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STUDY ON FINANCING THE DESTRUCTION OF UNWANTED OZONE-DEPLETING SUBSTANCES THROUGH THE VOLUNTARY CARBON MARKET

FINAL REPORT

(SUBMITTED BY THE WORLD BANK)

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FINAL REPORT

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PLACEHOLDER

ACKNOWLEDGEMENTS / FOREWORD

PLACEHOLDER 2

LETTER FROM THE DIRECTOR

Table of Contents

List of Tables, Figures and Exhibits

Tables:

Figures:

Exhibits:

,

Acronyms

A5	[Parties] Operating Under Article 5 Paragraph 1 of the Montreal Protocol
AAUs	Assigned Amount Units
AC	Air Conditioning
ACT	Air Control Testing, Inc.
AHRI	Air-Conditioning, Heating and Refrigeration Institute
AMS	Approved Methodology for a small scale CDM project activity
AR4	Fourth Assessment Report of the Intergovernmental Panel on Climate Change
CAAA	U.S. Clean Air Act Amendments
CCX	Chicago Climate Exchange
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
CERUPT	Certified Emission reduction Procurement Tender
CFCs	Chlorofluorocarbons
CFI	Carbon Financial Instrument
CH_4	Methane
CO_2	Carbon Dioxide
CRT	Climate Reserve Tonne (1+tCO_2e)
CTC	Carbon Tetrachloride
DRE	Destruction and Removal Efficiency
EB	Executive Board of the Clean Development Mechanism
EOL	End-of-Life
EPA	Environmental Protection Agency (US)
ERU	Emission Reduction Units
EU	European Union
EUA	EU Allowances
EU ETS	European Union Emission Trading Scheme
ExCom	Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol
FIASA	Frío Industrias Argentinas, SA
FINRA	Financial Industry Regulatory Authority (US)
GC	Gas Chromatography
GCC	Gulf Cooperation Council, also known as the Cooperation Council for the Arab States of the Gulf
GEF	Global Environment Facility
GHG	Greenhouse Gas
GWP	100-year Global Warming Potential, with the GWP of Carbon Dioxide Fixed at 1
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
IFIs	International Financial Institutions
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
JI	Joint Implementation, a Flexibility Mechanism of the Kyoto Protocol
KLH	Indonesian Ministry of Environment
LVCCs	Low-volume Consuming Countries
MOE	Japanese Ministry of Environment
MLF	Multilateral Fund for the Implementation of the Montreal Protocol
MT	Metric Tonnes
MtCO_2e	Million Tonnes of Carbon Dioxide Equivalent
N_2O	Nitrous Oxide
NEFCO	Nordic Environmental Financing Corporation
NGO	Non-governmental organization
Non-A5	[Parties] Not Operating Under Article 5 Paragraph 1 of the Montreal Protocol
NOU	National Ozone Unit
ODP	Ozone Depleting Potential
ODS	Ozone-Depleting Substance(s)

OEWG	Open-Ended Working Group of the Parties to the Montreal Protocol
OTC	Over the Counter (Sales of Carbon Credits)
PCBs	Polychlorinated Biphenyls
PDD	Project Design Document
PFCs	Perfluorocarbons
PIN	Project Idea Note
POPs	Persistent Organic Pollutants
RCRA	U.S. Resource Conservation and Recovery Act
The Reserve	Climate Action Reserve
RGGI	Regional Greenhouse Gas Initiative
SF_6	Sulfur Hexafluoride
SSRs	Sources, sinks, and reservoirs
tCO_2e	Tonnes of Carbon Dioxide Equivalent
TEAP	Technology and Economic Assessment Panel
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	UN Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
WEEE	EU Waste Electrical and Electronic Equipment legislation
VCS	Voluntary Carbon Standard
VER	Voluntary Emission Reductions or Verified Emission Reduction

Executive Summary

While the Montreal Protocol has achieved remarkable success in reducing the production and consumption of ozone depleting substances (ODS) worldwide, a significant amount of ODS still remains in equipment, products, and stockpiles. Because emissions from ODS banks are not explicitly controlled by the Montreal Protocol, there is a risk that these ODS could be released to the atmosphere if legislation or other incentives are not put in place. This study explores the opportunities for financing the destruction of unwanted ODS through the voluntary carbon market,[1] as commissioned by the Multilateral Fund Executive Committee through Decision 54/10(d).

This report finds that **significant opportunity exists for destroying ODS through the voluntary carbon market**. The high global warming potential (GWP) of ODS means that their destruction has the ability to generate significant volumes of carbon credits, which could then be sold in the voluntary carbon market. Because little ODS is currently recovered at equipment end-of-life, the possibility of earning carbon credits presents a potentially significant financial incentive for recovery and destruction of unwanted ODS, which would likely otherwise be eventually released to the atmosphere. In addition, by capitalizing on the existing Montreal Protocol infrastructure and institutions, and through supporting mechanisms to assist in the process of bringing ODS destruction projects to market, new opportunities can be promoted and facilitated.

Using the voluntary market is likely a win-win opportunity; incentives are created for the recovery and destruction of ODS through the carbon credits that can be earned, and buyers pay for real and verifiable emission reductions from the destruction of ODS that would have otherwise been emitted. A number of challenges and gaps exist, however, for applying the voluntary market financing concept broadly across all countries, project types and project sizes. These challenges must be considered in designing a comprehensive strategy for ensuring the recovery and destruction of unwanted ODS.

The remainder of the Executive Summary answers three main questions about the opportunity for financing ODS destruction through the voluntary carbon market:

- Is there a market for ODS destruction?
- How can we capitalize on the existing Montreal Protocol infrastructure?
- What challenges and gaps might be faced through reliance on the voluntary carbon market?

Is There a Market for ODS Destruction?

This question is fundamental to whether the voluntary carbon market represents an opportunity for financing ODS destruction: there must be some basic market structure to support ODS destruction and sufficient demand in the market for carbon credits from ODS destruction projects in order for the scheme to work.

Basic Market Structure

At the most basic level, in order for ODS destruction projects to be credited, there must be greenhouse gas (GHG) programs covering ODS—i.e., third-party voluntary standards that offer carbon credits for projects that destroy ODS—and methodologies to guide those ODS projects.

- As of early February 2010, the **Chicago Climate Exchange (CCX)** offers carbon credits for ODS destruction projects, and the **Voluntary Carbon Standard (VCS)** has officially expanded its GHG program to cover ODS destruction projects by publishing a series of eligibility criteria. In late February 2010, the **Climate Action Reserve (Reserve)** adopted two new offset project protocols (that will serve as methodologies) for ODS destruction.

[1] The global carbon market can be broadly divided into two key segments—the compliance market and the voluntary market—the latter of which is the focus of this report. The voluntary carbon market operates outside of compliance markets and allows organizations to offset carbon emissions on a voluntary basis.

- **Three standards now offer credits for ODS destruction projects**. With regard to available methodologies, CCX already offers a project protocol to guide ODS destruction projects and the Reserve has two project protocols to be used for ODS destruction for materials originating in the United States or imported from Article 5 (A5) countries. VCS will rely on the submission of ODS destruction methodologies by project proponents and other entities, and several methodologies have already been submitted. Among the three standards, the geographical scope of the ODS destruction program differs, as described in Exhibit ES-1, and some may provide a more restricted opportunity for participation by all Parties to the Montreal Protocol.

Exhibit ES-1: Geographical Scope of ODS Destruction Programs

- **CCX:** Destruction must occur within U.S. borders; material imported to the U.S. for destruction is also eligible.
- **The Reserve:** Destruction must occur within U.S. borders; material imported from an A5 country to the U.S. for destruction is also eligible.
- **VCS:** Destruction can occur in any country that can meet technical requirements.

Demand for ODS Destruction Credits

With regard to whether there will be sufficient demand in the voluntary market for ODS destruction, it is important first to consider the relationship between the volume of ODS destruction projects that could be registered and the overall projected size of the market.

- **There could be a substantial amount of ODS available for destruction in both A5 and non-A5 countries**, depending on the rate of recovery. Given currently low rates of recovery, ODS destruction could represent at most a quarter of the voluntary market volume in 2010 (assuming a recovery and destruction rate of 10%, which is likely optimistic for many A5 and even non-A5 countries, at least in the short term). Although recovery rates could increase as knowledge and capacity grows, even with increasing recovery rates, expected growth in the voluntary market and a decrease in the volume of reachable banks means that ODS destruction projects will be a small percentage of the market in later years.

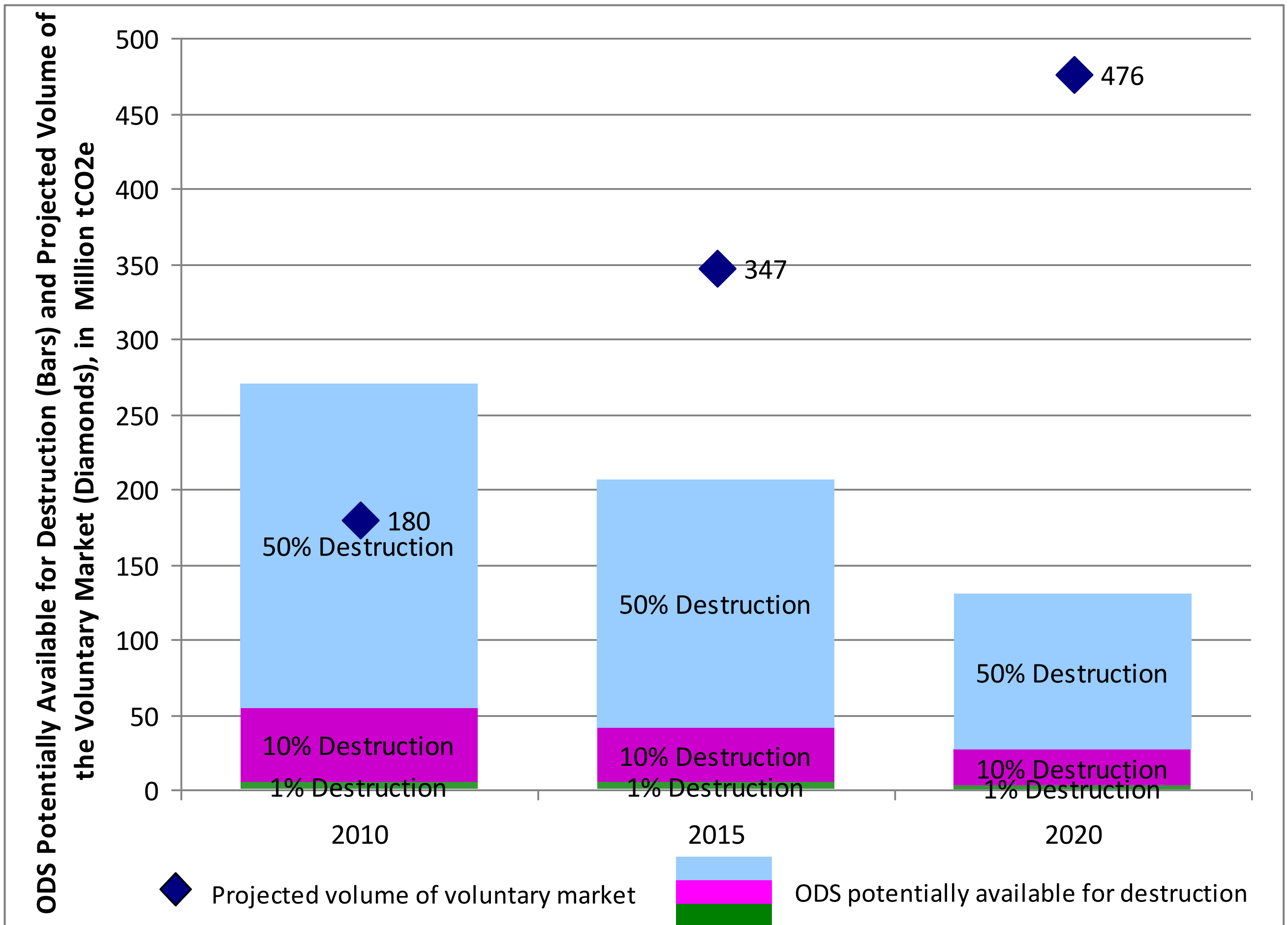
  Thus, this report finds that **ODS destruction projects are considered unlikely to overwhelm the voluntary market**. Figure ES-1 below compares the ODS potentially available for destruction with the projected volume of the voluntary market.

Exhibit ES-2: Future Outlook for the Voluntary Carbon Market

The voluntary market is projected to grow on average about 15% per year over the next decade, based on a survey of over 100 voluntary market participants conducted by Hamilton *et al.* (2009). This growth could potentially be mitigated by the expansion of the EU ETS into additional sectors and the passage of U.S. compliance market, both events which could reduce the pre-compliance demand in the voluntary market.

Another source of demand for credits from ODS destruction projects could be from the offset provisions in U.S. climate legislation. The current structure of the cap-and-trade bill put forward by U.S. representatives Henry Waxman and Edward Markey, as well as the Kerry-Boxer bill passed by the Senate Committee on Environment and Public Works, indicates a potential maximum allowance of 2 billion tCO_2e per year from offsets. Credits from ODS destruction projects could potentially be well placed to help meet this requirement, although they would represent a small portion of overall offsets—with 10% of ODS recovered and destroyed globally, this amount would account for 2% of the 2 billion tCO_2e offset allowance in 2015.

Figure ES-1: Comparing ODS Potentially Available and Eligible for Destruction (Bars) with the Projected Volume of the Voluntary Market (Diamonds), in Millions of Tonnes of Carbon Dioxide Equivalent



Note: This figure does not include ODS recovered in the EU Member States, nor HCFCs.
Note: This figure represents market volume, not the total number of offsets demanded/supplied. Because an offset can be traded several times before retirement, the market volume usually exceeds the number of actually existing offsets.
Source for voluntary market projected volumes: Hamilton *et al.* (2009). 2010 estimated by sight from Figure 35 of this report.

- **It will also be important to clearly differentiate ODS destruction projects from past industrial gas projects**, such as the destruction of HFC-23, which have encountered criticism in the carbon markets. ODS destruction has a compelling story: it extends the prior success of the Montreal Protocol in phasing out the consumption and production of ODS to cover the missing part—emissions—and, as such, ensures that the full lifecycle of ODS is addressed from initial production to end-of-life recovery and disposal. Highlighting these advantages will be important for creating a good reputation and demand for ODS destruction projects in the voluntary market.
- It is also possible that in the early years of an ODS destruction program, some investors might be shy to venture into a new project type or ODS owners might have difficulty finding a project developer or an investor. **Upfront financing from an organization with an array of financing capabilities, such as an international financial institution (IFI), could play an important role in ensuring that such projects *do* initially get developed**. Once the viability, reliability, and profitability of ODS destruction projects have been proven, IFIs would likely withdraw from providing financing, leaving it to the private sector.

Towards a Global Program for ODS Destruction: How Can We Capitalize on the Existing Montreal Protocol Infrastructure?

Capitalizing on the existing Montreal Protocol infrastructure can provide additional value and credibility for ODS destruction projects. Many of the roles and responsibilities already in place can be assembled in the form of a global program for facilitating the ODS destruction process.

- **Ozone Secretariat**—In a global program for ODS destruction, the Montreal Protocol Parties may wish to consider expanding the role of the Ozone Secretariat in two important ways. First, the Ozone Secretariat could offer a clearinghouse-type function for connecting owners of ODS banks with project developers and investors by building on its current responsibilities for managing the Parties' data reporting under Article 7 of the Montreal Protocol. Second, the Ozone Secretariat could play a role in managing a registry for tracking ODS imports and exports for destruction and complementing the verification procedures that would be undertaken for individual projects, thereby improving the credibility of the assets.
- **Country Governments**—As owners of unwanted ODS, governments would need to pursue ODS destruction projects either on their own or by contracting a private company. In a different role, as facilitators, governments could take on a number of activities. First, governments could collect data from the private sector on existing ODS banks as an input to the clearinghouse managed by the Ozone Secretariat. Second, governments could track the movement of ODS across their borders—imports and exports—for the express purpose of destruction, and report this information to the Ozone Secretariat. Third, governments could impose a tax on the sale of voluntary/verified emission reductions (VERs) earned through ODS destruction projects, the revenue from which could be put in a separate fund and used to provide upfront financing for less cost-effective projects or for ODS management more generally.[2] The tax rate could also be differentiated depending on the type and size of the project being undertaken; for example, for more cost-effective projects such as those destroying existing stockpiles or recovering refrigerant from industrial equipment, a higher tax could be assessed. Finally, governments have an important role to play in removing or minimizing regulatory, logistical, or technical barriers that exist independently of the financing source. Regulatory impediments to exporting ODS for destruction or a lack of infrastructure for recovery and collection of ODS will challenge the success of any strategy for promoting ODS destruction.
- **Multilateral Fund and Implementing Agencies**—The Multilateral Fund (MLF) and the Agencies could also play an important role in helping countries to overcome barriers to ODS destruction, such as helping to build infrastructure for ODS recovery or training technicians in proper ODS recovery procedures, in order to create the enabling environment in A5 countries to manage ODS, which would in turn facilitate participation in ODS disposal projects. In addition, Agencies with sufficient financing capabilities should explore options for providing upfront carbon finance to ODS destruction projects to catalyze the market and, to the extent possible, mainstream ODS disposal in waste management investment projects.
- **Technical Bodies**—TEAP is already playing an important role in developing the opportunity for financing ODS destruction through the voluntary market. For example, VCS' extension of scope refers to the report of the TEAP Task Force on Destruction Technologies as the source for screening criteria for destruction technologies and requirements for the destruction and removal efficiency (DRE). By relying on existing analysis and expert input developed by the TEAP, third-party standards and methodologies can help ensure that robust and real emission reductions are achieved through the destruction of ODS.

What Challenges and Gaps Might Be Faced Through Reliance on the Voluntary Carbon Market?

A number of challenges must be overcome in order for the voluntary market to become part of a viable financing strategy for all countries with remaining ODS banks.

- **Perverse incentives and unintended consequences**—The potentially significant revenue that could be generated through destroying ODS for carbon credit suggests that perverse incentives could be created to

[2] Such a tax would be similar to that levied by Chinese government on the sale of certified emission reductions (CERs) earned from the destruction of HFC-23 (a byproduct of HCFC-22 production), which was then put into a government fund for other sustainable development activities.

traffic ODS solely for the purpose of earning destruction credits. These might include illegal production of phased out ODS, such as CFCs, or export from one country with legislation that requires destruction to another that does not, false reporting of quantities, mislabeling of ODS, and other activities to promote the generation of carbon credits. Countermeasures to most of these perverse incentives can be put in place through the third-party voluntary market standards, methodologies, and registries. Such mechanisms already developed or currently under development are relatively successful at addressing these concerns.

- **Obtaining financing for less cost-effective ODS destruction projects**—Some ODS destruction projects will be more cost-effective than others. Because there are significant and largely fixed transaction costs associated with participating in the voluntary market—including project document preparation, validation, and verification—larger volume projects achieve some economies of scale and are therefore more cost-effective. Certain project activities are also more costly to implement, such as collecting household refrigerators from a sparsely populated area. This report has found that the carbon credit prices required to make some project types/sizes profitable are high; for example, a price of over $40/tCO_2e would be required for a project that only collected 1,000 refrigerators. The consequence is that some projects may never be developed or financed without additional assistance.

  One possible solution would be for governments to assess a tax on the sale of VERs generated by ODS destruction projects, as discussed above. Another solution is to improve the profitability of projects; some strategies to accomplish this are described in Exhibit ES-3.

Exhibit ES-3: Strategies to Minimize Costs and Maximize Revenues

- Combine ODS destruction projects with other activities or programs that are also eligible for crediting in the carbon market, such as equipment replacement for energy efficiency credits. This strategy could also be highly effective to fund ongoing collection programs, such as municipal, utility, or retailer programs to collect refrigerators upon disposal, and ensure that the ODS refrigerant and foam blowing agent are destroyed.
- Mainstream ODS destruction projects into larger programs and development projects, such as a comprehensive waste management program.
- Group or pool projects together to minimize transaction costs and achieve economies of scale.

- **ODS not covered by the voluntary market**—The goals of the greenhouse gas (GHG) market may not always serve to optimize ozone benefits or ODS destruction. For example, while the destruction of halons is allowed under CCX, halons will not be (at least initially) included under the ODS destruction programs of the Reserve or VCS. As it appears that halons will not be widely covered by standards in the voluntary market, the opportunity for halon destruction may be limited and represents a gap that must be addressed through other means.
- **Countries with low volumes of ODS**—As mentioned above, some A5 countries, such as low-volume consuming countries, may have volumes of ODS that are not cost-effective to collect and destroy, even with the added financial incentive of the voluntary carbon market. This situation would need to be reviewed on a case-by-case basis, but represents a possible gap for what the voluntary market can offer.
- **Countries with limited carbon finance capacity**—Some A5 countries may not have the base carbon finance capacity needed to participate in the voluntary carbon market, especially in the early years of such a program. A number of institutions, such as the World Bank Institute's Carbon Finance Assist program or UNEP Risoe, are already working to build carbon finance capacity in developing countries. Possible solutions to address insufficient capacity include initial upfront financing from IFIs, but without a strong and concerted effort to address this potential gap, some countries could fall through the cracks.
- **Restrictions on export/import of ODS for destruction, and accessing ODS destruction capabilities—** Existing policy frameworks in some A5 and non-A5 countries may not allow, or facilitate, the export and import of ODS for destruction. This is a critical challenge to address when considering the viability of using the voluntary market to finance ODS destruction.

These challenges and gaps are important to understand in designing an overall strategy for ensuring the recovery and destruction of unwanted ODS, especially since some of these gaps may require other approaches—beyond reliance on the voluntary market—to fully address ODS bank management in an environmentally sound manner. Given these challenges and gaps, a natural conclusion might be that the voluntary market cannot serve as the *only* source of financing for ODS destruction. That said, using the voluntary carbon market to finance ODS destruction could be a highly successful and cost-effective approach in many cases, and certain strategies—as described in this report—can be pursued for improving the opportunity for all Parties to the Montreal Protocol.

1. Introduction

At its 54th Meeting, the Multilateral Fund Executive Committee endorsed a proposal in the World Bank's 2008-2010 Business Plan to conduct a study on ODS destruction. It was agreed that the study would aim to determine the opportunities for financing the destruction of unwanted ODS through the voluntary carbon market while also 1) reviewing existing methodologies for validation and verification of ODS disposal and/or developing a methodology for recommendation to the Executive Committee and 2) evaluating specific case studies. As per Decision 55/34, the scope of the study is defined by the *Elements of Terms of Reference for a Study on Financing the Destruction of Unwanted ODS,* developed in collaboration with Executive Committee members, the Multilateral Fund Implementing Agencies and the World Bank (provided in Appendix B to this report).

This study responds to those Terms of Reference, and is organized as follows:

- Chapter 2 provides background and context for this study and generally responds to the question: why is funding needed for ODS destruction?
- Chapter 3 describes possible options for financing the destruction of ODS, including the Multilateral Fund (MLF), other multilateral funding agencies, and the voluntary carbon market.
- Chapter 4 gives an overview of the carbon market, going into particular detail on the voluntary carbon markets.
- Chapter 5 describes how ODS destruction could make use of the voluntary carbon market and progress already underway to allow such projects to access that market, compares the voluntary market third-party standards that are considering ODS destruction projects, and provides a step-by-step guide for how to develop an ODS destruction project in the voluntary market.
- Chapter 6 estimates the amount of ODS that could potentially be destroyed for credit in the voluntary market, and compares that quantity to the projected volume of the voluntary carbon market.
- Chapter 7 discusses other elements that affect the financial feasibility of financing ODS destruction through the carbon market, including supply and demand dynamics and the cost of ODS destruction.
- Chapter 8 describes potential sources of ODS for destruction projects, and provides a comparative analysis of existing methodologies for ODS destruction.
- Chapter 9 describes challenges to financing ODS destruction through the voluntary market, along with potential solutions.
- Chapter 10 summarizes the findings of the study and proposes strategies for pursuing ODS destruction through the voluntary market.
- Appendix A presents case studies on ODS destruction efforts to-date.
- Appendix B includes the approved Terms of Reference for this study.
- Appendix C gives a detailed accounting of the methodology used to estimate the amount of ODS that could be destroyed for credit in the voluntary market, as described in Chapter 6.
- Appendix D provides a sample of applicable templates for developing ODS destruction projects.

2. Background: Why Is Funding Needed for ODS Destruction?

2.1 Why Destroy ODS?

Ratified by 195 countries worldwide, the Montreal Protocol on Substances that Deplete the Ozone Layer has achieved remarkable success in reducing the production and consumption of ozone depleting substances (ODS) by over 97% from historic baseline levels (UNEP 2009). This success can be attributed to the strict mandates put in place for the phaseout of ODS production and consumption.

