Chicago Climate Exchange®

Ozone Depleting Substance Destruction Offset Project Protocol

Ozone Depleting Substance Destruction Offset Projects

The Chicago Climate Exchange (CCX®) Ozone Depleting Substance Destruction Offset Project Protocol outlines the process and requirements for Project Proponents to register greenhouse gas emission reductions resulting from the voluntary destruction of ozone depleting substances. CCX General Offsets Program Provisions, CCX Offset Project Verification Guidance and CCX Offset Project Protocols can be downloaded by visiting www.theccx.com. Requests for further information or comments may be directed to offsets@theccx.com.

CHICAGO CLIMATE EXCHANGE OFFSET PROJECT PROTOCOL

Ozone Depleting Substances Destruction

Updated as of 5/17/2012

**Cover photo provided by Remtec International®*

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ACRONYMS[1]

ANSI	American National Standards Institute
CAAA	Clean Air Act Amendments
CCX	Chicago Climate Exchange
DRE	Destruction Removal Efficiency
EPA	U.S. Environmental Protection Agency
HAP	Hazardous Air Pollutant
HWC	Hazardous Waste Combustor
IPCC	Intergovernmental Panel on Climate Change
MACT	Maximum Achievable Control Technology
ODS	Ozone Depleting Substances
RCRA	Resource Conservation and Recovery Act
WBCSD	World Business Council on Sustainable Development
WRI	World Resources Institute

[1] Please refer to CCX General Offsets Program Provisions for additional "Acronyms, Terms and Definitions"

1. INTRODUCTION

Chicago Climate Exchange (CCX) is the world's first and North America's only active voluntary, legally binding integrated trading system to reduce emissions of all six major greenhouse gases (GHGs), with Offset Projects worldwide. CCX Members with significant GHG emissions voluntarily enter into a legally binding agreement to reach CCX GHG Emission Reduction Commitment[2]. Upon enrollment with CCX, Exchange Allowances are issued to Members in amounts equal to their emission reduction targets. CCX Offsets are issued to Owners or Aggregators of registered projects on the basis of verified sequestration, destruction or reduction of GHG emissions not included under the CCX Emission Reduction Commitment. Members are required to turn in the amount of Exchange Allowances and/or Offsets equal their actual GHG emissions annually.

CCX strives to promote transparency and integrity in the carbon market. In accordance with this goal, in developing this document, CCX was guided by the fundamental principles of project GHG accounting outlined in ISO 14064-2: *Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancemen*ts, Version 1. These principles include:

- Relevance
- Completeness
- Consistency
- Accuracy
- Transparency
- Conservativeness

The following sections of this Protocol discuss the project criteria, boundaries, monitoring requirements, avoided emissions calculations and other guidelines that each Project Proponent must adhere to in order to generate Offsets from ODS destruction projects.

1.1 Ozone Depleting Substances Background

Production of chlorofluorocarbons (CFCs), halons, and other ODS has been phased out in the U.S. under the Montreal Protocol; phase out of hydrochlorofluorocarbons (HCFCs) is in progress. In addition to depleting stratospheric ozone, these chemicals have global warming potentials relative to CO_2 ranging between 500 and 10,000 when eventually emitted from equipment and storage stockpiles. While production of these chemicals has been or is being ended, there are no regulations or market incentives to ensure recovery and destruction of the chemicals contained in older appliances, commercial air conditioning and refrigeration equipment, insulation foam, fire fighting systems, storage cylinders, and other "banks".

[2] http://theccx.com/content.jsf?id=72

For the US in 2007, EPA estimates that accessible quantities of ODS contained in equipment represent over 1,400 million metric tons of CO_2 equivalent ($MMTCO_2e$). Accessible quantities of ODS that have been phased out of production in the U.S. account for approximately 330 $MMTCO_2e$. EPA estimates that by 2010, 13% of this amount will be emitted if not recovered and destroyed or converted. Appendix B presents historical and projected estimates for accessible quantities of ODS by ODS type for the years 2000 to 2030. Additional quantities of ODS (e.g., CFC-12, halon 1301) are contained in bulk storage (pressurized 30 pound cylinders, 250 gallon tanks, or large ISO tanks). Some stockpiled ODS could be made available for destruction, particularly if destruction incentives are provided to the owners of such stockpiles.

2. GENERAL PROVISIONS

Projects are subject to the conditions of this Protocol, the CCX General Offset Program Provisions and determinations of the CCX Committee on Offsets. All Project Proponents should review CCX General Offset Program Provisions and CCX Offset Project Protocol for ODS Destruction Offset Projects.

3. ASSOCIATED DOCUMENTS

This Protocol references the use of the following associated documents. These documents include:

- CCX General Offset Program Provisions
- CCX General Verification Guidance Document
- CCX Project Implementation Document
- CCX Project Specific Conflict of Interest Form
- CCX Greenhouse Gas Emission Factors Document
- CCX Project Owner Attestation

These documents are available on the Offsets section of the CCX website: www.theccx.com.

4. PROJECT DEFINITION

An ODS destruction project consists of the destruction of eligible ODS at a destruction facility that meets the eligibility criteria and other requirements outlined in these guidelines.

These guidelines are based on the reporting requirements under the Resource Conservation Recovery Act and destruction at hazardous waste combustors are detailed within this Protocol. Destruction of ODS material at Non-RCRA permitted facilities must propose and

have approved a specific monitoring and verification procedure and checklist appropriate for the destruction technology.

Project which destroy ODS that is entrained in refrigerator insulation foam are included in the project definition and an applicable monitoring and verification procedure and checklist is also included within this Protocol.

5. ELIGIBILITY CRITERIA

Several factors determine a project's eligibility to generate Offsets including the Proponent's membership status, ownership status, project start date, location, eligible ODS material, eligible destruction facilities, and whether the project meets the CCX performance benchmark.

5.1 CCX Membership

The Project Proponent(s) must be a Member or Participant Member (Offset Provider or Aggregator) of CCX. For-profit entities, cooperatives, governmental bodies and non-profit organizations may act as CCX Offset Aggregators. An Aggregator serves as an administrative representative, on behalf of Project Owners, of one or more projects. Project Proponents should contact CCX directly for membership rules and information.

