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California Environmental Protection Agency

AIR RESOURCES BOARD

Compliance Offset Protocol Ozone Depleting Substances Projects

Destruction of U.S. Ozone Depleting Substances Banks

Adopted: [INSERT Date of Board Adoption]

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Abbreviations and Acronyms

A/C	Air conditioning
AHRI	Air-Conditioning, Heating and Refrigeration Institute
CAA	Clean Air Act
CAR	Climate Action Reserve
CEMS	Continuous emissions monitoring system
CFC	Chlorofluorocarbons
CH_4	Methane
CO_2	Carbon dioxide
CPT	Comprehensive Performance Test
DOT	U.S. Department of Transportation
DRE	Destruction and removal efficiency
EPA	United States Environmental Protection Agency
GWP	Global warming potential
HBFC	Hydrobromofluorocarbons
HCFC	Hydrochlorofluorocarbons
HFC	Hydrofluorocarbons
HWC	Hazardous waste combustor
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

Regulation	Cap-and-Trade Regulation, title 17, California Code of Regulations, sections 95800 et seq.
SSR	GHG Sources, GHG Sinks, and GHG Reservoirs
TEAP	Technology & Economic Assessment Panel

1 Introduction

The Compliance Offset Protocol Ozone Depleting Substances Projects provides methods to quantify and report greenhouse gas (GHG) emission reductions associated with the destruction of high global warming potential ozone depleting substances (ODS) sourced from and destroyed within the U.S. that would have otherwise been released to the atmosphere. This project category includes ODS used in foam blowing agent and refrigerant applications. All destroyed ODS must be fully documented, chemically analyzed, and destroyed at a qualifying facility to be eligible for crediting under this protocol. All ODS must originate in the United States. The protocol is built off of The Climate Action Reserve's U.S. Ozone Depleting Substances Project Protocol Version 1.0[1] and includes the information provided in the Errata and Clarification[2].

ODS Offset Project Operators or Authorized Project Designees must use this protocol to quantify and report GHG reductions. The protocol provides eligibility rules, methods to quantify GHG reductions, offset project-monitoring instructions, and procedures for preparing Offset Project Data Reports. Additionally, all offset projects must submit to annual, independent verification by ARB-accredited verification bodies. Requirements for verification bodies to verify Offset Project Data Reports are provided in the Cap and Trade Regulation (Regulation).

This protocol is designed to ensure the complete, consistent, transparent, accurate, and conservative quantification of GHG emission reductions associated with an ODS destruction project. The protocol is comprised of both quantification methodologies and regulatory program requirements to develop an ODS project and generate ARB or registry offset credits.

AB 32 exempts quantification methodologies from the Administrative Procedure Act (APA)[3], however those elements of the protocol are still regulatory. The exemption allows future updates to the quantification methodologies to be made through a public review and Board adoption process but without the need for rulemaking documents. Each protocol identifies sections that are considered quantification and exempt from APA requirements. Any changes to the non-quantification elements of the offset protocols would be considered a regulatory update subject to the full regulatory development process. Those sections that are considered to be a quantification methodology are clearly indicated in the title of the chapter or subchapter if only a portion of that chapter is considered part of the quantification methodology of the protocol.

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[1] Climate Action Reserve (2010) U.S. Ozone Depleting Substances Project Protocol Version 1.0. February 3, 2010. http://www.climateactionreserve.org/how/protocols/adopted/ods/current/ (accessed August 30, 2010)

[2] Climate Action Reserve (2010) U.S. Ozone Depleting Substances Project Protocol Errata and Clarifications. May 7, 2010. http://www.climateactionreserve.org/how/protocols/adopted/ods/current/ (accessed August 30, 2010)

[3] Health and Safety Code section 38571.

2 The GHG Reduction Project

2.1 Background

The term “ozone depleting substances” (ODS) refers to a large group of chemicals known to destroy the stratospheric ozone layer when released into the atmosphere. ODS were historically used in a wide variety of applications including refrigerants, foam blowing agents, solvents, and fire suppressants. In addition to their potency as ozone depleting substances, the ODS addressed by this protocol also exhibit high global warming potentials (GWP). The GWP of these ODS range from several hundred to several thousand times that of carbon dioxide (see Table 5.1).

2.2 Offset Project Definition – Quantification Methodology

For the purposes of this protocol, an offset project is defined as any set of activities undertaken by a single Offset Project Operator or Authorized Project Designee resulting in the destruction of eligible ODS at a single qualifying destruction facility over a 12-month period. Destruction may take place under one or more Certificates of Destruction. Each Certificate of Destruction must document the ODS destroyed. The ODS destroyed may come from a single origin (e.g., one supermarket) or from numerous sources. However, the entire quantity of eligible ODS destroyed must be documented on one or more Certificates of Destruction issued by a qualifying destruction facility.

Although Offset Project Operators or Authorized Project Designees may engage in ongoing collection and destruction activities, destruction events that fall outside of the single calendar year designated for an offset project may only be counted as part of a separately registered offset project. Offset Project Operators or Authorized Project Designees may choose a shorter time horizon for a single offset project (e.g., 3 months or 6 months), but no offset project may run longer than a calendar year.

In order for multiple Certificates of Destruction to be included under a single offset project, all of the following conditions must be met:

- The Offset Project Operator or Authorized Project Designee of GHG emission reductions are the same for all ODS destroyed
- The qualifying destruction facility is the same for all Certificates of Destruction
- The destruction activities span a timeframe occurring in one calendar year
- No Certificate of Destruction is included as part of another offset project

For all offset projects, the end fate of the ODS must be destruction at either an approved Hazardous Waste Combustor (HWC) subject to the Resource Conservation and Recovery Act (RCRA), CAA, and the National Emissions Standards for Hazardous Air Pollutants (NESHAP) standards, or any other transformation or destruction facility that meets or exceeds the Montreal Protocol’s Technology & Economic Assessment Panel (TEAP) standards provided in the *Report of the Task Force on Destruction Technologies* and listed in The Climate Action Reserve’s *U.S. Ozone Depleting Substances Project Protocol Version 1.0*. All facilities must meet any applicable

requirements under the CAA and NESHAP. Non-RCRA permitted facilities cannot receive and destroy ODS materials that are classified as hazardous waste and must demonstrate compliance with the Title VI requirements of the CAA for destruction of ODS, as well as demonstrate destruction and removal efficiency (DRE) of 99.99% and emission levels consistent with the guidelines set forth in the aforementioned TEAP report.

2.3 Eligible ODS – Quantification Methodology

This protocol provides requirements for the accounting of GHG reductions from two general sources of ODS eligible under the offset project definition:

- **Refrigerants:** an offset project may collect eligible ODS refrigerant (see Section 2.3.1) from industrial, commercial or residential equipment, systems, and appliances or stockpiles, and destroy it at a qualifying destruction facility.

- **Foams:** an offset project may extract eligible ODS blowing agent (see Section 2.3.2) from appliance foams and destroy the concentrated ODS foam blowing agent at a qualifying destruction facility; or, an offset project may destroy intact foam sourced from building insulation at a qualified destruction facility.

A single offset project may incorporate ODS obtained from one or both of these ODS source categories. Tracking procedures and calculation methodologies differ depending on the source of ODS.

ODS that were produced for, used as, or intended for use as solvents, medical aerosols, or other ODS applications are not eligible.

2.3.1 Refrigerant Sources

This source category consists of ODS material produced prior to the U.S. production phase-out that could legally be sold into the U.S. refrigerant market. The ODS must originate from domestic U.S. supplies; imported refrigerant is not eligible under this protocol.

In the absence of an offset project, this material may be illegally vented or recovered for re-sale into the refrigerant recharge market. As described in Section 5.1.1, for GHG reduction calculation purposes, this protocol conservatively assumes that the refrigerant would be reclaimed.

Only destruction of the following ODS refrigerants is eligible to generate ARB or registry offset credits under this protocol:

- CFC-11
- CFC-12
- CFC-13
- CFC-113
- CFC-114

- CFC-115

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 foam source. ODS sourced from federal government installations or stockpiles is not eligible under this protocol.

Additionally, all refrigerant collection, handling, and destruction must be performed in accordance with the reporting and operation requirements of the Regulation.

2.3.2 Foam Sources

This source category consists of ODS blowing agent entrained in foams that, absent a GHG reduction project, would have been released at end-of-life. The ODS blowing agent must originate from U.S. foam sources; imported foams are not eligible under this protocol.

Only the following ODS foam blowing agents are eligible to generate ARB or registry offset credits under this protocol:

- CFC-11
- CFC-12
- HCFC-22
- HCFC-141b

To be eligible to generate ARB or registry offset credits, the ODS blowing agent must be destroyed in one of two ways:

1. **ODS blowing agent extracted from appliance foam and destroyed.** The ODS blowing agent must be extracted from the foam to a concentrated form prior to destruction. This must be done under negative pressure to ensure that fugitive release of ODS cannot occur. The recovered ODS blowing agent must be collected, stored, and transported in cylinders or other hermetically sealed containers.

2. **Intact foam containing ODS blowing agent from buildings destroyed intact.** When the intact foam is separated from building panels, it must be stored, transported, and destroyed in sealed containers.

All foam collection, handling, extraction, and destruction must be performed in accordance with the reporting and operation requirements in the Regulation.

2.4 Offset Project Operator or Authorized Project Designee

The Offset Project Operator or Authorized Project Designee is responsible for offset project listing, monitoring, reporting, and verification. The Offset Project Operator or Authorized Project Designee must submit the information in the Regulation and in Appendix C. The Offset Project Operator or Authorized Project Designee must have legal authority to implement the offset project.

3 Eligibility Rules

Offset projects that meet the requirements in Section 2.2 must fully satisfy the eligibility requirements in the Regulation in addition to the eligibility rules in this protocol in order to be eligible to receive ARB or registry offset credits.

3.1 Location

For ODS destruction to be eligible as an offset project under this protocol, all ODS must be sourced from stocks in the United States or its territories and destroyed within the United States or its territories. In addition, offset projects situated on the following categories of land are only eligible under this protocol if they meet the requirements of this protocol and the Regulation, including the waiver of sovereign immunity requirements of section 95975(l) in the Regulation:

1. Land that is owned by, or subject to an ownership or possessory interest of a Tribe;
2. Land that is “Indian lands” of a Tribe, as defined by 25 U.S.C. §81(a)(1); or
3. Land that is owned by any person, entity, or Tribe, within the external borders of such Indian lands.

3.2 Offset Project Commencement

For this protocol, Offset Project Commencement is defined as the date on which destruction activities commence, as documented on a Certificate of Destruction. Offset projects may always be submitted for listing prior to their commencement date.

3.3 Project Crediting Period

An ODS project is a discrete series of destruction events over a single calendar year. For the purposes of this protocol, it is assumed that, absent the offset project, the avoided ODS emissions would have occurred over a longer time horizon.