Exhibit 6: ODPs and GWPs of Common ODS

Gas	ODP	GWP (100 year)
CFC-11	1.0	4,750
CFC-12	1.0	10,900
CFC-13	1.0	14,400
CFC-113	0.8	6,130
CFC-114	1.0	10,000
CFC-115	0.6	7,370
Halon-1301	10.0	7,140
Halon-1211	3.0	1,890
Carbon tetrachloride	1.1	1,400
Methyl bromide	0.6	5
HCFC-22	0.055	1,810
HCFC-123	0.02	77
HCFC-124	0.022	609
HCFC-141b	0.11	725
HCFC-142b	0.065	2,310

GWPs: IPCC (2007); ODPs: UNEP (2006a)

Today, however, a large amount of ODS still remains in equipment and products such as refrigerators and air conditioners (as refrigerant and foam blowing agent), and fire protection systems and fire extinguishers, as well as in stockpiles held by countries and industrial and commercial users. Together these sources are referred to as ODS banks (MLF 2008). Because emissions from ODS banks are not (explicitly) controlled by the Montreal Protocol, there is a risk that these ODS could be released to the atmosphere if legislation or other incentives are not put in place. ODS banks must be recovered and properly treated, otherwise the ODS will be released to the atmosphere over time through slow leakage, catastrophic leaks, and unintentional (or intentional) venting.

Because of their high GWPs, destroying unwanted ODS[3] can avoid significant greenhouse gas (GHG) emissions. IPCC/TEAP (2005) found that approximately a third of the ODS banks existing in 2002 would be vented by 2015 unless action was taken, resulting in emissions of nearly 7 billion metric tonnes (MT) of carbon dioxide equivalent (tCO_2e). Destroying that ODS instead would result in a substantial emission reduction, equivalent to approximately one seventh of global anthropogenic GHG emissions in 2004 (IPCC 2007). Of course, destroying the ODS also has an important positive impact on the ozone layer; the 2005 supplemental report from the Montreal Protocol's Technology and Economic Assessment Panel (TEAP) estimates that the destruction of ODS could accelerate the recovery of the ozone layer by up to two years, which could result in the avoidance of a significant number of skin cancer mortalities and morbidities (TEAP 2005).

As noted, the magnitude of this ODS bank challenge is considerable. A report by TEAP estimated worldwide ODS banks at approximately 3.78 million ODP-weighted tonnes in 2002, which is more than 55 times the global consumption of ODS in 2007, and equates to over 20 billion tCO2e (UNEP 2009). Of these banks, about 1 million tonnes are believed to be available for recovery and destruction, although a sizeable amount would require significant effort for recovery/collection (TEAP 2002). Additionally, collecting and destroying ODS is a time-sensitive exercise since ODS leak from equipment and storage containers at varying rates. While some ODS banks may remain until 2050 based on expected product lifecycles (e.g., foam applications with longer lifetimes), if not properly recovered and destroyed, banks may be emitted well before then (TEAP 2009a).

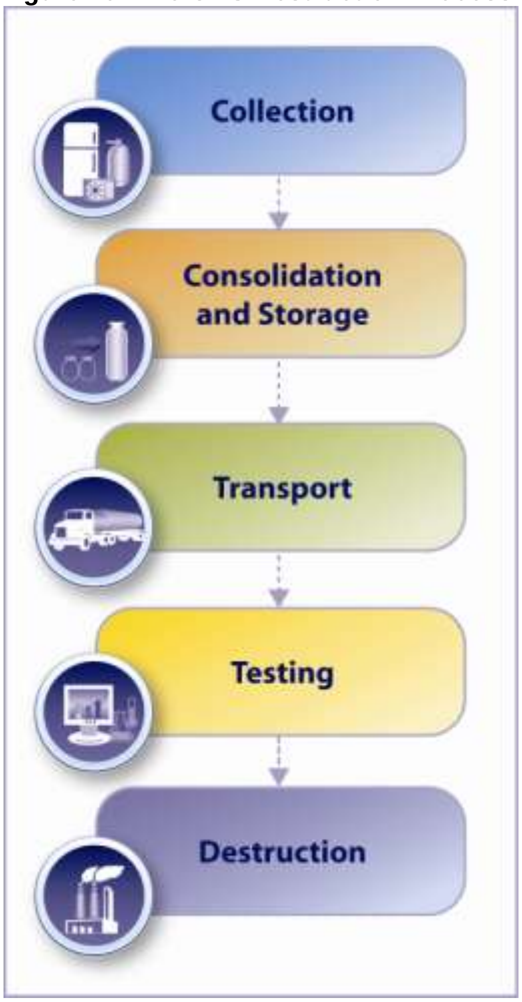
Recognizing the importance of managing these ODS banks in an environmentally sound manner, the Parties to the Montreal Protocol took Decision XX/7. This decision outlined preliminary actions to better understand and address the issue of ODS banks, including: requesting the Executive Committee (ExCom) of the Multilateral Fund (MLF) to consider commencing pilot projects related to the destruction of ODS; requesting the TEAP to conduct a cost-benefit analysis of destroying ODS banks; requesting the Ozone Secretariat to consult with experts from other funding mechanisms on possible funding opportunities for managing and destroying ODS banks; and requesting the Ozone Secretariat to convene a workshop prior to the Open-Ended Working Group in Geneva in July 2009 to further consider the challenge of ODS banks. As previously mentioned, this study is also

[3] ODS are usually "unwanted" for re-use because they are non-reusable or surplus.

an input to an ongoing discussion of how to manage ODS banks, and was commissioned by the ExCom in Decision 55/34.

2.2 Constraints on the Recovery and Destruction of ODS: The Need for Funding

Figure 19: The ODS Destruction Process



While there is a substantial volume of ODS banks that needs to be recovered and properly treated, a number of barriers stand in the way. To understand these obstacles, however, it is first important to understand the general process for disposing of unwanted ODS.

2.2.1 The Process of ODS Destruction: From Recovery to Destruction

This process of disposing ODS can vary depending on the source of ODS, the country in which recovery and destruction occurs, and other factors, but generally follows the steps described below. A graphic depiction of these steps is also provided in Figure 1.

The first step is the **collection** of ODS from the obsolete appliances, commercial or industrial equipment, or stockpiles in which it is contained. For refrigeration/AC units undergoing servicing, a certified service technician uses specialized pumping equipment to remove the refrigerant and store it in a recovery cylinder.[4] This typically occurs on-site. The removal of refrigerant from commercial/industrial equipment at end-of-life similarly occurs on site, and is conducted by certified technicians. For obsolete household appliances, units are collected and taken to a demanufacturing facility where a technician drains the refrigerant; alternatively, the refrigerant is sometimes evacuated before transportation. Refrigerator cabinets may be shredded whole and steam-treated in an airtight chamber in order to recover ODS blowing agents in the foam or the foam may be removed and treated separately. Larger industrial ODS stocks held in facilities and warehouses are also collected. These stocks are often stored in tanks, and recovery consists of either tank pick-up or transfer from tank to tank.

The next step is often **consolidation and storage**. Because ODS might be collected from a large number of smaller units (such as household refrigerators or small cylinders), it needs to be combined before sending it for destruction; this step avoids the shipping of many smaller containers, which can lead to additional expense, possible damage and leakage, and other obstacles. The collected ODS are typically brought to a central facility, where it is consolidated into larger cylinders or storage tanks. The size of the storage tank used depends on the source of the ODS, with small cylinders typically used for recovered refrigerant and pressure vessels often used for industrial stocks. The ODS are stored until a quantity sufficient for destruction has been aggregated. This consolidation step may in fact occur at several levels. For example, a local ODS service company may consolidate its stocks and send them to a regional consolidator, so that an even larger shipment can be sent for destruction. It is also important to note that at this step, destruction is not the only choice; some ODS consolidators will send some of their stocks for reclamation and eventual resale.

For those ODS intended for destruction, the next step is **transportation**. ODS are transported to a destruction facility by truck, rail, or ship as needed. A variety of container types are used for ODS transport, ranging in size from 30 lbs to 200,000 lbs (MLF 2008). Some smaller containers may be transported as-is, without transfer of

[4] Note that recovery cylinders are different than the cylinders in which material is contained at time of purchase.

their contents into transport vessels. ODS may be transported several times before its ultimate destruction, often as it moves through the consolidation process.

Upon arrival at the destruction facility, the ODS may be pumped into a holding tank or can be destroyed directly from the container it arrives in. Before the material is destroyed, **testing** of the container contents is undertaken to verify exactly what materials are being destroyed, often through gas chromatography. ODS material is also tested prior to being sent to the destruction facility (e.g., at the original source), and comparing these records serves as a means of verification.

Finally, **destruction** of the ODS is undertaken. Destruction facilities use any one of several types of technologies to incinerate the ODS, typically destroying it with an efficiency of 99.99% or higher. The TEAP has issued a list of destruction technologies approved for destruction of concentrated sources (largely refrigerant) and for dilute sources (i.e., foams containing ODS). These include cement kilns, argon and nitrogen plasma arc, rotary kiln incinerators, liquid injection incineration, and gaseous/fume oxidation. The full list of approved technologies was updated at the Fifteenth Meeting of the Parties through Decision XV/9 (UNEP 2003).

2.2.2 Key Barriers to Destruction

There are many barriers to effective recovery and end-of-life management of ODS, especially for Article 5(1) (A5) countries, as illustrated in Exhibit 2. The market for reclamation and recycling of ODS presents a good financial option for many operators, which can detract from the amount of ODS destroyed. One of the most important barriers, however—and the main barrier with which this report is concerned—is the funding constraints that both A5 and non-A5 Parties face for the destruction of ODS. In fact, a recent study for the MLF found that costs associated with unwanted ODS recovery and reclamation or destruction is the primary obstacle in achieving improved ODS management in A5 Parties (MLF 2008). The TEAP has estimated that the costs to manage all easily accessible banks ("low effort") could reach US$62 billion, while adding less accessible banks ("medium effort") would escalate that total cost to nearly US$180 billion.[5] While these costs would likely be borne over several decades, they are still sizeable.

To widely facilitate ODS destruction, A5 Parties will require financial assistance for ODS recovery, transport, storage, and destruction, as well as for technology transfer and cooperation. While the MLF has provided assistance to A5 countries over the past two decades to fund the phaseout of ODS consumption and production, its mandate is limited with respect to ODS banks. To date, the Parties have agreed to fund only pilot projects related to the environmentally sound management of ODS banks. In addition, while non-A5 Parties are thought to be more capable of encouraging ODS destruction or raising funds to do so through government mandated rebates, taxes, or producer responsibility programs, these types of programs lead to costs for holders of obsolete ODS. Creating additional financial incentives to encourage ODS destruction would likely lead to increased levels of destruction (MLF 2008).

Exhibit 7: Other Barriers to ODS Destruction

Apart from cost issues, there a number of other obstacles to ODS destruction that are complex and wide-ranging:

- Most countries lack regulatory frameworks to promote ODS destruction.
- A wide geographic distribution of ODS banks, versus the centralized destruction facilities they must be sent to, presents a significant obstacle to efficient collection.
- Proper disposal of ODS also requires that persons dealing with the ODS be trained in the technical means to prevent their release.
- Countries undertaking ODS destruction also need the proper tools and access to the infrastructure to collect, transport, store, and destroy the ODS. The process for developing this infrastructure can be significant, presenting a barrier for some A5 countries.
- For countries without domestic destruction facilities, shipping ODS to another country for destruction may be the best option. However, the logistical and legal complexities of shipment may present a barrier to some countries.
- Finally, several international conventions regulate the international shipment of ODS, including the Basel Convention, Central American Agreement, and Waigani Convention. The legal and administrative requirements of navigating these agreements may prove to be a barrier for some projects.

Source: MLF (2008).

[5] Examples of types of banks requiring low and medium effort to recover are given in TEAP (2009).

Potential options for funding ODS destruction are discussed in the next section, including the possibility of financing through the voluntary carbon market.

3. Possible Options for Financing ODS Destruction

As part of their Decision XX/7, the Parties to the Protocol asked the Ozone Secretariat to identify funding opportunities for the management and destruction of ODS banks through consultation with the MLF Secretariat and other multilateral and bilateral organizations and funding mechanisms. The results of that inquiry were presented at a workshop prior to the OEWG in Geneva in July 2009 and are incorporated into the discussion here (UNEP 2009). At the end of this section, a more detailed introduction to the voluntary carbon market as a potential funding mechanism is provided.

3.1 Multilateral Fund

To assist developing countries that might not otherwise have the technical and financial means necessary to phase out ODS, the MLF provides funding to cover the incremental costs incurred by A5 Parties to enable their compliance with ODS consumption and production phaseout obligations. These funds are provided through contributions from non-A5 Parties.

To date, the ExCom has decided to provide limited funding for select ODS disposal pilot projects in response to Decision XX/7 of the Parties. One key advantage of funding ODS disposal through the MLF is the already-established institutional structure and process for project development and implementation which is familiar to A5 countries and Implementing Agencies. Significant obstacles include the lack of a full mandate for ODS destruction and limited available funding.

At its 58th Meeting, the ExCom approved a set of interim guidelines for the funding of demonstration projects for the disposal of ODS (Decision 58/19). According to these guidelines, the MLF will fund a limited number of demonstration projects that cover aspects not yet covered by other demonstration projects, at a maximum level of US$13.2/kg of ODS to be destroyed (to be adjusted as appropriate considering the project scope). Funding is intended to cover transport, storage, and destruction, and will not be available for collection of ODS except as it relates to monitoring of the sources of ODS. Funding is also envisioned for a maximum of one destruction project each for disposal of halon and for carbon tetrachloride. As of January 2010, the MLF has approved project preparation funding for nearly a dozen projects addressing different aspects of ODS disposal in Algeria, Brazil, China, Colombia, Cuba, Ghana, Indonesia, Mexico, Nepal, Philippines, Turkey, and a regional project in Asia and the Pacific. In addition, the MLF has requested that UNIDO submit two additional project preparation requests for ODS disposal pilot projects, one for Africa and one for West Asia as part of their business plan for 2010.

Another option for funding ODS disposal under the MLF is the creation of a special facility for funding climate co-benefits, as has been discussed at previous ExCom meetings. The funds from the repayment of a US$1.2 million concessional loan project are being considered as starting income that could be used to create such a facility (UNEP 2009). Discussions on a special facility have been ongoing at the level of the ExCom and more recently brought to the level of the Parties in 2009. The Parties requested through Decision XXI/2 that the facility be considered as an agenda item at the 30th Meeting of the Open-ended Working Group in 2010.

3.2 Other Multilateral Organizations and Funding Mechanisms

Apart from the MLF, there are several other opportunities to fund ODS destruction through multilateral and global lending organizations. In most cases, opportunities exist to integrate ODS destruction into existing programs where there is potential overlap of themes. The feasibility of these, and any other possible opportunities would have to be carefully considered before selecting one or another option to pursue, along with possibilities for packaging and sourcing different funds as a means of financing the costs of ODS destruction.

The Global Environment Facility (GEF)—which acts as a sort of equivalent to the MLF for other international environmental treaties, such as the United Nations Framework Convention on Climate Change and the Stockholm Convention—represents one such opportunity for accessing additional funding for ODS destruction. The GEF has authority to grant funds under its ozone, climate change, and persistent organic pollutants focal area programs to activities related to ozone and climate change protection. The GEF's ozone focal area is authorized to fund activities and countries not covered by the MLF, but which are consistent with the Montreal Protocol's objectives. In addition, ODS destruction could potentially be funded under the GEF's climate change program, focusing on the high-GWP value of the gases being destroyed. To date, the GEF has funded a few projects under its climate change focal area that have phased out ODS in household refrigerators, and potential might exist to augment these projects to include an ODS destruction component. Moreover, the GEF's persistent organic pollutant projects focus on the phaseout and disposal of persistent organic pollutants and waste, as well as the establishment of infrastructure for collection, storage, and disposal of persistent organic pollutant waste. One project has already included an investigation of ODS disposal (UNEP 2009).

Another potential option would be to seek financing through international financial institutions (IFIs), including the World Bank or the regional development banks like the Asian Development Bank, the African Development Bank, or the Inter-American Development Bank. For example, ODS destruction could be mainstreamed into other related environmental programs, such as hazardous waste management, and receive funding through those programs. Alternatively, dedicated trust funds or carbon funds could be accessed to provide upfront credit to finance the preparation of ODS destruction projects or ODS destruction components piggybacking on other carbon market projects (such as energy efficiency chiller replacement projects), which would be paid back at an agreed rate after credits were issued. Such an arrangement could also guarantee a price floor (and/or ceiling) to limit the risk of both parties.

3.3 Other Schemes for Financing ODS Destruction

Apart from seeking funding or financing through multilateral organizations, a number of other schemes to promote and cover the costs of ODS destruction at the local or national level have been identified. These opportunities include both voluntary and government-mandated programs that create financial and behavioral incentives (or remove disincentives).

One option is producer responsibilities schemes, which rely on levies or licensing fees (usually on the production/import of ODS-containing equipment), and rebates (for the return of recovered ODS), to encourage producers to safely manage the entire lifecycle of ODS-containing equipment. Producer responsibility schemes are thought to work best in countries with strong public support and/or government support, and in situations where few players are involved (i.e., limited to producers/importers) (MLF 2008).

Fees and taxes can also be assessed outside of a producer responsibility scheme to generate revenue to fund ODS collection, recycling, and disposal. For example, disposal fees can be added to the cost of new appliances containing ODS, which also have the added benefit of providing a price signal encouraging consumers to purchase non-ODS containing equipment. Taxes can also be imposed, for instance on the production of new equipment containing ODS. Among the countries that have taxed ODS are Australia, Belarus, Bulgaria, the Czech Republic, Denmark, Hungary, Republic of (South) Korea, Poland, the Seychelles, Singapore, South Africa, Sweden, Thailand, Vietnam and the United States (TEAP 2003).

Another possibility is leveraging the interest of producers of ODS substitutes as a means of funding ODS destruction. In Italy, for example, a producer of halon alternatives offered to collect and destroy halons from users who committed to using the alternative. In China, a fire extinguisher program was developed that gave a new alternative-based fire extinguisher to those needing to refill their halon extinguishers (UNEP 2009).

3.4 The Voluntary Carbon Market

The carbon market represents another potential avenue for funding ODS disposal, and the one that is the primary focus of this report. The high global warming potential (GWP) of ODS means that their destruction has the ability to generate significant volumes of carbon credits, which can then be sold in the carbon market. For example, destroying 1 tonne of CFC-12 with a GWP of 10,900 could yield up to 10,900 credits (one credit is equal to one tonne of CO_2 equivalent) (IPCC 2007). At a price of US\$4.60/tCO_2e (the average price of a voluntary carbon credit for an industrial gas project in 2008), the destruction of 1 tonne of CFC-12 could generate US\$50,140 (Hamilton *et al.* 2009). This is substantially higher than the cost of destruction estimated by TEAP (2005) at about US\$5/kg (or US\$5,000/tonne) (not including other project costs such as collection, transportation, and storage) and also higher than the maximum level of funding agreed by the MLF in its interim guidance on approving ODS disposal projects of US\$13.2/kg (or US\$13,200/tonne). The MLF maximum funding level translates into approximately US\$1.21/tCO_2e, using the GWP of CFC-12. Thus, the revenue gained through the carbon market could go a long way towards covering the total costs of destruction, including collection, storage, and transportation. It is also important to note that more easily accessible banks (e.g., CFC refrigerant stockpiles or installed banks in large systems or from appliances in densely populated areas) may be profitable to destroy, but less accessible banks (e.g., CFC foams or small systems in low volume consuming countries) can be significantly more costly. It should also be kept in mind that profits made from destroying more accessible banks could be used to fund less accessible ones or to create better storage facilities fund the introduction of newer energy efficient technologies and/or other environmental protection activities. This concept is discussed at more length in Chapter 9.

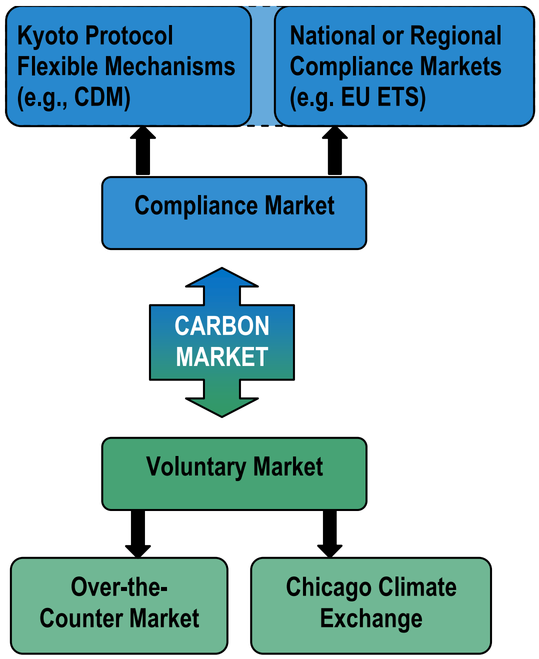
Because ODS are not included in the Kyoto Protocol basket of greenhouse gases, ODS destruction projects are not currently eligible under the Kyoto Protocol's carbon market trading mechanisms, including the Clean Development Mechanism (CDM) and Joint Implementation (JI). While the Parties to the Kyoto Protocol have the power to interpret the Protocol definitively—meaning that they could decide, for example, to include ODS destruction under the CDM—there is no indication that Parties are moving in that direction (UNEP 2009).

With ODS destruction ineligible for CDM, the *voluntary* carbon market has instead been pinpointed as a funding source for global ODS destruction due to its flexibility in terms of participation and evolving acceptance of emission reduction activities. The voluntary market operates outside of compliance markets and allows organizations to offset carbon emissions on a voluntary basis. Background information on understanding the carbon market is provided in the next chapter, and then a more detailed explanation of how the voluntary carbon market system could be applied for ODS follows in Chapter 5.

4. Understanding the Carbon Market

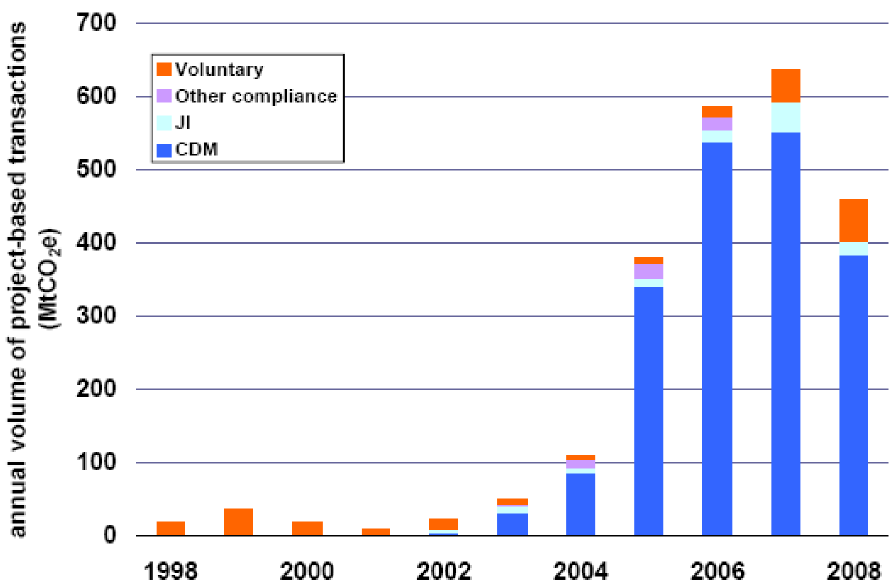
The global carbon market can be broadly divided into two key segments—the compliance market and the voluntary market—as depicted in Figure 2. In 2008, the global carbon market represented a total traded value of US$126 billion, of which the voluntary market represented less than 1% (World Bank 2009). While the value of the voluntary market represented a very small portion of the total global carbon market, it has demonstrated strong growth in recent years and doubled between 2007 and 2008 as it grew from US$335 million in 2007 to US$704.8 million in 2008 (World Bank 2009). The compliance and voluntary markets are described in more detail in Sections 4.1 and 4.2, respectively.

Figure 20: Structure of the Carbon Market



The market can also be segmented into allowance markets and project-based markets. Allowance markets are based around a restricted number of tradable carbon credits that are given away or sold to participants by governments or international bodies. Project-based markets rely on individual projects that result in a decrease in emissions and therefore generate *emission reduction credits.* An example of a project based market is the CDM. Most emission reduction activities in the voluntary market are project-based. The allowance and project-based markets do often interact and the credits within each are, to some extent and with some limitations, interchangeable. For example, operators can use a certain amount of CDM credits for compliance under the EU Emission Trading Scheme (EU ETS). The project-based voluntary market is significantly smaller than project-based elements of the compliance market, as shown in Figure 21.