5.2 Eligibility Governing Entities with Minor Emissions

Entities with an entity-wide emissions profile greater than 10,000 metric tons CO_2 equivalent for the most recent calendar year may register and trade CCX Offsets only if the entity is a Member of CCX and undertakes the CCX Emission Reduction Commitment. For specific guidance on this provision, Project Proponents should review CCX General Offset Program Provisions.

Entities who are unsure of their emissions profile should estimate their direct CO_2 emission using well accepted methodologies such as those available at the World Resources Institute (WRI)/World Business Council on Sustainable Development (WBCSD). CCX requires that all entities that are not Members, including producers enrolled with Aggregators, provide an attestation relating to their direct emissions in a form provided by CCX.

5.3 Ownership Status

The Project Proponent must demonstrate clear ownership of the GHG mitigation rights associated with the project in order to register ODS destruction Offset projects with CCX. Contract documentation may be provided by the Project Proponents to express ownership of the GHG mitigation rights. Where appropriate, an attestation of Project Ownership shall satisfy this requirement

CCX Offset Aggregators must have acquired appropriate control of the GHG mitigation rights from the Project Owner in order to execute its responsibilities on CCX pursuant to CCX General Offset Program Provisions. Aggregators must demonstrate to the project Verifier and CCX that they have acquired appropriate control.

5.4 Project Start Date

Projects must start on or after January 1, 2007, which corresponds with the year this Protocol was created.

5.5 Project Location

Only destruction projects located in the United States are eligible under these guidelines.

5.6 Project Specific Eligibility Requirements

Eligible ODS materials are limited to ODS whose production has been phased out under the Montreal Protocol and Title VI of the CAAA (all CFCs, halons, carbon tetrachloride, methyl chloroform, hydrobromofluorocarbons, and HCFC-141b). A complete list of eligible ODS can be found in Appendix C.

Certain Class I and Class II ODS (such as CFCs for use in metered dose inhalers) are allowed to be produced or imported as part of the EPA essential use exemption program. The essential use process is highly regulated by EPA and is designed to allow the use of banned ODS for specific purposes. Therefore, only destruction of ODS listed in Appendix C that is not produced or imported in relation to a critical use exemption is eligible under these guidelines.

5.6.1 Eligible Destruction Facilities

ODS destruction must take place at RCRA-permitted hazardous waste facilities, or at Non-RCRA permitted facilities that have current, one-time reports filed with the U.S. EPA indicating that they are a facility that destroy ODS. Projects undertaken at non-RCRA permitted facilities must have their project specific monitoring and verification plan approved by CCX.

5.6.2 Imported ODS

EPA requires that imports of used/recycled ODS into the U.S. receive approval based on documentation specified in the Code of Federal Regulations (CFR) at 82.13(g)(2) and 82.24(c)(3). Limited exemptions allow for the imports of virgin ODS. In order to be eligible under these guidelines, Project Proponents seeking to earn Offset for the destruction of imported ODS must meet all national and international requirements for imported ODS.

5.7 Performance Benchmark

ODS destruction projects are not eligible to generate Offsets in instances where the destruction of ODS can be considered a standard business practice (i.e. business as usual) or is required by law or other legally binding framework. CCX has identified two performance criteria that projects must meet to be considered for Offset issuance.

For imported ODS, the Project Proponent shall demonstrate that production and importation of the ODS is ceased in the exporting country, the material was not produced pursuant to a critical use exemption and that disposal by destruction is not common practice as outline below. To proceed with a CCX project, CCX must specifically approve these projects.

5.7.1 Regulatory Criteria

In order to generate Offsets under these guidelines, the project shall not be required to destroy ODS under any federal, state or local regulations or other legally binding framework.

Currently, no regulation in the United States requires the destruction of ODS. Similarly, no regulations require the dismantling of refrigerators and freezers and the removal and incineration of the ODS entrained in foam. However, because new regulations may be implemented in the future, CCX members must make an attestation that that federal, state and/or local regulations or other legally binding framework are not mandating the ODS destruction when implementing specific individual projects.

5.7.2 Common Practice Criteria

According to the GHG Protocol for Project Accounting, *"Common practice refers to the predominant technologies or practices in a given market, as determined by the degree to which those technologies or practices have penetrated the market (defined by a specified geographic area)."*[3]

CCX reviewed information regarding estimates of total ODS destroyed in 2003 and 2004.[4] CCX also reviewed information relating to the common practice in disposal of refrigerators and freezers and the ODS entrained in insulation foam. Common practice disposal involves either the shredding or crushing of refrigerators and freezers for disposal in landfill.[5] Based

[3] World Resources Institute and World Business Council for Sustainable Development. 2005. *The Greenhouse Gas Protocol for Project Accounting*. WRI/WBCSD, Washington, D.C.
[4] U.S.EPA, 2008, *Destruction of Ozone-Depleting Substances in the United States. Draft report prepared by ICF International for U.S. EPA*
[5] United Nations Environment Program, 2005, *Report of the Technology and Economic Assessment Panel: Volume 3 Report of the Task Force on Foam End-of-Life Issues.*

on the reviewed information, CCX has concluded that it is currently not common practice to destroy ODS.

Given the common practice definitions above and the CCX review of available ODS destruction estimates, voluntary ODS destruction is clearly not common practice. Therefore, a project that meets the regulatory criteria above and elects to voluntarily destroy ODS can be considered beyond business as usual.[6]

6. PROJECT BOUNDARY

A clearly defined boundary is vital to accurately assess avoided GHG emissions due to the destruction of ODS. Although the destruction technology may vary, the Project Boundary for all ODS Destruction Offset Projects will include the ODS destruction, monitoring and recording equipment, and relevant project-based emission sources. Fugitive emissions from leaks in ODS storage equipment are not included in the Boundary as these emissions would have occurred in the absence of the project under the baseline scenario identified below.

6.1 Identification of GHG Sources, Sinks and Reservoirs

The following summary table identifies the GHG Sources for an ODS destruction project. Project Proponents should, on a case-by-case basis, evaluate the applicability of each GHG Source included in the table below.