Under this protocol, the offset project crediting period is the period of time over which avoided emissions are quantified for the purpose of determining creditable GHG reductions. Specifically, ODS projects will be issued ARB or registry offset credits for the quantity of ODS that would have been released over a ten-year period following a destruction event. At the time the offset project is verified, ARB or registry offset credits are issued for all ODS emissions avoided by an offset project over the 10-year crediting period.

3.4 Additionality

Offset projects must meet the additionality requirements set out in the Regulation in addition to the requirements in this protocol.

The destruction of ODS by the U.S. government is common practice and considered business-as-usual, and therefore ineligible for crediting under this protocol.

3.5 Regulatory Compliance

As stated in the Regulation, an Offset Project Operator~~s~~ or Authorized Project Designee~~s~~ must fulfill all applicable local, regional and national requirements on environment impact assessments that apply based on the offset project location. Offset projects must also meet any other local, regional, and national requirements that might apply. Offset projects are not eligible to receive ARB or registry offset credits for GHG reductions that occur as the result of collection or destruction activities that are not in compliance with regulatory requirements.

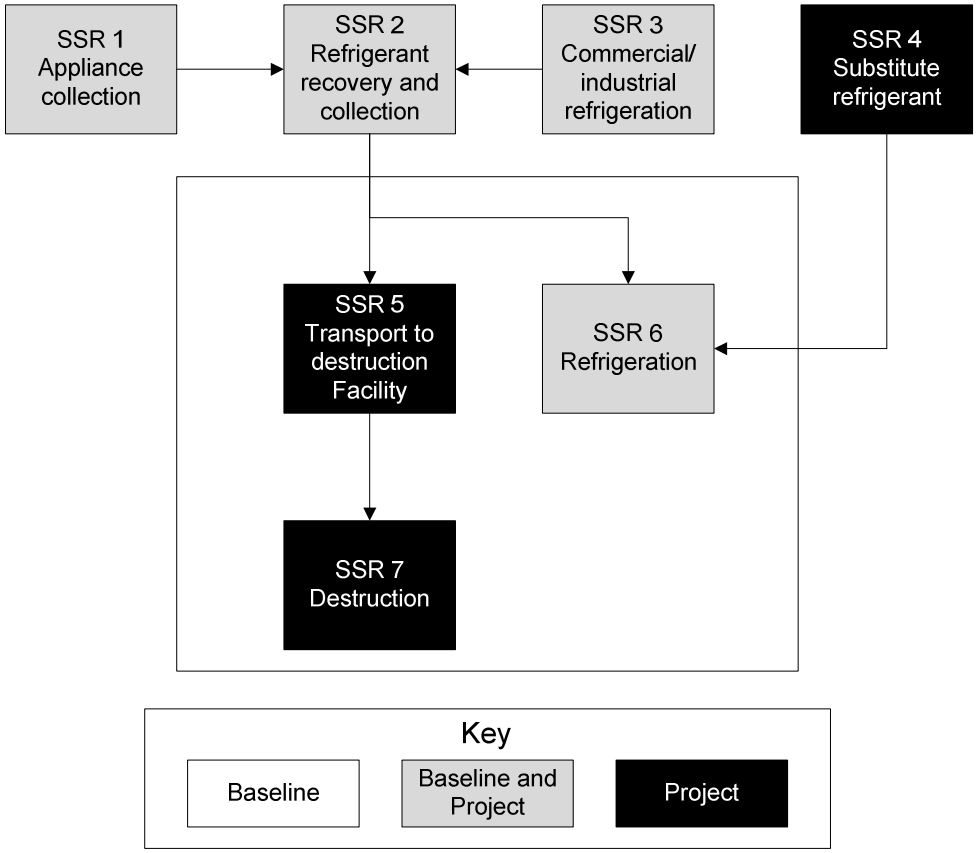
The regulatory compliance requirement extends to the operation of destruction facilities where the ODS is destroyed. Destruction facilities have the potential to contribute to environmental impacts beyond ozone depletion and climate change. Accordingly, all destruction facilities must meet the full burden of applicable regulatory requirements during the time the ODS destruction occurs. Any upsets or exceedences of permitted emission limits must be managed in keeping with an authorized startup, shutdown, and malfunction plan required by EPA (40 CFR 63.1206).

4 Offset Project Boundary – Quantification Methodology

The Offset Project Boundary delineates the GHG sources, GHG sinks, and GHG reservoirs (SSRs) that shall be assessed by the Offset Project Operator~~s~~ or Authorized Project Designee~~s~~ in order to determine the total net change in GHG emissions caused by an ODS project.

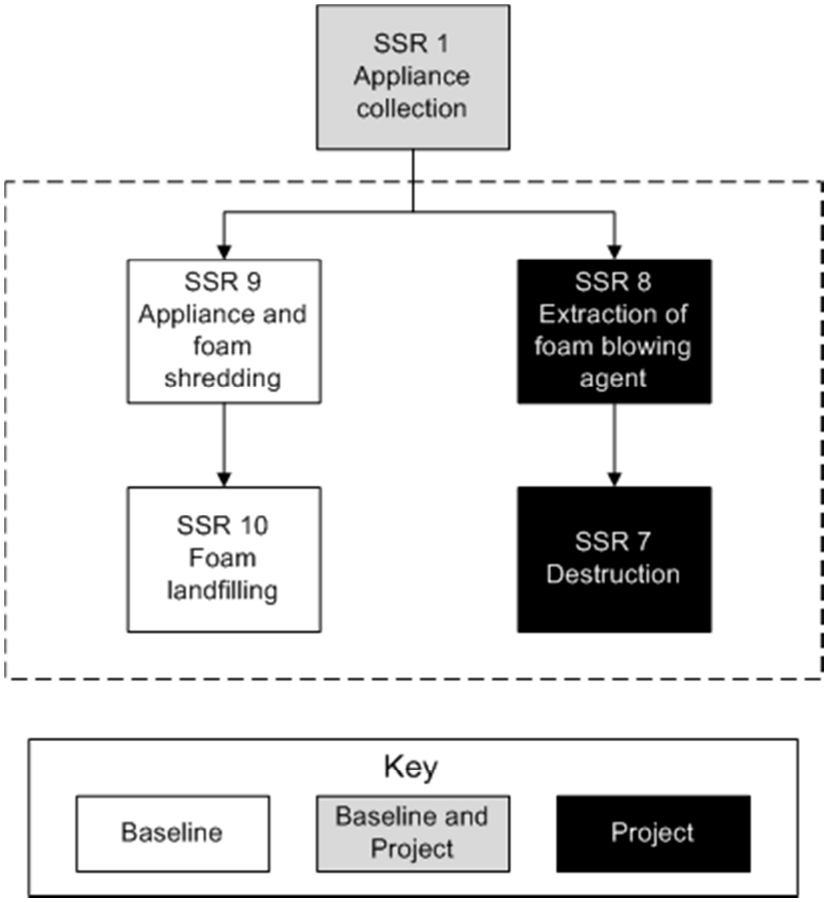
Figure 4.1, Figure 4.2, and Figure 4.3 provide a general illustration of the Offset Project Boundaries for different types of ODS destructions projects, indicating which SSRs are included or excluded from the boundary.

Table 4.1 gives greater detail on each SSR and provides information for all SSRs and gases that are excluded from the Offset Project Boundary.



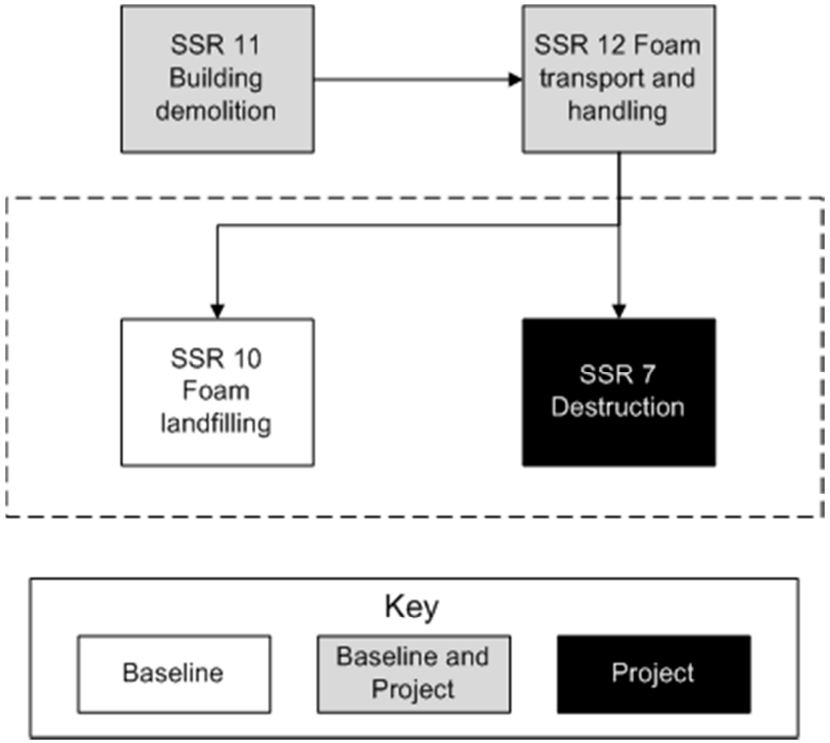
Note: Emissions from all GHG sources within the box above are accounted for within this protocol.

Figure 4.1. Illustration of the Offset Project Boundary for Refrigerant Projects



Note: Emissions from all GHG sources within the dashed box above are accounted for within this protocol.

Figure 4.2. Illustration of the Offset Project Boundary for Appliance Foam Projects



Note: Emissions from all GHG sources within the dashed box above are accounted for within this protocol.