Figure 21: Volume Comparison of the Project-based Compliance and Voluntary Markets



Source: World Bank (2009).
Note: this chart excludes secondary CERs, as well as CCX (which is not classed as a "project-based" system).

4.1 Compliance Markets

Compliance markets for GHGs exist both at an international level, between governments with binding targets under the Kyoto Protocol, and at national and regional levels through legally-binding policy instruments introduced in order to tackle climate change and/or to help national governments achieve their Kyoto Protocol targets.

The key aspect of compliance markets is that there is a legal requirement for those bodies covered to demonstrate that they hold carbon credits equivalent to the amount of GHGs that they have emitted. Monitoring, reporting and third party verification systems are used to ensure that this process is robust and transparent and penalties can be applied to participants that do not comply.

4.1.1 The Kyoto Protocol and its Flexible Mechanisms

A key component of the global carbon market is formed through the Kyoto Protocol and its three flexible mechanisms: emissions trading, CDM, and JI. Six main GHGs (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) are covered by the Kyoto Protocol and each carbon credit—of the various types created by the Protocol—represents one tonne of CO_2 equivalent. As noted above, the Kyoto Protocol limits trading to non-Montreal Protocol GHGs; ODS are therefore currently not eligible for projects under the CDM.

Annex I countries to the Kyoto Protocol have binding targets, defined as a certain number of "Assigned Amount Units" (AAUs), to limit GHG emissions.[6] The first of the three Kyoto Protocol flexible mechanisms, emissions trading, allows AAUs to be traded between countries. Such trades currently represent a very small proportion of the total global carbon market.

The second flexible mechanism, the CDM, allows certified emission reduction credits (CERs) to be generated by projects that reduce emissions in non-Annex I countries.[7] The sale of these credits to buyers in Annex I countries (such as national governments with binding emission targets under the Kyoto Protocol) generates revenue that makes the project activity financially viable. CERs generated through the CDM can also be used to help organizations meet targets under regional systems, such as the EU ETS described below., Given this additional source of demand for CERs and the fact that a strong secondary market for CERs exists, the CDM is the second largest component of the global carbon market on a pure volume basis (i.e. tCO_2e transacted), with the EU ETS first. The secondary CDM market (i.e., third-party CER transactions) accounted for 20% of the value of all carbon market transactions in 2008 (US$26 billion) with the primary CDM market (i.e., CER purchases directly from the CDM project) forming a further 5% (US$6.5 billion).

JI, the third of the flexible mechanisms, allows entities to generate emission reduction units (ERUs) by investing in emission reduction projects in an Annex I country. Again, these credits can then be sold to an Annex I country or entity to help meet its Kyoto Protocol commitments. Since 2008, ERUs have been eligible for limited use under the EU ETS.

4.1.2 National or regional compliance markets

A number of national or regional compliance markets have now been established or are under development. The largest of these—with a traded value of almost US$92 billion in 2008—is the European Union Emission Trading Scheme (EU ETS) (World Bank 2009). Under the EU ETS, mandatory emissions limits are set for energy intensive organizations covered by the scheme, and EU Allowances (EUAs) can be traded between participants.

The Regional Greenhouse Gas Initiative (RGGI) in the United States is an example of a sub-national compliance market established through the introduction of a mandatory emission trading scheme covering electricity generators in ten U.S. states. It is significantly smaller than the EU ETS with a total traded volume in 2008 of US$246 million. While CERs from the CDM are not eligible as offsets under RGGI, other types of project-based offset credits, representing emission reductions in the U.S. outside the power sector, can be used.

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[6] As noted above, each AAU is equivalent to one tonne of CO_2.

[7] Developing countries, without binding emission targets are referred to as Non-Annex I countries to the Kyoto Protocol and are broadly equivalent to Article 5 countries of the Montreal Protocol. Developed countries, with emission reduction targets are referred to as Annex I countries under the Kyoto Protocol. Such countries are broadly equivalent to non Article 5 countries (Article 2) countries under the Montreal Protocol.

4.2 Voluntary Markets

The voluntary market operates outside the compliance market, where organizations can offset carbon emissions on a voluntary basis. In contrast to the compliance market, demand in the voluntary market is driven not by regulation but by buyers' interest in mitigating and offsetting their emissions.

Motivations for participating in the voluntary market are varied, but the primary drivers include the following (ICF 2008):

- Reputation—As public concern over climate change has increased, companies and governments have become more interested in gaining recognition for reducing their net carbon emissions. Specifically, companies care about gaining recognition from their employees, shareholders and customers.
- Experience—Although certain sectors face either no mandatory carbon constraint or only partial constraints, organizations may elect to enter the voluntary market to reduce net emissions and gain market experience in anticipation of possible future regulation (e.g., pre-compliance).
- Principle—Organizations and consumers may have adopted a formal or informal environmental ethos and choose to offset emissions on principle.
- Competitiveness—Companies seek to differentiate their products by offering carbon offsets to customers bundled with their products.

The remainder of this section describes the different aspects of the voluntary market, including the non-binding and binding sections of the market, the structure of the market, and the project cycle.

4.2.1 Non-binding (Over-the-Counter) versus Binding (Chicago Climate Exchange)

The voluntary market can be split into two main sections. Under the larger, non-binding, section of the market, buyers may establish targets to reduce emissions, but they face no legal requirement to meet those targets. This section of the market, known as the over-the-counter (OTC) market, is comprised of project-based emission reduction (offset) activities that are often certified by a number of voluntary third-party standards. Such standards include the Voluntary Carbon Standard (VCS), the Climate Action Reserve (the Reserve), and the Gold Standard (see Exhibit 3).[8] Voluntary project offset credits are known as VERs (voluntary emission reductions or verified emission reductions). In 2008, these projects accounted for 54 million tCO_2e, (about 12% of the total value of project-based transactions in 2008) up from 43 million tCO_2e (6.7%) in 2007.

While the compliance market can be considered binding, in that participants are legally bound by regulation to comply with a carbon constraint, elements of the voluntary market are also binding in nature. Under voluntary schemes, such as the Chicago Climate Exchange (CCX), participants make legally binding voluntary commitments to comply with a carbon constraint. In 2008, CCX projects accounted for 69 million tCO_2e, up from 23 million tCO_2e in 2007 (Hamilton *et al.* 2009).

Exhibit 8: Third-Party Standards

As a means of ensuring quality, legitimate, and consistent offsets in the voluntary market, a number of third-party standards—along with verification procedures and associated registries—have been established. Almost all credits earned in the voluntary market—about 96%—are now verified against a third-party standard. While about 17 third-party standards and certification programs currently exist, some are utilized more than others. Nearly half the voluntary market transaction volume is verified by the Voluntary Carbon Standard, followed by the Gold Standard with 12% and the Climate Action Reserve with 10%.

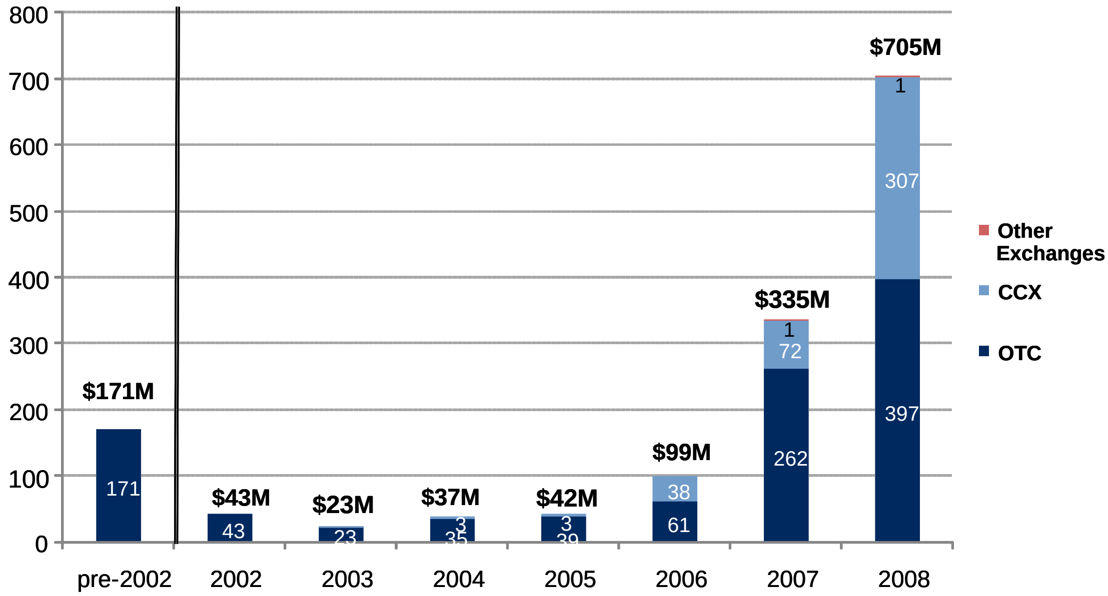
Most standards focus on legitimizing carbon credit development, but among them there are many differences in scope and approach. For instance, some standards only cover certain project types, such as the Gold Standard, which provides methodologies for renewable energy and energy efficiency projects with significant contributions to sustainable development. Other standards are only applicable for projects that follow CDM or JI project methodologies (but are not eligible for CDM/JI accreditation), like VER+. Others, like the Reserve, will only verify projects that are designed to their project methodologies, while the VCS will accept projects verified to methodologies created by outside parties for the VCS, as well as other standards' methodologies, like CDM. CCX has produced a series of prescriptive protocols but will also entertain project submissions using other standards.

Source: Hamilton *et al.* (2009).

[8] While there is no strict requirement to operate in accordance with a third-party standard in the voluntary market, demand from the end consumer is driving demand for projects developed in this way.

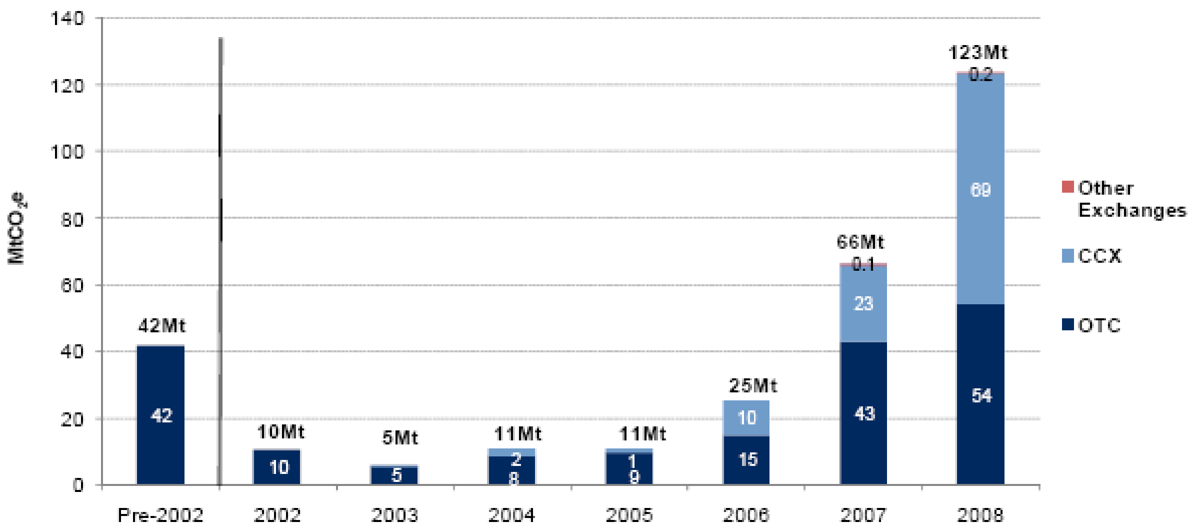
Figure 22 and Figure 23 below demonstrate the relative size of the OTC and CCX components (in terms of total traded value and volume) as well as the rapid growth in the voluntary market—especially CCX—over the past few years.

Figure 22: Relative Size (Value) of the OTC and CCX Components of the Voluntary Market



Source: Hamilton *et al.* (2009)

Figure 23: Volume Growth in the Voluntary Carbon Market



Source: Hamilton *et al.* (2009)

Note: this figure represents market volume, not the total number of offsets demanded/supplied. The difference between the two is that, depending on the turnover rate in the market, each offset originated can be traded several times before reaching the final user. As a result, the market volume usually exceeds the number of actually existing offsets.

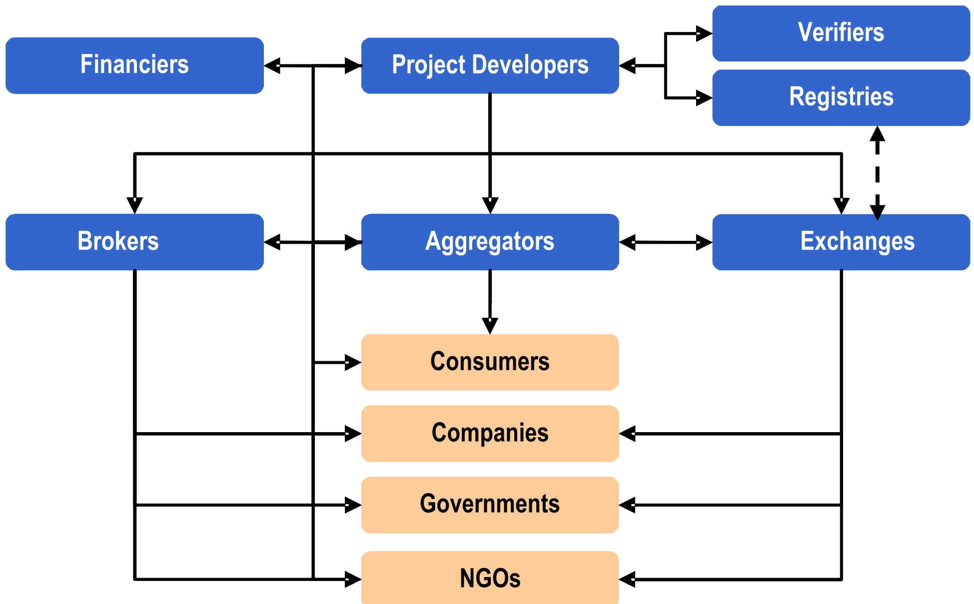
4.2.2 Voluntary Market Structure

The voluntary carbon market is comprised of participants from both the supply and demand sides, as well as intermediaries. The roles of each these players are described below, followed by a description of how they interact and a visual depiction of those interactions.

<table>
<tr><th>Demand</th><th>Supply</th></tr>
<tr><td>On the demand side of the market, there are four principal types of players:
❑ Companies may sponsor specific projects, participate directly on exchanges, or pay into offset schemes through project developers, aggregators, or brokers.
❑ Governments have similar options for participating in the offset market, though there may be additional requirements regulating spending of public monies.
❑ NGOs have also taken an interest in the offset market, with a similar path to market as companies and governments.
❑ Consumers generally cannot participate on exchanges or through brokers, but rely on a packaged retail offset product supplied by a developer or aggregator.</td><td>On the supply side of the market, there are three major classes of players. Some may play more than one role:
❑ Project developers oversee all aspects of identifying and completing carbon offset projects. They seek out project opportunities, ensure projects are carried out to any applicable standards, arrange financing, and seek buyers for the generated offsets directly in the retail market or through brokers, exchanges, or aggregators.
❑ Aggregators pool carbon offsets across multiple projects to sell them on to retail or other secondary buyers. By aggregating across projects, it is possible to reduce the risk of delivery through a more diverse portfolio. Aggregators include both companies and NGOs.
❑ Offset Wholesalers, similar to offset aggregators, pool together carbon offset projects. However they sell offsets not directly to retailers but to other companies, such as aggregators or carbon funds.</td></tr>
<tr><th colspan="2">Intermediaries</th></tr>
<tr><td colspan="2">A third group of market participants is formed by institutions that facilitate transactions between the demand and supply sides.
❑ Brokers serve as intermediaries in offset transactions, typically for business-to-business deals.
❑ Exchanges offer a platform for trading offsets in an open marketplace.
❑ Registries record carbon emissions or emission reductions in a central and standardized carbon registry.
❑ Verifiers audit offset projects to verify that they have been completed, meet necessary standards, and have calculated the achieved emissions reductions correctly.
❑ Carbon Funds are vehicles that collect money from different investors to purchase carbon reductions or to invest equity or provide loans to emission reduction projects. Carbon funds can provide a return to their investors either in carbon offsets or in cash. They can be placed on the demand side of the market - when purchasing offsets from project developers - or on the supply side of the market - when carbon funds invest in the underlying projects and sell the offsets. Finally, carbon funds may act as mere intermediaries between investors and project developers. Most funds that provide returns in the form of emission reductions were set up as compliance vehicles and have targeted mostly CDM and JI projects (e.g., the twelve carbon funds managed by the World Bank's Carbon Finance Unit); and CERUPT (Certified Emission Reduction Procurement Tender) – the Dutch carbon fund). In contrast, carbon funds operating on the voluntary carbon market generally provide their investors with returns in cash rather than carbon reductions. To date, carbon funds have played a relatively limited role in the voluntary market with most voluntary buyers interacting directly with aggregators/brokers to purchase their offsets. Carbon funds that provide equity to projects are more likely to enter the voluntary carbon market than carbon funds which only sign off-take agreements. The former use the voluntary carbon market projects as a way to diversify their finance portfolio, particularly given current uncertainty surrounding the future of the Kyoto Protocol mechanisms post 2012. Compliance funds have also used the voluntary market for pre-compliance credits.</td></tr>
</table>

Generally, project developers team with financiers to fund the project and engage a verifier to certify the validity of the project's emissions reductions. Project developers may then sell offsets through brokers to aggregators or final customers. Developers may also sell to aggregators directly or onto an exchange. Companies and governments typically have the institutional capacity to trade on exchanges directly, or work through brokers to pay into specific projects or aggregations of projects. Financial institutions or other sophisticated buyers may choose to invest directly into specific projects to achieve more favourable prices or exercise more control over the types of projects and their execution. Consumers are more likely to purchase more structured retail products from a project aggregator. Alhough aggregators will pursue different types of projects with different standards and verification procedures, consumers have somewhat less control over the specific projects they fund. Figure 24 illustrates how these various players interact in the market.

Figure 24: Voluntary Carbon Market Structure



Source: Adapted from ICF (2008).

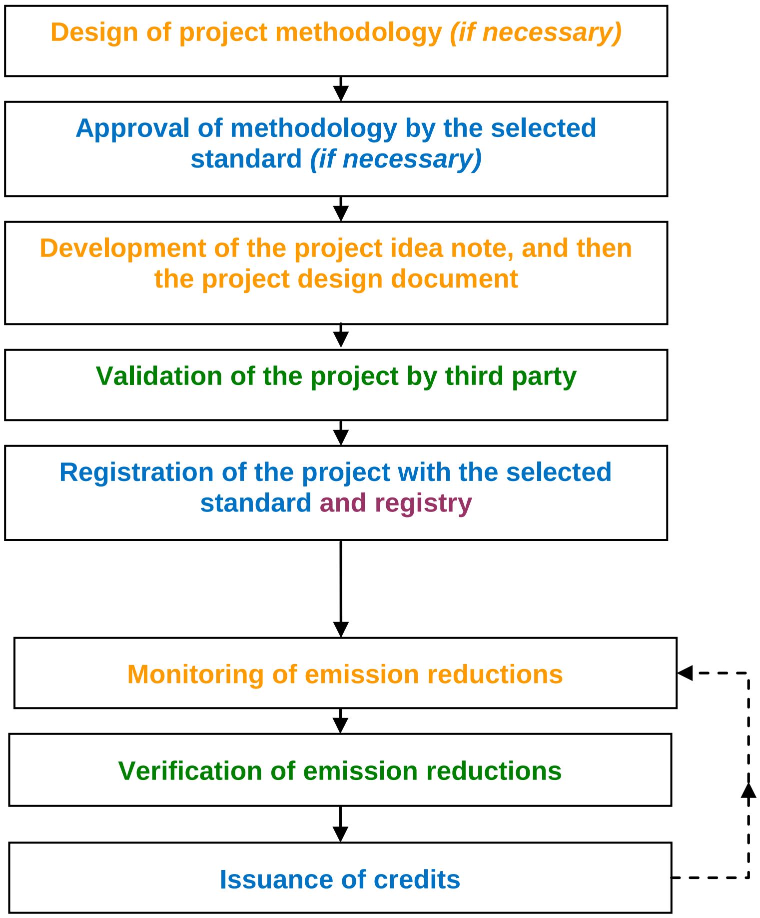
4.2.3 Voluntary Market Project Cycle

The development of a voluntary carbon market project generally follows a number of broad steps, as shown in Figure 25 below. The cycle below describes the general steps for a project that is developed in accordance with one of the existing third-party standards, such as VCS or the Reserve. Technically, there is no strict requirement to operate in accordance with a third-party standard; however, end-consumer requirements are driving demand for projects developed under recognized third party standards. In 2008, 96% of transacted VERs was verified by a third-party standard (Hamilton *et al.* 2009).

As such, the process starts with an evaluation of all existing methodologies accepted by the third-party standard being pursued that could be applicable to the project in question. To certify a project to a specific third-party standard, a project developer must follow a methodology approved by that standard. A methodology specifies the project activity, the criteria for determining the eligibility and additionality of the project under the methodology, the calculation of the emission reductions, and the requirements for monitoring and recordkeeping. The concept of additionality is central to the project-based market. Projects need to demonstrate that in a business-as-usual scenario (i.e., without the revenue stream associated with the sale of the credits either to the voluntary or compliance market) the project activity would not have taken place and the emission reductions would not have been realized. This concept, and its rigorous verification by third-parties, enables one tonne of CO_2e saved to “offset” the emission of another tonne of CO_2e elsewhere.

If an existing methodology is appropriate for the project in question, then the development of a project design document can begin. However, if this is not the case, then either a revision to an existing methodology can sometimes be sought, or a new methodology must be developed and approved by a third-party standard.

Figure 25: Voluntary Market Project Cycle



Developing a voluntary project involves a number of generic steps regardless of the specific standard bring pursued. Different stakeholders specific to the project cycle are:

- **Project Developer**
- **Verifier:** third party in charge of assessing compliance of the project with the rules of the standard pursued
- **Standard:** the specific authority that officially registers the project and issues credits.
- **Registry:** a system for creating, tracking, trading and retiring carbon credits.

5. Accessing the Voluntary Market for ODS Destruction

This chapter explains how access can be gained to the voluntary market for ODS destruction projects, beginning with a practical overview of project-related access (i.e., how would a company with ODS to destroy develop, finance, and register a project on the voluntary carbon market?), and followed by a discussion of the existing and upcoming opportunities for ODS destruction on the voluntary markets.

5.1 How the Voluntary Market Would Work for ODS Destruction

The broad steps that an organization, such as a company owning a stockpile of ODS, could take towards developing a voluntary market project are described below.

1. **Review the voluntary market third-party standards for selection.** A project developer (which could be the organisation that actually owns the ODS bank or an entity working in collaboration with the owner) would first review the available standards to identify the market that meets the needs of the envisioned ODS destruction project (e.g., given the standard's rules, geographical coverage, etc.). For example, if a project developer intends to carry out destruction outside of the United States, then a standard that limits eligible projects to those carried out in the United States would not be the right choice.

2. **Review existing methodologies for selection.** Once a third-party standard has been selected, the project developer would then review the existing methodologies accepted by that standard that could be applicable to the envisioned project. In some cases, if only one methodology exists for ODS destruction—such as is currently the case for CCX—this step may be combined with the first step. In other cases—such as the situation under VCS—multiple approved methodologies might be available for consideration and selection. If one of these methodologies is appropriate for the project in question (e.g., the envisioned project seems eligible under the methodology, the methodology seems "doable"), then the project developer can move on to the next step. If this is not the case, however, then the project developer generally has two options: either it can seek a revision or deviation to an existing methodology (if allowed), or it can develop a new methodology for submission and approval by the third-party standard that is being pursued (if the standard accepts new methodologies). If neither option is possible, then the project developer cannot move forward under the standard selected. This issue is described further in Section 5.2 below.

3. **Develop a project idea note**. Once a methodology is selected (or approved), the project developer usually develops a project idea note (PIN) (see example in Appendix D). This document describes the project and sets out the business case for the voluntary credit project, as well as the additionality case. It determines whether an existing methodology is applicable to the project or whether a new methodology needs to be developed. It also presents the likely costs, expected number of credits the project would produce, the voluntary standard that would be sought, and the potential revenue that the sale of the credits could generate. Depending on the level of in-house expertise, this, and other project documentation and support, may be provided by an external consultant.

