	The propellant used to dispense medication from a self-pressurized container. Certain ODS species have been used as medical aerosols.
Metered dose inhaler (MDI)	A device that delivers a specific amount of medication to the lungs, used to treat asthma and other respiratory diseases.
Mixed ODS or high-GWP foam blowing agent	Less than or equal to 90% composition of a single ODS or high-GWP foam blowing agent species.
Non-enclosed equipment de-manufacturing system	A system in which insulation foam in refrigerators and other appliances is removed manually in an open space that is not under negative pressure.
Non-mixed ODS or high-GWP foam blowing age	Greater than 90% composition of a single ODS or high-GWP foam blowing agent species.
Other Foam	Insulation foam used in refrigerated transportation, marine applications (such as boats and buoys), walk-in cooling units, and pipe-in-pipe/preformed pipe applications.
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), halons, methyl bromide (CH3Br), carbon tetrachloride (CCl4), methyl chloroform (CH3CCl3), hydrobromofluorocarbons (HBFC) and bromochloromethane (CHBrCl).
ODS or high-GWP foam blowing agent species	Any individual type of ODS or high-GWP foam blowing agent (e.g., CFC-11, CFC-113, HCFC-22, HFC-134a, etc.).

Refrigeration or air conditioning equipment	A refrigeration or air conditioning appliance or system used in any sector (including commercial, industrial, or residential).
Startup, shutdown, and malfunction plan (SSMP)	A plan, as specified under 40 CFR 63.1206, that includes a description of potential causes of malfunctions, including releases from emergency safety vents, that may result in significant releases of hazardous air pollutants, and actions the source is taking to minimize the frequency and severity of those malfunctions.
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.

Appendix A: Quantification Parameters for ODS and High-GWP Blowing Agents

Table 4: GWPs for eligible ODSs and HFCs

ODS/HFC	100-YR GLOBAL WARMING POTENTIAL (GWP_I)	
	VINTAGE YEAR 2020 & EARLIER	VINTAGE YEAR 2021+[6]
CFC-11	4,750	4,663
CFC-12	10,900	10,239
CFC-13	14,400	13,893
CFC-113	6,130	5,824
CFC-114	10,000	8,592
CFC-115	7,370	7,665
HCFC-22	1,810	1,764
HCFC-123	77	79
HCFC-141b	725	782
HCFC-142b	2,310	1,982
HFC-134a	1,430	1,301
HFC-245fa	1,030	858

[6] IPCC Fifth Assessment Report (AR5), Table 8.SM.16

ODS/HFC	100-YR GLOBAL WARMING POTENTIAL (GWP_I)	
	VINTAGE YEAR 2020 & EARLIER	VINTAGE YEAR 2021+[6]
HFC-365mfc	794	805
HCFC-225ca	122	128
HCFC-225cb	595	525
Halon 1211	1,890	1,746
Halon 1301	7,140	6,292

Table 5: Density of eligible ODSs and HFCs

ODS	DENSITY (G/ML)[7]
CFC-11	1.494
CFC-12	1.34
CFC-13	1.298
CFC-113	1.553
CFC-114	1.44
CFC-115	1.568
HCFC-22	1.177
HCFC-123	1.475
HCFC-141b	1.25
HCFC-142b	1.108
HCFC-225ca	1.55
HCFC-225cb	1.55
Halon 1211	1.85
Halon 1301	1.58
HFC-134a	1.21
HFC-245fa	1.32
HFC-365mfc	1.27

[7] ChemSpider | Search and share chemistry

Appendix B: Mass and Composition from Intact High-GWP Foam Projects

I. Prior to destruction, the precise mass and composition of intact high-GWP foam must be determined following the procedures described in this appendix.
   A. The foam's mass shall be determined on scales at the destruction facility. The scales must be calibrated at least within six months prior to the project start date with a demonstrated +/- 5% or better accuracy.
   B. Prior to determining building foam mass, any construction debris (e.g., wood, metal, glass) or any other non-foam material shall be separated from the foam.