Figure 4.3. Illustration of the Offset Project Boundary for Building Foam Projects

Table 4.1. Summary of Identified GHG Sources, GHG Sinks, and GHG Reservoirs – Quantification Methodology

SSR		Source Description	Gas	Included (I) or Excluded (E)	Quantification Method
1	Appliance Collection	Fossil fuel emissions from the collection and transport of end-of-life residential appliances	CO_2	E	N/A
			CH_4	E	N/A
			N_2O	E	N/A
2	Refrigerant Recovery and Collection	Emissions of ODS from the recovery and collection of refrigerant at end-of-life or servicing	ODS	E	N/A
		Fossil fuel emissions from the recovery and collection of refrigerant at end-of-life or servicing	CO_2	E	N/A
			CH_4	E	N/A
			N_2O	E	N/A
3	Commercial/ Industrial Refrigeration	Emissions of ODS from equipment leak and servicing	ODS	E	N/A
		Fossil fuel emissions from the operation of refrigeration and A/C equipment	CO_2	E	N/A
			CH_4	E	N/A
			N_2O	E	N/A
4	Substitute Refrigerant Production	▪ Emissions of substitute refrigerant occurring during production ▪ Fossil fuel emissions from the production of substitute refrigerants	CO_2e	E	N/A
			CO_2	E	N/A
			CH_4	E	N/A
			N_2O	E	N/A
5	Transport to Destruction Facility	Fossil fuel emissions from the vehicular transport of ODS from aggregation point to final destruction facility	CO_2	I	**Baseline:**N/A **Project:** Estimated based on distance and weight transported

SSR		Source Description	Gas	Included (I) or Excluded (E)	Quantification Method
			CH_4	E	N/A
			N_2O	E	N/A
6	Refrigeration	Emissions of ODS from leaks and servicing through continued operation of equipment	ODS	I	**Baseline:** Estimated based on market-weighted emission rates **Project:** N/A
		Emissions of substitute from leaks and servicing through continued operation of equipment	CO_2e	I	**Baseline:** N/A **Project:** Estimated based on market-weighted emissions
		Indirect emissions from grid-delivered electricity	CO_2	E	N/A
			CH_4	E	N/A
			N_2O	E	N/A
7	Destruction	Emissions of ODS from incomplete destruction at destruction facility	ODS	I	**Baseline:** N/A **Project:** Estimated based on ODS destroyed, or included in default deduction
		Emissions from the oxidation of carbon contained in destroyed ODS	CO_2	I	**Baseline:** N/A **Project:** Estimated based on ODS destroyed, or included in default deduction
		Fossil fuel emissions from the destruction of ODS at destruction facility	CO_2	I	**Baseline:** N/A **Project:** Estimated based on ODS destroyed, or included in default deduction

SSR		Source Description	Gas	Included (I) or Excluded (E)	Quantification Method
			CH_4	E	N/A
			N_2O	E	N/A
		Indirect emissions from the use of grid-delivered electricity	CO_2	I	**Baseline:** N/A **Project:** Estimated based on ODS destroyed, or included in default deduction
			CH_4	E	N/A
			N_2O	E	N/A
8	Extraction of ODS Blowing Agent from Appliance Foam	Emissions of ODS released during the separation of foam from appliance	ODS	I	**Baseline:** N/A **Project:** Estimated based on recovery efficiency
9	Appliance and Foam Shredding	Emissions of ODS from the shredding of appliances for materials recovery, releasing ODS from foam	ODS	I	**Baseline:** Estimated based on total quantity of ODS destroyed and default shredding factors **Project:** N/A
10	Foam Landfilling	Emissions of ODS released from foam disposed of in landfills	ODS	I	**Baseline:** Estimated based on release and degradation of ODS in landfill **Project:** N/A
		Emissions of ODS degradation products from foam disposed of in landfills	HFC, HCFC	E	N/A
		Fossil fuel emissions from the transport and placement of shredded foam waste in landfill	CO_2	E	N/A
			CH_4	E	N/A

SSR		Source Description	Gas	Included (I) or Excluded (E)	Quantification Method
			N_2O	E	N/A
11	Building Demolition	Emissions of ODS from the demolition of buildings and damage to foam insulation panels	ODS	E	N/A
		Fossil fuel emissions from the demolition of buildings	CO_2	E	N/A
			CH_4	E	N/A
			N_2O	E	N/A
12	Foam transport and handling	Emissions of ODS released from foam during transport and handling	ODS	E	N/A
		Fossil fuel emissions from the transport and handling of building foam	CO_2	E	N/A
			CH_4	E	N/A
			N_2O	E	N/A

5 Quantifying GHG Emission Reductions - Quantification Methodology[4]

GHG emission reductions from an ODS project are quantified by comparing actual project emissions to calculated project baseline emissions. Project baseline emissions are an estimate of the GHG emissions from GHG sources within the Offset Project Boundary (see Section 4) that would have occurred in the absence of the ODS destruction project. Project emissions are actual GHG emissions that occur at GHG sources within the Offset Project Boundary. Project emissions must be subtracted from the project baseline emissions to quantify the offset project's total net GHG emission reductions (Equation 5.1).

An offset project may not span more than a single calendar year, although an Offset Project Operator or Authorized Project Designee may choose a shorter time length than 12 months for their offset project. GHG emission reductions must be quantified and verified at least once for the entire project time length. The quantification methodologies presented below are specified for a single reporting period, which may be less than or equal to the entire project time length.

Equation 5.1. Total Emission Reductions

$$ER_t = BE_t - PE_t$$

Where,

			Units
ER_t	=	Total quantity of GHG emission reductions during the reporting period	tCO_2e
BE_t	=	Total quantity of project baseline emissions during the reporting period	tCO_2e
PE_t	=	Total quantity of project emissions during the reporting period	tCO_2e

5.1 Quantifying Project Baseline Emissions

Total project baseline emissions must be estimated by calculating and summing the calculated project baseline emissions for all relevant SSRs (as indicated in Table 4.1) using Equation 5.2 and the supporting equations presented below. This includes GHG emissions from continued use of ODS in the secondary recharge market for refrigerants, and the GHG emissions from end-of-life disposal for foams.

Equation 5.2. Total Project Baseline Emissions

$$BE_t = BE_{refr} + BE_{foam}$$

Where, Units

[4] The entirety of Section 5 is considered a quantification method

BE	=	Total quantity of project baseline emissions	tCO_2e
BE_{refr}	=	Total quantity of project baseline emissions from refrigerant ODS	tCO_2e
BE_{foam}	=	Total quantity of project baseline emissions from ODS blowing agent	tCO_2e

Project baseline emissions for an ODS destruction project include the total calculated project baseline emissions from each eligible source category – ODS refrigerant and ODS blowing agent. If an offset project does not destroy any ODS from a particular source category, project baseline emissions for that source category are assumed to be zero.

Table 5.1 provides the applicable GWP to be used for calculating project baseline emissions in units of CO_2-equivalent metric tons.

Table 5.1. Global Warming Potential of Eligible ODS

ODS Species	100-yr Global Warming Potential (CO_2e)
CFC-11	4,750
CFC-12	10,900
CFC-13	14400
CFC-113	6130
CFC-114	10,000
CFC-115	7,370
HCFC-22	1,810
HCFC-141b	725

5.1.1 Calculating Project Baseline Emissions from Refrigerant Recovery and Resale

To ensure that actual GHG reductions from ODS destruction are not overestimated, this protocol project estimates baseline emissions according to the assumption that refrigerant ODS would be entirely recovered and resold.

Equation 5.3 shall be used to estimate the project baseline emissions that would have occurred over ten years had the destroyed ODS been used in existing refrigeration or air conditioning equipment. This equation requires the use of the ODS-specific GWP provided in Table 5.1, and emission rate (inclusive of both leak rate and servicing emissions) provided in Table 5.2.

Equation 5.3. Project Baseline Emissions from Refrigerant ODS

$$BE_{refr} = \sum_i \left(Q_{refr,i} \times ER_{refr,i} \times GWP_i\right)_i$$

Where,			Units
BE_{refr}	=	Total quantity of refrigerant project baseline emissions during the reporting period	tCO_2e
$Q_{refr,i}$	=	Total quantity of refrigerant ODS *i* sent for destruction by the offset project	tODS
$ER_{refr,i}$	=	10-year cumulative emission rate of refrigerant ODS *i* (see Table 5.2)	%
GWP_i	=	Global warming potential of ODS *i* (see Table 5.1)	tCO_2e/ tODS

Table 5.2. Emission rate for ODS refrigerants

ODS Species	Annual Weighted Average Emission Rate (%/yr)	10-year Cumulative Emission Rate (%/10 years) (ER_{refr})
CFC-11	20%	89%
CFC-12	26%	95%
CFC-13	9%	61%
CFC-113	20%	89%
CFC-114	14%	78%
CFC-115	9%	61%

5.1.2 Calculating Project Baseline Emissions from Shredding and/or Landfilling ODS Foam Blowing Agents

Depending on the origin of the foam, there are two different predominant baseline practices applicable to foams containing ODS blowing agent. The two baseline practices are as follows:

Origin	Baseline Practice
Insulation foam recovered from appliances	The foam is shredded, and subsequently landfilled
Foam recovered from building demolition	The foam is landfilled

Equation 5.4 shall be used to calculate the ODS emissions that would have resulted from the assumed project baseline practice applied to foams in the absence of the offset project. Project baseline emissions include the total GHG emissions that would have occurred as a result of foam shredding and landfilling. In order to calculate total project baseline emissions, offset projects destroying blowing agent extracted from appliance foam must calculate an offset project-specific recovery efficiency for use in Equation 5.4. Methods for developing the recovery efficiency can be found in Appendix A.

Equation 5.4. Project Baseline Emissions from ODS Blowing Agent

$$BE_{foam} = \sum_{i,j} \left[\left(BA_{app,i} + BA_{build,i} \right) \times ER_{i,j} \times GWP_i \right]$$

Where,

			Units
BE_{foam}	=	Total quantity of ODS blowing agent project baseline emissions	tCO_2e
$BA_{app,i,}$	=	Total quantity of ODS blowing agent *i* from appliance foam prior to treatment or processing, including blowing agent lost during processing	tODS
$BA_{build,i}$	=	Total quantity of ODS blowing agent *i* from building foam sent for destruction	tODS
$ER_{i,j}$	=	Lifetime emission rate of ODS blowing agent *i* from application *j* at end-of-life (see Table 5.3)	%
GWP_i	=	Global warming potential of ODS *i* (see Table 5.1)	tCO_2e/ tODS

$$BA_{app,i} = Q_{recover} + Q_{recover} \left(\frac{1 - RE}{RE} \right)$$

Where,

			Units
$BA_{app,i}$	=	Total quantity of ODS foam blowing agent in foam prior to treatment or processing, including ODS foam blowing agent lost during processing	tODS
$Q_{recover}$	=	Total quantity of ODS foam blowing agent recovered during processing and sent for destruction, as determined according to Section 6.5	tODS
RE	=	Recovery efficiency of the ODS foam blowing agent recovery process[5] (See Appendix A for calculation of RE)	%

$$BA_{build} = Q_{foam} \times BA\%$$

Where,

BA_{build}	=	Total quantity of ODS blowing agent *i* from building foam sent for destruction	tODS
Q_{foam}	=	Total weight of foam with entrained ODS blowing agent sent for destruction	Metric tons
BA%	=	Mass ratio of ODS blowing agent entrained in building foam, as determined according to Section 6.3	% (0-1)

[5] RE does not extend to the ODS destruction efficiency, which is handled separately under this protocol.

The total percent of ODS foam blowing agent that would be released throughout the end-of-life processing (i.e., 10-year emission rates) for each ODS foam blowing agent and foam origin is presented in Table 5.3. These values include emissions from:

1. ODS blowing agent released during foam shredding,[6] plus
2. ODS blowing agent released during foam compaction, plus
3. Landfilled ODS blowing agent that is released during anaerobic conditions (but is not degraded).