Table 1: Relevant GHG sources to be Included within the Project Boundary

GHG Source Category	GHG Source	GHG	Included in Project Boundary	Comment
ODS Destruction Process	Emissions resulting from ODS destruction	CO_2	Yes	ODS combustion results in the formation of CO_2. Because this CO_2 is not biogenic in nature, it is included as a GHG Source.
	Emissions resulting from the combustion of fuel used by the ODS	CO_2	Yes	All CO_2 emissions due to fossil fuel used in the ODS destruction process are included.

[6] CCX will periodically review this data to assess whether the performance benchmark has changed and may implement modifications in the future based on the review. Once a project is registered with CCX, it is not affected by changes to the common practice criteria for the market period in which it registers. The current market period is from January 1, 2003 through December 31, 2010.

	destruction device	CH_4	No	Excluded, as this emission source is assumed to be very small[7].
		N_2O	No	Excluded, as this emission source is assumed to be very small[3].
Other Project-Based Emissions	Emissions resulting from the transportation of ODS to eligible destruction facility. Mobile source GHG emissions should, at a minimum, be estimated based on fuel type and mileage.	CO_2	Yes	Mobile source GHG emissions should, at a minimum, be estimated based on fuel type and mileage.
		CH_4	No	Excluded, as this emission source is assumed to be very small[8].
		N_2O	No	Excluded, as this emission source is assumed to be very small[4].

The GHG Sink(s) will be the destruction device or devices used by the project. No Reservoirs are anticipated in ODS destruction projects.

ISO 14064-2 requires that the project's GHG Sources and Sinks be categorized as controlled by the Project Proponent, related to the project, or affected by the project. These are discussed below.

6.1.1 Controlled GHG Sources and Sinks

Controlled GHG Sources and Sinks for ODS destruction projects are those that occur on-site. Therefore, controlled GHG Sources and Sinks for ODS destruction projects refer to those that are part of the physical ODS destruction process.

6.1.2 Related GHG Sources and Sinks

Related GHG Sources and Sinks for ODS destruction projects refer to those that have material or energy flows into or out of the project. Therefore, Related GHG Sources and Sinks for an ODS destruction project are generally those that occur off-site and are associated with project emissions occurring from mobile source combustion due to transportation of the ODS to an eligible destruction facility.

[7] Based on emissions factors found in Volume 2, Table 2.2, of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, all CH4 and N2O emissions are excluded, as emissions will be small in comparison to CO2 emissions.

[8] Based on emissions factors found in Volume 2, Tables 3.2.1 and 3.2.2, of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, all CH_4 and N_2O emissions are excluded, as emissions will be small in comparison to CO_2 emissions.

6.1.3 Affected GHG Sources and Sinks

Affected GHG Sources and Sinks are those that are influenced by the ODS destruction project and result in new or changed activities outside the Project Boundary that actually increase GHG emissions. This concept is commonly referred to as leakage. CCX does not expect ODS destruction projects to result in new or changed activities that increase GHG emissions outside of the Project Boundary and, therefore, no leakage assessment is required.

6.2 Determining the Baseline Scenario

In accordance with the process outlined in ISO 14064, Part 2, possible baseline scenarios were evaluated for ODS destruction projects. CCX identified the plausible baseline scenarios for two types of ODS destruction projects:

1) Gaseous or Liquid ODS.
2) ODS Entrained in Foam.

6.2.1 Gaseous or Liquid ODS

CCX identified two possible baselines for ODS destruction projects as follows:

1) The fugitive emission of ODS to the atmosphere.
2) The voluntary destruction of ODS without the generation of revenue from Offsets sales.

Based on the information presented in section 5, the most likely baseline scenario in the absence of regulation or other requirements mandating ODS destruction is the fugitive emission of ODS to the atmosphere.

6.2.2 ODS Entrained in Foam

For projects which destroy ODS entrained in refrigerator or freezer insulation foam, CCX has identified three possible disposal baselines as follows:

1) Fugitive emissions of ODS gas from the foam material during shredding.
2) Capture of ODS gas from the foam material during shredding.
3) The voluntary destruction of ODS entrained in foam without the generation of revenue from emission Offsets sales.

Based on the information presented in section 5, the most likely baseline scenario in the absence of regulation or other requirements mandating foam incineration is the fugitive emission of ODS to the atmosphere. Based on a literature review, the amount of fugitive emissions which occur during shredding are between 24 and 70 percent, with the remainder

continuing to be entrained in the shredded foam.[9] For the purpose of project performed under this Protocol, CCX assumes that 24 percent of the ODS entrained in the foam is released during shredding.[10]

Projects which capture ODS released during foam destruction may result in marketable ODS which, if destroyed, have a baseline as defined in section 6.2.1.

6.2.3 Determining the Quantity of ODS

The emission reductions are determined by the quantity of ODS destroyed. To measure the quantity accurately a scale or a flow meter shall be used at the destruction facility.

Nonetheless, prior to shipment to the destruction facility, the Project Proponent will determine the amount of ODS to be destroyed. One method of doing this is to weigh the transport container before filling and after filling to determine the difference representing the quantity being shipped for destruction. Alternatively, a tare weight of the container may substitute for the pre-filling weight.

The transport container should be properly sealed after filling and data recorded to ensure a complete transportation chain of custody and that the container has not been tampered with (e.g. trucking manifests, tamper proof tags etc.). At the destruction facility, the transport container will be weighed prior to and after the destruction process. The Project Proponent must ensure procedures are in place and documented to ensure weights are reflective accounting for vehicle attachments to the transport container.

The weights from the destruction facility will be reconciled with those at the time of filling. The weights at the destruction facility will be used in the calculation of the emissions Offset and should be supported by the initial weights or other verification methods.

Should the weights at the destruction facility not be useable the project developer may use continuous flow monitoring data showing quantity of ODS that entered the destruction process.

Scale and/or flow meters must have been calibrated in accordance the manufacturer recommendations and records of these calibrations must be kept and inspected by the Verifier. Where a flow meter is used, it must be calibrated to the material in question.