II. To determine the composition and mass ratio of the high-GWP foam blowing agent(s) present in the intact foam, the following sampling requirements apply:
   A. For foams removed from buildings, at least two samples per building surface (e.g., wall, roof) must be taken;
   B. For foams removed from walk-in coolers or refrigerated transportation, one sample from each unit must be taken;
   C. For foams removed from pipes or marine applications, one sample must be taken from one unit from which foam will be taken for purposes of destruction (i.e., for projects that will aggregate multiple pipe sections or multiple units from marine sources such as buoys, one sample is required for each source type).
   D. The samples must conform to all the following requirements:
      i. Each sample must be at least 2 inches in length, 2 inches in width, and 2 inches thick;
      ii. For storage and transport, each sample must be placed and sealed in a separate air-tight and water-tight container that is at least 2 millimeters thick;
      iii. The analysis of high-GWP foam blowing agent content and mass ratio shall be performed at an independent laboratory unaffiliated with the project proponent. The analysis shall be done using one of the two following methods: (1) ASTM Method D 7132-14 Standard Test Method for Determination of Retained Blowing Agent in Extruded Polystyrene Foam or (2) the heating method to extract ODS blowing agent from the foam samples described in Scheutz et al. (2007). The Scheutz method must include all the following steps:

a. Each sample shall be prepared to a thickness no greater than 1 cm, placed in a 1123 mL glass bottle, weighed using a calibrated scale,[8] and sealed with Teflon-coated septa and aluminum caps;

b. To release the high-GWP blowing agent from the foam, the samples must be incubated in an oven for 48 hours at 140 degrees C;

c. When cooled to room temperature, gas samples must be redrawn from the headspace and analyzed by gas chromatography;[9]

d. The lids must be removed after analysis, and the headspace must be flushed with atmospheric air for approximately 5 minutes using a compressor. Afterwards, septa and caps must be replaced, and the bottles subjected to a second 48-hr heating step to drive out the remaining high-GWP blowing agent from the sampled foam; and

e. When cooled down to room temperature after the second heating step, gas samples must be redrawn from the headspace and analyzed by gas chromatography[8].

E. The mass of high-GWP blowing agent(s) recovered shall then be divided by the total mass of the initial foam samples prior to analysis to determine the mass ratio of each high-GWP foam blowing agent present; and

F. For foams removed from buildings, the results from all samples from a single building shall be averaged to determine the mass fraction of blowing agent in foam ($BA\%_{intf,i}$) used in Equation 5.

III. Alternatively, the composition and mass ratio of the high-GWP foam blowing agent(s) present in the intact foam recovered from appliances, buildings, and stockpiles may also be determined using the process described in Section 6.1.IX.C and D.

[8] The scale must be calibrated at least quarterly with a demonstrated +/- 1% or better accuracy.

[9] Room temperature is defined as a range between 20 and 25 degrees Celsius. Room temperature shall be recorded and documented at time of sampling.

Appendix C: Mass and Composition from Refrigerant, Medical Aerosol, Fire Suppressant, Solvent, and Extracted High-GWP Foam Blowing Agent Projects

Prior to destruction, the precise mass and composition of ODS refrigerant, ODS medical aerosol, ODS fire suppression agent, ODS solvent, and extracted high-GWP blowing agent must be determined.

I. For ODS and high-GWP blowing agent 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 or high-GWP blowing agent 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 Certificate of Destruction;

      iii. The empty mass must be measured no more than 48 hours after the conclusion of destruction per the Certificate of Destruction; and

      iv. Each single compartment, cylinder, drum, or any other eligible ODS or high-GWP blowing agent 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 or high-GWP blowing agent container has been identified and destined for destruction, ODS or high-GWP blowing agent 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 C 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 or high-GWP blowing agent which are included in the trailer's full mass prior to ODS or high-GWP blowing agent 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 until the mass stabilizes 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 C of this Methodology; and;

b. A container with a capacity over 1,000 pounds must be placed on the scale motionless until the mass stabilizes 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 or high-GWP blowing agent which are included in the truck's full mass prior to ODS or high-GWP blowing agent destruction must be included in the truck's empty mass after destruction;

c. If more than 1,000 pounds of ODS or high-GWP blowing agent is being transported for destruction, then the truck must be situated motionless on the scale until the mass stabilizes 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 or high-GWP blowing agent destruction must be rounded down and the fuel level after ODS or high-GWP blowing agent 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, as applicable from $Q_{refr,i}$ in Equations 3, $EBA_{,i}$ and $BA_{intf,i}$ in Equation 4, Q_{aer} in Equations 6, $Q_{fs,i}$ in Equation 7, and Q_{ODS}, Q_{BA}, and Q_{intf} in Equation 11. 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 Qrefr,i in Equations 3, $EBA_{,i}$ and $BA_{intf,i}$ in Equation 4, Q_{aer} in Equations 6, $Q_{fs,i}$ in Equations 7, and Q_{ODS}, Q_{BA}, and Q_{intf} in Equation 11.