4. **Establish funding**. The project developer then has two main options. Either it funds the entire project activity itself with a view to selling the credits once the project is registered and the credits are issued (see Section 7.2 for full details of costs) or it uses the PIN to attract interest from a financier. A financier could provide the capital required to support the project through the cycle and fund the destruction process in return for more favorable credit prices, or could support just the carbon costs of the project.

5. **Develop full project documentation**. If successful, the full project documentation (i.e., the project design document or its equivalent, as defined by the third-party standard that describes the emission reduction activity) would be developed and, as outlined in Figure 25, the validation process would begin. (See Appendix D for VCS' project document template.)

6. **Monitor and verify emission reductions, and receive credits**. As described in Figure 25, this is followed by the annual monitoring and verification of emission reductions generated by the project by an external auditor. Upon receipt of a completed verification report, the selected registry issues the credits.

7. **Validation:** The project documentation is submitted for validation. If successful, the project is then registered under the selected standard.

8. **Market the credits**. Depending on the arrangements with the financier, the credits would pass to the owner (or be shared between the owner and the developer, as negotiated). They would then market the credits to consumers or companies looking to voluntarily offset their emissions. Alternatively aggregators, exchanges or brokers could come into play at this point as intermediaries.

For national governments that are the legal owner of an ODS stockpile, such as ODS confiscated through customs, there is no clear precedent for their participation in the project development side of the voluntary market. Generally, government roles have tended to focus on facilitating market intervention through capacity building and legislation, although there is some experience with governments serving as the project developer and coordinating entity for a programme of activities through CDM. Although, technically, there are no specific rules restricting governments from acting as project developers, the primary concerns surrounding government participation stem from the treatment of project additionality. For example, questions could be raised about why a government does not pay for the destruction of ODS banks itself; specifically, are ODS project costs so prohibitive that a government needs market funding to support it? It may also be possible for their facilitative role to expand; for example, a government might sell its stockpile of ODS, perhaps through an auction, to a private entity who could then develop a voluntary credit project. It could also impose taxes on private entities that develop voluntary credit projects to generate revenue for ODS management or other environmentally-related initiatives. These opportunities—and the role for governments—are discussed at more length in Chapter 10.

5.2 Existing and Upcoming Opportunities for ODS Destruction on the Voluntary Market

The opportunities to use the voluntary market to finance ODS destruction have been limited in the past. However, as of February 2010, the **Chicago Climate Exchange (CCX),** the **Voluntary Carbon Standard (VCS),** and the **Climate Action Reserve (the Reserve)** represent market platforms that cover ODS destruction as part of their GHG programs. Eleven ODS destruction projects have been registered—for a total of 787,300 tCO_2e—since the addition of the ODS destruction protocol to the CCX in 2007; these projects earn carbon credits (called Carbon Financial Instrument® or CFI™ contracts) under CCX. The VCS has only recently—as of late January 2010—expanded its GHG program to cover ODS, by approving a series of eligibility criteria for ODS destruction projects. The Reserve has most recently undertaken efforts to expand its GHG program to include ODS destruction projects. The Reserve has developed project protocols for ODS destruction for material sourced domestically and for ODS imported to the U.S. for destruction, which serve as standardized approaches for quantifying and monitoring reductions in GHG emissions from ODS destruction projects. Draft versions of the protocols were publicly released in late January 2010 and were adopted by the Reserve Board in February 2010.

Table 13 below compares the rules and procedures for these three standards and is followed by a discussion of the direction each standard has taken for including ODS destruction projects as well as the possible implications of these rules and procedures on ODS destruction.

Table 13: Rules and Procedures in CCX, VCS, and the Reserve

	Chicago Climate Exchange Offset Program	Voluntary Carbon Standard	Climate Action Reserve
Overview			
Description	The offsets program for a voluntary cap-and-trade program in North America.	A global standard for voluntary offsets initiated by the Climate Group, the International Emissions Trading Association, and the World Economic Forum.	A national carbon offsets program in the United States that works to establish standards for GHG reduction projects in North America, issues carbon offset credits.
Governance	Overseen by a Committee on Offsets made up of representatives of CCX Member companies.	Headed by a board, and in the process of forming advisory groups.	Headed by a board of directors; Center for Climate Action and California Climate Action Registry operate as part of the organization.
Members	Members are participants on the exchange, and include manufacturers, organizations, power companies, and city and state governments.	Not membership-based. Project proponents to date include energy industries, waste handlers, and offset development firms.	Not membership-based. Project Developers to date include state and local government, offset development firms, waste authorities, and forestry plantations.
Market size	55,950,000 tCO_2e registered as of Jan. 2009	8,366,000 tCO_2e issued as of Sep. 2009	1,646,000 tCO_2e issued as of Sep. 2009
Credit units	Carbon Financial Instrument (CFI) contract, equal to 100 tCO_2e	Voluntary Carbon Unit (VCU), equal to 1 tCO_2e	Climate Reserve Tonnes (CRT) , equal to 1 tCO_2e
Over-the-counter or private market?	Private market (although prices are transparent and reported daily)	OTC	OTC
Project Requirements & Limitations			
Who is eligible to develop projects?	Any project developer; developers may become a CCX Member or Participant Member (Offset Provider or Aggregator) to register a project.	Any project developer.	Any project developer; developers must have (person or organization) with an account with the Reserve and anyone may apply for an account regardless of location or affiliation.
Geographic scope	International	International	United States (with some allowances for internationally imported material, and protocols applicable in Mexico and Canada soon)
Gases covered	All six Kyoto gases, and ODS (for destruction)	All six Kyoto gases, and certain ODS (for destruction)	All GHGs
Project start date limits	On or after 1 Jan. 2007 for ODS destruction; 1 Jan. 2003 for all other offset types	On or after 1 Jan. 2002	After 1 Jan. 2001 (except new project protocols)
Is grouping of projects allowed?	Projects may be grouped together by an Offset Aggregator as a "pooled project."	Yes, submitted under one project document as a "grouped project."	Not explicitly, although "joint verification" is permitted.
Are co-benefits required?	No	No	No, not on a project-by-project basis, although they are a factor in the selection of project types.

	Chicago Climate Exchange Offset Program	Voluntary Carbon Standard	Climate Action Reserve
Validation and verification procedures	Validation is conducted by CCX staff. Independent verification by a CCX-approved verifier is required. Conflicts of interest must be cleared on a project-specific basis. Verification reports are reviewed by CCX staff and subsequently by FINRA for quality assurance.	Validators and verifiers approved under a VCS-approved GHG Program (e.g., CDM, the Reserve) or under ISO 14065 with VCS scope (through national accreditation bodies) are eligible to perform VCS validations and verifications in the sectoral scopes for which they have been accredited.	Verifiers are trained by the Reserve, approved by ANSI. All verification materials are public. The Reserve does not require that validation be conducted separately; verifier can confirm project eligibility. Conflict of interest requirements must be cleared prior to verification.
Offset Registration			
Approval process	The CCX Committee on Offsets approves project protocols, project-specific proposals where no protocol is approved, and project-specific deviations to existing protocols. Verification reports are reviewed by CCX staff and subsequently by FINRA for quality assurance prior to issuing offsets.	The VCS Registry reviews requests for issuance of credits.	The Reserve reviews project forms and then lists the project. Verification must then be completed for registration.
Does the standard have a registry system?	Yes, incorporated with trading platform.	Yes, a project database and a multi-registry system with services provided by several registry providers.	Yes, incorporated.
Fees	Registration fee: \$0.15/tC0₂e Transaction fee: \$0.05/tC0₂e Annual membership: \$5000/year	VCS Registration Levy: €0.04/tC0₂e Registries' fees (vary by registry): Issuance fee: \$0.05/tC0₂e Transfer fee: \$0.02-0.03//tC0₂e Annual fee: \$100-500/year	Issuance fee: \$0.20/ tC0₂e Transfer fee: \$0.03/ tC0₂e Project fee: \$500/project Annual account fee: \$500/year
Project crediting period	CFIs issued for the year in which mitigation took place.	Over a maximum of 10 years, which may be renewed no more than two times. Crediting begins only after reductions begin.	Crediting begins with the start of the project. Most projects are subject to a 10-year nonrenewable crediting period.
Double-counting prevention measures	Project may not be registered in other offset registries. All registered projects are publicly listed. Registry uses serialization to identify and track CFIs.	Proof must be provided for certain projects that reductions are not part of another emissions trading program or regulatory program. All registered projects are publicly listed. Registry uses serialization to identify and track VCUs.	Projects must not be registered in other registries. All registered projects are listed publicly. Registry uses serialization to identify and track CRTs.
Methodologies			
Can new methodologies be submitted for review?	Yes, CCX may accept or reject any proposal or approve a project on a project-specific basis without accepting the protocol for application generally.	Yes. Methodologies must go through the VCS Double Approval process, which the proponent pays for.	No, project protocols are developed by the Reserve.
Can projects be prepared using other standards' methodologies?	Yes, CCX may accept or reject any proposal or approve a project on a project-specific basis without accepting the protocol for application generally.	Yes, CDM and the Reserve's methodologies can also be used.	No, can only use the Reserve's methodologies.

	Chicago Climate Exchange Offset Program	Voluntary Carbon Standard	Climate Action Reserve
Additionality requirements	Established based on an assessment of common practice for a sector; projects and protocols must be demonstrated to be beyond common practice and regulatory requirements for the sector in question.	All projects approved under the VCS must be additional, and additionality requirements are set out in the methodology that the project uses. The project must face one or more distinct barriers and must be above and beyond the regulatory requirement.	The Reserve establishes performance standards and other criteria that projects must meet in order to be considered additional (i.e., a regulatory test). These standards and criteria are established separately for each project type. This approach differs from some other offset programs, where additionality is determined using information specific to each project.
Does an ODS destruction methodology exist?	Yes	VCS has expanded its GHG program to cover ODS destruction, but specific methodologies have not been approved as of this writing (Feb. 2010).	Yes. Two protocols have been approved for 1) imports from A5 countries and, 2) the U.S.

Sources: CCX 2007, 2009a; VCS 2008a, 2008b; Climate Action Reserve 2009a, 2009b.

Some of these rules and procedures will have important effects on the opportunities for destroying ODS for carbon credit in the voluntary market. For example, while VCS and the Reserve operate as part of the open, OTC market (as described in Section 4.2), CCX currently operates as a private, formal market that is guided by a voluntary membership-based cap-and-trade system. Members commit to a certain reduction in GHG emissions, which can be met be making reductions internally, purchasing credits, or undertaking offset projects. While any firm may become a CCX Member and register a project, because CCX is more than an offsets program, it requires entities with significant direct GHG emissions from their operations to commit to an emission reduction schedule.

For project requirements, limitations in geographical scope at the standard-level will affect the types of ODS destruction methodologies that are accepted or developed. While VCS has an international scope, the Reserve has been limited primarily to projects in the United States (although a protocol for destroying ODS imported from A5 countries to the United States has also been adopted) and CCX has limited eligible ODS destruction projects to those carried out within U.S. borders (although material may also be imported to the United States for destruction). Such limitations may present some challenge for the participation of other countries.

Whether grouping or pooling of projects is allowed may also be important for the viability of financing ODS destruction through the voluntary market. Given the dispersed location of ODS banks, there may be advantages in grouping a number of ODS destruction activities together. This approach, which is allowed under VCS, CCX, and the Reserve—although with different specific rules and terminology[9]—could involve developing one set of project documentation and making one financing arrangement for the destruction of ODS banks sourced from a number of different locations or countries. The advantage would be leveraging economies of scale and reducing the fixed transaction costs. A private sector entity may be able to source ODS banks under the ownership of a number of different companies and develop a project as described above. Governments or multilateral organizations could potentially play a role in facilitating this process through, for example, developing an international clearinghouse, which could provide access to information on ODS banks for private sector entities to pursue and develop.

[9] The rules for grouping projects are dependent on the standard being sought. Under the VCS, a "grouped project" is "a number of projects and their related methodologies included in a single VCS Project Description (VCS PD) at the time of the validation." Under CCX, a "pooled project" is "the multiple projects that are represented in CCX by a single Aggregator." Under the Reserve, "joint verification" means that multiple projects can be verified jointly by a single verifier, if certain conditions are met. Under CDM, "bundling" and a "program of activities" also have specific definitions and rules.

With regard to tracking and registering projects, all three standards have associated registry systems. CCX's registry system is separate from its trading platform, although the systems connect daily for clearing. VCS operates both a project database and a multi-registry system, with registry services provided by several third-party registry providers. Opening a registry account is required in all cases for project credits to be issued. All three standards assess some fees on project proponents, including fees to open and maintain registry accounts, fees for registering a project and issuing credits, and transfer fees (e.g., to transfer credits between accounts). Given the high GWP of some ODS, the issuance fees can be a substantial component of total costs. For example, destroying 100 tonnes of CFC-12 with a GWP of 10,900 could yield up to 1,090,000 credits,[10] which would have a registration cost of US$163,500 for CCX. For more detailed project cost calculations, see Section 7.2.

Some important differences also exist between these three standards with regard to methodology approval and development procedures. CCX and the Reserve develop their own project protocols in-house. CCX will also accept methodology proposals, which it may accept or reject. It may also approve a project on a project-specific basis without accepting the protocol for application more generally. The Reserve does not accept other methodologies, implying that the protocols developed by the Reserve represent the only opportunity for destroying ODS under this standard. On the other hand, VCS both accepts projects prepared under the Reserve and CDM methodologies and accepts new methodology submissions for review and approval. New methodologies are subject to a double approval process in which two independent validators under the VCS give their assessment of the methodology, and public stakeholder comments are also sought.[11] Once these methodologies are approved, they may be used by other projects without requiring additional approvals. There are advantages and disadvantages to each approach; these are discussed at length in Chapter 8 on methodologies for destroying ODS.

To date, only CCX has registered ODS destruction projects, although VCS has expanded its GHG program and the Reserve has approved two new protocols to cover ODS destruction. With the VCS expansion, VCS is now open to receive methodologies for ODS destruction projects and also to register destruction projects that meet its criteria and use approved methodologies. The Reserve has also completed its process to include ODS in its GHG program. The Reserve began by convening a multi-stakeholder workgroup that worked with Reserve staff to develop protocols for ODS destruction (for domestically sourced ODS and for imported ODS from A5 countries); stakeholders included representatives from industry, government, project developers, and verifiers, as well as the World Bank and ICF.[12] Project protocols were publicly released for Reserve Board approval in late January 2010 and include projects relating to ODS in refrigerants and foams. The protocols were approved in February 2010 meaning that the Reserve is now accepting projects. Further discussion on the implications of the methodologies and approaches developed is provided in Chapter 8.

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[10] Assuming one credit is equal to one tonne of CO_2 equivalent.
[11] This process is paid for by the project proponent submitting the methodology.
[12] Because of their directly relevant work and dialogue undertaken for the ExCom-approved study on opportunities for financing ODS destruction from the VCM, the World Bank and ICF applied to join the workgroup.

6. Potential Impact of ODS Destruction on the Voluntary Market

Given the high GWP of ODS and its prevalence in common equipment used worldwide, it is important to consider the amount of ODS that could potentially be destroyed and credited on the voluntary market over time. In particular, the ban on CFC production and consumption in developing countries in 2010 means that significant volumes of ODS could soon be recovered and be eligible for destruction under a voluntary market program. Because most methodologies (see Chapter 8) are expected to prohibit crediting for destruction of ODS that has not yet been fully phased out of production and import, the Montreal Protocol phaseout dates represent important milestones for the potential eligibility of ODS for destruction.

In this chapter, estimates are developed that represent the portion of the total *reachable* bank that reaches *end-of-life in each year* and could be *recovered and destroyed*. A few notes of clarification are important to understand what is represented by these estimates of ODS potentially available for destruction.

- The first important qualifier in that definition is "*reachable*"—ODS banks range in their level of accessibility, a fact that has implications for the amount of ODS potentially available for destruction. Both technical and economic feasibility of recovery factor into whether ODS banks are reachable; these measures are together expressed as the "effort" required to collect the ODS by the 2006 Experts Workshop (commissioned by the ExCom) and the TEAP.[13] Only reachable banks are included in the estimates developed in this chapter, as described more fully in the methodology provided in Appendix C. Generally, ODS in refrigeration applications require a low or medium specific effort to collect (depending on whether the equipment is located in a densely or sparsely populated region), while ODS in foam applications typically require a medium or high effort. Halons in firefighting equipment can require a low or medium effort for collection.
- The second important part of the definition is "*end of life in each year*"—in other words, these estimates represent the annual flow of ODS recovered from equipment reaching the end of its service life and retiring in each year. Only a portion of the total bank is retired and recovered in each year.
- Regarding the last part of the definition—"*recovered and destroyed*"—it is important to note three things:
  - First, over the lifetime of equipment, some ODS is leaked to the atmosphere, thus the full ODS charge is not recoverable at end-of-life. The amount of ODS that is recoverable includes assumptions about the percentage of ODS remaining in the equipment at end-of-life; for some equipment types, like household refrigerators, very little ODS refrigerant may remain.
  - Second, it is unlikely that all recoverable ODS will actually be recovered, for a number of reasons including lack of necessary recovery equipment, geographical dispersion of equipment, cost barriers, and a host of other factors. Exhibit 4 discusses the differences between ODS actually recovered in practice and estimates of ODS *recoverable*. The result is that the total amount of ODS recoverable does not equal the amount of ODS potentially available for

Exhibit 9: ODS Recoverable from Equipment/Products in Practice

Based on limited experiences to date, the actual quantity of ODS recoverable from equipment/products reaching end-of-life may be significantly lower than the estimated quantities recoverable. For example, while state-of-the-art recycling facilities are capable of removing more than 90% of the refrigerant and foam blowing agent from household refrigerators/freezers (RAL, undated), actual reported recovery levels have been significantly lower due to improper appliance disposal methods and the high number of appliances that arrive at recycling facilities with little or no intact ODS. According to one appliance recycling company in the United Kingdom, it struggles to recover 50% of the original CFC refrigerant charge from domestic refrigerators/freezers, given that so many units arrive at the facilities in poor condition, with little refrigerant remaining (MLF 2008).

Likewise, the amounts of ODS recovered in projects financed to date by the MLF have often been far less than the amounts that were believed to be recoverable. For example, an expert report prepared for the MLF in 2006 (UNEP.OzL.Pro/Excom/48/42) found that of the 4,275 tonnes of CFCs used in refrigerant servicing in 11 countries operating under paragraph 1 of Article 5, only 23 tonnes were recovered (UNEP 2009).

[13] Other factors, such as population density, can also affect the effort required to collect ODS.

destruction. Instead, upper (50% recovery), middle (10% recovery) and lower (1% recovery) bound assumptions about the amount of ODS actually recovered *and destroyed* are applied as a means of estimating the range of ODS potentially available for destruction. It should be noted that the rate of recovery will vary significantly by country, with a higher proportion of material likely recovered in non-A5 countries and in A5 countries with more established recovery infrastructure or denser population centers.

- Lastly and importantly, destruction is not the only option for ODS recovered from reachable banks. These ODS may be stored indefinitely or recycled or reclaimed[14] for re-use in servicing; the latter option is currently attractive because it has an associated revenue stream. However, if projects for ODS destruction become more widely eligible in the voluntary carbon market, the financial incentives could tip more in favor of destruction over reclamation. This point is discussed in more detail later in this report, but is mentioned here to point out that the balance of financial incentives between reclamation and destruction will play a role in determining the actual amount of ODS that is destroyed.

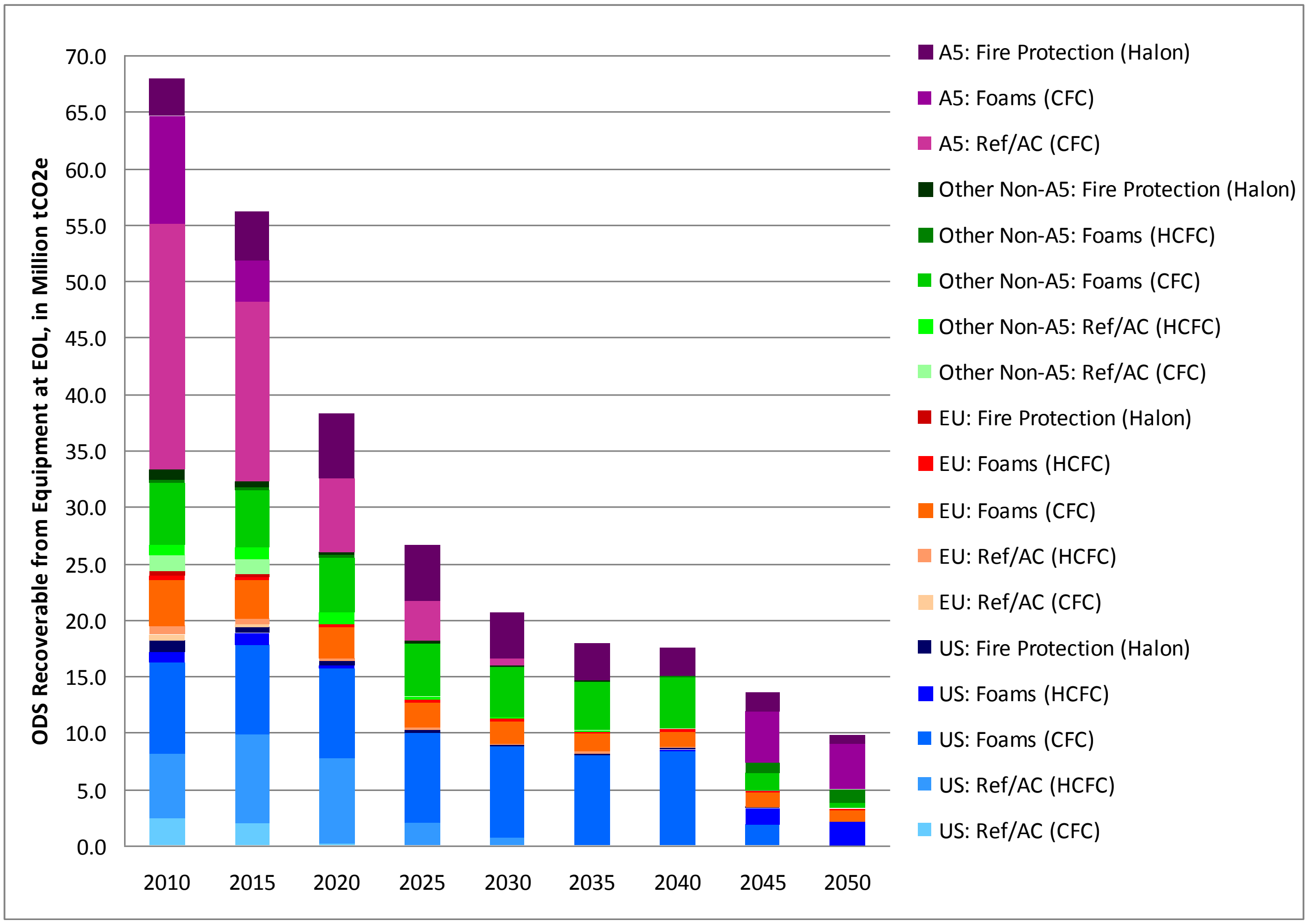
To develop estimates of the amount of ODS potentially available for destruction, existing projections from a number of sources were employed and expanded upon. For the United States, estimates of ODS recoverable at equipment end-of-life were based on U.S. EPA-provided data from the U.S. Vintaging Model, which ICF manipulated for this study, and for the European Community, modeling estimates prepared by ICF for the European Commission were used with permission. For the rest of the non-A5 countries, ODS recoverable at end-of-life was inferred based on estimates developed for the United States and the European Community and ratios of ODS consumption pre-phaseout.[15] For A5 countries, single year estimates prepared in the *Report of the Meeting of Experts to Assess the Extent of Current and Future Requirements for the Collection and Disposition of Non-reusable and Unwanted ODS in Article 5 Countries* (UNEP 2006b)—as commissioned by the ExCom in Decision 47/52—were used, and time trends were developed based on the amounts recovered as modeled for non-A5 countries. A full description of this methodology is provided in Appendix C.

Figure 26 presents the estimates of ODS potentially available for destruction from retired equipment at end-of-life, assuming a 10% recovery rate. As shown, in the coming years, the majority of ODS for destruction is expected to be CFCs from refrigeration/AC applications, particularly from A5 countries.