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[9] Scheutz, C., Fredenslund, A.M., Tant, M. and Kjeldsen, P. 2007, Release of fluorocarbons from insulation foam in home applicances during shredding. *Journal of Air and Waste Management Association*, 57, 1452-1460, Available online at: http://www.ncbi.nlm.nih.gov/pubmed/18200930

[10] For clarity, the baseline for CCX projects shall not include ODS emissions that may be avoided by not placing shredded foam in a landfill. Whereas some research indicates that ODS entrained in shredded foam is emitted to atmosphere, CCX has determined that these emissions shall not be included in the baseline. CCX may revise this determination as more research is done on the fate of ODS entrained in foam in a landfill. Background information may be found in the following two studies:
Scheutz, C., Dote, Y. Fredenslund, A.M., Mosbeak, H and Kjeldsen, P. 2007. Attenuation of insulation foam released fluorocarbons in landfills. *Environmental Science & Technology*, 41, 7714-7722. Available online at http://www.ncbi.nlm.nih.gov/pubmed/1805079
Kjeldsen, P. and Jensen, M.H. 2001. Release of CFC 11 from Disposal of Polyurethane Foam Waste, Journal of Environmental Science and Technology. Available online at http://pubs.acs.org/doi/abs/10.1021/es000194i

For ODS entrained in foam, the amount of ODS must be determined by multiplying the weight of foam times the percentage of the ODS in the foam material. The amount of ODS by weight shall be determined by taking a representative sample of the waste stream. Project Proponents must propose to CCX their sampling methodology.[11]

6.2.4 Composition of ODS

Purity of ODS in the transport container is determined by sampling and subsequent analysis of the sample using gas chromatography at an independent Air-Conditioning, Heating and Refrigeration Institute (ARI) Refrigerant Testing Laboratory Certification Program certified laboratory (certified laboratory). To determine composition, sample(s) must be taken, in a consistent manner, prior to destruction when the ODS is in custody of the destruction facility or a licensed hazardous waste hauler.

For foam destruction projects, composition of ODS must be determined by tracking the serial numbers and manufacturer data of the refrigerators and by taking a representative sample from the waste stream. Project Proponents must propose to CCX their sampling methodology.[12]

6.2.4.1 Sampling Requirements for Bulk or Transportation Containers

Since mixed ODS may stratify in the bulk container a proper sampling procedure shall be followed to ensure representative sample(s). The sampling requirements are dependent on the type of the material (mixed or pure) and its physical movements. Samples of mixed refrigerants must follow either (a) or (b) below depending on whether or not the material has been stationary for an extended period of time.

a) For mixed ODS that has remained stationary for more than 3 hours, the following recirculation must take place:

   - Recirculation from the liquid port of the bulk container to the vapor port with a means to confirm flow and quantity exchanged
   - A properly sized system should be used to circulate the content in the ODS tank in order to create a uniform liquid mixture.
   - At least one complete recirculation must occur.
   - Liquid ODS samples should be taken immediately after this mixing process is finished.

[11] Over time CCX will look to standardize the sampling methodology or accept a standard weight percentage in combination with refrigerator source tracking. Several research reports indicate the amount of ODS in the foam of a typical refrigerator to be between 8.5 and 13.2 percent or 0.85 and 1.35 pounds per refrigerator (approximately 10 pounds of foam).[11]

[12] As in the case of weight, CCX will look to standardize the sampling methodology or may accept an alternative methodology to determine composition.

- Recordkeeping of the recirculation process prior to sampling is required for verification.

b) For mixed ODS that is sufficiently agitated from transportation:

- Samples must be taken immediately upon receipt at the destruction facility or other location following transportation. This process takes advantage of the inherent recirculation which occurs during transportation. For this process, samples must be taken within 3 hours of transportation at the sampling point.

c) For pure ODS, there are no recirculation or agitation requirements provided samples demonstrate the material is pure (i.e. at least 99.5%) and import and/or commercial invoice documentation clearly indicates the purity of the ODS.

6.2.4.2 Sampling Procedures for ODS Not Contained in Bulk Containers

Since not all projects involve ODS that is aggregated into bulk or transport containers Project Proponents may propose a sampling procedure to CCX that is sufficient to establish confidence on the constituents of various containers.

6.2.4.3 Sample Taking

A suitable sample container may be used and should contain a minimum one-half kilogram of material. In all cases, the sample shall be taken in the following manner:

- Two samples are taken.
- One sample is analyzed by a certified laboratory while the other is retained by the Project Proponent in case the material needs to be re-analyzed.
  - Since U.S. regulations require that importers of pure ODS destroy all of the imported material, projects involving the destruction of imported material need not take and retain the duplicate sample.
- Taken by a qualified person that is independent of the project

The label on each sample bottle must include the following information at a minimum:

- Transport container identification.
- Tamper proof tag or other tracking number used for the chain of custody.
- Sample date and time.
- Location of transport container when sample was taken.
- Primary ODS material expected.
- Sample container identification #.

- Name of technician who took the sample.

The sample must be tracked from the sampling location to the certified laboratory using a controlled tracking process or chain of custody.

6.2.4.4 Certified Laboratory Requirements

Certified laboratory testing for determination of the composition of ODS Material shall include the following:

- ODS purity, chemical composition, and molecular weight of the ODS material in the transport container, will be determined by using Gas Chromatography in a certified laboratory.
- All testing of Chlorofluorocarbons will follow the ARI Standard 700-2006 testing procedures.
- All testing of Halon 1301 and Halon 1211 will follow ISO 7201 testing procedures.
- Each sample is tested twice, and a confidence level of 99% must be achieved before rendering final results.
- The test results and worksheets are maintained in the independent certified laboratory data files. These results become part of the recordkeeping required to be furnished in the verification process.

The certified laboratory will provide results to the Project Proponent that will be used to:

- Compare to the initial sample or calculation of the composition expected at the destruction facility (i.e. – Hazardous Material Bill of Lading, and export/import permits if foreign material)
- Confirm the identity/composition of the ODS that is used in the calculation of the destruction credit.