Table 5.3. 10-year Emission Rates of Appliance and Building Foam at End-of-Life

ODS Blowing Agent	Appliance ODS blowing agent 10-year emission rate ($ER_{i,j}$)	Building ODS blowing agent 10-year emission rate ($ER_{i,j}$)
CFC-11	44%	20%
CFC-12	55%	36%
HCFC-22	75%	65%
HCFC-141b	50%	29%

5.2 Quantifying Project Emissions

Project emissions are actual GHG emissions that occur within the Offset Project Boundary as a result of offset project activities.

As shown in Equation 5.5, project emissions equal:

- GHG emissions from non-ODS substitutes (applicable only to refrigerant projects), plus
- GHG emissions from ODS foam blowing agent extraction (applicable only to appliance foam projects), plus
- GHG emissions from the transportation of ODS, plus
- GHG emissions from the destruction of ODS

Equation 5.5. Total Project Emissions

$$PE_t = Sub_{ref} + BA_{pr} + Tr + Dest$$

Where,

			Units
PE	=	Total quantity of project emissions during the reporting period	tCO_2e
Sub_{ref}	=	Total GHG emissions from substitute refrigerant	tCO_2e
BA_{pr}	=	Total quantity of ODS blowing agent from appliance foam released during ODS extraction	tCO_2e
Tr	=	Total GHG emissions from transportation of ODS (calculated using either the default value in Equation 5.8 or Equation 5.14)	tCO_2e
Dest	=	Total GHG emissions from the process associated with destruction of ODS (calculated using either the default value in Equation 5.8 or Equation 5.9 through Equation 5.13)	tCO_2e

[6] Note that the emissions from foam shredding have only been factored into the emission rates from appliance ODS blowing agents in Table 5.3, as building foam is not typically shredded before being landfilled.

5.2.1 Calculating Project Emissions from the Use of Refrigerant Substitutes

When refrigerant ODS are destroyed, continued demand for refrigeration will lead to the production and consumption of other refrigerant chemicals whose production is still legally allowed. Offset projects that destroy refrigerant ODS must therefore estimate the GHG emissions associated with the non-ODS substitute chemicals that are assumed to be used in their place. Like the estimates of project baseline emissions, substitute emissions shall be accounted for based on the projected emissions over a ten year crediting period.

Project emissions from the use of substitute refrigerants shall be calculated for all ODS refrigerant projects according to Equation 5.6 using the emission factors from Table 5.4. The use of site-specific substitute parameters (refrigerant, GWP, and leak rate) is not permitted.

Equation 5.6. Project Emissions from the Use of Non-ODS Refrigerants

$$Sub_{refr} = \sum_i \left(Qref_i \times SE_i \right)$$

Where,

			Units
Sub_{refr}	=	Total quantity of refrigerant substitute emissions	tCO_2e
$Qref_i$	=	Total quantity of refrigerant *i* sent for destruction	t
SE_i	=	Emission factor for substitute(s) for refrigerant *i*, per Table 5.4	tCO_2e/ tODS destroyed

ODS substitute emissions presented in Table 5.4 are based on the weighted average of expected new refrigerant supplies into the refrigeration market. These substitute refrigerants were modeled using the EPA Vintaging Model and data provided by industry sources.

Table 5.4. Refrigerant Substitute Emission Factors[7][8]

ODS Refrigerant	Substitute Emissions (t CO_2e/t ODS) (*SE_i*)
CFC-11	223
CFC-12	686
CFC-13	7144
CFC-113	220
CFC-114	659
CFC-115	1139

5.2.2 Calculating Project Emissions from ODS Blowing Agent Extracted from Appliance Foam

Offset projects that extract ODS blowing agent from appliance foam must account for the GHG emissions of ODS that occur during processing, separation, and extraction using Equation 5.7. These GHG emissions are calculated in Equation 5.7 based on the quantity of ODS blowing agent sent for destruction ($BA_{app,i}$, as calculated in Equation 5.4), and an offset project-specific recovery efficiency that represents the percentage of ODS that is not lost during these steps. Recovery efficiency must be independently established once for each individual offset project according to the methods provided in Appendix A.

Equation 5.7. Calculating Project Emissions from the Release of ODS Blowing Agent during Processing

$$BA_{pr} = \sum_i \left(BA_{app,i} \times (1 - RE) \times GWP_i \right)$$

Where,

			Units
BA_{pr}	=	Total quantity of ODS blowing agent from appliance foam released during ODS extraction	tCO_2e
$BA_{app,i}$	=	Total quantity of appliance ODS foam blowing agent in foam prior to treatment or processing, including ODS foam blowing agent lost during processing (see Equation 5.4 to calculate this term)	tODS
RE	=	Recovery efficiency of the ODS foam blowing agent recovery process (See Appendix A to calculate RE)	%
GWP_i	=	Global warming potential of ODS *i* (see Table 5.1)	tCO_2e/ tODS

[7] IPCC (2007). Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007. Table 2.14 Errata. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.) Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

[8] Substitute emissions were developed using a weighted average of 10-year emissions rates in CO_2 equivalent based on the market share, amounts, and leakage rates of the ODS subsitutes. If a substitute is a mix of gases, the GWP for each gas and proportion of each in the mixture is used to determine the GWP of the mixture. The GWPs for the refrigerant substitutes are from the Second Assessment Report, cited in the above footnote.

5.2.3 Calculating Default Project Emissions from ODS Transportation and Destruction

Offset projects must account for GHG emissions that result from the transportation and destruction of ODS. Because these GHG emission sources are both individually and in aggregate very small, the protocol default emission factors for ODS projects are based on conservative assumptions and the SSRs outlined in Table 4.1:

- 7.5 metric tons CO_2e per metric ton ODS for refrigerant or extracted ODS blowing agent projects
- 75 metric tons CO_2e per metric ton ODS for intact building foam projects

These emission factors aggregate both transportation and destruction emissions. An Offset Project Operator~~s~~ or Authorized Project Designee has the option of using the default emission factors or using the methods in Sections 5.2.4 and 5.2.5 to calculate offset project-specific emissions.

Equation 5.8 shall be used to calculate ODS transportation and destruction emissions if default emission factors are used. If an Offset Project Operator or Authorized Project Designee elects not to use the default emission factors, GHG emissions associated with transportation and destruction of ODS must be calculated separately.

Equation 5.8. Project Emissions from Transportation and Destruction Using the Default Emission Factors

$$Tr + Dest = \sum_i \left(Q_{ODS,i} \times EF_i \right)$$

Where,			Units
Tr+Dest	=	Total GHG emissions from ODS transportation and destruction, as calculated using default emission factors	tCO_2e
$Q_{ODS,i}$	=	Total quantity of ODS *i* sent for destruction in the project	tODS
EF_i	=	Default emission factor for transportation and destruction of ODS *i* (7.5 for refrigerant or extracted ODS blowing agent projects, 75 for intact building foam projects)	tCO_2e/ tODS

5.2.4 Calculating Site-Specific Project Emissions from ODS Destruction

Under this protocol, ODS must be destroyed at facilities that have a RCRA permit for hazardous waste destruction or that demonstrate compliance with the TEAP recommendations. TEAP facilities are required to demonstrate their ability to achieve destruction efficiencies upwards of 99.99% for substances with thermal stability ratings higher than the ODS included under this protocol.[9] Associated with the operation of these facilities are emissions of CO_2 from the fuel and electricity used to power the destruction, as well as emissions of undestroyed ODS. Equation 5.9 through Equation 5.11 provide requirements for calculating GHG emissions from ODS destruction in cases where Offset Project Operators or Authorized Project Designees opt not to use the default factors provided in Section 5.2.3.

Equation 5.9. Project Emissions from the Destruction of ODS

$$Dest = FF_{dest} + EL_{dest} + ODS_{emissions} + ODS_{CO2}$$

Where,			Units
Dest	=	Total GHG emissions from the destruction of ODS	tCO_2e
FF_{dest}	=	Total GHG emissions from fossil fuel used in the destruction facility (Equation 5.10)	tCO_2
EL_{dest}	=	Total indirect GHG emissions from grid electricity used at the destruction facility (Equation 5.11)	tCO_2
$ODS_{emissions}$	=	Total GHG emissions of undestroyed ODS (Equation 5.12)	tCO_2e
ODS_{CO2}	=	Total GHG emissions of CO_2 from ODS oxidation (Equation 5.13)	tCO_2

Equation 5.10. Fossil Fuel Emissions from the Destruction of ODS

$$FF_{dest} = \frac{\sum_k \left(FF_{PR,k} \times EF_{FF,k} \right)}{1000}$$

Where, Units

[9] Demonstration of compliance with TEAP recommendations must be conducted by a third party verifier.

FF_{dest}	=	Total carbon dioxide emissions from the destruction of fossil fuel used to destroy ODS	tCO_2
$FF_{PR,k}$	=	Total fossil fuel *k* used to destroy ODS	volume fossil fuel
$EF_{FF,k}$	=	Fuel specific emission factor (see Appendix B)	kg CO_2/ volume fossil fuel
1000	=	kg/t of CO_2	$kgCO_2$/ tCO_2

Equation 5.11. Electricity Emissions from the Destruction of ODS

$$EL_{dest} = \frac{(EL_{PR} \times EF_{EL})}{2204.6}$$

Where,

			Units
EL_{dest}	=	Total carbon dioxide emissions from the consumption of electricity from the grid used to destroy ODS	tCO_2
EL_{PR}	=	Total electricity consumed to destroy ODS	MWh
EF_{EL}	=	Carbon emission factor for electricity used (see Appendix B)	lb CO_2/ MWh

Equation 5.12. Calculating Project Emissions from ODS Not Destroyed

$$ODS_{emissions} = \sum_i Q_{ODS,i} \times 0.01\% \times GWP_i$$

Where,

			Units
$ODS_{emissions}$	=	Total GHG emissions of undestroyed ODS	tCO_2e
$Q_{ODS,i}$	=	Total quantity of ODS *i* sent for destruction in the project	tODS
0.01	=	Maximum allowable percent of ODS fed to destruction that is not destroyed	%
GWP_i	=	Global warming potential of ODS *i* (see Table 5.1)	tCO_2e/ tODS

Equation 5.13. Calculating Project Emissions of CO_2 from the Oxidation of ODS

$$ODS_{CO_2} = \sum_i Q_{ODS,i} \times 0.9999 \times CR_i \times \frac{44}{12}$$

Where,

			Units
ODS_{CO2}	=	Total GHG emissions of CO_2 from ODS oxidation	tCO_2
$Q_{ODS,i}$	=	Total quantity of ODS *i* sent for destruction in the project	tODS
0.9999	=	Minimum destruction efficiency of destruction facility	% (0-1)

CR_i	=	Carbon ratio of ODS *i* CFC-11: 12/137 CFC-12: 12/121 CFC-113: 12/90 CFC-114: 24/187 CFC-115: 12/74 HCFC-22: 12/87 HCFC-141b: 24/117	mole C/ mole ODS
44/12	=	Ratio of CO_2 to C	mole CO_2/ mole C

5.2.5 Calculating Site-Specific Project Emissions from ODS Transportation

As part of any ODS destruction project, ODS will be transported from aggregators to destruction facilities, and GHG emissions from this transportation must be accounted for under this protocol. Equation 5.14 must be used to calculate CO_2 emissions associated with the transport of ODS in cases where an Offset Project Operator or Authorized Project Designee chooses not to use the default emission factors presented in Section 5.2.3. Emissions shall be calculated for each leg of the transportation process separately, and then summed according to Equation 5.14 below.