[14] According to the Montreal Protocol (UNEP 1992), recycling is defined as: "the re-use of a recovered controlled substance following a basic cleaning process such as filtering and drying," which normally occurs on-site. Reclamation is defined as: "the re-processing and upgrading of a recovered controlled substance through such mechanisms as filtering, drying, distillation and chemical treatment in order to restore the substance to a specified standard of performance," which often occurs off-site.

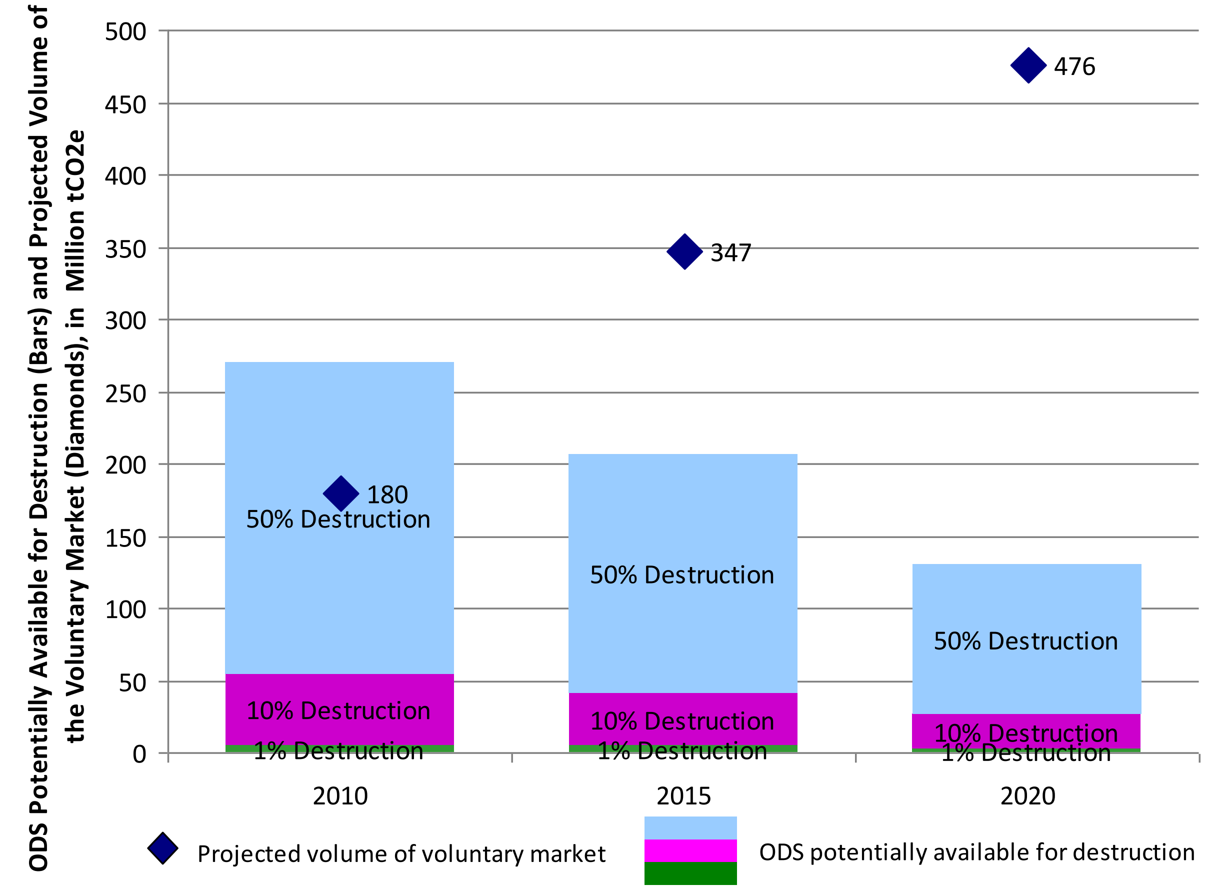
[15] IPCC/TEAP (2005) estimates of ODS banks for non-A5 countries, such as those developed in the Special Report on Ozone and Climate, are inappropriate for this exercise because they estimate static banks of ODS contained in equipment, and not the *annual flow* of ODS potentially recovered from equipment that reaches the end of its service life and is retired in each year. As noted above, the annual flow represents the portion of the bank that reaches end-of-life in each year and is recoverable.

Figure 26: ODS Potentially Available for Destruction from Retired Equipment at End-of-Life in Millions of tCO_2e, Assuming a 10% Recovery Rate (2010-2050)



In Figure 27 below, the amount of ODS potentially available and eligible for destruction is compared to the projected volume of transactions in the voluntary market in future years. Because HCFCs are unlikely to become widely eligible for destruction before 2020, these ODS are not included, nor are any ODS recovered in the European Union Members States, where a requirement for ODS destruction means that recovered and destroyed ODS are unlikely to be eligible for carbon credits (see Chapter 8). As shown, with a 1% recovery rate, the amount of ODS that could be eligible for destruction for crediting represents only about 3% of the total projected transaction volume in the voluntary market in 2010, becoming less than 1% by 2020. When compared to the compliance market, ODS destruction potential represents an even smaller percentage, given that the voluntary market in total is about 1% of the compliance market volume. By comparison, if 10% of ODS was recovered and developed into destruction projects, these projects could represent a quarter to a third of the voluntary market in 2010—provided that demand exists to purchase the projects.

Figure 27: Comparing ODS Potentially Available and Eligible for Destruction (Bars) with the Projected Volume of the Voluntary Market (Diamonds), in Millions of Tonnes of Carbon Dioxide Equivalent



Note: This figure does not include ODS recovered in the EU Member States, nor HCFCs.
Source for voluntary market projected transaction volumes: Hamilton *et al.* (2009). 2010 volume is estimated by sight from Figure 35 of this report.

However, it is considered highly unlikely that by 2010 more than 1% of recoverable ODS worldwide will be recovered and developed into destruction projects; the learning curve is simply too steep and the barriers still too high (see Section 2.2.2 above for more details on these barriers). Furthermore, while recovery and destruction rates will vary from country to country, they are generally expected to be higher in non-A5 countries, and yet the current state of practice for ODS disposal is still quite minimal even in these countries. For example, the 11 projects that have been registered since the addition of the ODS destruction protocol to the CCX in 2007 represent a total of 787,300 tCO_2e, or less than 1% of the total amount of CFC refrigerant and halon estimated to be *recoverable* in the United States from 2007-2009. This suggests that U.S. recovery and destruction rates have not responded in the aggregate to this financial incentive to-date; recovered material may instead be going to internal recycling and reuse, or reclamation and resale. Thus, it seems safe to assume that the amount of ODS destroyed for credit in the voluntary market should not exceed a couple of percentage points of the total amount recoverable, at least in the next five years or so.

The rate of recovery and destruction could increase over time, however, as recovery practices become more common, knowledge and capacity increases, and the financial incentive from the voluntary market expands. Even with increasing recovery rates, though, projected growth in the voluntary market and the decreasing volume of reachable banks means that ODS destruction projects will represent an even smaller percentage of the market in later years. The voluntary market is projected to grow on average about 15% per year over the next decade, based on a survey of over 100 voluntary market participants conducted by Hamilton *et al.* (2009).[16] This growth could potentially be mitigated by the expansion of the EU ETS into additional sectors and the passage of a U.S. compliance market, both events which could reduce the pre-compliance demand in the voluntary market. That said, the past year has demonstrated that a compliance market does not necessarily eliminate the space for the voluntary market, with European buyers purchasing more than half of voluntary market volumes (Hamilton *et al.* 2009). Regardless, as the volume of reachable banks decreases substantially over time, ODS destruction would represent a smaller portion of the voluntary market, and as such, even if the voluntary market grows more slowly than expected, ODS destruction would still account for a reasonably small portion of the market.

Some notes for interpreting the size of the voluntary market in Figure 27 above are necessary. Demand for new offset credits is likely smaller than the volume of transactions shown in Figure 27 because the turnover rate in the market means that each offset credit can be traded several times before it is retired. In 2008, a credit was estimated to change hands over four times before retirement (Hamilton *et al.* 2009). This means that ODS destruction projects could represent a *higher* percentage of the total offset credits demanded by the market than is represented in Figure 27. However, even if the demand for credits in the voluntary market was four times smaller than the total volume, with a 1% recovery and destruction rate, ODS destruction projects would still only represent about 12% of the volume in the market. It is still worth considering, however, whether there is sufficient demand in the voluntary market to absorb these destruction projects. This issue is addressed in the following chapter.

[16] This annual report on the state of the voluntary carbon market is produced by Ecosystem Marketplace and New Carbon Finance, based on input from over 200 participants in the voluntary market, and is considered the most comprehensive review available. Other sources also predict significant growth in the voluntary market, such as ICF (2008).

7. Financial Feasibility of Financing through the Voluntary Market

As demonstrated in Chapter 6, it is clear that, in theory, ODS destruction projects have the potential to overwhelm the voluntary market with credits if they are developed to their absolute full potential. However, ODS destruction projects can be more realistically estimated to represent closer to 15% of the voluntary market by 2015. This amount represents an even smaller percentage of the compliance market, considering that the entire voluntary market represented approximately 1% of the compliance market volume in 2008. The amount of ODS potentially available for destruction in 2010 also represents about 1% of today's compliance market volume and just 2% of the EU ETS traded volume (World Bank 2009). Looking forward, the compliance market and EU ETS are expected to grow in the future (e.g., as new sectors and gases come on board), while ODS potentially available for destruction will decrease, representing an even smaller piece of the pie.

However, simply comparing the volume of potential ODS destruction projects to the size of the voluntary market does not provide the whole story. A number of different factors will influence the likely availability of resources that can be leveraged from the voluntary market for the destruction of ODS, including the dynamics of supply and demand, market perceptions, cautionary attitudes, uncertainty, and potential for future changing regulatory landscapes. The cost of an ODS destruction project—including collection, transportation, and destruction costs, as well as project development costs—will also influence the feasibility and attractiveness of using the voluntary market to finance the management of ODS banks. These considerations are discussed in the sections that follow.

7.1 Availability of Resources from the Voluntary Carbon Market

The projected volume of transactions in the voluntary market masks a number of underlying trends that provide a more telling picture of how the market is developing and what the implications could be for ODS disposal projects. The buyers' and sellers' perspectives are first considered for ODS destruction, followed by a discussion of the outlook for the voluntary carbon market.

7.1.1 Challenges from the Buyers' Perspective

Recent voluntary market participant statistics provide a revealing portrait for how the market is developing. Of the four key drivers for buying VERs outlined in Section 4.2 (reputation, experience, principle and competitiveness), it is the *reputational drivers* that are the most prevalent. This is reflected in a recent survey, which indicated that corporate social responsibility and public relations/ branding were the primary drivers for purchasing voluntary credits. This is supported by a statistic from the same survey that, in 2008, 29% of VERs were purchased by businesses to offset their own emissions, retiring them upon purchase (Hamilton *et al.* 2009). In addition, 92% of all voluntary credits traded in 2008 were purchased by buyers either in the United States or Europe, countries where corporate transparency and stakeholder awareness of climate change is relatively high (Hamilton *et al.* 2009). These statistics demonstrate the current reputational focus that is driving market purchases.

This reputational focus is further illustrated in recent buying trends. Generally, buyers have become very selective about the specific type of credits they purchase. This is seen in the drastic decline in the level of interest in, and purchase of, credits from industrial gas abatement projects on the voluntary markets. In 2006, credit transactions from industrial gas abatement projects totaled 5 million tCO_2e and accounted for 20% of the total volume of all OTC (i.e., not including CCX) credit transactions that year. By 2008 the number of OTC credit transactions from industrial gas abatement projects had fallen to 0.7 million tCO_2e (0.6% of total volume that year). In comparison, projects citing renewable energy benefits had increased in market share from 15% to 51% during the same period. Based on recent discussions with voluntary market traders, transactions for industrial gases have further declined in 2009. These changes in credit transaction profiles are a clear indication of market sentiment towards the different types of project.

Given the significant reputational drivers of many voluntary market buyers, if ODS projects are to become a viable voluntary market credit source, then, at a minimum, they must be packaged in a way that is acceptable to buyers and their stakeholders. ODS project proponents will need to present a good "story" highlighting the "value-added" benefits of the credit. Critically, they will need to differentiate themselves from other industrial gas emission reduction projects, such as HFC-23 destruction, which have encountered significant levels of criticism in the past. For example, it is important to emphasize that voluntary ODS destruction projects help to pay for the removal of GHGs that, if left unattended, would be emitted over time anyway, making a strong case for the projects' additionality. Three aspects might be emphasized in distinguishing ODS destruction projects from other industrial gases projects, specifically HFC-23 projects:

1. **ODS destruction is a finite opportunity**. Although credits were capped based on historical production data, critics of HFC-23 destruction projects point out there was a perverse incentive for HCFC-22 facilities to continue production to generate HFC-23 for destruction. Because ODS only qualifies for destruction where it has been prohibited from new production or import under the Montreal Protocol, this perverse incentive does not exist for ODS destruction.
2. **ODS destruction projects destroy unwanted compounds that have served societal needs**. HFC-23 destruction projects reduce emissions from one GHG, but also imply the production of another GHG (HCFC-22). ODS destruction projects destroy intentionally produced compounds that exist in surplus and as such are unwanted. In some cases, the ODS being destroyed may be replaced by another high-GWP compound, though most ODS destruction methodologies account for this possibility in their calculations of eligible emission reductions (see Chapter 8).
3. **ODS destruction projects are more expensive**. Because ODS destruction projects are more costly, it is highly unlikely that ODS destruction will multiply in the same way that HFC-23 destruction projects did which enjoyed high "profit" margins. While the cost of destroying HFC-23 byproduct has been estimated at less than US\$0.2/tCO_2e (IPCC/TEAP 2005), the cost of an ODS destruction project can be 5 to 200 times higher, ranging from US\$1/tCO_2e up to more than US\$40/tCO_2e (see Section 7.2).

Projects destroying ODS recovered from equipment at end-of-life may have an easier road forward in telling a compelling story and differentiating themselves from other industrial gas projects, while projects aiming to destroy virgin stockpiles (e.g., from confiscated supplies or from manufacturers) may be more challenged in this regard.

Another positive aspect of ODS destruction projects that will be important to highlight is their reliability and predictability—i.e., the emission reductions predicted in project documentation are likely to be very close to the amount monitored and issued ex-post. This reliability is valued by investors and buyers in both the compliance and voluntary primary markets (ICF 2009).

An additional characteristic of the voluntary market is that a significant portion of VER transactions are currently for pre-CDM VERs; voluntary credits claimed retroactively by CDM projects for emission reductions achieved in the past between the time that the project became operational and the time it received CDM registration (see Exhibit 5). However, credits from ODS destruction projects alone are unlikely to play any role in the market for pre-CDM VERs because, as non-Kyoto gases, ODS are not eligible to be the subject of CDM projects.

Exhibit 10: Pre-CDM VERs

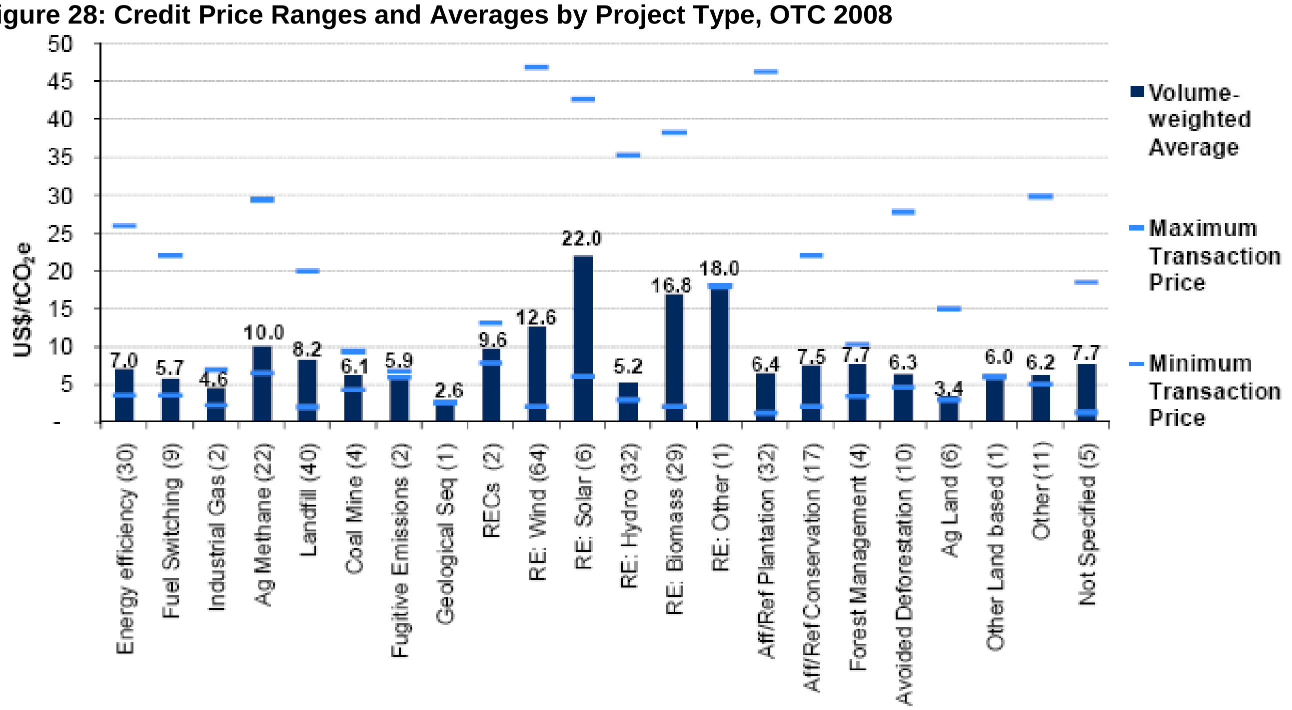
Pre-CDM credits in the voluntary market are originated from projects that have been registered by the United Nations Framework Convention on Climate Change's (UNFCCC) CDM Executive Board (EB) under the Kyoto Protocol. The VERs are essentially pre-CDM tranches, following the same technology transfer, project design and sustainable development approach, and have been similarly verified by UN-approved verifiers according to the methodologies of the CDM standard. The VERs represent the emission reductions that occurred between the time that the project became operational and the time it received CDM registration. Since these emissions cannot be claimed as CERs under the CDM, they are claimed as VERs under a voluntary market standard. For buyers, such credits present a more straight-forward transaction compared to supporting a project through the full voluntary registration cycle. Additionally, due to reputational risk concerns, many companies demand high standards and adhering to the same additionality criteria as the CDM provides this necessary security.

7.1.2 Uncertainties on the Sellers' Side

Because of the low price that VERs currently generate in the market place, as well as the lack of a clearing price and associated risk and uncertainty in the voluntary market, investors are generally less willing to support voluntary market projects. While 2008 average prices for OTC and CCX trades were US\$7.3/tCO_2e and US\$4.4/tCO_2e, respectively, in 2009, these have decreased significantly due to the combined impact of the global recession and uncertainty surrounding future global climate change policy (Hamilton *et al.* 2009), the latter of which is even more pronounced after outcomes of the December 2009 Conference of the Parties (COP) in Copenhagen. OTC trades were between US$2 and US$5/tCO_2e in July 2009, while CCX trades have dropped below US$1/t$CO_2$e in September 2009 (ICF 2009). The economic slowdown has similarly affected the compliance markets, which have also experienced declining price trends over the past year; EUA prices fell from over €20/tCO_2e in August 2008 to around €13/ tCO_2e in September 2009, and primary CDM prices decreased from €10-15/ tCO_2e to around €7-8/ tCO_2e in April 2009 (World Bank 2009). In addition to the declining market, the current strong focus from buyers in the voluntary market for pre-CDM VER credits, can draw interest and financing away from other types of voluntary projects, such as ODS destruction.

The future price trend will have important implications for the viability of ODS destruction projects, since they can be costly to develop (see Section 7.2). Prices in the voluntary market have traditionally varied considerably depending on the type and location of the project activity, the standard to which it is developed, the perceived quality of the methodology used, and the volume transacted. As demonstrated in Figure 28, this remains the case today, with credits from projects with a good "story" behind them, such as solar and other types of renewable energy, still able to command a premium. Industrial gases projects have typically earned prices on the lower end of the spectrum, around US$4.6/t$CO_2$e. Prices also vary within project types, such as renewable wind with a high bound price of over US$45/t$CO_2$e.

Figure 28: Credit Price Ranges and Averages by Project Type, OTC 2008



Source: Hamilton *et al.* (2009)

This current reality in the voluntary market also means that it is critical for ODS destruction projects to follow robust, credible, and well-regarded methodologies to ensure that projects have a good reputation in the marketplace. Inclusion of ODS destruction projects in the VCS and Climate Action Reserve is a step in the right direction. In 2008, VCS was the most utilized third-party standard by transaction volume, with nearly 50% of the total, and the Reserve was third with 10% (Hamilton *et al.* 2009). Both VCS and the Reserve also have associated registries.

Because ODS destruction projects could generate a large number of credits—both because of their high GWP and the inevitable need to pursue larger projects for cost-effectiveness (see discussion in Section 7.2 below)—these credits may need to be split up into smaller trade sizes that are more attractive to buyers. In the voluntary markets, the typical trade size is small, on the order of 30,000-80,000 tCO_2e. These low volumes are often preferred since demand is limited to what corporations and individuals require for "offsetting," and as a means of spreading risk across a number of different projects. Aggregators commonly break up larger projects for these purposes, and thus ODS destruction project sizes should not be an impediment for the market.

7.1.3 Outlook for the Voluntary Carbon Market

Given the rapid development of the carbon markets so far, it is unlikely that the situation described above will be representative of the markets in the future. Key considerations and outlook for the future are discussed below, along with their important implications for ODS destruction projects.

Looking forward, the decline in the voluntary market observed through 2009 is expected to be a relatively short term phenomenon with price and volume declines being driven by the economic downturn. The voluntary carbon market currently represents a small fraction of the global carbon market; this situation is not likely to change, especially as future international climate change policy signals strengthen. An expansion of the sectoral and geographical coverage of the EU ETS (which currently focuses only on the energy and industrial sectors of the economy), and the possibility for a U.S. compliance market to come online in the next five years, makes the longer term outlook for the voluntary market unclear. On one hand, pre-compliance buying in the United States has been an important source of demand in the market, and as such, purchases may decrease as the compliance market coverage increases (i.e., the space left for the voluntary market diminishes). In particular, if an organization must pay for its GHG emissions under an emissions trading system it has no further incentive to voluntarily offset these emissions. On the other hand, however, according to a survey of nearly 200 voluntary market participants (Hamilton *et al.* 2009), sellers believe that corporate social responsibility and public relations/branding are the major drivers for voluntary purchases, to which pre-compliance is secondary. Moreover, these motivations will not necessarily evaporate in the presence of a compliance market; for example, this reputational demand for VERs could continue from the commercial sectors, which are largely excluded from the compliance markets due to their lack of direct GHG emissions. The voluntary market does co-exist with the compliance market in Europe—and indeed the existence of a compliance market gives creditability to carbon trading and offsetting that is important to the voluntary market. Indeed, market participants continue to predict growth in the voluntary market—despite these regulatory uncertainties—through the next decade (Hamilton *et al.* 2009).

Another source of demand for credits from ODS destruction projects could be from the offset provisions in U.S. climate legislation. The current structure of the cap-and-trade bill put forward by U.S. representatives Henry Waxman and Edward Markey, as well as the Kerry-Boxer bill passed by the Senate Committee on Environment and Public Works, indicate a potential maximum allowance of 2 billion tCO_2e per year from offsets.[17] Credits from ODS destruction projects could potentially be well placed to help meet this requirement, although they would represent a small portion of overall offsets—with 10% of ODS recovered and destroyed globally, this amount would account for 2% of the 2 billion tCO_2e offset allowance in 2015. For destruction projects taking place in the United States, ODS destruction offsets are explicitly accepted; in the version of the Waxman-Markey bill that passed in the House on June 30, 2009 (H.R. 2454), provisions were provided in the HFC program for the issuance of destruction credits for CFC destruction in the United States after 2012, at a rate of 80% of the emission reduction achieved through destruction. Other ODS, such as CTC or HCFCs, may also be eventually considered for destruction offset credits.

The outlook for international ODS projects or any other offset project registered under one of the various voluntary standards is less clear. Certain voluntary offset standards for both international- and U.S.-based domestic offsets, such as those defined by state level programs such as the Climate Action Reserve and RGGI as well as the VCS, CCX, and the Gold Standard have indicated confidence that they will be accepted into a U.S. federal cap and trade scheme. However, this is an open question, as some contrary market opinions believe that such standards will not be accepted into U.S. federal cap and trade scheme, since they do not provide as vigorous a validation procedure as the CDM (ICF 2009). Even if a standard is accepted, it is possible that not all types of project and project locations will be eligible. As such, the ability of ODS destruction projects to contribute to the large U.S. demand for offsets remains unclear, until final clarification on U.S. climate legislation is made.