6.3 Project Emissions

Emissions resulting from the ODS destruction process, the combustion of fossil fuel in the destruction device and mobile source emissions resulting from the transportation of ODS to the eligible destruction facility shall be accounted for as project emissions. Since carbon dioxide emissions from these sources are of much greater magnitude than emissions of other GHGs, only carbon dioxide emissions shall be included as project emissions.

7. MONITORING REQUIREMENTS

The Project Proponent shall develop and maintain a monitoring plan with procedures for obtaining, recording, compiling and analyzing data and information required for quantifying and reporting GHG emission reductions.

The monitoring requirements for an ODS destruction project are based primarily on pre-existing recordkeeping and reporting requirements for ODS destruction facilities under the CAAA in order to minimize the additional work needed for conformance with these guidelines. Specific monitoring requirements are detailed in the Verification Checklist in Appendix A.

8. QUANTIFYING AVOIDED GHG EMISSIONS

The following equations should be used to quantify avoided GHG emissions from ODS destruction projects.

Equation 1: Project Avoided GHG Emissions

$$AE = ODS_{dest} - (ODS_{co2} + Dest_{CO2} + MS_{CO2})$$

Where:

AE	Avoided GHG emissions in time period (as measured in tCO_2e)
ODS_{dest}	Total ODS destroyed in time period (as measured in tCO_2e)
PE	Project emissions in time period (as measured in tCO_2e)

Equation 2: Total ODS Destroyed

$$ODS_{dest} = (Q_{ODSWaste} * Conc_{ODS} * GWP * 0.98)/2204.62$$

Where:

ODS_{dest}	Total ODS destroyed (tCO_2e)
$Q_{ODSWaste}$	Quantity of ODS-containing waste fed into destruction unit (as measured in pounds)
$Conc_{ODS}$	Measured concentration of ODS in waste material sent for destruction (as determined through laboratory samples)
GWP	Global warming potential of ODS destroyed (values taken from Appendix C)

0.98	Destruction Removal Efficiency – Minimum required by EPA. Please see Appendix D for more information.
2204.62	Conversion factor - Pounds of ODS destroyed to Metric Tonnes of ODS destroyed

9. QUANTIFYING PROJECT GHG EMISSIONS

Depending on project-specific circumstances, certain emissions sources shall be subtracted from total project emission reductions using the equations below.

Equation 3: CO_2 Emissions from ODS Destruction

$$ODS_{co2} =$$

$$((Q_{ODSWaste} * Conc_{ODS} * 0.98)/ 2204.62)) * EF_{ODS}$$

Where:

ODS_{co2}	CO_2 emissions from destruction of ODS (tCO_2e)
$Q_{ODSWaste}$	Quantity of ODS-containing waste fed into destruction unit (as measured in pounds)
$Conc_{ODS}$	Measured concentration of ODS in waste material sent for destruction (as determined through laboratory samples)
0.98	Destruction Removal Efficiency – Minimum required by EPA. Please see Appendix D for more information.
2204.62	Conversion factor - Pounds of ODS destroyed to Metric Tonnes of ODS destroyed
EF_{ODS}	ODS specific emission factor – taken from equation: = 44/(molar mass of ODS/number of C molecules in ODS)

Equation 4: CO_2 Emissions from Fossil Fuel Combustion

$$Dest_{CO2} =$$

$$\sum_y (FF_y * EF_y)$$

Where:

$Dest_{CO2}$	CO_2 emissions from fossil fuel used in ODS destruction process (tCO_2)
FF_y	Total quantity of fossil fuel,y, consumed (as measured in volume of fuel)
EF_y	Fuel specific emission factor for fuel, y (as measured in t_{CO2}/fuel quantity - values should be taken from The CCX GHG Emissions Factors online document[13])

Equation 5: CO_2 Emissions from Mobile Source Combustion

$$MS_{CO2} = \sum_y (MSF_y * EF_y)$$

Where:

MS_{CO2}	CO_2 emissions from fossil fuel used in transportation of ODS (tCO_2)
MSF_y	Total quantity of mobile source fossil fuel, y, consumed (as measured in volume of fuel)
EF_y	Fuel specific emission factor for fuel, y (as measured in t_{CO2}/fuel quantity - values should be taken from The CCX GHG Emissions Factors online document[5])

If total quantity of fuel (MSF_y) is not known, an alternate calculation (found below) based on vehicle CO_2 efficiency may be used:

$$MS_{CO2} = DIS * CO_{2DIS}$$

Where:

MS_{CO2}	CO_2 emissions from fossil fuel used in transportation of ODS (tCO_2)
DIS	Total distance traveled in transportation of ODS material (as measured in miles)
CO_{2DIS}	CO_2 emission per unit of ODS transported and distance transported. For road transportation the emission factor shall be 0.299 kg CO_2/ metric ton-mile[14]

[13] Relevant GHG emission factors can be found here: http://theccx.com/docs/misc/GHG_Emission_Factors.pdf

	For ocean transportation the emission factor shall be 3 grams CO_2/metric ton/kilometer (5 grams CO_2/metric ton-mile)[15]

10. RECORD-KEEPING AND REPORTING REQUIREMENTS

The Project Proponent shall implement monitoring, recordkeeping and procedures for quality management and uncertainty assessments. All relevant project documentation shall be kept by the Aggregator for a minimum of 2 years beyond the completion of the project.

11. VALIDATION AND VERIFICATION REQUIREMENTS

11.1 VALIDATION

CCX Projects utilizing these guidelines are validated one of two ways. All projects must submit a PID to CCX Staff for review. Projects that adhere strictly to the requirements of this protocol are validated by CCX staff and do not require a separate Validation by CCX Offsets Committee. For all Projects seeking to deviate from specific components of this protocol, the Project Proponent is required to complete the deviation request section of the PID for review and approval by the CCX Offsets Committee. Upon receipt and review of the deviation request, the CCX Offsets Committee will review the feasibility and appropriateness of the requested deviation(s) and, as needed, seek guidance from appropriate technical experts. Project Proponents will be notified of the CCX Offsets Committee decision and shall proceed accordingly.