C. Composition and concentration of ODS or high-GWP blowing agent must be established for each individual container by taking a sample from each container of ODS or high-GWP blowing agent and having it analyzed for composition and concentration at an AHRI-certified laboratory using the AHRI Standard 700 – Specifications for Refrigerants (AHRI 700), 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 or high-GWP blowing agent is in the possession of the company that will destroy the ODS or high-GWP blowing agent;

ii. Samples must be taken with a clean, fully evacuated sample bottle that meets applicable DOT requirements in the U.S., or equivalent requirements in Canada (or another country if the destruction facility is located outside U.S. and Canada), with a minimum capacity of one pound;

iii. Each sample must be taken in liquid state;

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

v. 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. Size of the sample in pounds;
   f. Volume of container from which sample was extracted; and
   g. Ambient air temperature at time of sampling; and
   h. Chain of custody for each sample from the point of sampling to the eligible lab 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 or ISO/IEC 17025 to confirm the mass percentage and identification of each component of the sample. The analysis shall provide:
   i. Identification of the ODS or high-GWP blowing agent;
   ii. Purity (%) of the ODS or high-GWP blowing agent 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 or high-GWP blowing agent based on the temperature recorded at the time the sample was taken;
      a. For non-mixed ODS or high-GWP blowing agent, the saturation point is the saturation point of the major ODS or high-GWP blowing agent species;
      b. For mixed ODS or high-GWP blowing agent, 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 or high-GWP blowing agent in the case of mixtures of ODS or high-GWP blowing agent, 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 or high-GWP blowing agent destruction associated with that container.

F. If a container holds non-mixed ODS or high-GWP blowing agent, no further information or sampling is required to determine the mass and composition of the ODS or high-GWP

blowing agent. For non-mixed ODS or high-GWP blowing agent, 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 or high-GWP blowing agent, 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 or high-GWP blowing agent are analyzed;

iv. Prior to sampling, the ODS or high-GWP blowing agent 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 except for mandatory baffles;

b. The containers were fully evacuated prior to filling;

c. The containers must have sampling ports to sample liquid and gas phase ODS or high-GWP blowing agent;

d. The sampling ports must be located in the middle third of all of the containers. Front and back ports can also be used if liquid take-off and return are located on the opposite sides of the tank (e.g., take-off at the rear and return in the front); 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 or high-GWP blowing agent container or two connected containers do not meet these requirements, the mixed ODS or high-GWP blowing agent 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 or high-GWP blowing agent into and out of the temporary container or two connected containers, ODS or high-GWP blowing agent shall be recovered to the vacuum levels required by the U.S. EPA (see 40 CFR 82.156), equivalent agency in Canada, or equivalent agency in another country (if the transfer takes place outside U.S. and Canada in the process of transporting the ODS or high-GWP blowing agent for destruction at a destruction facility outside U.S. and Canada) for that ODS or high-GWP blowing agent;

vi. Once the mixed ODS or high-GWP blowing agent is in a container, two connected containers, or temporary storage unit that meets the criteria above, circulation of mixed ODS or high-GWP blowing agent 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 5; if converting between mass and volume, the mixed ODS or high-GWP blowing agent 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 an eligible laboratory; 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.

II. Refrigerant and extracted high-GWP blowing agents destroyed in enclosed equipment de-manufacturing systems shall be analyzed using FTIR. FTIR shall be used to determine the mass and composition of each ODS refrigerant and extracted high-GWP blowing agent destroyed.

Appendix D: Discussion and Rationale for Including Eligible ODS and High-GWP HFC

D.1 High-GWP Insulation Foam

D.1.1 ELIGIBILITY OF HIGH-GWP BLOWING AGENTS

The CARB ODS Protocol lists several ODS foam blowing agents that are eligible for destruction credits – CFC-11, CFC-12, HCFC-22, and HCFC-141b. These ODS were discontinued from use in foam applications beginning in 1996, and more recently in the case of HCFC-141b and HCFC-22, in 2003 and 2009, respectively. This Methodology adds CFC-114, HCFC-142b and three HFCs, HFC-134a, HFC-245fa, and HFC-365mfc, to the list of eligible blowing agents for foam destruction projects.