[17] The Waxman-Markey bill splits this amount 50% (1 billion tCO_2e) for domestic offsets from within the U.S. and 50% (1 billion tCO_2e) for international offsets outside the U.S., while the Kerry-Boxer bill allows 75% from domestic sources (1.5 billion tCO_2e) and 25% from international sources (500 million tCO_2e). Both bills also allow for additional international sourcing if domestic offsets are inadequate, with Waxman-Markey allowing international supplies up to 1.5 billion tCO_2e per year, and Kerry-Boxer allowing a maximum of 1.25 billion tCO_2e.

7.2 Cost of an ODS Destruction Project

As noted previously, the overall cost of developing an ODS destruction project for the voluntary carbon market involves several components, including the costs of collection, transportation, storage, testing, and destruction, as well as the costs of project preparation, validation, and verification. All these costs are extremely difficult to estimate precisely since they vary widely depending on a host of factors such as geographical location, nature of the ODS bank and the effort required to recover the ODS, quantity of ODS being handled, technologies used, type of ODS, firms contracted, and demand for services. Estimates of the cost of ODS destruction and the transaction costs to develop and register a project on the voluntary market are provided below, followed by examples of project cost calculations and suggestions for a minimum viable project size.

As requested by Decision XX/7, the TEAP has developed estimates of the full costs of ODS disposal—from collection to destruction. These are reproduced in Table 14 below, with the exception of the average cost per tonne of CO_2 equivalent (tCO_2e), which has been calculated for this report. Other implementation costs may also be incurred, such as the cost of insurance for shipping ODS internationally, which can be quite substantial as illustrated in the Indonesia case study in Appendix A.

As shown, for most applications the majority of the total cost is related to collection, transport, and recovery. This is supported by past experience in managing the destruction of obsolete persistent organic pollutants (POPs) and pesticides, which has shown that the collection, repackaging, transport and temporary-storage can become a significant proportion of the overall costs of their safe removal and destruction, especially where access is difficult and/or the materials are highly dispersed. The cost of packaging, transporting, and destroying POPs has ranged from US$3-5/kg, depending on the type of chemicals and their condition, location, and any transport issues (e.g. landlocked countries, accessible roads) and other factors such as security, oil price and currency exchange rates (FAO 2009). This cost is significantly lower than the total cost shown for ODS, which ranges from US$9-$157/kg, depending on the sector and effort level. This may be a result in part of the nature of the material as it relates to collection, transportation and destruction costs.

Table 14: Unit Cost for Destruction of ODS from Reachable Banks Requiring Low or Medium Effort (all Costs Shown in US$ per kg, unless otherwise Indicated)

Effort Level	Sector	Pop. Density	ODS Type	Segregation / Collection Costs	Transport Costs (Recovery)	Recovery Processing Costs	Transport Costs (Destruction)	Destruction Costs	Total Cost	*Average Cost per tCO_2e ‡*
Low Effort	Domestic Ref.	D	R	6-10*	6-8	10-20	0.01-0.06**	5-7	27-45	***7-11***
	Domestic Ref.	D	BA			20-30			37-55	***9-13***
	Commercial Ref.	D	R	8-12*	8-10	8-15	0.01-0.06**	5-7	29-44	***10-15***
	Commercial Ref.	D	BA			25-35		5-7	46-64	***16-22***
	Transport Ref.+	D/S	R	------	------	15-20	0.01-0.06**	5-7	20-27	***6-8***
	Industrial Ref.	D/S	R	------	------	4-6	0.01-0.06**	5-7	9-13	***3-5***
	Stationary A/C^	D	R	1-2^^	------	4-25	0.01-0.06**	5-7	10-34	***5-16***
	Mobile A/C	D	R	------	------	4-6	0.01-0.06**	5-7	9-13	***1-2***
	Fire Protection	D	F	1-2^^	------	4-25	0.01-0.06**	6-8	11-35	***3-11***
Medium Effort	Domestic Ref.	S	R	10-15*	30-40^^^	10-20	0.01-0.06**	5-7	55-82	***13-20***
	Domestic Ref.	S	BA			20-30			65-92	***16-22***
	Commercial Ref.	S	R	15-20*	40-50^^^	8-15	0.01-0.06**	5-7	68-92	***24-32***
	Commercial Ref.	S	BA			25-35		5-7	85-112	***30-39***
	Stationary A/C	S	R	1-2^^	------	10-35	0.01-0.06**	5-7	16-44	***7-21***
	Mobile A/C	S	R	1-2^^	------	4-6	0.01-0.06**	5-7	10-15	***1-2***
	Steel-faced Panels	D	BA	75-90	5-10	30-40	0.01-0.06**	5-7	115-147	***38-49***
	Block – Pipe	D	BA	10-15	15-20	30-40	0.01-0.06**	5-7	60-82	***22-30***
	Block – Slab	D	BA	80-100	5-10	30-40	0.01-0.06**	5-7	120-157	***44-58***
	Fire Protection	S	F	1-2^^	------	10-35	0.01-0.06**	6-8	17-45	***5-14***

Population Density: D = dense; S = sparse; ODS Recovered: R = refrigerant; BA = blowing agent; F = fire suppressant
* Very dependent on local collection strategy; ** Covering shipment distances of 200-1000 km for destruction; note that longer distances (such as those incurred through exporting materials) may incur higher transport costs.
+ Refrigerant only.
^ Assumed on-site recovery; ^^ Awareness raising for recovery schemes; ^^^ Shipping complete units.
‡ Calculated for this report based on the average GWPs given for each sector for developing countries in TEAP (2009a).
Source: TEAP (2009b).

In addition to the cost of ODS collection, transport, and disposal, developing a project for the voluntary market incurs certain transaction costs, which are not included in the estimates provided in Table 14. These transaction costs are summarized in Table 15 and include the cost of project preparation, validation, verification, and costs involved in registration, such as fees to join a carbon credit standard and issuance fees. These costs vary considerably depending on the scale, location and complexity of the project. Costs can also be incurred to meet project monitoring requirements, which may entail additional investments; these costs are not quantified in the table below and will vary on a project-by-project basis.

Table 15: Indicative Transaction Costs for Project Preparation and Registration

Item	Description	Cost range (US$)
Project preparation	This is typically the cost of consultant support to undertake an initial feasibility assessment, develop project documents, and support the validation and registration processes. This cost may be considerably lower than estimated if local consultants (in-country) are used or, particularly, if expertise exists in-house to undertake these tasks.	$0 - 60,000
Third-party validation	This one-off fee is largely a fixed cost, but might be slightly reduced for particularly simple or small projects. Note that this fee is not required for CCX or the Reserve.	$0 - 40,000
Third-party verification (annual)	Like the cost of validation, this cost is largely fixed, but might be slightly lower for particularly simple or small projects. For projects carried out on an ongoing or multi-year basis, this would be an annual cost.	$20,000
One-off joining fee (plus annual fee)	Some standards charge project proponents to open a registry account (needed to have credits issued). Some standards also charge an annual fee for registry account maintenance. For example, the Reserve charges US$500 per year for this service.	$0 – 500
Project fee	Some standards charge a project submission fee. For example, the Reserve charges US$500 per project.	$0 – 500
Issuance/registration fee	Some standards charge an issuance fee per credit (tCO_2e) issued. For example, CCX charges 0.15 US$/$tCO_2e$, while the Reserve charges 0.20 US$/$tCO_2e$.	$0.05 – 0.20 US$/tCO_2e

Sources: Climate Action Reserve (2009a); VCS (2008c); ICF International estimates.

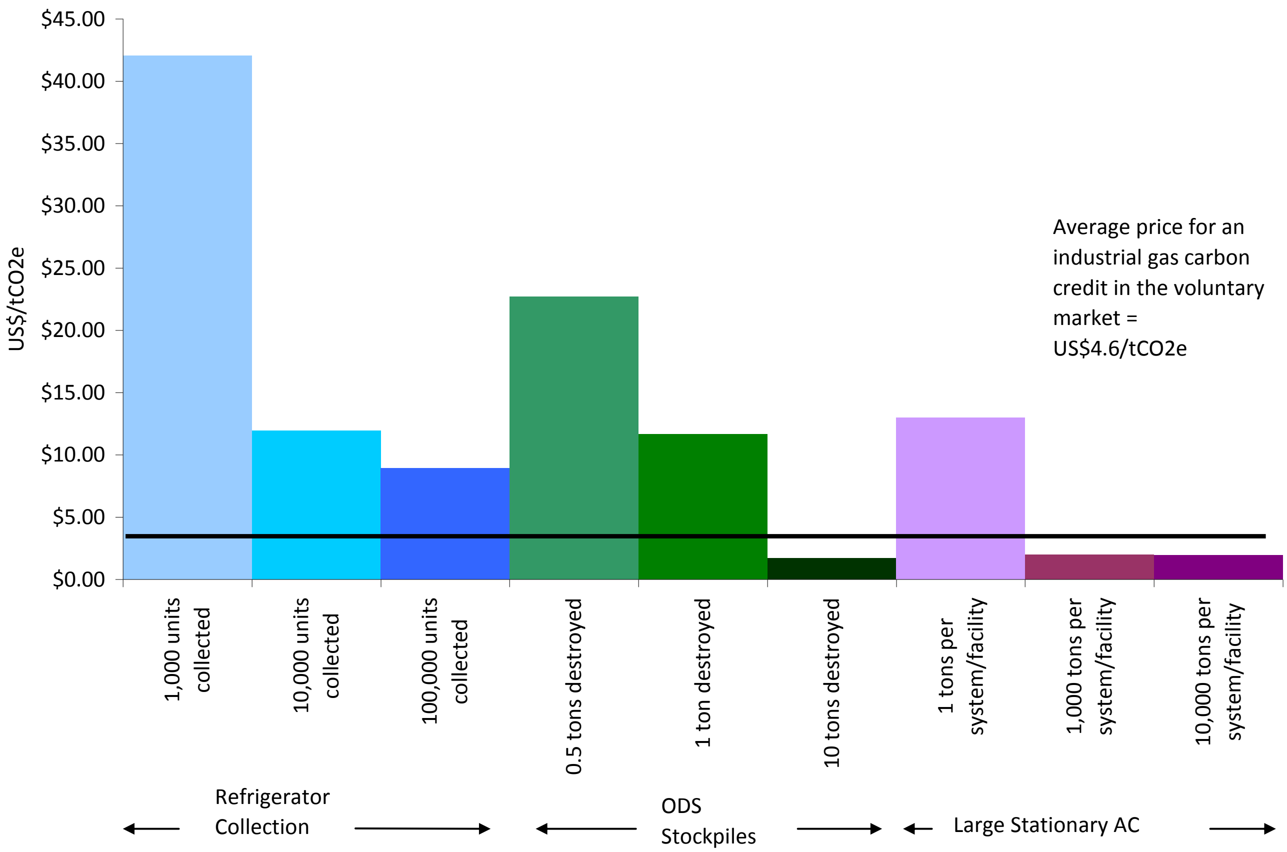
To illustrate the total costs incurred to develop, implement, and register ODS destruction projects on the voluntary market, a series of example project cost calculations have been developed, as presented in Table 16. In this table, the break-even cost represents the price that would have to be generated in the carbon market in order to cover full project transaction and recovery, transport, and destruction costs. For project proponents to earn a profit, the carbon market price would have to exceed this break-even price. As shown, the break-even price decreases as the project size increases, as a result of realizing project economies of scale associated with the mostly fixed transaction costs. Figure 29 directly following the table below provides a graphic comparison of these break-even prices to the average price of an industrial gas carbon credit on the voluntary market in 2008.

Table 16: Example ODS Destruction Project Cost Calculations

Project Description	Project Size	Total Project Cost (thousands of US$)†	Carbon Credits Generated (tCO_2e)‡	Break-even Carbon Market Price (US$/$tCO_2e$)
Refrigerator Collection:* Collection of CFC-containing refrigerators, and recovery and destruction of CFC-12 refrigerant and CFC-11 foam	1,000 units collected	$151	3,599	$42.07
	10,000 units collected	$430	35,990	$11.94
	100,000 units collected	$3,212	359,900	$8.93
Bulk ODS: Destruction of stockpiled CFC-12	0.5 tonnes destroyed	$124	5,450	$22.72
	1 tonne destroyed	$127	10,900	$11.67
	10 tonnes destroyed	$187	109,000	$1.72
Large AC Units: Recovery and destruction of CFC-12 refrigerant from large stationary AC units	1 tonne per system/facility	$142	10,900	$13.00
	1,000 tonnes per system/facility	$21,310	10,900,000	$1.96
	10,000 tonnes per system/facility	$212,011	109,000,000	$1.95

* Assumes that 0.06 kg of CFC-12 and 0.62 kg of CFC-11 are recovered from each unit.
† Includes project transaction costs and average costs of recovery, transport, and destruction. These costs are based on those shown in Table 14 and Table 15, but could be higher or lower depending on the local costs of recovery, transport, and destruction, as well as whether local or international consultants are engaged for project preparation. The higher bound of the project transaction costs were used for this analysis, so costs could be lower if, for example, project preparation is carried out in-house at no or low cost, or third-party validation costs are not incurred.
‡ In this table, the calculation of carbon credits generated is gross, i.e., it is not net of project emissions such as emissions during the destruction process or CO_2 emissions from the transport of ODS to the destruction facility. Credits are calculated using AR4 GWPs (as is used in all calculations in this report).

Figure 29: ODS Destruction Project Break-even Costs Compared to the Average Price for an Industrial Gas Carbon Credit



Source for carbon credit price: Hamilton *et al.* (2009).

These break-even prices must be interpreted cautiously, since a number of important additional factors could push the break-even prices up or down (as indicated by the arrows below).

First, associated new infrastructure costs—such as the construction of new ODS central collection, storage, or destruction facilities, or the retrofit of existing facilities such as cement kilns to accept ODS for destruction—are not included in the cost calculations. Many of these costs may be substantial one-time investments. For example, building a new destruction facility can cost upwards of half a million dollars. Australia's plasma arc facility, capable of destroying roughly 65 kg/hr cost roughly US$1.4 million (including installation and training), while one of Japan's catalyst dehalogenation facilities had an initial cost of roughly US$360,000 and destroys 6 kg/hour (MLF 2008). By comparison, a superheated steam reactor with a 25 kg/hr capacity can cost US$500,000 (Pedersen 2007). Modifying existing facilities can be more cost-effective, though still expensive. Retrofitting a cement kiln to destroy ODS has been reported as costing between US$50,000 and US$100,000 (see Appendix A for the case study on Indonesia's experience).

Second, another cost-influencing factor associated with the collection of ODS-containing equipment is that collection is most often (and most efficiently) done on a sectoral basis, rather than by ODS type. As a result, different types of refrigerant can be gathered up in mass collection efforts that are not eligible for destruction credits, thereby potentially decreasing the cost-effectiveness of collection. For example, household refrigerators collected through a curbside pickup program might include both CFC-12 and HFC-134a refrigerators. Because HFCs are not eligible for voluntary market destruction credits under ODS destruction protocols (since new production and import of HFCs are still allowed), they would represent a cost without an associated carbon credit revenue. Credits against HCFC and HFC destruction in the future have not been ruled out.

Third, ODS destruction projects may be able earn other revenues from the collection of ODS equipment. In particular, the recycling of metal components—such as the bodies of refrigerators—can represent substantial revenue streams that make some collection programs profitable even without the added revenues from the generation and sale of carbon credits for destruction. ODS destruction may also be able to tie in with energy efficiency programs that aim to replace energy-inefficient ODS-containing equipment, or with utilities undertaking demand side management programs. Some relevant CDM methodologies have already been developed, such as the approved small scale methodology (AMS) II.C, which credits for emission reductions from energy efficiency gains such as through refrigerator replacement. These partnerships can greatly increase the revenue potential—or share the cost burden—of ODS disposal.

8. Methodologies for ODS Destruction in the Voluntary Market

Before an ODS destruction project can be undertaken in the voluntary carbon market to earn carbon credits, applicable methodologies must be in place to guide the project development, validation, and verification process. As described in Chapter 4 above, methodologies specify the project activity and the criteria for determining the eligibility and additionality of projects. Thus, a critical step in the process toward accessing the voluntary carbon market to finance ODS destruction is the development of robust and credible methodologies.

For ODS destruction, the development and approval of credible methodologies serves multiple purposes. First, methodologies can ensure that ODS destruction activities are undertaken in a legitimate and verifiable manner, in order to reinforce a good reputation for real reductions that result from the destruction of intentionally produced GHGs that otherwise would have been emitted to the atmosphere. The development or approval of methodologies by third-party standards serves as a guarantee to provide assurance to market investors and buyers that the carbon credits issued to projects following a particular methodology are real, additional, and permanent. Methodologies must include carefully crafted provisions to avoid perverse incentives that could be created by crediting ODS disposal projects, such as production of ODS solely for the purposes of generating destruction credits, or the destruction of ODS that may be needed for future use (e.g., to meet servicing needs or for feedstock uses).

Second, the methodologies must be flexible[18] to account for the wide range of sources and scenarios from which unwanted ODS originate and must be accessible to A5 country participants. In order for the voluntary carbon market to be a viable option for financing ODS destruction, consideration must be made of the different needs and capacities of project proponents around the globe. For example, given that many A5 countries may not have suitable destruction facilities, methodologies should allow for the export of unwanted ODS to other countries for ultimate disposal.

These goals are closely related to an underlying challenge, namely that the development of methodologies is either determined by the voluntary market standard itself or driven by the private market and thus not centrally directed. While some voluntary market standards (e.g., the Reserve) develop their own project methodologies and do not accept outside methodology submissions, other standards (e.g., VCS) do not develop methodologies themselves and instead accept methodologies developed by other standards or private sector actors, often in conjunction with the development of a specific project. CCX develops both its own project methodologies (as it has done for ODS destruction) and also accepts methodologies for submission, which it may approve or reject, or approve on a project-specific basis without general applicability.

This difference on the origin and acceptance of the methodology could have important implications for ODS destruction projects. For example, as each of the Reserve's protocols limit the sectors or geographic regions from which ODS can be recovered or destroyed, a project proponent cannot propose a project under the Reserve based on another methodology to bypass these parameters. At most the Reserve could decide to review or revise its protocols.[19] Under the VCS—which will also accept projects prepared under the Reserve's methodologies—or CCX, if a company wanted to develop a specific project, such as to destroy ODS confiscated by Customs' offices, but an applicable methodology did not exist, the company might create a methodology in the context of developing its project. While a standard like VCS provides a vital quality check through its approval processes, it does not control what methodologies are submitted for review. The development and submission of methodologies is primarily an undertaking of the private sector, driven by the project desires and needs of those proponents. In other words, it is difficult to guarantee that methodologies generated by the private sector—or by the Reserve or CCX—can meet the project requirements of all signatories to the Montreal Protocol. This is not a question of the integrity of the methodologies, but rather a question of the focus that methodologies developed by the private sector under VCS, for example, take. These may not necessarily cover all possible project scenarios that might arise in different A5 and non-A5 countries. This is true for any carbon offset project independent of the particular sector it covers.

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[18] Or numerous enough, since there is no specific restriction on the number of methodologies that can pertain to the destruction of ODS.
[19] The Reserve has developed a project protocol for destruction of ODS sourced and destroyed within U.S. borders, and a separate protocol for destruction of ODS sourced from A5 countries and imported to the United States for destruction.

A public entity or multilateral institution acting on behalf of the interests of those signatories could also develop and submit a methodology, if thought to be needed. In fact, the World Bank has played this role by developing a number of GHG methodologies that were intended for wider use and ensured that strategic interests, in terms of the global public goods in question, were addressed.

The remainder of this chapter introduces the various sources of ODS and project scenarios that would need to be covered by ODS destruction methodologies, then presents key elements for a robust and transparent methodology and criteria that are necessary for ODS destruction projects, and finally reviews and assesses existing ODS destruction methodologies developed to date based on these criteria.

8.1 Sources of ODS and Project Scenarios

Unwanted ODS for destruction can stem from a number of different sources. For example, ODS banks are held by industrial and commercial users, stored indefinitely in containers, installed in refrigeration and air-conditioning equipment, contained in building and appliance foams, and so on. Many of these banks are unwanted because of a lack of need or demand for their use, such as ODS materials contained in retired equipment or storage containers that no longer have a market value; ODS recovered from equipment that is too contaminated for recycling or reclamation; or, material that cannot be cost-effectively reclaimed due to the lack of reclamation infrastructure. For the health of the stratospheric ozone layer and global climate, it is critical that these unwanted ODS be properly collected and destroyed.[20]

In order to illustrate the range of circumstances in which unwanted ODS are found—and which ODS destruction methodologies would ideally find a way to cover—six scenarios are presented below. Each scenario is accompanied by a description of how a suitable methodology would be adaptable to the project type. The scenarios are as follow:

1. ODS Recovered from Equipment in the Past, with Incomplete Documentation
2. ODS Recently Recovered from Equipment, with Appropriate Documentation
3. Accessible ODS Stocks in Use (“Banked”) in Equipment
4. Stockpiles of Mixed or Contaminated ODS that cannot be Reused
5. ODS Confiscated by Customs’ Authorities
6. Virgin ODS Stockpiled in Industrial Storage

An important theme illustrated by the scenarios is that unwanted ODS will have been recovered at different times relative to the approval of a methodology for ODS destruction, a fact that has implications for the extent of documentation that can be reasonably expected. For example, some ODS recovered in the past (e.g., under scenarios 1, 4, 5, and 6) are still being stored indefinitely as a result of financial, technical, and regulatory barriers. While ODS collected after the approval of a methodology can be expected to meet documentation requirements, ODS recovered in the more distant past are less likely to have full documentation. However, the destruction of that material is still important. Methodologies should rise to this challenge of ensuring real reductions through rigorous documentation requirements while also finding a way to enable the destruction of long-since recovered ODS with less documentation on its origin.

The scenarios, and how a methodology might cover them, are described below.

1. **ODS Recovered from Equipment in the Past, with Incomplete Documentation—**This scenario concerns stockpiles of ODS previously recovered from equipment—such as refrigerators, industrial chillers, air-conditioning units, commercial freezers, and fire protection systems—for which there is incomplete documentation about the origin of the ODS. Recovery may have been part of an earlier phaseout effort, a voluntary initiative, municipal program, or industry buyback program, and now the recovered ODS is unwanted and stored indefinitely. A lack of easy access to a destruction facility and/or high costs generally prevents destruction of the stocks. In this scenario, documentation on the origin of the ODS is lacking due to

[20] As mentioned previously, the recycling and reclamation of some ODS will be essential to satisfy after-market servicing demand, and so a proper balance between destruction projects and servicing must be sought within a national approach.

either poor recordkeeping or lost records. As a result, it is difficult to fully verify the source of the ODS in this scenario, although in general, volumes would tend to be small (i.e., a few metric tonnes).

In order to allow this ODS to be destroyed and to receive carbon credits, a methodology must allow projects to be eligible with some basic level of documentation or other means of verification. Alternatively, the use of a volume threshold—balancing the amount of ODS at which illegally pursuing destruction becomes attractive with the minimum volume needed for a viable project—could be used to determine eligibility.

2. **ODS Recently Recovered from Equipment, with Appropriate Documentation—**This scenario includes ODS recently recovered from equipment with appropriate documentation to verify that it came from eligible decommissioned equipment. Similar to the first scenario, this recovered ODS is unwanted and being stored indefinitely, owing to destruction costs or a lack of access to destruction facilities. In this case, good documentation is available to demonstrate eligibility. The project methodology simply must accept the destruction of ODS recovered from a variety of equipment.

3. **Accessible ODS Stocks in Use ("Banked") in Equipment—**After ODS production and consumption phaseout dates are reached, ODS currently in use in equipment will become a source for ODS recovery and destruction. Under this scenario, ODS is recovered *after* approval of an ODS destruction methodology and thus should be expected to meet all methodology requirements.

4. **Stockpiles of Mixed or Contaminated ODS that cannot be Reused—**ODS recovered under this scenario are mixed or contaminated to such a degree that they cannot be reused. (Note that this scenario may overlap with others, as these contaminated ODS can come from a variety of sources.) In many cases, evacuated ODS refrigerant is mixed in with lubricating oils, or may be consolidated with different types of refrigerants. As a result, it cannot be reused as is and/or may not be technically or economically feasible to reclaim; the only remaining options are permanent storage, illegal venting, or destruction.