11.2 VERIFICATION

Prior to undertaking verification, the prospective Verifier must conduct a project specific conflict of interest process. The prospective Verifier must complete and submit the CCX Project Specific Conflict of Interest Form[16] to CCX for approval prior to the commencement of verification activities.

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[14] U.S. EPA 2008. Climate Leaders GHG Inventory Protocol Core Module Guidance: Optional Emissions from Commuting, Business Travel and Product Transport, EPA430-R-08-006. (Equation 6). [http://www.epa.gov/climateleaders/documents/resources/commute_travel_product.pdf]

[15] World Resource Institute and World Business Council on Sustainable Development - GHG Protocol Initiative Calculating CO_2 Emissions from Mobile Sources.

[16] CCX Project Specific Conflict of Interest Form can be found in the Associated Documents section of the CCX website: www.theccx.com.

Projects seeking to register Offsets shall be verified by a CCX-Approved Verifier[17] in accordance with CCX General Offsets Program Provisions, CCX Verification Guidance Document and the Project Protocols. A checklist list of verification requirements is contained in Appendix A. Independent verification is critical to ensure that the requirements of this Protocol are correctly applied. Projects shall be verified on an annual basis at minimum.

To ensure impartiality, completeness and consistency in the verification report review process an additional independent review of the submitted verification reports is conducted by the CCX Provider of Regulatory Services. Further information about the roles and responsibilities of Verifiers and the roles and responsibility of Members during verification are discussed in detail in *Chicago Climate Offset Program Verification Guidance Document* available on the CCX webpage: www.theccx.com.

[17] A list of CCX-Approved Verifiers is found on the CCX website: www.theccx.com

APPENDIX A – VERIFICATION CHECKLIST

CCX Requirement	Assessment Criteria	Verification Findings
Validation	CCX Project Approval Letter.	
Verification: Conflicts of Interest	Complete a conflicts of interest assessment.	
Monitoring Plan	Confirmation that the project developer has a project data monitoring plan.	
Project Definition	Confirm the project meets the project definition, and if applicable it has been specifically approved by the CCX via a deviation request approval.	
CCX Membership	Confirm that enrollment of the project is by a CCX Member or Participant Member (Offset Aggregator or Provider).	
Eligibility Governing Entities with Minor Emissions	Confirm the Project Owner's attested emissions and the applicability the CCX rule on entities with minor emissions.	
Ownership Status	Confirm the Project Owner has title to the GHG emission reductions.	
	and if applicable that the Offset Aggregator has the right to market them on CCX.	
Project Start Date	Confirm the project began on or after January 1, 2003 or that it is a project grandfathered by CCX.	
Project Location	Confirm that the destruction took place in the U.S.	
	Confirm that the destruction took place at a RCRA permitted facility.	
	If applicable, if the material was destroyed at a facility not permitted under RCRA, confirm the facility was permitted by US EPA to destroy ODS.	

	If applicable, if the material was destroyed at a facility not permitted under RCRA, confirm the Project Proponent's monitoring and verification plan was approved by CCX.	
Eligible ODS Material	Confirm the material is eligible is listed in Appendix B.	
	Confirm the Project Proponents demonstration that the ODS material was not produced pursuant to a critical use exemption.	
Imported ODS	Confirm the Project Proponent has a copy of approval or used/recycled materials pursuant to CFR 82.13(g)(2) and 82.24(C)(3) or similar documents for virgin ODS.	
Regulatory Criteria	For ODS which was not imported, confirm the Project Proponents demonstration (e.g. by attestation) that the ODS material was voluntarily destroyed.	
	For imported ODS, confirmation that CCX has accepted the Project Proponent's evaluation the regulatory criteria.	
Common Practice Criteria	For imported ODS, confirmation that CCX has accepted the Project Proponent's evaluation of common practice for the disposal of ODS in the exporting country.	
Project Boundary	Confirmation that the Project Proponent has evaluated each relevant GHG source and sink.	
Applicable for Projects Destroying ODS not Entrained in Foam		
Determining the Quantity of ODS	Confirmation of the recording of weight prior to shipment of ODS.	
	Confirmation of chain of custody system to ensure ODS material will not be tampered with in transit.	
	Confirmation of the recording of weight at the destruction facility.	

	Confirm the weight measurement device was calibrated in accordance with the manufacturers' recommendation and at the required frequency.	
	Confirm device calibration was performed by qualified independent entity.	
Composition of ODS	Confirmation of procedure for taking ODS sample at, or prior to, destruction facility in a manner consistent with the bulk container chain of custody process to ensure sample represents material eventually destroyed.	
	Confirmation that procedures and data recording processes demonstrate effective re-circulation or agitation prior to sampling.	
	If applicable, confirmation of recording of sufficient volume exchange occurred during re-circulation.	
	If applicable, confirmation that the sample was taken within 3 hours of its arrival at the sampling location.	
	If applicable, confirmation that the ODS is pure based on sample, import documentation and other commercial invoices.	
	Confirmation that the sample was taken in a suitable sample bottle containing at least 0.5 kg.	
	Confirmation that duplicate samples were taken.	
	Confirmation that the sample taken was independent to the Project Proponent.	

	Confirmation of recording of sample taking data including: bulk container ID, tamper proof tag number or other chain of custody information, sample date and time, location of bulk tank when sampled, primary ODS material expected, sample bottled identification number, sampling technician name, recirculation time prior to sample.	
	Confirmation of chain of custody process for sample from the sampling location to the laboratory.	
	Confirmation that an certified laboratory was used.	
	Confirmation of the results from the certified laboratory, included: ODS purity, composition, molecular weight.	
	Confirmation of documentation demonstrating standards used to test ODS (i.e. ARI Standard 700-2006 for CFCs, ISO 7201 for Halons).	
	Confirmation that the laboratory analysis achieved a confidence level of 99%.	
Project Emissions	Confirm the identification and inclusion of project emissions (including transportation, non-waste fuel used to sustain combustion and other project emission sources).	
Other monitoring requirements	Confirmation of days and times of destruction activity	
	Confirmation of documentation of destruction unit's DRE.	
	Confirmation of documentation of the methods used to record the destruction unit's DRE.	