These HFCs are in production in the U.S. for use in the manufacture of foam products, particularly appliance foam. Destruction of foam recovered from end-of-life appliances does not trigger additional production of the HFC blowing agents beyond what would be produced anyway.

At a macro-level, when an appliance reaches end-of-life, demand is created for the manufacture of a new replacement appliance. For example, the decision to purchase a new refrigerator-freezer, in general, is made when the old fridge is discarded. That decision at the consumer level translates to a decision at the manufacturing level to produce a new fridge. Today, the new fridge may be manufactured with insulation foam containing HFC-134a, HFC-245fa, or in some cases, a hydrocarbon-based blowing agent. Regardless of how the foam in the end-of-life appliance is discarded - shredded and landfilled (the baseline scenario) or incinerated in conformance with this Methodology - the same quantity of new blowing agent will be produced for use in a newly manufactured appliance. As is the case for ODS refrigerants and the other eligible ODS categories in this Methodology, destruction of CFC, HCFC, and HFC blowing agents therefore prevents greenhouse gas emissions that would otherwise occur under the baseline scenario (shredding and landfilling of the foam). Since the process of extracting blowing agents from discarded and EoL foams is difficult and costlier (compared to refrigerants), almost all discarded foams, at present, end up in landfill and hence eventually 100% of the remaining blowing agents leak into the atmosphere.

D.1.2 ELIGIBILITY OF HIGH-GWP FOAM SOURCES

In addition to the inclusion of new high-GWP foam blowing agents, this Methodology has been expanded to include additional foam sources. The CARB ODS Protocol only allows foam removed from appliances or buildings. Based on industry communications and research conducted during the development of this Methodology, it was determined that there were no compelling reasons to exclude additional sources of high-GWP foam. Therefore, the following sources have been added:

- Walk-in coolers,
- Refrigerated transportation,
- Refrigeration cases,
- Pipe-in-pipe/preformed pipe, and
- Marine applications.

D.1.3 HIGH-GWP FOAM BLOWING AGENT CONCENTRATION AND ANALYSIS

This Methodology preserves the ability of a project proponent to extract high-GWP blowing agents, containerize them, and have the constituents analyzed just as any refrigerant, medical aerosol, solvent, or fire suppressant ODS destruction project. However, it is highly unlikely, due to cost and complexity, that this method will be employed in practice. To that end, the Methodology includes provisions for the destruction of extracted blowing agents in enclosed equipment de-manufacturing systems. Recently, new equipment de-manufacturing technologies have been introduced that allow for a closed loop process where blowing agents are extracted and destroyed in enclosed systems. These systems are capable of real time analysis of constituent gases as well as the determination of total volumes destroyed over selected time frames. The Methodology includes requirements for the necessary continuous monitoring and maintenance of these systems.

D.1.4 PROJECT EMISSIONS DURING REMOVAL OF FOAM FROM APPLIANCES

For appliance foam ODS destruction projects that do not involve foam extraction within an enclosed appliance de-manufacturing system, project emissions include the ODS foam blowing agent that is released during manual removal of the foam from the interior walls of the appliance. The 2005 TEAP Task Force on Foam End-of-Life Issues (TEAP 2005) cited research (JTCCM, 2004) that showed that emissions of ODS blowing agent from manual removal of foam can range from 1.5 to 5%.

A more recent life-cycle analysis on appliances used an assumption based on industry input that emissions of blowing agent from manual foam removal can range from 10-15% but could be lower if best practices are used (ICF, 2011). The industry input was provided by two U.S. appliance recyclers. One of the recyclers had employed manual foam removal in unconfined space. That company is no longer operating and has since been replaced in the market by a business that relies exclusively on enclosed equipment de-manufacturing in which the insulation foam is separated in a closed system under negative pressure, resulting in no fugitive emissions.

The Yesiller et al. (2016) analyses calculated blowing agent emissions from appliance foam recovery rate in the range of 4% of the initial blowing agent content.

Given the full range of estimates (1.5% to 15%), and the more recent trends in the U.S. towards more advanced appliance recycling technology, this Methodology applies a default value of 10% for the ODS blowing agent project emissions from removal of foam from appliances in a non-enclosed equipment de-manufacturing system, as specified in Equation 10.