   To cover this unwanted ODS, an ODS destruction methodology must allow for project developers to destroy mixed ODS and claim credit for the various amounts of different ODS destroyed. In addition, the methodology might make an exception for the destruction of non-reclaimable, contaminated ODS that has not yet been phased out of production, with appropriate proof of contamination required. Otherwise, these ODS are likely to be stored indefinitely, subject to storage costs, and ultimately fully leaked to the atmosphere over time.

5. **ODS Confiscated by Customs' Authorities—**Many countries around the world have enacted regulations to restrict the import of virgin ODS, with some countries completely banning ODS imports. Customs' officials are responsible for enforcing these regulations and confiscating illegal shipments into the country. ODS shipments confiscated by Customs are likely to be held without a definite destination. In the absence of a regulatory requirement for ODS destruction, there is no guarantee that the ODS will be destroyed, especially given the cost of doing so. An often complicating factor is that many national regulations prohibit the use or sale of the confiscated stocks as a means of ensuring compliance to the Protocol. As a result, the ODS may end up in a Customs' storage facility indefinitely, subject to leakage over time or released into the market, and in some cases, vented—inadvertently, or otherwise. Customs' storage facilities are unlikely to be designed for long-term storage, and the frequent movement of items in the storage space can increase the likelihood of damaging a tank. These factors contribute to a high overall risk of unintentional venting.

   A project methodology that permits destruction of bulk stockpiles of ODS (i.e., not recovered from equipment) should cover this scenario. In addition, as records for illegal shipments have a good chance of being incomplete, the methodology should have flexibility to adjust for this circumstance.

6. **Virgin ODS Stockpiled in Industrial Storage—**Some entities have stockpiles of virgin refrigerants in storage that are either phased-out or have been subject to production closure. These ODS might have previously been destined for installation in new equipment, but for any number of reasons (e.g., a lack of demand, financial issues, and so on), the virgin ODS was never sold or used and was instead stored indefinitely. The stocks may consist of several to hundreds of tonnes and are typically stored in large industrial tanks. Because most countries have banned the import of certain virgin ODS, these cannot be sent elsewhere to meet servicing needs, and the remaining options are permanent storage, unintentional or

illegal venting, or destruction. As is the case in scenario #5, a project methodology that permits destruction of bulk stockpiles of ODS (i.e., not recovered from equipment) should cover these circumstances.

8.2 Elements for a Robust ODS Destruction Methodology

This section identifies broad criteria that any methodology for the destruction of unwanted ODS should meet in order to be considered robust, creditable, and widely applicable for use by both A5 and non-A5 countries. These criteria are also consistent with the ISO 14064-2:2006 standard on guidance for quantification, monitoring and reporting of GHG emission reductions, which was developed by the International Organization for Standardization (ISO) to be "regime neutral" and thus able to be used as the basis for any program. This standard is well-accepted for GHG projects; for example, VCS uses these requirements as the basis for its standard.

These criteria relate to eligibility requirements, additionality requirements, guidance on developing a baseline scenario and calculating emission reductions, and guidance for monitoring and recordkeeping. Table 17 below presents these criteria, along with recommendations for each to ensure a robust methodology that can be applied widely for a range of project scenarios in both A5 and non-A5 countries. In the following Section 8.3, the specifications of existing methodologies for ODS destruction are compared and considered with these criteria and recommendations in mind.

Table 17: Criteria and Recommendations for a Robust and Widely Applicable Methodology

A good methodology should:	Examples and recommendations for a robust and widely applicable methodology:
Eligibility/Applicability:	
Clearly specify the types of ODS that are eligible	All ODS should be eligible, as long as the ODS have been phased out completely in the country of origin (not including essential/critical use material). Some exceptions to this rule might be appropriate under specific circumstances. For example, if ODS have been phased out in certain sectors (e.g., commercial refrigeration) but not in others, ODS recovered from the sectors in which the ODS has been phased out could be eligible for destruction. In addition, ODS that have not been phased out or other halocarbons (like HFCs) might also be considered eligible for destruction if they are part of a blend that cannot be easily separated or are contained in a contaminated mixture. These exceptions are also proposed in one of the methodologies for ODS destruction (EOS Climate) and are discussed at more length in the following Section 8.3.
Clearly specify geographic eligibility (i.e., where destruction can take place)	Destruction should be eligible in any country, as long as other technical criteria can be met.
Clearly specify the types of destruction technologies that are eligible	A wide range of destruction technologies should be permitted, as long as the technologies are approved or meet screening criteria for ODS destruction (e.g., by TEAP (2002)).
Clearly specify the technical requirements for destruction facilities	DRE requirements should meet TEAP (2002) guidance of 99.99% for concentrated sources at 95% for dilute sources. Emission limits for other potential products of incomplete combustion should also be specified and meet TEAP (2002) guidance.
Ensure that ODS are destroyed by facilities legally permitted to do so	Project developers should abide by local regulations to ensure that ODS classed as hazardous waste is only destroyed by those facilities permitted to do so.
Ensure that ODS produced for the sole purpose of earning destruction credits are not eligible	This can be achieved by requiring that the ODS being destroyed be phased out in the country in which it originated, and requiring documentation as to the origin of material. An appropriate balance must be sought here between requiring rigorous documentation and also ensuring that ODS that was recovered in the distant past and is missing documentation or ODS that was confiscated by Customs' offices without a good paper trail can still be destroyed for credit.

Ensure that ODS is imported/exported in accordance with national regulations and international treaties	Project developers should abide by local laws.
Additionality:	
Clearly specify a justifiable method for determining and demonstrating additionality	Additionality tests specific to the project should be required (e.g., regulatory surplus, implementation barriers, common practice test, performance threshold, etc.). At a minimum, projects should demonstrate or attest that there are no international, national, state, or local regulations requiring ODS destruction, and that destruction is not common practice.
Emission Reduction Calculations:	
Clearly describe the project activity	A wide range of project scenarios, as described in Section 8.1 (e.g., collection of refrigerant, foam, and fire suppressant from equipment, destruction of bulk ODS, etc.), should be included.
Include requirement to define all relevant greenhouse gas sources, sinks, and reservoirs (SSRs) for the project activity and baseline, including those that are directly attributable to the project activity (controlled by the project proponent) and those related to or affected by the project activity	In addition to the ODS being destroyed, other sources of emissions associated with the destruction process should be subtracted, such as fuel and electricity use associated with the destruction process, emissions associated with the destruction process, and emissions *indirectly* associated with the destruction process, such as CO_2 emissions from the transport of the ODS. The project boundary should extend from the transportation of the ODS from a consolidation point to the destruction facility, and include any emissions through to the actual destruction of the ODS. If the ODS are being recovered from equipment, and likely replaced with a substitute compound, the emissions from that substitute might also be included; this issue is discussed at more length in Section 8.3.
Provide a clear methodology for identifying, justifying, and quantifying a baseline scenario	An equation should be provided including the elements described above.
Provide a clear methodology for quantifying the overall emission reduction, including subtracting direct and indirect SSRs for the project activity	An equation should be provided including the elements described above.
Clearly describe the timing for crediting	Crediting should be one-time, upfront, at the time at which the ODS is destroyed. This approach is administratively most simple and provides the best incentive for project developers, who may incur significant costs upfront to destroy, ODS. For ODS destruction, the carbon market is the only revenue stream for project developers, so upfront crediting is important.
Monitoring and Recordkeeping:	
Clearly specify the types of data to be measured and recorded (including units of measurement)	These data might include DRE, amount and characteristics of ODS fed to a destruction unit, consumption and characteristics of energy used by destruction unit, operating parameters during destruction, etc.
Clearly specify the monitoring/testing methodologies	These might include performance test standards, laboratory analytical methods, sampling procedures, calibration requirements, etc. Internationally recognized testing standards, such as those published by the Air-Conditioning, Heating and Refrigeration Institute (AHRI) (e.g., AHRI 700-2006 standard for fluorocarbon refrigerants), should be referenced.
Clearly specify the times and periods during which monitoring should take place	Such as prior to shipment, prior to destruction, and during the actual destruction of ODS.
Clearly specify roles and responsibilities for monitoring and data collection and storage	While most monitoring is likely to take place at the destruction facility, responsibility may also need to be taken for testing prior to shipment to the destruction facility.
Clearly specify other documentation requirements for project validation and verification	Any data or documentation requirements should be made clear.

8.3 Comparison of Known ODS Destruction Methodologies

To date, to the best of our knowledge, four methodologies and an approved scope extension for including ODS under the VCS program[21] have been developed for destroying unwanted ODS for purposes of earning carbon credits through the voluntary carbon market. As of February 2010, offset methodologies under CCX and the Reserve have been approved for use in project development. The VCS extension of scope defines the eligibility criteria for future ODS destruction methodology submission under VCS. The other two methodologies have been submitted to or shared with VCS and the Reserve and were used as input into the development of each standard's respective program. These four methodologies and one extension of scope are as follow:

- **ARGE/Tanzer/USG (Austria):** This methodology was developed by a private sector firm and is tailored to a specific type of project – the recovery and destruction of CFCs from domestic refrigerators.
- **EOS Climate:** Also stemming from the private sector, EOS's methodology establishes criteria encompassing a wide range of projects, with selected project types described in extensive detail, including specific project boundaries and emission reduction calculations.
- **Chicago Climate Exchange (CCX):** The CCX protocol allows ODS destruction from a wide range of sources, but requires the ODS to be destroyed in the United States. Note that this protocol has recently gone through a review and updating process.
- **Voluntary Carbon Standard (VCS):** This extension of scope provides for the inclusion of ODS under the VCS Program by establishing broad eligibility criteria for destruction projects.
- **Climate Action Reserve:** The Reserve has developed two project protocols for ODS destruction—one covering ODS sourced from and destroyed in the United States, and the second covering ODS sourced from A5 countries and imported for destruction to the United States. The information presented in the table below is based on the final drafts of these protocols released for Reserve Board approval in January 2010.

These methodologies and approach have some important similarities and differences in terms of the eligibility of different project and ODS types, additionality determinations, and calculations of emission reductions. They are summarized in Table 18 followed by a subsequent analysis.

Table 18: Comparison of Selected Methodologies and Approach

	ARGE / Tanzer / USG (Austria)	EOS Climate	CCX	VCS Extension of Scope	The Reserve
Project Activity	Specific project for recovery of CFC refrigerant and blowing agent from refrigerators and freezers	Open to a wide range of ODS destruction projects	Destruction in the U.S. of specified ODS from a range of sources	Set of eligibility criteria for inclusion of ODS in the VCS program	Destruction in the U.S. of specified ODS refrigerants or foam blowing agents
Applicable to ODS in:					
Bulk/stockpiles		✓	✓	✓	✓
Appliances	✓	✓	✓	✓	✓
Commercial/Industrial Ref/AC Equipment		✓	✓	✓	✓
Foams	✓	✓	✓	✓	✓
Fire Equipment		✓	✓	✓	
Aerosols		✓	✓		
ODS accepted (if eligibility criteria met):					
CFCs	✓	✓	✓	✓	✓
HCFCs		✓	✓[a]	✓	✓[a]
CTC		✓	✓		
Halons		✓	✓		

[21] Although the VCS extension of scope is not considered a "methodology" *per se*, it serves to define a set of eligibility criteria for ODS destruction projects that would be similar to those defined in project methodologies, and is thus considered here.

	ARGE / Tanzer / USG (Austria)	EOS Climate	CCX	VCS Extension of Scope	The Reserve
HFCs		✓[b]			
Eligibility and additionality criteria:					
Methodology applies to destruction in any country, if other eligibility criteria met	✓	✓		✓	
ODS must be phased out of production and import in the country where the ODS has resided	✓	✓	✓	✓	✓
Exception for stocks that are contaminated		✓			
Exception if specific sector has a phaseout		✓	✓[c]		
ODS destruction cannot be required by law in country where project is executed	✓	✓	✓	✓	✓
Exception for low compliance rate with destruction law	✓			✓	
ODS destruction cannot be common practice in sector/country where project is executed	✓	✓	✓		✓
TEAP-approved technology must be used	✓	✓	✓[d]	✓	✓
Specified DRE must be met	✓	✓	✓	✓	✓
Emission reduction calculation:					
Emission reduction calculation includes:					
Amount fed into destruction unit	✓	✓	✓	n/a	✓
DRE of facility/process		✓	✓	n/a	✓
Fuel use of destruction process	✓	✓	✓	n/a	✓
Electricity use of destruction process	✓	✓	✓	n/a	✓
Emissions from transportation at various stages	✓	✓	✓	n/a	✓
Carbon dioxide emissions from incineration	✓	✓	✓	n/a	✓
Substitution of new refrigerant[e]	n/a	✓		✓	✓
Specific calculation provided for foams	✓	✓	✓	n/a	✓
Timing for crediting:					
Upfront at the time of destruction	✓	✓	✓	✓	✓
Monitoring and verification:					
Guidance on specific data to be monitored	✓	✓	✓	n/a	✓
Third party verification required	✓	✓	✓	n/a	✓

Sources: CCX 2009b; Climate Action Reserve 2010a, 2010b; VCS 2010.
[a] HCFC-141b and HCFC-22 foam only for the U.S.-based protocol
[b] If recovered as part of a blend with ODS that cannot be separated
[c] By proposal to CCX only.
[d] Facility must meet Clean Air Act Amendments and Resource Conservation and Recovery Act (RCRA) requirements; this allows the use of TEAP-approved technologies, plus lightweight aggregate kilns and fixed hearth units. Facilities not permitted under RCRA are allowed if they have current reports filed with the EPA permitting ODS destruction.
[e] The calculation of the emission reduction including the emissions from the ODS substitute is determined differently in the EOS Climate and the Reserve's methodologies, as discussed at more length below.

There are a number of similarities and differences between these methodologies and approach that are important to point out, given their implications for the types of ODS destruction projects that they will allow.

- **ODS sources**—the EOS Climate and CCX methodologies and VCS extension of scope all apply to a wide range of sources of ODS. The Reserve's protocols apply to specific ODS refrigerants and blowing agents only; ODS used as aerosols or fire extinguishing agents are not allowed. The EOS Climate methodology is especially comprehensive in this regard, including a long discussion of possible project scenarios for generating unwanted ODS and mentioning the possibility of additional scenarios. On the other side of the spectrum, the ARGE/Tanzer/USG (Austria) methodology project activity is limited to CFCs recovered from end-of-life refrigerators and freezers; this methodology also requires both refrigerant and foam recovery and destruction.
- **ODS types—**again, the EOS Climate and CCX methodologies apply to a range of ODS types, provided those ODS meet the eligibility criteria (e.g., have been phased out of production/import). The Reserve's

protocols currently apply only to CFC refrigerants (primarily CFC-11 and CFC-12) and to CFC and HCFC blowing agents. VCS covers CFCs and HCFCs. As mentioned previously, the ARGE/Tanzer/USG (Austria) methodology applies only to CFCs.

The EOS Climate methodology is unique in accepting non-phased out ODS and HFCs for carbon credit under very specific circumstances, namely if those substances are recovered as part of a blend with ODS that cannot be separated. One alternative is that project proponents could pay for the destruction of all contaminated cylinder contents—with some of those contents not being eligible for carbon credits—which dilutes profitability. Whether the reduction in profitability would keep a project from moving forward, however, would likely be determined on a project-by-project basis. As the project cost analysis in Chapter 7 demonstrates, some project types will be profitable even if say 30% of the amount destroyed was not eligible for crediting. Other project types are barely (or not) profitable even if all the ODS destroyed was creditable. In the past, at least one ODS destruction project has been known to move forward with destruction of non-eligible materials. In one case study of ODS destruction undertaken for crediting (see Appendix A), a private company paid for the destruction of containers filled with CFCs, HCFCs, HFCs, but was only credited for the CFC destruction through CCX.

Thus, such an exception for contaminated materials could be important for the financial viability of projects, especially in A5 countries, where a large proportion of cylinders are expected to be contaminated with HCFCs or HFCs. A valid concern with crediting the destruction of non-phased out materials in contaminated mixtures is that it creates a perverse incentive for intentional contamination of CFCs with, for example, HCFCs or HFCs, in order to generate additional carbon credits. For higher priced compounds, such as HFC-134a, this might be less of a concern, but for less expensive ODS, like HCFC-22, it could be problematic. These issues should be considered as the rules for crediting ODS destruction develop and evolve.

- **Eligibility and additionality criteria**—except under the CCX and Reserve's methodologies, which restrict destruction activities to the United States (but also accept material imported to the U.S., with the Reserve limiting imports to those from A5 countries), ODS destruction may take place in any country, as long as the facility meets certain requirements, such as the use of a TEAP-approved destruction technology or meeting certain screening criteria, such as the demonstration of a certain destruction and removal efficiency (DRE). The TEAP standard serves as a reputable international guideline that can be used by all countries worldwide. Although ODS may be imported to the United States for destruction, the actual destruction must take place at a U.S. facility under CCX and the Reserve's methodologies, as mentioned. However, as illustrated in the case studies to this report (see, for example, Indonesia in Appendix A), there are possible challenges associated with exporting ODS to another country for destruction, including higher costs and regulatory hurdles, that may make the use of the CCX and Reserve's protocols less appealing for dealing with ODS stockpiles from A5 countries in certain cases.

  To avoid creating a perverse incentive to produce ODS for the purpose of destruction, all methodologies specify that eligible ODS must be phased out of production and import in the country where the ODS has resided. EOS Climate also adds two exceptions here: namely that if the ODS is contaminated, it may be destroyed for credit regardless of the phaseout status, and that if a specific sector has phased out an ODS, ODS recovered from that sector is eligible for crediting, even if other sectors continue to the use the ODS type. As discussed previously, both exceptions are justifiable, but would require robust documentation to ensure that they are not abused.

  To ensure that the GHG emission reductions are additional, all methodologies specify that ODS destruction must not be required by law in the country where the project is executed. Such a requirement will likely disqualify the European Union Member States from eligibility under these methodologies, but should not prevent a collection project in Senegal, for example, from sending ODS for destruction in European facilities. The ARGE/Tanzer/USG (Austria) methodology and VCS extension of scope, however, both provide an exception for low compliance with laws requiring ODS destruction. The EOS Climate, CCX, ARGE/Tanzer/USG (Austria), and Reserve methodologies all also layer in an additionality measure of common practice, such that if destruction is not required by law but is common practice in a certain sector or country, the ODS destruction project may not be eligible.

- **Emission reduction calculation**—the specification of baseline and project scenarios and subsequent calculation of the emission reduction can be fairly complicated. EOS Climate, CCX, ARGE/Tanzer/USG (Austria), and the Reserve's calculations factor in not just the amount of ODS actually destroyed, but also emissions resulting from the transport of ODS to the destruction facility, the fossil fuel use of the destruction facility associated with the ODS destruction, emissions from the use of electricity during the destruction process, and emissions associated with the destruction process.[22] Baseline scenarios must also be specified to determine what emissions would have been under "business-as-usual" circumstances; for example, in most project categories in the EOS Climate methodology, 100% eventual emission of the ODS is assumed in most cases, with the exception of halons and foam applications. Under the Reserve's project protocols, baseline emissions are calculated assuming the destroyed ODS has instead been used in existing refrigeration equipment, with default leak rates for that equipment.

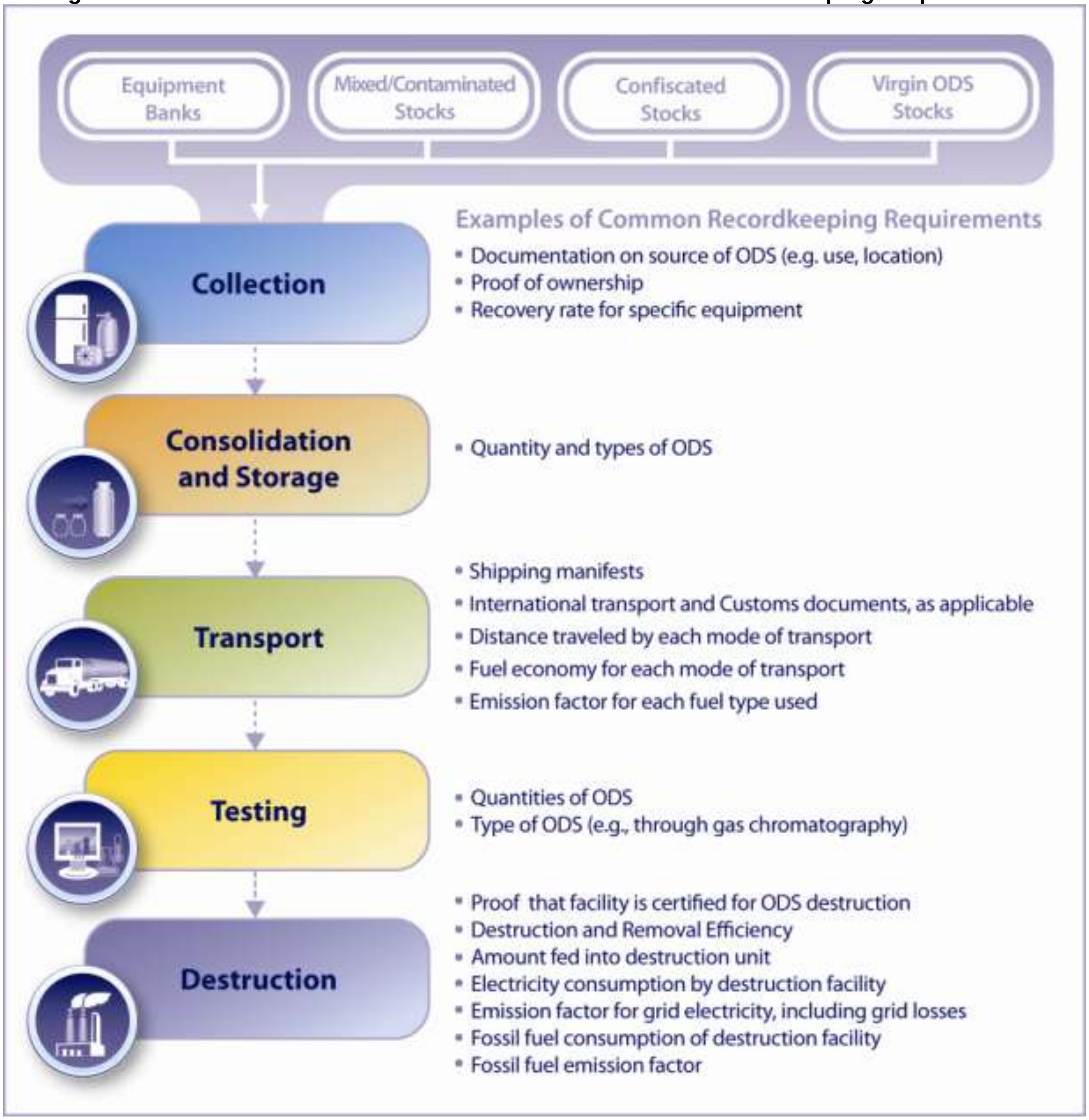
Another important aspect of the emission reduction calculation that EOS Climate and the Reserve's methodologies, as well as VCS's extension of scope, include is emissions associated with replacement of destroyed ODS with substitutes. The Reserve's protocols account for a deduction in the overall emission reduction based on a shift to an ODS substitute, providing default GWPs and leak rates for ODS substitutes to feed into the project emission calculations. The EOS Climate methodology, on the other hand, subtracts off the baseline emissions the difference between the continued use of the baseline ODS and the new use of the substitute ODS for the remaining lifetime of the equipment in question. The EOS methodology also requires project proponents to specify the origin and GWP of the ODS; the years of expected continued use of the ODS refrigerant in the absence of the destruction projects; the amount of GWP of the refrigerant that will replace the ODS being destroyed; and leak rates of the existing source of ODS and new replacement equipment (using actual performance data).[23] This information is then used to calculate the incremental impact of the replacement; the EOS Climate methodology notes that in some cases project proponents might be able to increase their total emission reductions if leak rates are much tighter in new equipment, for instance.

In calculating the total emission reduction, the Reserve differs in an important aspect: baseline and project emissions are calculated over a ten-year timeframe. This means that the difference between the emissions that would have occurred in the baseline (e.g., leakage from old equipment) and the project emissions (e.g., leakage from the new, replacement equipment) is counted over a finite, ten-year period. Any emission reductions that might have occurred past the ten-year period are not credited. The impact of this ten-year period has not been specifically analyzed, but is expected to somewhat reduce the amount of credits earned under this protocol relative to, for example, the CCX methodology.