	Confirmation of destruction units operational performance by reviewing the CMS data and specifically; confirmation of carbon monoxide (CO) concentration did not exceed 100 parts per million volume, over an hourly rolling average, dry basis and corrected to 7% oxygen (CO ppmvd (@7%O2)) during the destruction period and a confirmation that the incinerator was operated in compliance with 40 CFR Part 63 Subpart EEE requirements during the destruction period.	
	Confirmation of the destruction facilities submission of continuous monitoring date to US EPA.	
	Confirmation that the Project Proponent has copy of the destruction verification document as required under 40 CFR 82.13(k).	
	Confirmation that the Project Proponent has copy of the destruction unit's one time report to EPA per 40 CFR 82.13(j).	
Applicable for Projects Destroying ODS Entrained in Foam		
Eligibility	Confirm source of foam is from refrigerators.	
Determining the Quantity of ODS	Confirmation of source of number of refrigerators, serial numbers, manufacturer name.	
	Confirmation of the recording of weight prior to shipment of ODS.	
	Confirmation of chain of custody system to ensure ODS material will not be tampered with in transit.	
	Confirmation of the recording of weight at the destruction facility.	
	Confirm the weight measurement device was calibrated in accordance with the manufacturers' recommendation and at the required frequency.	
	Confirm device calibration was performed by qualified independent	

	entity.	
Composition of ODS	Confirmation of procedure for determining ODS content in foam by weight (i.e. representative sample).	
	Confirmation of procedure for taking ODS sample at, or prior to, destruction facility in a manner consistent with the bulk container chain of custody process to ensure sample represents material eventually destroyed.	
	Confirmation that the sample was taken in a suitable sample container.	
	Confirmation that duplicate samples were taken.	
	Confirmation that the sample was taken by an entity independent to the Project Proponent.	
	Confirmation of recording of sample taking data including: transport container ID, tamper proof tag number or other chain of custody information, sample date and time, location of transport container when sampled (if applicable), primary ODS material expected, sample container identification number, sampling technician name.	
	Confirmation of chain of custody process for sample from the sampling location to the laboratory.	
	Confirmation that a certified laboratory was used.	
	Confirmation of the results from the certified laboratory, included: ODS purity, composition, molecular weight.	
	Confirmation of documentation demonstrating standards used to test ODS (i.e. ARI Standard 700-2006 for CFCs, ISO 7201 for Halons).	
	Confirmation that the laboratory analysis achieved a confidence level of 99%.	

Project Emissions	Confirm the identification and inclusion of project emissions (including transportation, non-waste fuel used to sustain combustion and other project emission sources).	
Other monitoring requirements	Confirmation of days and times of destruction activity.	
	Confirmation of documentation of destruction unit's DRE.	
	Confirmation of documentation of the methods used to record the destruction unit's DRE.	
	Confirmation of destruction units operational performance by reviewing the CMS data and specifically; confirmation of carbon monoxide (CO) concentration did not exceed 100 parts per million volume, over an hourly rolling average, dry basis and corrected to 7% oxygen (CO ppmvd (@7%O2)) during the destruction period and a confirmation that the incinerator was operated in compliance with 40 CFR Part 63 Subpart EEE requirements during the destruction period..	
	Confirmation of required destruction temperatures during destruction run.	
	Confirmation of the destruction facilities submission of continuous monitoring data to US EPA.	
	Confirmation that the Project Proponent has copy of the destruction verification document as required under 40 CFR 82.13(k).	
	Confirmation that the Project Proponent has copy of the destruction unit's one time report to EPA per 40 CFR 82.13(j).	

APPENDIX B: ESTIMATED ODS ACCESSIBLE BANKS IN U.S. EQUIPMENT

Table 2: Total ODS Accessible Banks in U.S. Equipment, By ODS Type (Million **Metric Tons**)[18]

Year	CFC-11	CFC-12	CFC-115	CFC Totals	Halon 1211	Halon 1301	Halon Totals	HCFC-22	HCFC-123	HCFC-124	HCFC-141b	HCFC-142b	HCFC Totals	Overall Totals
2000	0.0134	0.0844	0.0037	0.1015	0.0074	0.0154	0.0229	0.5167	0.0125	0.0004	0.0000	0.0002	0.5297	**0.6541**
2005	0.0094	0.0270	0.0020	0.0385	0.0016	0.0135	0.0151	0.5928	0.0195	0.0001	0.0000	0.0000	0.6123	**0.6659**
2010	0.0065	0.0136	0.0008	0.0210	0.0014	0.0050	0.0064	0.5490	0.0251	0.0000	0.0000	0.0000	0.5742	**0.6016**
2015	0.0018	0.0030	0.0001	0.0049	0.0017	0.0029	0.0045	0.3546	0.0298	0.0000	0.0000	0.0000	0.3845	**0.3939**
2020	0.0000	0.0000	0.0000	0.0000	0.0019	0.0015	0.0034	0.1623	0.0271	0.0000	0.0000	0.0000	0.1895	**0.1929**
2025	0.0000	0.0000	0.0000	0.0000	0.0022	0.0015	0.0037	0.0371	0.0207	0.0000	0.0000	0.0000	0.0578	**0.0615**
2030	0.0000	0.0000	0.0000	0.0000	0.0026	0.0016	0.0042	0.0117	0.0145	0.0000	0.0000	0.0000	0.0262	**0.0304**

[18] The quantity of accessible ODS contained in U.S. banks is estimated from the *U.S. EPA Vintaging Model* (Version VM IO 3-1-07). These estimates include ODS in fire protection and refrigeration/AC equipment in any given year. It is assumed that the amount of ODS recoverable from this equipment is equal to the full equipment charge minus the average annual loss rate (from leakage and service events) times the charge size.