Equation 5.14. Calculating Project Emissions from the Transportation of ODS

$$Tr = \sum_i \left(\frac{TMT_i \times EF_{TMT}}{1000} \right)$$

Where,			Units
Tr	=	Total GHG emissions from transportation of ODS	tCO_2e
TMT_i	=	Ton-miles-traveled[10] for ODS *i* destroyed (to be calculated including the ODS, any accompanying material, and containers from point of aggregation to destruction)	ton-miles
EF_{TMT}	=	CO_2 emissions per ton-mile-traveled On-road truck transport = 0.297 Rail transport = 0.0252 Waterborne craft = 0.048 Aircraft = 1.5279	$kgCO_2$ / ton-mile
1000	=	Conversion from kg to tons	kg/ton

6 Project Documentation Requirements

An ODS destruction project must comply with documentation requirements in the Regulation. The monitoring, reporting, and record retention requirements cover all aspects of this protocol and the documentation must specify how data for all relevant parameters in Table 6.2 was collected and recorded.

[10] A ton-mile is defined as the product of the distance travelled in miles and the mass transported in metric tons. Therefore, half a ton transported four miles is equal to two ton-miles.

The Offset Project Operator or Authorized Project Designee is responsible for monitoring the performance of the offset project and ensuring that there is no double-counting of GHG reductions associated with ODS destruction.

6.1 Point of Origin Documentation Requirements

As in the Regulation, the Offset Project Operator~~s~~ or Authorized Project Designee is responsible for collecting data on the point of origin of each quantity of ODS as part of tracking chain of custody, as defined in Table 6.1. The Offset Project Operator or Authorized Project Designee must maintain detailed acquisition records of all quantities of ODS destroyed under the offset project.

Table 6.1. Identification of Point of Origin

ODS	Defined Point of Origin
1. Refrigerant ODS stockpiled for greater than 24 months; or stockpiled prior to the adoption date of this protocol and destroyed within twelve months of the adoption date of this protocol.	Location of stockpile
2. Refrigerant ODS quantities less than 500 lbs	Location where ODS is first aggregated with other ODS to greater than 500 lbs[b]
3. Refrigerant ODS quantities greater than 500 lbs	Site of installation where ODS is removed
4. ODS blowing agent extracted from foam	Facility where ODS blowing agent is extracted
5. ODS blowing agent in building foam	Location of building from which foam was taken

[b] The point of origin for ODS collected by service technicians in individual quantities less than 500 pounds is defined as the holding facility at which several small quantities were combined and exceeded 500 pounds in aggregate. That is, those handling quantities less than 500 pounds need not provide documentation. However, once smaller quantities are aggregated and exceed 500 pounds collectively, tracking will be required from that location and point in time forward.

All data must be generated *at the time of collection* from the point of origin. Documentation of the point of origin of ODS must include the following:

- Facility name and physical address
- Point of origin zip code
- Identification of the system by serial number, if available, or description, location, and function, if serial number is unavailable (for quantities greater than 500 pounds)
- Serial or ID number of containers used for storage and transport

6.2 Chain of Custody Documentation Requirements

In conjunction with establishing the point of origin for each quantity of ODS, the Offset Project Operator~~s~~ or Authorized Project Designee must also document the custody and ownership of ODS beginning from the point of origin as required in the Regulation. These records shall include names, addresses, and contact information of persons/entities buying/selling material for destruction and the quantity of the material (the combined mass of refrigerant and contaminants) bought/sold. Such records may include Purchase Orders, Purchase Agreements, packing lists, bills of lading, lab test results, transfer container information, receiving inspections, freight bills, transactional payment information, and any other type of information that will support previous

ownership of the material and the transfer of beneficial ownership rights. The verifier will review these records and will perform other tests necessary to authenticate the previous owners of the material, the physical transfer of the product, and the transfer of beneficial ownership rights to the Offset Project Operator or Authorized Project Designee.

6.3 Building Foam Requirements – Quantification Methodology

The following information shall be collected and recorded related to ODS blowing agents from building insulation foam destroyed by the offset project:

- Building address
- Date of construction
- Blowing agent used
- Approximate building dimensions

All recovered foam pieces must be placed in air- and water-tight storage for transport to the destruction facility.

ODS blowing agent from building insulation foam may be destroyed intact without extraction of the blowing agent if the following procedures are followed to characterize the mass of foam and type(s) and mass ratio of ODS blowing agent contained in that foam.

1. The mass of the foam shall be determined through weight measurements taken at the destruction facility on scales calibrated quarterly. Scales are considered calibrated if they demonstrate accuracy of +/- 5% of reading.

2. The composition and mass ratio of the ODS foam blowing agent(s) present in the building insulation foam shall be determined based on a selection of a minimum two samples per building surface taken prior to demolition. Accordingly, a building with four exterior walls and a roof would be required to analyze a total of 10 samples: two for each wall, and two for the roof.

3. All samples must be collected and analyzed according to the following requirements:

    - Each foam sample shall be at a minimum 2 inches in length, 2 inches in width, and 2 inches thick
    - Each sample shall be placed and sealed in a separate waterproof, air-tight container, that is at minimum 2 millimeters thick for storage and transport
    - The analysis of ODS foam blowing agent content and mass ratio shall be done at an independent laboratory unaffiliated with the Offset Project Operator or Authorized Project Designee
    - The analysis shall be done using the heating method to extract ODS foam blowing agent from the foam samples described in Scheutz et al (2007)

referenced in The Climate Action Reserve's *U.S. Ozone Depleting Substances Project Protocol Version 1.0*:

- 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, and sealed with Teflon-coated septa and aluminum caps
- To release the ODS blowing agent from the foam, the samples must be incubated in an oven for 48 hours at 140 degrees C
- When cooled to room temperature, gas samples must be redrawn from the headspace and analyzed by gas chromatography
- 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 ODS blowing agent from the sampled foam
- When cooled down to room temperature after the second heating step, gas samples must be redrawn from the headspace and analyzed by gas chromatography

- The mass of ODS 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 ODS foam blowing agent present

The results from all samples from a single building shall be averaged to determine the mass ratio of blowing agent to foam, and this value multiplied by the weight of destroyed foam. The result shall represent the total quantity of ODS blowing agent from building foams destroyed for that building, and shall be used for the quantity as BA_{build} in Equation 5.4**.**

These practices shall be documented and must be demonstrated during verification activities.

6.4 Appliance Foam Requirements – Quantification Methodology

The following information shall be collected and recorded related to ODS blowing agent from appliance foams destroyed by the project:

- Number of appliances processed
- Facility at which ODS foam blowing agent is extracted to concentrated form
- Facility at which appliance de-manufacture occurs, if applicable

All appliance foam must be processed to recover and destroy concentrated ODS blowing agent. The following requirements must be met:

- The ODS blowing agent must be extracted from the foam to a concentrated form prior to destruction
- ODS blowing agent must be extracted under negative pressure to ensure that fugitive release of ODS is limited

- The recovered ODS blowing agent must be collected, stored, and transported in containers meeting U.S. Department of Transportation (DOT) standards for refrigerants

Extraction of the foam blowing agent may be performed using any technology capable of recovering concentrated ODS foam blowing agent. The processes, training, QA/QC, and management systems must be documented. The same process must be followed during project implementation and during the calculation of the project-specific recovery efficiency, as described in Appendix A.

Concentrated ODS blowing agent shall be measured according to the procedures provided in Section 6.5.

6.5 Concentrated ODS Composition and Quantity Analysis Requirements – Quantification Methodology

The requirements of this section must be followed to determine the quantities of both ODS refrigerants and concentrated ODS blowing agent. Prior to destruction, the precise mass and composition of ODS to be destroyed must be determined. The following analysis must be conducted:

Mass shall be determined by individually measuring the weight of each container of ODS: (1) when it is full prior to destruction; and (2) after it has been emptied and the contents have been fully purged and destroyed. The mass of ODS and any contaminants is equal to the difference between the full and empty weight, as measured. The following requirements must be met when weighing the containers of ODS:

1. A single scale must be used for generating both the full and empty weight tickets at the destruction facility
2. The scale used must be properly calibrated per the facility's RCRA permit, or for non-RCRA facilities calibrated at least quarterly to an accuracy of within 5% of reading. RCRA facilities that do not have calibration requirements defined in their RCRA permits must calibrate scales quarterly to an accuracy of within 5% of reading.
3. The full weight must be measured no more than two days prior to commencement of destruction per the Certificate of Destruction
4. The empty weight must be measured no more than two days after the conclusion of destruction per the Certificate of Destruction

Composition and concentration of ODS shall be established for each individual container by taking a sample from each container of ODS and having it analyzed for composition and concentration at an Air-Conditioning, Heating and Refrigeration Institute (AHRI) certified laboratory using the AHRI 700-2006 standard as referenced in The Climate Action Reserve's *U.S. Ozone Depleting Substances Project Protocol*

Version 1.0. The laboratory performing the composition analysis must not be affiliated with the Offset Project Operator or Authorized Project Designee.

The following requirements must be met for each sample:

1. The sample must be taken while ODS is in the possession of the company that will destroy the ODS
2. Samples must be taken by a technician unaffiliated with the Offset Project Operator or Authorized Project Designee [11]
3. Samples must be taken with a clean, fully evacuated sample bottle that meets applicable U.S. Department of Transportation requirements with a minimum capacity of one pound
4. Each sample must be taken in liquid state
5. A minimum sample size of one pound must be drawn for each sample
6. Each sample must be individually labeled and tracked according to the container from which it was taken, and the following information recorded:
    a) Time and date of sample
    b) Name of Offset Project Operator or Authorized Project Designee
    c) Name of technician taking sample
    d) Employer of technician taking sample
    e) Volume of container from which sample was extracted
    f) Ambient air temperature at time of sampling[12]
7. Chain of custody for each sample from the point of sampling to the AHRI lab must be documented by paper bills of lading or electronic, third-party tracking that includes proof of delivery (e.g., FedEx, UPS)

All project samples shall be analyzed using ARI 700-2006 to confirm the mass percentage and identity of each component of the sample. The analysis shall provide:

1. Identification of the refrigerant
2. Purity (%) of the ODS mixture by weight using gas chromatography
3. Moisture level in parts per million. The moisture content of each sample must be less than 75% of the saturation point for the ODS based on the temperature recorded at the time the sample was taken.
4. Analysis of high boiling residue, which must be less than 10% by mass
5. Analysis of other ODS in the case of mixtures of ODS, and their percentage by mass

If any of the requirements above are not met, no GHG reductions may be verified for ODS destruction associated with that container.