D.2 HCFC-22 Refrigerant

HCFC-22 was excluded as an eligible refrigerant at the time of development of early ODS destruction protocols because HCFC-22 production in the U.S. was not controlled.[10] Beginning in 2010, the phase out of HCFC-22 began in the U.S. under the U.S. Clean Air Act. As of January 1, 2020, production and import of HCFC-22 was banned except for servicing equipment manufactured before January 1, 2010.

Newer equipment manufactured after January 1, 2010, must be serviced with reclaimed HCFC-22 refrigerant. To service older equipment, the U.S. EPA issued annual production and import consumption[11] allowances, with a declining cap, to 21 companies, including chemical producers and equipment manufacturers. EPA developed its annual allocations based on precise calculations of the servicing needs of the industry (EPA, 2014 – see Table 18). These allocations continued through 2019. On January 1, 2020, all production and import of HCFC-22 ended in the U.S. and in Canada.

[10] Destruction credits for HCFC-22 foam blowing agent was allowed because its use in the U.S. as a blowing agent ended as of March 1, 2008.

[11] Consumption = (Production + Imports) - Exports

D.2.1 ADDITIONALITY OF HCFC-22 DESTRUCTION

First, as is the case for CFCs, there is no requirement for destruction of HCFC-22 in the U.S. and Canada.

Second, as also is the case for CFC refrigerants, under business as usual, all HCFC-22 currently in equipment will either leak, be recovered for re-use in other leaky equipment or ultimately end up in stockpile and eventually leak. Thus, all HCFC-22 that has been produced will ultimately be released to the atmosphere.

Since the production of HCFC-22 is banned, the destruction of HCFC-22 has net benefit.

- Manufacture of new equipment containing HCFC-22 is prohibited; old HCFC-22 equipment would be replaced with new equipment containing alternative refrigerants such as HFCs, HFOs, hydrocarbons, ammonia, or CO_2;
- Removal of HCFC-22 from the "national inventory" via destruction will lower the chances of eventual leak from reuse in older equipment.

There is no expected adverse impact in terms of affecting the market availability of HCFC-22 needed for servicing older equipment. Any destruction would be done on a voluntary basis to accelerate the retirement of older equipment and reduce excess stockpiles.

D.3 Medical Aerosol ODS

D.3.1 CFC PHASEOUT

Under the Montreal Protocol "essential use nominations" program, limited production of CFCs was authorized in the U.S. and other countries for use as the propellant in metered dose inhalers (MDIs), which are relied upon by asthmatics, and in other medical devices. Essential use production for MDIs in the U.S. was gradually phased out as the Food and Drug Administration approved CFC-free products for treatment of asthma, chronic obstructive pulmonary disease, and other respiratory diseases, including HFC-propelled MDIs, dry powder inhalers, and oral medications. As of January 1, 2012, all production and import of CFCs in the U.S. for MDIs ended, and on January 1, 2013, sale of CFC-based inhalers ended in the United States. Similar bans are also in effect in Canada.

Two medical products remain classified as essential uses of CFC propellant: anesthetic drugs requiring a cannula for application for use on accessible mucous membranes (21 CFR 2.125(e)(4)(iii)), and sterile aerosol talc administered intrapleurally by thorascopy (21 CFR 2.125(e)(4)(ix)).

D.3.2 ADDITIONALITY OF DESTRUCTION OF U.S. OR CANADA INVENTORIES

Some of the CFCs that had been produced under the essential use nominations in the U.S. before 2012 and in Canada have never been used. The resulting stockpile is eligible for sale in the United States and Canada for use in remaining essential use applications. Given continued demand for CFC-11 and CFC-114 for at least one of the exempted products, under business as usual, the U.S. or Canada CFC stockpile would be sold for use as a propellant in the exempted product, and eventually released to the atmosphere. In contrast, under the alternative "project" scenario, the CFCs would be destroyed, preventing direct GHG emissions, and result in increased use of CFC-free alternative products.

Any additional production of CFCs and HCFCs in the U.S. or Canada for remaining essential uses would require approval by the Parties to the Montreal Protocol, as recommended by the Montreal Protocol Medical Technical Options Committee of the Technology and Economics Assessment Panel. Production of CFCs for asthma inhalers has ended. Because of the remaining stockpiles, there is no indication and virtually no likelihood that the U.S. or Canada would request any new production of CFCs for the remaining exempted products. In other words, if some of the existing CFC stockpiles are destroyed, there would be no new, compensatory CFC production. Similarly, production and import of virgin HCFC-22 and HCFC-142b has been fully banned in the U.S. and Canada since 2020. Destruction of these Class II ODSs will not result in replacement with virgin ODSs.