Table 3: Total ODS Accessible Banks in U.S. Equipment, By ODS Type (Direct GWP-Weighted Million Metric Tons [MMT CO_2e) [19,20]

Year	CFC-11	CFC-12	CFC-115	CFC Totals	Halon 1211	Halon 1301	Halon Totals	HCFC-22	HCFC-123	HCFC-124	HCFC-141b	HCFC-142b	HCFC Totals	Overall Totals
2000	63	905	27	995	14	108	122	920	1	0	0	0	921	2,038
2005	44	290	15	349	3	95	98	1,055	1	0	0	0	1,057	1,503
2010	31	146	6	182	3	35	38	977	2	0	0	0	979	1,199
2015	9	32	1	41	3	20	23	631	2	0	0	0	633	698
2020	0	0	0	0	4	11	14	289	2	0	0	0	291	305
2025	0	0	0	0	4	10	14	66	2	0	0	0	68	82
2030	0	0	0	0	5	11	16	21	1	0	0	0	22	38

[19] Source: *U.S. EPA Vintaging Model* (Version VM IO 3-1-07).

[20] The amount of ODS in Table A1 was converted into million metric tons of carbon dioxide equivalent [MMT CO2 Eq] using direct global warming potentials (GWP) published in the *Special Report on Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons* (IPCC/TEAP 2006).

APPENDIX C: COMMON OZONE DEPLETING SUBSTANCES AND THEIR DIRECT GWPS[21,22]

Class I	Direct GWP (100yr)	Class II	Direct GWP (100yr)
CFC-11 (Trichlorofluoromethane)	4,680	HCFC-141b (Dichlorofluoroethane)	713
CFC-12 (Dichlorodifluoromethane)	10,720		
CFC-13 (Chlorotrifluoromethane)	14,420		
CFC-113 (1,1,2-Trichlorotrifluoroethane)	6,030		
CFC-114 (Dichlorotetrafluoroethane)	9880		
CFC-115 (Monochloropentafluoroethane)	7250		
Halon 1211 (Bromochlorodifluoromethane)	1,860		
Halon 1301 (Bromotrifluoromethane)	7,030		
Halon 2402 (Dibromotetrafluoroethane)	1,620		
Carbon Tetrachloride	1,380		
Methyl Chloroform (1,1,1-trichloroethane)	144		

[21] Compounds included in this table have been phased out under Title VI of the CAAA and are, therefore, eligible for destruction under this Protocol.

[22] IPCC/TEAP. 2006. Special Report on Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons. p. 162. Available online at: http://www.ipcc.ch/pdf/special-reports/sroc/sroc_full.pdf

APPENDIX D: DESTRUCTION EFFICIENCY REVIEW

ODS that are classified as hazardous wastes are regulated under RCRA. Therefore, facilities that operate hazardous waste storage tanks, manage hazardous waste containers, and operate hazardous waste treatment units are required to have RCRA permits which regulate what specific hazardous wastes the facilities are permitted to receive and store, and in what quantities.

RCRA-permitted hazardous waste facilities that operate HWCs are also required by the MACT standard under the CAAA to obtain a Title V Operating Permit as a HAP emission source. Title V Operating Permits contain emission limits for the release of air pollutants, including HAPs, from the combustion of hazardous wastes to ensure the protection of human and environmental health. Under the MACT standards, when hazardous wastes are to be destroyed by way of combustion, the combustion unit must adhere to a minimum 99.99 percent DRE and also meet the air emission limits listed in 40 CFR 63.1216 – 63.1221. The air emission limits relevant to ODS destruction include limits for dioxins and furans, PM, total chlorine (HCl and Cl_2), and CO. Additional operating limitations for HWCs, including maximum hazardous waste feed rates and ranges of hazardous waste composition (e.g., maximum feed rate of chlorine to the unit), are established on a unit-specific basis by the Title V Operating Permit based on a review of the unit design, waste characterization data, and performance test results.

At this time, all of the known commercial destruction facilities, with the exception of one plasma arc unit, are RCRA-permitted HWCs and, therefore, must meet all regulatory requirements under the CAAA and RCRA, including meeting a 99.99 percent DRE[23] when destroying hazardous waste. While the 99.99 percent DRE is not required for ODS that are not classified as hazardous wastes research has indicated that it is probable that all ODS will be destroyed to at least this DRE when sent to a permitted HWC.

Finally, under the authority of the CAAA, the stratospheric ozone protection regulations (40 CFR Part 82, Subpart A) establish the following definitions relating to the destruction of controlled substances[24]:

- "*Destruction* means the expiration of a controlled substance to the destruction efficiency actually achieved, unless considered completely destroyed as defined in

[23] According to the United Nations Environmental Programme Technology and Economic Assessment Panel (TEAP), destruction efficiency is a more comprehensive measure of destruction than DRE as it includes emissions of undestroyed chemical from all points (e.g., stack gases, fly ash, scrubber, water, bottom ash), while DRE includes emissions of undestroyed chemical from the stack gas only. However, "because of the relatively volatile nature of ODS and because, with the exception of foams, they are generally introduced as relatively clean fluids, one would not expect a very significant difference between DRE and DE". This information along with reviewed ODS destruction technologies and recommendations are available from the TEAP Report of the Task Force on Destruction Technologies (2002) available at http://ozone.unep.org/teap/Reports/TEAP_Reports/index.shtml.

[24] According to 40 CFR 82.3, "the inadvertent or coincidental creation of insignificant quantities of a listed [ODS] during a chemical manufacturing process, resulting from unreacted feedstock, from the…use [of ODS] as a process agent present as a trace quantity in the chemical substance being manufactured, or as an unintended byproduct of research and development applications, is not deemed a controlled substance."

this section. Such destruction does not result in a commercially useful end product and uses one of the following controlled processes approved by the Parties to the MP:

1. Liquid injection incineration;
2. Reactor cracking;
3. Gaseous/fume oxidation;
4. Rotary kiln incineration;
5. Cement kiln;
6. Radio frequency plasma; or
7. Municipal waste incinerators only for the destruction of foams."
8. Argon Plasma Arc

- "*Completely destroy* means to cause the expiration of a controlled substance at a destruction efficiency of 98 percent or greater using one of the destruction technologies approved by the Parties."

In other words, the stratospheric ozone protection regulations require the use of one of the technologies approved by the Parties to the MP when destroying a controlled substance. Additionally, if the substance is to be considered "completely destroyed" as defined in the regulations, it must be destroyed to a 98 percent or greater destruction efficiency.