[11] For instances where the Offset Project Operator or Authorized Project Designee is the destruction facility itself, an outside technician must be employed for taking samples.
[12] Offset projects that destroy ODS prior to the adoption date of this protocol may use proxy data from NOAA recording stations in the area.

If the container holds non-mixed ODS (defined as greater than 90% composition of a single ODS species) no further information or sampling is required to determine the mass and composition of the ODS.

If the container holds mixed ODS, which is defined as less than 90% composition of a single ODS species, the Offset Project Operator or Authorized Project Designee must meet additional requirements as provided in Section 6.5.1.

6.5.1 Analysis of Mixed ODS

If a container holds mixed ODS, its contents must also be processed and measured for composition and concentration according to the requirements of this section (in addition to the requirements of Section 6.5). The sampling required under this section may be conducted at the final destruction facility or prior to delivery to the destruction facility. However, the circulation and sampling activities must be conducted by a third-party (i.e., not the Offset Project Operator or Authorized Project Designee), and by individuals who have been properly trained for the functions they perform. Circulation and sampling may be conducted at the Offset Project Operator or Authorized Project Designee's facility, but all activities must be directed by a properly trained and contracted third-party. The offset project's documentation must specify the procedures by which mixed ODS are analyzed.

The composition and concentration of ODS on a mass basis must be determined using the results of the analysis of this section for each container. The results of the composition analysis in Section 6.5 shall be used by verifiers to confirm that the destroyed ODS is the same ODS that is sampled under these requirements.

Prior to sampling, the ODS mixture must be circulated in a container that meets all of the following criteria:

1. The container has no solid interior obstructions[13]
2. The container was fully evacuated prior to filling
3. The container must have sampling ports to sample liquid and gas phase ODS
4. The sampling ports must be located in the middle third of the container (i.e., not at one end or the other)
5. The container and associated equipment can circulate the mixture via a closed loop system from the bottom to top

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

[13] Mesh baffles or other interior structures that do not impede the flow of ODS are acceptable.

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

1. Liquid mixture shall be circulated from the liquid port to the vapor port
2. A volume of the mixture equal to two times the volume in the container shall be circulated
3. Circulation must occur at a rate of at least 30 gallons/minute
4. Start and end times shall be recorded

Within 30 minutes of the completion of circulation, a minimum of two samples shall be taken from the bottom liquid port according to the procedures in Section 6.5. Both samples shall be analyzed at an AHRI approved laboratory per the requirements of Section 6.5. The analysis will determine the GWP weighted concentrations for both samples. The Offset Project Operator or Authorized Project Designee will use the results with the lesser GWP-weighted concentration for the protocol.

6.6 Destruction Facility Requirements – Quantification Methodology

Destruction of ODS must occur at a facility that meets all of the aforementioned TEAP requirements. This includes any RCRA-permitted HWC as well as any other facility that meets the aforementioned TEAP requirements. Facilities permitted as RCRA HWCs are considered to meet the guidelines by default; no further testing for TEAP compliance is required.

At the time of ODS destruction, all destruction facilities must have a valid Title V air permit, if applicable, and any other air or water permits required by local, state, or federal law to destroy ODS. Facilities must document compliance with all monitoring and operational requirements associated with the destruction of ODS materials, as dictated by these permits, including emission limits, calibration schedules, and training. Any upsets or exceedences must be managed in keeping with an authorized startup, shutdown, and malfunction plan. Non-RCRA facilities must further document operation consistent with the TEAP requirements. A third party must certify that the non-RCRA facility meets the TEAP requirements.

Operating parameters during destruction of ODS material shall be monitored and recorded as described in the Code of Good Housekeeping approved by the Montreal Protocol. This data will be used in the verification process to demonstrate that during the destruction process, the destruction unit was operating similarly to the period in which the DRE[14] was calculated. The DRE is determined using the Comprehensive Performance Test (CPT)[15] as a proxy for DRE and is disclosed to the public in the destruction facility's Title V operating permit.

To monitor that the destruction facility operates in accordance with applicable regulations and within the parameters recorded during DRE testing, the following parameters must be tracked continuously during the entire ODS destruction process:

[14] DRE disclosed in Title V operating permit.
[15] CPT must have been conducted with a less combustible chemical than the ODS in question.

- The ODS feed rate
- The amount and type of consumables used in the process (not required if default project emission factor for transportation and destruction is used)
- The amount of electricity and amount and type of fuel consumed by the destruction unit (not required if default project emission factor for transportation and destruction is used)
- Operating temperature and pressure of the destruction unit during ODS destruction
- Effluent discharges measured in terms of water and pH levels
- Continuous emissions monitoring system (CEMS) data on the emissions of carbon monoxide during ODS destruction

The Offset Project Operator or Authorized Project Designee must maintain records of all of these parameters for review during the verification process.

Destruction facilities shall provide valid Certificate(s) of Destruction for all ODS destroyed as part of the offset project. The Certificate of Destruction shall include:

- Offset Project Operator or Authorized Project Designee
- Destruction facility
- Generator name
- Certificate of Destruction ID number
- Serial, tracking, or ID number of all containers for which ODS destruction occurred
- Weight and type of material destroyed from each container
- Start destruction date
- Ending destruction date

6.7 Monitoring Parameters – Quantification Methodology

Prescribed monitoring parameters necessary to calculate project baseline and offset project emissions are provided in Table 6.2. In addition to the parameters below that are used in the calculations provided in Section 5, the Offset Project Operator~~s~~ or Authorized Project Designee~~s~~ is responsible for maintaining all records required by the Regulation and this protocol.

Table 6.2. ODS Project Monitoring Parameters – Quantification Methodology

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c) Measured (m) Reference (r) Operating records (o)	Comment
		Legal Requirement Test	N/A	For each offset project		Must be monitored and determined for each project
		Mass of ODS (or ODS mixture) in each container	mass of mixture	Per container	M	Must be determined for each container
		Concentration of ODS (or ODS mixture) in each container	mass ODS/ mass of mixture	Per container	M	Must be determined for each container
Equation 5.1	ER_t	Total quantity of GHG emission reductions during the reporting period	tCO_2e	For each offset project	C	
Equation 5.1, Equation 5.2	BE_t	Total quantity of project baseline emissions during the reporting period	tCO_2e	For each offset project	C	
Equation 5.1, Equation 5.5	PE_t	Total quantity of project emissions during the reporting period	tCO_2e	For each offset project	C	
Equation 5.2, Equation 5.3	BE_{refr}	Total quantity of project baseline emissions from refrigerant ODS	tCO_2e	For each offset project	C	
Equation 5.2, Equation 5.4	BE_{foam}	Total quantity of project baseline emissions from ODS blowing agent	tCO_2e	For each offset project	C	
Equation 5.3, Equation 5.6	$Q_{refr,i}$	Total quantity of refrigerant ODS *i* sent for destruction	tODS	For each offset project	M	
Equation 5.3	$ER_{refr,i}$	10-year cumulative emission rate of refrigerant ODS *i*	0 - 1.0	N/A	R	See Table 5.1
Equation 5.3, Equation 5.4, Equation 5.7, Equation 5.12	GWP_i	Global warming potential of ODS *i*	tCO_2e/ tODS	N/A	R	See Table 5.1
Equation 5.4, Equation 5.7	$BA_{app,i,}$	Total quantity of ODS blowing agent *i* from appliance foam prior to treatment or processing, including blowing agent lost during processing	tODS	For each offset project	C	

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c) Measured (m) Reference (r) Operating records (o)	Comment
Equation 5.4	$BA_{build,i}$	Total quantity of ODS blowing agent *i* from building foam sent for destruction.	tODS	For each offset project	C	
Equation 5.4	$ER_{i,j}$	Lifetime emission rate of ODS blowing agent *i* from application *j* at end-of-life (see Table 5.3)	% (0-1)	N/A	R	
Equation 5.4	$Q_{recover}$	Total quantity of ODS foam blowing agent recovered during processing and sent for destruction	tODS	For each offset project	M	
Equation 5.4, Equation 5.7	RE	Recovery efficiency of the ODS foam blowing agent recovery process	% (0-1)	Once for each offset project	C	See Appendix A for calculation of RE
Equation 5.4	Q_{foam}	Total weight of foam with entrained ODS blowing agent sent for destruction	tonnes	For each offset project	M	
Equation 5.4	BA%	Mass ratio of ODS blowing agent entrained in building foam, as determined according to Section 6.3	% (0-1)	For each offset project	M	
Equation 5.5, Equation 5.6	Sub_{refr}	Total GHG emissions from substitute refrigerant	tCO_2e	For each offset project	C	
Equation 5.5, Equation 5.7	$BA_{pr,i}$	Total quantity of ODS foam blowing agent *i* from appliance foam released during ODS extraction	tCO_2e	For each offset project	C	
Equation 5.5, Equation 5.8, Equation 5.14	Tr	Total GHG emissions from transportation of ODS	tCO_2e	For each offset project	C	
Equation 5.5, Equation 5.8, Equation 5.9	Dest	Total GHG emissions from the destruction process associated with destruction of ODS	tCO_2e	For each offset project	C	
Equation 5.6	SE_i	Emission factor for substitute emissions of refrigerant *i*, per Table 5.5	tCO_2e/ tODS destroyed	Per container	R	See Table 5.4 (see 10 for summary of the development of SE)

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c) Measured (m) Reference (r) Operating records (o)	Comment
Equation 5.8, Equation 5.12, Equation 5.13	$Q_{ODS,i}$	Total quantity of ODS *i* sent for destruction	tODS	For each offset project	M	
Equation 5.8,	EF_i	Default emission factor for transportation and destruction of ODS *i*	tCO_2e/ tODS	N/A	R	Equal to 7.5 for refrigerant projects, and 75 for foam projects
Equation 5.9, Equation 5.10	FF_{dest}	Total GHG emissions from fossil fuel used in the destruction facility	tCO_2e	For each offset project	C	Use only if calculating site-specific project emissions from ODS destruction
Equation 5.9, Equation 5.11	EL_{dest}	Total GHG emissions from grid electricity at the destruction facility	tCO_2e	For each offset project	C	Use only if calculating site-specific project emissions from ODS destruction
Equation 5.10	$FF_{PR,k}$	Total fossil fuel *k* used to destroy ODS	tCO_2e	For each offset project	M	Use only if calculating site-specific project emissions from ODS destruction
Equation 5.10	$EF_{FF,k}$	Fuel specific emission factor	$kgCO_2$/ volume fuel	N/A	R	Use only if calculating site-specific project emissions from ODS destruction
Equation 5.11	EL_{PR}	Total electricity consumed to destroy ODS	MWh	For each offset project	M	Use only if calculating site-specific project emissions from ODS destruction
Equation 5.11	EF_{EL}	Carbon emission factor for electricity used	$lbCO_2$/ MWh	N/A	R	Use only if calculating site-specific project emissions from ODS destruction
Equation 5.9, Equation 5.12	$ODS_{emissions}$	Total GHG emissions of un-destroyed ODS	tCO_2e	For each offset project	C	Use only if calculating site-specific project emissions from ODS destruction
Equation 5.9, Equation 5.13	ODS_{CO2}	Total emissions of CO_2 from ODS oxidation	tCO_2	For each offset project	C	Use only if calculating site-specific project emissions from ODS destruction
Equation 5.13	CR_i	Carbon ratio of ODS *i*	mole C/ mole ODS	N/A	R	Use only if calculating site-specific project emissions from ODS destruction
Equation 5.14	TMT_i	Tonne-miles-traveled for ODS *i* destroyed	tonne-miles	For each offset project	M	Use only if calculating site-specific project emissions from ODS transportation
Equation 5.14	EF_{TMT}	Mode-specific emission factor	$kgCO_2$/ tonne-mile	N/A	R	Use only if calculating site-specific project emissions from ODS transportation

7 Reporting Parameters

General requirements for reporting and record retention are included in the Regulation. This section provides additional requirements on reporting rules and procedures specific to this protocol. A priority of this protocol is to facilitate consistent and transparent information disclosure by the Offset Project Operator or Authorized Project Designee.