D.4 ODS Fire Suppressants

D.4.1 ATMOSPHERIC IMPACTS AND APPLICATIONS OF HALONS AND SUBSTITUTES

Like CFCs and HCFCs, halon fire suppressants are controlled under the Montreal Protocol. Halons contain bromine, which destroys stratospheric ozone at a rate many times higher than chlorine. Because of their high ozone depleting potentials, halons were phased out of production in the U.S. as of January 1, 1994, prior to CFCs. As of January 1, 2010, halon production in developing countries ended.

Halon 1211 is contained in older portable "streaming" fire extinguishers, and halon 1301 is contained in older "total flooding" systems ranging in size from large computer rooms, bank vaults, libraries, oil and gas extraction facilities and submarines, to the engine nacelle on jets (HTOC, 2014). There are several alternative non-ODS fire suppression agents now in wide use, many with significantly lower GWPs (e.g., water mist, CO_2, nitrogen, fluoroketone) compared to halons, while others have comparable GWPs (HFC-227ea, HFC-236fa).

D.4.2 CONDITIONS FOR HALON DESTRUCTION CREDITS AND ADDITIONALITY

Similar to HCFC-22 refrigerant, destruction of halons recovered from end-of-life equipment will have the following impacts:

- Prevention of the inevitable emissions of halons from the older equipment via leaks, testing, accidental discharges, or release during fire extinguishing; and
- Incentivization of the continued transition to safe and effective halon alternatives, including many with little or no climate impact.

Destruction of halons under the conditions specified in the Methodology meets the additionality criteria because:

- As is the case for refrigerants, halons recovered from end-of-life equipment can be expected to be re-used to recharge other older equipment and systems. While fire suppression equipment is typically well maintained and monitored, releases occur during testing, transfers, and accidental discharges. The intended use of these agents is for release in the event of a fire or explosion. Ultimately, these agents are emitted.
- There is no requirement in the U.S. and Canada that halons recovered from equipment be destroyed; and
- Destruction of the halons will not trigger any additional halon production because of the complete phaseout of halons worldwide.

D.4.3 HALON STRATEGIC STOCKPILES

This Methodology does not allow credits for destruction of halon 1301 strategic stockpiles because some halon 1301 stockpiles likely include strategic reserves that are being maintained for fire suppression systems in aviation, military use, shipping, oil and gas, computer rooms, and other

critical applications.[12] Even though all projects under this Methodology would be voluntary activities, there is concern that the potential availability of carbon offset credits would incentivize premature destruction of strategic stockpiles of halon 1301.

D.5 ODS Solvents

ODSs and other chemicals are used as solvents in industrial cleaning and degreasing, dry cleaning, paint thinning and coating, fabric scouring, auto and airplane manufacturing and maintenance, and many other uses. Items to be cleaned are usually moved within a solvent bath or stream. The used solvents are continuously recycled and reused through a distilling and cleaning process until almost all the original quantity is emitted as gas (EPA, 2021). The remaining solvent in the form of sludge or waste is classified as hazardous waste (F-list) by EPA and must be disposed as required by RCRA (EPA, 2016b).

D.5.1 CONDITIONS FOR SOLVENT DESTRUCTION CREDITS AND ADDITIONALITY

Around 90% of solvents used as cleaning agent get emitted over the course of cleaning, recycling, and re-use. The remaining 10% end up as sludge and must be disposed as hazardous waste following RCRA requirements (EPA, 2021; EPA 2016b). Unused solvents that fall under the P and U lists of hazardous waste (40 CFR 261 subpart D), are also considered hazardous waste if they are accidentally spilled, shelf-life expires and become unusable, are off-specification, or can no longer serve the purpose for which they were produced (EPA, 2016b).

Unused solvents that are not determined as hazardous waste according to above criteria are not required to be destructed by RCRA and hence may be destructed to create carbon offsets. ODSs like CFC-11, CFC-113, HCFC-123, HCFC-141b, HCFC-225ca, and HCFC-225cb that were manufactured for use as solvents but were never used and are in virgin state are eligible for destruction under this methodology. These ODSs, at unused state, are not included in the P and U lists of hazardous wastes and are hence eligible.

[12] As of a decade ago, stockpiles of halon 1211 for portable fire extinguishers were maintained in lesser quantities (HTOC, 2006).

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