7.1 Annual Reporting Requirements

The Offset Project Operator~~s~~ or Authorized Project Designee~~s~~ must submit an Offset Project Data Report according to the requirements in the Regulation. The Offset Project Data Report must include the information listed in the Regulation and this protocol and cover a single Reporting Period. See the Regulation and Appendix D for specific requirements.

7.2 Document Retention

The Offset Project Operator or Authorized Project Designee is required to retain all documentation and information outlined in the Regulation and this protocol. Record retention requirements are set forth in the Regulation.

System information the Offset Project Operator or Authorized Project Designee should retain includes, but is not limited to:

- All data inputs for the calculation of the offset project emission reductions, including all required sampled data
- Copies of all permits, Notices of Violations (NOVs), and any relevant administrative or legal consent orders dating back at least 3 years prior to the project commencement date
- Destruction facility monitor information (CEMS data, DRE documentation, scale readings, calibration procedures, and permits)
- Chain of custody and point of origin documentation
- ODS composition and quantity lab reports

See section 95976 for regulatory record-keeping requirements.

7.3 Verification Cycle

Project verification schedules can be found in the Regulation.

8 Regulatory Verification Requirements

All Offset Project Data Reports are subject to regulatory verification as set forth in the Regulation by an ARB accredited verification body. The Offset Project Data Reports

must receive a positive or qualified positive verification statement to be issued ARB or registry offset credits.

9 Glossary of Terms[16]

Certificate of Destruction	An official document provided by the destruction facility certifying the date, quantity, and type of ODS destroyed.
Project commencement	The date of the beginning of the destruction activity.
Commercial refrigeration equipment	The refrigeration appliances used in the retail food, cold storage warehouse or any other sector that requires cold storage. Retail food includes the refrigeration equipment found in supermarkets, grocery and convenience stores, restaurants, and other food service establishments. Cold storage includes the refrigeration equipment used to house perishable goods or any manufactured product requiring refrigerated storage.
Container	An air- and water-tight unit for storing and/or transporting ODS material without leakage or escape of ODS.
Destruction	Destruction of ozone depleting substances by qualified destruction, transformation or conversion plants achieving greater than 99.99% destruction and removal efficiency, in order to avoid their emissions. Destruction may be performed using any technology, including transformation, that results in the complete breakdown of the ODS into either a waste or usable by-product.
Destruction facility	A facility that destroys, transforms or converts ozone depleting substances using a technology that meets the standards defined by the UN Environment Programme Technology and Economic Assessment Panel Task Force on Destruction Technologies as provided in the *Report of the Task Force on Destruction Technologies* and listed in The Climate Action Reserve's *U.S. Ozone Depleting Substances Project Protocol Version 1.0*.

[16] For terms not defined in this section, the definitions in the Regulation apply.

Emission rate	The rate at which refrigerant is lost to the atmosphere, including emissions from leaks during operation and servicing events.
Ozone Depleting Substances (ODS)	Ozone depleting substances are substances known to deplete the stratospheric ozone layer. The ODS controlled under the Montreal Protocol and its Amendments are chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC), halons, methyl bromide (CH_3Br), carbon tetrachloride (CCl_4), methyl chloroform (CH_3CCl_3), hydrobromofluorocarbons (HBFC) and bromochloromethane (CHBrCl).
Recovery efficiency	The percent of total ODS blowing agent that is recovered during the process of ODS blowing agent extraction.
Recharge	Replenishment of refrigerant agent (using reclaimed or virgin material) into equipment that is below its full capacity because of leakage or because it has been evacuated for servicing or other maintenance.
Reclaim	Reprocessing and upgrading of a recovered ozone depleting substance through mechanisms such as filtering, drying, distillation and chemical treatment in order to restore the ODS to a specified standard of performance. Chemical analysis is required to determine that appropriate product specifications are met. Reclaiming and the associated chemical analysis often involve processing off-site at a central facility.
Recovery	The removal of ozone depleting substances from machinery, equipment, containment vessels, etc., during servicing or prior to disposal without testing or processing it in any way.
Reuse/recycle	Reuse of a recovered ozone depleting substance following a basic cleaning process such as filtering and drying. For refrigerants, recycling normally involves recharge back into equipment and it often occurs ‘on-site’.
Startup, shutdown, and malfunction plan	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 location. These quantities may be composed of many small containers or a single large container.
Substitute refrigerant	Those refrigerants that will be used to fulfill the function that would have been filled by the destroyed ODS refrigerants. These refrigerants may be drop-in replacements used in equipment that previously used the type of ODS destroyed or may be used in new equipment that fulfills the same market function.
Substitute emissions	A term used in this protocol to describe the greenhouse gases emitted from the use of substitute refrigerants in technologies that are used to replace the ODS destroyed in a project.
Transportation system	A term used to encompass the entirety of the system that moves the ODS from the point of aggregation to the destruction facility.

10 References

CAR (2010) U.S. Ozone Depleting Substances Project Protocol Version 1.0. February 3, 2010.
http://www.climateactionreserve.org/how/protocols/adopted/ods/current/ (accessed August 30, 2010)

CAR (2010) U.S. Ozone Depleting Substances Project Protocol Errata and Clarifications. May 7, 2010.
http://www.climateactionreserve.org/how/protocols/adopted/ods/current/ (accessed August 30, 2010)

Appendix A Foam Recovery Efficiency and Calculations – Quantification Methodology

The following methodology calculates the site- or process-specific recovery efficiency for blowing agent recovery projects, and uses this value for calculation of GHG emission reductions in Section 5. Determination of accurate recovery efficiency allows project baseline emissions and project emissions to be calculated in reference to the initial quantity of foam blowing agent diverted from project baseline treatment.

A.1 Calculating Recovery Efficiency

All appliance foam projects must calculate a recovery efficiency based on a run of a minimum ten appliances. Basing this analysis on a number of appliances greater than ten will likely result in a higher calculated recovery efficiency due to the 90% upper confidence limit used for calculating the concentration of ODS blowing agent in the foam. A larger sample size will decrease uncertainty and thus lower the estimated blowing agent concentration and increase recovery efficiency; however, sampling of additional appliances will also increase testing costs.

The procedures below shall be used to calculate recovery efficiency.

Estimate initial blowing agent concentration

The concentration of ODS blowing agent in the PU foam prior to any appliance treatment shall either be assumed to equal to 14.9% or calculated according to the steps below. Calculating a sample-specific value allows the Offset Project Operator~~s~~ or Authorized Project Designee~~s~~ to document a lower ODS blowing agent concentration, which will result in a higher estimated recovery efficiency.

The following steps shall be followed to document a sample-specific ODS blowing agent concentration:

1. Cut four PU foam samples from each appliance (left side, right side, top, bottom) using a reciprocating saw. Samples must be at least four inches square and the full thickness of the insulation.
2. Seal the cut edges of each foam sample using aluminum tape or similar product that prevents off-gassing.
3. Individually label each sample to record appliance model, and site of sample (left, right, top, or bottom)
4. Analyze samples according to the procedures dictated for building foam in Section 6.3. Samples may be analyzed individually (four analyses per appliance), or a single analysis may be done using equal masses of foam from each sample (one analysis per appliance).
5. Based on the average of the samples for each appliance, calculate the 90% upper confidence limit of the concentration. The 90% upper confidence limit shall be used as the parameter BA_{conc} in the equations below.

Extract the ODS blowing agent and separate foam residual

The ODS blowing agent from the sampled appliances must be collected and quantified according to the steps below.

1. Begin processing with all equipment shut down and emptied of all materials.
2. Process all sample appliances.
3. Extract and collect concentrated BA. The mass of the recovered blowing agent shall be determined by comparison of the mass of the fully evacuated receiving containers to their mass when filled. This value shall be used as the parameter BA_{post} in the equations below.

Separate foam residual

The quantity of foam in the processed appliances must be established either through use of a default value of 12.9 pounds per appliance, or according to the following steps. If the value of 12.9 pounds per appliance is used, it shall be multiplied by the number of appliances processed to determine $Foam_{res}$ in the calculation of recovery efficiency.

1. Separate and collect all foam residual, which may be in a fluff, powder, or pelletized form. Processes must be documented to demonstrate that no significant quantity of foam residual is lost in the air or other waste streams.
2. If desired, manually separate non-foam components in the residual (e.g., plastic) to determine a percent of foam in residual. If performed, this analysis must be conducted on at least one kilogram of residual, and results may be no lower than 90%.
3. Weigh the total recovered foam residual, and, if performed, multiply by the percent foam in residual, to calculate total mass of foam recovered. This value shall be used as the parameter $Foam_{res}$.

Calculate recovery efficiency

To calculate the recovery efficiency, apply the calculated values to the equations below. The recovery efficiency (RE) calculated below shall be used in the calculations of Section 5.

$$BA_{init} = \frac{Foam_{res}}{(1 - BA_{conc})} \times BA_{conc}$$

Where,			Units
$Foam_{res}$	=	Mass of foam recovered	lbs foam
BA_{conc}	=	Initial concentration of blowing agent in PU foam	lbs BA / lbs PU
BA_{init}	=	Initial quantity of blowing agent in appliances prior to treatment	lbs BA

$$RE = \frac{BA_{post}}{BA_{init}}$$

Where,

			Units
RE	=	Recovery efficiency	%
BA_{post}	=	Quantity of recovered blowing agent in concentrated form	lbs BA
BA_{init}	=	Initial quantity of blowing agent in appliances prior to treatment	lbs BA

Appendix B Emission Factor Tables

Table B.1. CO_2 Emission Factors for Fossil Fuel Use

Fuel Type	Heat Content	Carbon Content (Per Unit Energy)	Fraction Oxidized	CO_2 Emission Factor (Per Unit Energy)	CO_2 Emission Factor (Per Unit Mass or Volume)
Coal and Coke	**MMBtu / Short ton**	**kg C / MMBtu**		**kg CO_2 / MMBtu**	**kg CO_2 / Short ton**
Anthracite Coal	25.09	28.26	1.00	103.62	2,599.83
Bituminous Coal	24.93	25.49	1.00	93.46	2,330.04
Sub-bituminous Coal	17.25	26.48	1.00	97.09	1,674.86
Lignite	14.21	26.30	1.00	96.43	1,370.32
Unspecified (Residential/ Commercial)	22.05	26.00	1.00	95.33	2,102.29
Unspecified (Industrial Coking)	26.27	25.56	1.00	93.72	2,462.12
Unspecified (Other Industrial)	22.05	25.63	1.00	93.98	2,072.19
Unspecified (Electric Utility)	19.95	25.76	1.00	94.45	1,884.53
Coke	24.80	31.00	1.00	113.67	2,818.93
Natural Gas (By Heat Content)	**Btu / Standard cubic foot**	**kg C / MMBtu**		**kg CO_2 / MMBtu**	**kg CO_2 / Standard cub. ft.**
975 to 1,000 Btu / Std cubic foot	975 – 1,000	14.73	1.00	54.01	Varies
1,000 to 1,025 Btu / Std cubic foot	1,000 – 1,025	14.43	1.00	52.91	Varies
1,025 to 1,050 Btu / Std cubic foot	1,025 – 1,050	14.47	1.00	53.06	Varies
1,050 to 1,075 Btu / Std cubic foot	1,050 – 1,075	14.58	1.00	53.46	Varies
1,075 to 1,100 Btu / Std cubic foot	1,075 – 1,100	14.65	1.00	53.72	Varies
Greater than 1,100 Btu / Std cubic foot	> 1,100	14.92	1.00	54.71	Varies
Weighted U.S. Average	1,029	14.47	1.00	53.06	0.0546
Petroleum Products	**MMBtu / Barrel**	**kg C / MMBtu**		**kg CO_2 / MMBtu**	**kg CO_2 / gallon**
Asphalt & Road Oil	6.636	20.62	1.00	75.61	11.95
Aviation Gasoline	5.048	18.87	1.00	69.19	8.32
Distillate Fuel Oil (#1, 2 & 4)	5.825	19.95	1.00	73.15	10.15
Jet Fuel	5.670	19.33	1.00	70.88	9.57
Kerosene	5.670	19.72	1.00	72.31	9.76
LPG (average for fuel use)	3.849	17.23	1.00	63.16	5.79
Propane	3.824	17.20	1.00	63.07	5.74
Ethane	2.916	16.25	1.00	59.58	4.14
Isobutene	4.162	17.75	1.00	65.08	6.45
n-Butane	4.328	17.72	1.00	64.97	6.70
Lubricants	6.065	20.24	1.00	74.21	10.72
Motor Gasoline	5.218	19.33	1.00	70.88	8.81
Residual Fuel Oil (#5 & 6)	6.287	21.49	1.00	78.80	11.80
Crude Oil	5.800	20.33	1.00	74.54	10.29
Naphtha (<401 deg. F)	5.248	18.14	1.00	66.51	8.31
Natural Gasoline	4.620	18.24	1.00	66.88	7.36
Other Oil (>401 deg. F)	5.825	19.95	1.00	73.15	10.15
Pentanes Plus	4.620	18.24	1.00	66.88	7.36
Petrochemical Feedstocks	5.428	19.37	1.00	71.02	9.18
Petroleum Coke	6.024	27.85	1.00	102.12	14.65
Still Gas	6.000	17.51	1.00	64.20	9.17
Special Naphtha	5.248	19.86	1.00	72.82	9.10
Unfinished Oils	5.825	20.33	1.00	74.54	10.34
Waxes	5.537	19.81	1.00	72.64	9.58

Default CO_2 emission factors (per unit energy) are calculated as: Carbon Content × Fraction Oxidized × 44/12.
Default CO_2 emission factors (per unit mass or volume) are calculated as: Heat Content x Carbon Content × Fraction Oxidized × 44/12× Conversion Factor (if applicable).
Heat content factors are based on higher heating values (HHV).

Table B.2. CO_2 Electricity Emission Factors

eGRID subregion acronym	eGRID subregion name	Annual output emission rates	
		(lb CO_2/MWh)	(metric ton CO_2/MWh)*
AKGD	ASCC Alaska Grid	1,232.36	0.559
AKMS	ASCC Miscellaneous	498.86	0.226
AZNM	WECC Southwest	1,311.05	0.595
CAMX	WECC California	724.12	0.328
ERCT	ERCOT All	1,324.35	0.601
FRCC	FRCC All	1,318.57	0.598
HIMS	HICC Miscellaneous	1,514.92	0.687
HIOA	HICC Oahu	1,811.98	0.822
MROE	MRO East	1,834.72	0.832
MROW	MRO West	1,821.84	0.826
NEWE	NPCC New England	927.68	0.421
NWPP	WECC Northwest	902.24	0.409
NYCW	NPCC NYC/Westchester	815.45	0.370
NYLI	NPCC Long Island	1,536.80	0.697
NYUP	NPCC Upstate NY	720.80	0.327
RFCE	RFC East	1,139.07	0.517
RFCM	RFC Michigan	1,563.28	0.709
RFCW	RFC West	1,537.82	0.698
RMPA	WECC Rockies	1,883.08	0.854
SPNO	SPP North	1,960.94	0.889
SPSO	SPP South	1,658.14	0.752
SRMV	SERC Mississippi Valley	1,019.74	0.463
SRMW	SERC Midwest	1,830.51	0.830
SRSO	SERC South	1,489.54	0.676
SRTV	SERC Tennessee Valley	1,510.44	0.685
SRVC	SERC Virginia/Carolina	1,134.88	0.515

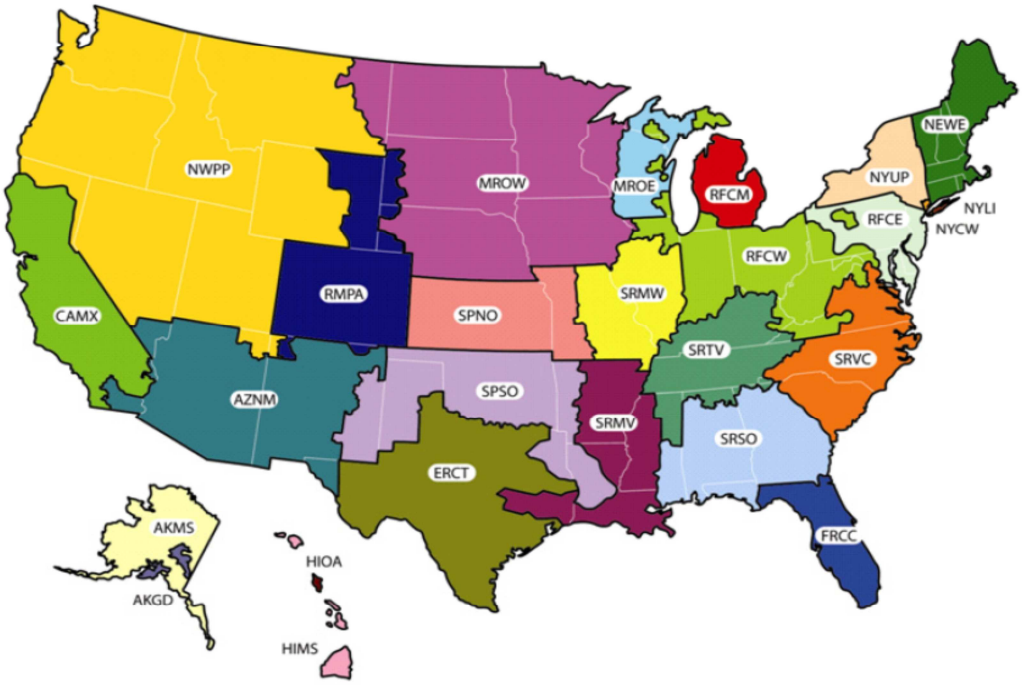


Figure B.1. Map of eGRID2007 Subregions

Appendix C Offset Project Listing Information

1. Offset project Name
2. Offset Project Operator or Authorized Project Designee
3. Technical Consultants
4. Other parties with a material interest
5. Date of form completion
6. Form completed by (name, organization)
7. Offset project Description: 1-2 paragraphs
8. List all points of origin by US state for ODS sourced for this project
9. All ODS sources that will be destroyed under this project:
   Refrigerant Destruction: CFC-11, CFC-12, CFC-113, CFC-114, or CFC-115
   Destruction of ODS Blowing agent in intact building foam: CFC-11, CFC-12, HCFC-22, HCFC-141b
   Destruction of concentrated ODS blowing agent in appliance foam: CFC-11, CFC-12, HCFC-22, HCFC-141b
10. Name of destruction facility
11. Address of destruction facility
12. Is the destruction facility a RCRA permitted hazardous waste combustor (HWC)?
13. If the destruction facility is not a RCRA-permitted HWC, has it met the TEAP requirements for ODS destruction?
14. Offset project commencement date
15. Reporting period
16. Have any GHG reductions associated with the offset project ever been registered with or claimed by another registry or program, or sold to a third party prior to our listing? If yes, identify the registry or program (Vintage and reporting period)
17. Is this offset project being implemented and conducted as the result of any law, statute, regulation, court order, or other legally binding mandate? If yes, explain.
18. Has an Offset Project Data Report been developed? If not, what date will it be in place?
19. Has the offset project-specific recovery efficiency been determined (for appliance foam projects only)? If not, when will this factor be established? If yes, what is the factor?
20. Was, or will, any of the destroyed ODS be sources from the US government? If yes, how much?
21. Was, or will, any of the destroyed ODS be considered hazardous waste under US, state or local law? If yes, how much and explain.

Appendix D Offset Data Report Information

1. Offset project name
2. Offset Project Operator or Authorized Project Designee
3. Report date
4. Contact information for Offset Project Operator or Authorize Project Designee
    a. Address, email, phone number
5. Name of individual completing report
6. Reporting Period
7. Does offset project meet all local, state, or federal regulatory requirements?
8. Date(s) of ODS destruction
9. Destruction facility name and location
10. Type of ODS destroyed
11. Mass and composition of ODS as determined by the process outlined in Section 6.6 of the Protocol.
12. Names of all parties and their contact information included in the chain of custody documentation
13. Is all the information in the offset project listing still accurate? If not provided updates.
14. Project baseline emissions
15. Project emissions
16. Total GHG reductions