- **Timing for crediting**—all methodologies and the VCS extension of scope provide for upfront crediting, at the time that destruction occurs. For example, if a project recovers and destroys ODS that otherwise would have been slowly emitted over time from retired refrigerators, the credit is provided when the ODS is destroyed instead of when the ODS would have been emitted from the refrigerators in the baseline scenario. Crediting based on when the ODS would have been emitted in the baseline would be extremely complicated.
- **Monitoring and verification**—all three methodologies give specific instruction on the types of data that will be required to be monitored and reported, and also require third-party verification. Figure 30 illustrates the most likely type of data needed to be recorded at each step of the destruction process.

[22] During a high temperature thermal destruction process, the carbon in ODS is converted to CO_2 and emitted.
[23] For projects destroying "ODS recovered from either operational or decommissioned equipment used for commercial refrigeration, industrial process refrigeration, comfort cooling for commercial and residential buildings, motor vehicle air conditioning, and other refrigeration/air conditioning applications."

Figure 30: The Process of ODS Destruction and Illustrative Recordkeeping Requirements



As the discussion above has illustrated, there are important differences among the methodologies that affect how widely they can be used by proponents in countries that are Parties to the Montreal Protocol, for both eligibility and complexity reasons. As noted, the ARGE/Tanzer/USG (Austria) methodology applies to only a very specific project type, while the CCX and the Reserve's protocols can only be used for projects where the destruction is carried out in the United States. Unlike CCX, the Reserve's protocols limits eligible imports for destruction to those from A5 countries and proposes a time limit for the import of eligible virgin stockpiles for destruction. The Reserve also limits eligible ODS to refrigerants and foam blowing agents, excluding halons. The VCS extension of scope also excludes halons. The EOS Climate methodology is the most comprehensive and is clearly intended to encompass a broad range of project circumstances worldwide. However, the complexity of this methodology—with requirements spanning 126 pages—poses a potential hurdle for first-time project developers or any project where resources and capacity for project development may be limited. That said, the methodology does contain modules that can be streamlined for individual project types, in an effort to reduce that complexity, and a short user guide could be developed to assist project developers.

In the case of ODS destruction particularly, there is a clear need to strike a balance between being robust and being user-friendly in order to engage both A5 and non-A5 Parties. As can be seen through the numerous requirements for developing, documenting, implementing, and verifying an ODS destruction project for crediting through the voluntary market, a minimum technical capacity might be needed to undertake such projects depending on project implementation arrangements. In some A5 countries, this capacity may not exist, and this is a critical consideration for developing an effective strategy for using the voluntary market to fund ODS destruction and one that is taken up further in the concluding chapter of this report.

9. Challenges and Potential Solutions

As this report has demonstrated, there are numerous opportunities and challenges associated with financing ODS destruction through the voluntary carbon market. While several third-party standards have already included ODS in their GHG programs—representing a potentially significant opportunity for future ODS destruction project development—a number of challenges must be overcome in order for the voluntary market to become a viable financing strategy for all countries with remaining ODS banks. This section first describes those major challenges along with possible solutions, grouped into the following five categories:

- Avoiding perverse incentives and unintended consequences;
- Addressing ODS not covered by the voluntary market;
- Dealing with challenges for buyers and sellers in the voluntary market;
- Obtaining financing for less cost-effective ODS destruction projects;
- Addressing special needs of some A5 countries; and
- Restrictions on export/import of ODS for destruction and accessing ODS destruction capabilities.

Many of these challenges are also illustrated through the five ODS destruction case studies in Appendix A of this report.

9.1 Avoiding Perverse Incentives and Unintended Consequences

Because of the high GWP and potentially high volumes of ODS that could become available for destruction, destroying ODS for voluntary market credits could generate significant revenues for project proponents. While this is good news for those holding stockpiled or banked ODS, it also means that perverse incentives could be created for production of ODS solely for the purpose of earning destruction credits (including illegal production of phased out ODS, such as CFCs, or export from one country with legislation that requires destruction to another that does not), false reporting of quantities, mislabeling of ODS, and other activities to promote generation of carbon credits.

Most of the countermeasures to these perverse incentives can be put in place through recognized and well-established voluntary market standards supported by robust and transparent methodologies. The use of a reputable third-party standard (such as VCS, CCX, or the Reserve) represents the best strategy for ensuring that the emission reductions achieved through ODS destruction projects have a measurable effect. These standards have established rules and requirements for third party validation and verification that increase the credibility of carbon credits. While the incentive of earning carbon credits effectively uses the market to promote best practices—i.e., the more ODS that makes it to the destruction facility, the more credits are earned, and thus there is a disincentive to handle the ODS in improper ways that result in release—robust methodologies are also essential to ensure that ODS destruction projects are carried out in an environmentally sound and creditable manner.

Standards including the CCX, Reserve, and VCS have developed, or are in the process of developing ODS program rules that serve to address many of these perverse incentives. For example, CCX limits eligible ODS materials to those ODS whose production has been phased out under the Montreal Protocol and Title VI of the CAAA. As such, the perverse incentive to produce ODS solely for destruction for carbon credits is avoided. Other perverse incentives such as false reporting of quantities and mislabeling of ODS will be addressed through the incorporation of detailed monitoring and reporting procedures for verifying where and how the material being destroyed was generated. While no standard or methodology can be expected to prevent all illegal activity, these types of requirements can go a very long way toward ensuring that only real, additional, and verifiable emission reductions from ODS destruction are credited in the voluntary market. As discussed at more length in Chapter 8, the methodologies and approach for ODS destruction currently being considered are reasonably successful at addressing these concerns.

In addition to creating perverse incentives, financing ODS destruction through the voluntary market may also create unintended consequences worth considering. For example, by creating a financial incentive to destroy ODS, some ODS that would have otherwise been reclaimed or recycled might instead be destroyed. Because the ODS in question can no longer be produced or imported,[24] reclamation/recycling of these ODS can be important for ensuring that sufficient quantities of the ODS are available to meet future servicing needs. For example, in the United States, a U.S. Environmental Protection Agency (EPA) report (2008) found that the U.S. refrigeration and AC industry may face shortage risks beginning in 2015 if not enough HCFC refrigerant is recovered and reclaimed.

Whether ODS will be diverted from reclamation/recycling to destruction will largely depend on the price signals from each activity. Both reclamation and destruction have an associated cost as well as an associated revenue—resale of the reclaimed ODS in the case of the former, and the sale of carbon credits for the latter. The relative costs of reclamation versus destruction, as well as the relative market prices of reclaimed ODS versus carbon credits, will affect the movement of unwanted ODS toward reclamation or destruction. However, the high GWP of ODS may indicate that the price signals are more likely to favor destruction over reclamation. It is important to note, however, that currently few ODS are thought to be recovered at all, let alone reclaimed or destroyed. Including ODS destruction in the voluntary carbon market provides a potentially strong financial incentive for the recovery of material, which can serve the purposes of both reclamation (particularly for meeting servicing needs after new production is prohibited) and destruction.

For critical applications—such as CFCs and halons in aerospace and defense applications—many governments or private entities already own the ODS material they need for future servicing and have placed that material in critical reserves. Barring overall supply shortfalls (or other restrictions like tax barriers), users with critical needs should be able to purchase the material they need regardless of the market for destruction, as long as they are willing to pay a higher price since they would be competing with destruction and the carbon credit price. From an environmental perspective, if ODS is destroyed instead of reclaimed, this may force the switch to alternatives more quickly, which could produce a positive effect. Accelerating equipment replacement can mean the transition to more energy efficient equipment and no-ODP, low-GWP alternatives, which is good for the climate and beneficial to protecting the ozone layer. Because critical or essential use exemptions—such as for new CFC production for servicing household refrigerators in A5 countries—are extremely unlikely to be entertained by the Parties, it will be important for countries to undertake proper planning to ensure the proper allocation to reclamation and destruction streams.

9.2 Addressing ODS Not Covered by the Voluntary Market

Members of the Montreal Protocol community have been influential in the processes to include ODS in the GHG programs of the Reserve, VCS, and CCX. That said, because voluntary market standards operate *GHG* emission reduction programs, without specific scope for reducing ODS emissions, the programs being developed for destroying ODS through the voluntary market are not necessarily designed to comprehensively address emissions from all ODS banks. The goals of the GHG market may not always serve to optimize ozone benefits or ODS destruction. This is true for many sectors generating GHGs. Consequently, active dialogue with the global carbon community becomes increasingly important.

For example, while the destruction of halons is allowed under CCX, halons have not been included under the ODS destruction programs under the Reserve and VCS. The current uncertainty surrounding a negative net GWP (direct plus indirect) of halons makes the climate case for destroying halons somewhat challenging (IPCC/TEAP 2005). However, if halons are not eligible for carbon crediting, then stockpiles around the world may be stored indefinitely (and often in inappropriate conditions for long-term storage) or vented if other funding to destroy the halons is not made available. For example, countries of the Gulf Cooperative Council have numerous stockpiles of halons that are currently stored indefinitely without any disposal plan. Without an incentive to destroy these stocks, the fate of the halon remains unknown, especially as storage capacity becomes scarce.

One possible solution to this challenge would be to incorporate a discount into the crediting schemes to account for halons. In other words, the number of credits issued for ODS destruction projects could be discounted by a certain set percentage (regardless of the type of ODS being destroyed) to account for the negative net GWP of halons. Halons represent a very small portion of total ODS banks—less than 3% of global banks on an

[24] In order to be eligible for destruction, the ODS in question would have to be phased out from production and import.

unweighted basis, according to TEAP (2009a)—but have a large net GWP (more than -30,000 for halon 1301), which could affect the magnitude of the discount. Whether or not such an approach is adopted, the Montreal Protocol community should remain part of this important conversation about how halons will be dealt with in the voluntary market.

9.3 Dealing with Challenges for Buyers and Sellers in the Voluntary Market

As discussed in Section 7.1, some challenges exist from both the buyers' and sellers' sides of the voluntary market. On the buyers' side, ODS projects will need to be packaged in a way that is attractive to buyers and their stakeholders. Given the reputational motivation for many voluntary market buyers, ODS project proponents will need to differentiate themselves from other industrial gas projects that have drawn criticism (and lower carbon prices) in the past, such as HFC-23 destruction. A potentially beneficial solution here would be for ODS destruction projects to tell a compelling story emphasizing that they help pay for the removal of GHGs that would otherwise be emitted over time if left unaddressed. Specific points that distinguish ODS projects from HFC-23 destruction projects are described in Section 7.1.1. For projects that destroy ODS recovered from equipment at end-of-life, this may not be a significant challenge. It may be a bigger hurdle for projects that destroy virgin stockpiles, although the story may still be sufficiently compelling: the alternative may be leakage to the atmosphere over the long- or short-term.

From the sellers' side of the market, uncertainty about carbon prices will be an ongoing challenge that is inherent to the carbon market. Because break-even carbon prices range considerably for ODS destruction projects (see Section 7.2), the price that can be earned on the market will be an important determinant of whether projects are undertaken. Prices depend on a variety of factors, including: the standard to which the project is developed and the perceived robustness of the methodology used. In the past, low prices on the CCX market have contributed to decisions not to move forward with an ODS destruction project. This was the situation in Argentina, where some CTC was sold to Mexico for feedstock use rather than destroyed in the U.S. for crediting under CCX (see the Argentina case study in Appendix A). If project developers are uncertain about whether a project will earn a profit, it may not be pursued. Tracking price trends in the voluntary carbon market on a real-time basis could be helpful for stakeholders; credit price information is publicly available for CCX on its website (www.chicagoclimatex.com). Prices for the OTC market are not generally disclosed publicly but are available indirectly through several sources, including an annual report published by Ecosystem Marketplace and New Carbon Finance (available at www.ecosystemmarketplace.com).

The next section addresses possible opportunities for obtaining financing for less cost-effective ODS destruction projects.

9.4 Obtaining Financing for ODS Destruction Projects with Low Cost-effectiveness

Some ODS destruction projects will clearly be more cost-effective than others. As discussed in Section 7.2, there are significant and largely fixed transaction costs associated with participating in the voluntary market—costs including project document preparation, validation, and verification—that suggest that larger volume projects achieve some economies of scale and are more cost-effective. Certain project activities are also more costly to implement; for example, collecting household refrigerators and freezers from a sparsely populated area is substantially more expensive on a per-kilogram-of-ODS basis than recovering ODS from industrial systems or simply destroying existing stockpiles. As Section 7.2 demonstrates, the carbon credit prices required to make some project types/sizes profitable are high; for example, a voluntary market price of over US$40/$tCO_2e$ would be required for a project that only collected 1,000 refrigerators. The consequence is that some projects may not be developed or financed without additional assistance.

Government-owned ODS could use revenue from highly cost-effective projects to fund their destruction in less cost-effective projects. Such mechanisms may be viable. For example, a country government could destroy ODS confiscated by Customs' (a low-cost, high-profit project), and use that revenue to fund a program to collect domestic refrigerators at end-of-life and destroy the recovered ODS. Alternatively, a pilot project for destroying ODS could re-invest carbon revenue earned in retrofitting or replacing old equipment or facilities and thereby gather more ODS for destruction. For the private sector, however, there can be no expectation that revenues from a more profitable project would be used to cover expenses for other activities without government intervention. The situation for the private sector is further complicated by the fact that ODS destroyed in one project versus another could very likely have different owners.

Thus, in order to increase the viability of using the voluntary market to more broadly finance ODS destruction, additional options may need to be in place to ensure that revenues from highly profitable projects are used to fund other needed but less cost-effective activities to manage ODS. One possible solution would be for governments to impose a tax on the sale of VERs earned through ODS destruction projects, the revenue from which could be put in a separate fund and used to provide upfront financing for less cost-effective projects. Such a tax would be similar to that levied by the Chinese government on the sale of CERs earned from the destruction of HFC-23 (a byproduct of HCFC-22 production), which was then put into a government fund for other sustainable development activities. While the Chinese government's tax rate of 65% on the sale of CERs was feasible for the HFC-23 project type, a lower tax rate would be required for ODS destruction. The cost of an ODS destruction project (from collection to transportation to destruction) could be 200 times higher than the cost to destroy HFC-23 byproduct for some project types, such as for collection of household refrigerators in small volumes (see Section 7.2).[25] For ODS destruction projects, the tax rate could be differentiated depending on the type and size of the project being undertaken; for example, for more cost-effective projects such as those destroying existing stockpiles or recovering refrigerant from industrial equipment, a higher tax could be assessed. For less cost-effective projects, such as the collection of household refrigerators, a lower or no tax could be levied. If the tax rate is differentiated, care must also be taken to avoid perverse incentives, such as the incentive to break up larger projects into smaller efforts in order to avoid taxes on larger volume projects.

Building on the project cost examples developed in Chapter 7, Table 19 below provides examples of tax revenue that could be generated by assessing a 10% or 20% levy on the sale of VERs for projects destroying 10 tonnes of stockpiled CFC-12, or recovering and destroying CFC-12 from large stationary AC units in large volumes. These project types were found to be the most cost-efficient in the examples developed in Chapter 7. As shown, assessing a 10% tax on a large stationary AC project destroying 1,000 tonnes of CFC-12 could generate over US$5 million in tax revenue, or upwards of US$50 million for a project destroying 10,000 tonnes.

These substantial tax revenues could go a long way towards financing less cost-effective projects, such as domestic refrigeration collection and destruction. For example, the cost of a project that collects 10,000 refrigerators is estimated to be close to half a million dollars, so the tax revenue from just one highly profitable project could fund several municipal refrigerator collection projects in a given country. Or, this revenue could be used to subsidize the replacement of ODS-based equipment with non-ODS alternatives, thereby creating a self-sustaining mechanism for funding and conducting replacement activities while also collecting ODS for destruction.

Table 19: Examples of Tax Revenue Generated per Project (All Costs and Revenues Shown in Thousands of US$)

Project Type		**Destruction of stockpiled CFC-12 (no recovery)**	**Recovery and destruction of CFC-12 refrigerant from large stationary AC units**	
Project Size		**10 tons destroyed**	**1,000 tons per facility**	**10,000 tons per facility**
Carbon Credits Generated		109,000	10,900,000	109,000,000
Gross Revenue*		$501	$50,140	$501,400
Project Costs		$187	$21,310	$212,011
10% Tax on Gross Revenue	Tax	$50	$5,014	$50,140
	Net Revenue†	$264	$23,817	$239,250
20% Tax on Gross Revenue	Tax	$100	$10,028	$100,280
	Net Revenue†	$214	$18,803	$189,110

Note: Totals may not sum due to independent rounding.

[25] The cost of destroying HFC-23 byproduct has been estimated at less than US$0.2/t$CO_2$e (IPCC 2005) compared to upwards of $40/t$CO_2$e estimated for the collection of 1,000 CFC-containing refrigerators.

* Assuming a VER sale price of US$4.6/$tCO_2e$, the average price of an industrial gas credit in the voluntary market in 2008.
† Equal to gross revenue minus project costs minus tax.

Rather than using the revenues from more profitable projects to finance less cost-effective ones, another possible solution would be to find ways to improve the cost-effectiveness of projects. One way to do this is to couple ODS destruction projects with other activities that are eligible for crediting in the carbon market, such as earning energy efficiency credits for chiller or refrigerator replacement. By combining an ODS destruction project with an energy efficiency project, the project developer can apply for both types of credits and increase revenues. Governments could also capitalize on existing programs, such as municipal programs to take back household appliances, and use the existing recovery infrastructure to keep costs down.

Another way to improve profitability is through grouping or pooling project activities.[26] Such an approach is allowed under the VCS (activities must be submitted under one project document) and CCX (where projects can be grouped by an Offset Aggregator). By gathering up a series of activities (e.g., refrigerator collection in several different municipalities) to earn more carbon credits, projects can reduce transaction costs and be more cost-efficient.

9.5 Addressing Special Needs of Some Article 5 Countries

While countries with active or larger carbon markets including China and Brazil may be well poised to move into the voluntary market for ODS destruction, the current capacity of some less developed countries to participate in the development of ODS destruction projects through the voluntary market is limited. To improve this capacity, A5 countries may need to draw on certain resources and sources of assistance to facilitate the process.

The first part of this challenge relates to carbon finance capacity. While the MLF has built important capacity in A5 countries for the phaseout and management of ODS, carbon finance capacity to enable A5 countries to effectively participate in the carbon market is a different issue. Programs such as the World Bank's Carbon Finance Assist program, UNEP Risoe, and the Nairobi Framework[27] have the express purpose of helping developing countries build the capacity to participate in carbon markets. But even with these programs' assistance, some A5 countries—particularly in Africa—have never developed a carbon market project, either for CDM or for the voluntary market, and local capacity and knowledge of the carbon market and how it operates may be limited. While private sector actors in A5 countries may know how to collect ODS for destruction, engaging the financial sector to secure financing for collection and developing a voluntary market project (including potentially complicated project documentation) presents a significant hurdle for some countries.

In some cases, private sector companies from non-A5 countries could see a good investment and lead the project development effort in an A5 country. However, some initial help might be warranted. International financial institutions (IFIs) could play an important role in overcoming this initial hurdle and catalyzing the market. IFIs could initially provide upfront financing for ODS destruction projects and taper off their participation as the private market develops. Securing financing through a designated fund could also provide the added advantage to project proponents by guaranteeing a certain floor price for the carbon credits.

IFIs could also provide guidance to A5 countries on the step-by-step process for developing an ODS destruction project or a standard template for describing projects to project developers and investors. For instance, the World Bank's Carbon Finance Unit developed templates for project idea notes (PINs). These could be adapted for ODS destruction. Examples of potentially useful and applicable templates are provided in Appendix D of this report.

[26] The rules for grouping projects are dependent on the standard being sought. Under the VCS, a "grouped project" is "a number of projects and their related methodologies included in a single VCS Project Description (VCS PD) at the time of the validation." Under CCX, a "pooled project" is "the multiple projects that are represented in CCX by a single Aggregator." Under CDM, "bundling" and a "program of activities" also have specific definitions and rules.
[27] The Nairobi Framework was initiated by UNDP, UNEP, the World Bank Group, the African Development Bank, and the Secretariat of the UNFCCC to help least developed countries, especially those in sub-Sahara Africa, to improve their level of participation in CDM.

Another option for facilitating the connection between possible projects and investors would be to create a type of international clearinghouse that could serve as a centralized inventory of ODS banks and potential project activities. The clearinghouse would serve to connect owners and investors: banks (e.g., amounts, types, and location) would be listed in the inventory, and interested project developers or investors could contact ODS owners to make arrangements to develop an ODS destruction project. An international clearinghouse would also make it easier for project developers in non-A5 countries, for instance, to become aware of potential projects in A5 countries that may not have the carbon finance or technical capacity to carry out the project on their own. This clearinghouse-type function could be managed by the Ozone Secretariat, capitalizing on its existing data management role with regard to reporting under Article 7. Collection of data on ODS banks could be coordinated at the national level by each country's national ozone unit (NOU), which already has systems in place to collect ODS production, consumption, and other data. Although it has been historically difficult to collect data on ODS banks, companies should have an incentive to list their banks with the clearinghouse since it represents a potential investment opportunity. NOUs may also be able to develop specific incentives for data reporting that would be effective in their countries. In addition, depending on how the clearinghouse was created, it might also be feasible to have the clearinghouse pay for itself. For instance, if a small fee (like a broker's fee) was assessed on successful connections between entities owning ODS and project developers, then the clearinghouse could be a profitable or break-even enterprise.

Another challenge to the participation of some A5 countries is the volume of recoverable ODS and the cost-effectiveness of resulting projects. Given the economies of scale associated with larger projects, some A5 countries—especially the low-volume consuming countries (LVCCs)—may find themselves with small amounts of ODS that are not cost-effective to collect and destroy, even with the financial incentive of the voluntary carbon market. As discussed in Section 9.4, possible solutions for dealing with low volumes of ODS are to combine projects with other activities that are also eligible for carbon credits, such as refrigerator replacement for energy efficiency credits, or to group projects together to reduce transaction costs. However, grouping project activities across countries may be administratively difficult and would require a project developer to be aware of opportunities across borders. For a multinational company, this might be feasible, but for a local developer it would be much more challenging. The international clearinghouse described above could also facilitate the coordination of project opportunities.

9.6 Restrictions on Export/Import of ODS for Destruction and Accessing ODS Destruction Capabilities

A critical challenge to the ability of both A5 and non-A5 countries to participate in the voluntary market is countries' regulatory restrictions on the export/import of ODS for destruction. Existing policy frameworks in some countries may not allow, or facilitate, the export/import of ODS for destruction. Addressing these restrictions would be critical to the viability of using the voluntary market to finance ODS destruction. For example, in Saudi Arabia, export of ODS is currently prohibited, implying that if destruction of those materials is to take place, it must happen domestically, unless regulations can be changed (see case study in Appendix A). In addition, some countries face regulatory hurdles in the export of unwanted ODS for destruction. Indonesia, for example, requires a cumbersome government approval process for all ODS and hazardous waste exports. Consequently, the Indonesian government instead adapted a domestic cement kiln for ODS destruction (see case study in Appendix A for further details).

However, few A5 countries have existing capacity to destroy ODS, and building new destruction facilities is not always feasible, cost-effective, or environmentally sound, given the carbon footprint of new construction. This particular challenge is somewhat independent of the source of financing; regardless of whether ODS destruction is financed through the voluntary market or otherwise, the issue of limited technical capacity to actually destroy the material needs to be overcome. One option is to use mobile destruction units, current models of which can destroy hazardous waste at rates of 5 kg per hour and can provide a cost-effective destruction option for small stockpiles of ODS (MLF 2008). For countries with ODS export restrictions, CCX and the Reserve may not be options for financing destruction through the voluntary market, since these standards are already expected to limit eligible projects to those carried out in the United States, at least in the near-term. CCX also accepts ODS imported to the United States for destruction. VCS, however, is expected to accept ODS destruction projects carried out throughout the world. The value of ODS destruction project credits could vary depending on the location where destruction is actually carried out; the extent to which this variation will occur has yet to be experienced.

Article 5 countries may also be able to facilitate ODS destruction by utilizing existing infrastructure and minimizing the construction of new facilities. For example, the Nordic Environmental Financing Corporation is planning an initiative to recover and destroy ODS from end-of-life appliances in the greater Moscow region, using an existing retailer network for collection (see case study in Appendix A for details). While the units must be transported to Finland for recovery and destruction, this can be accomplished by utilizing the idle capacity of the Finnish trucks that deliver new refrigerators to Russia and often return empty. Furthermore, the demanufacturing of refrigerators will be conducted at an existing facility that has the capacity to handle more units than it currently processes. Projects which minimize the implementation of new infrastructure and utilize existing capacity are also a way to destroy ODS at lower cost.

10. Towards a Comprehensive Strategy for Financing ODS Destruction through the Voluntary Market

Because little ODS is currently thought to be recovered at equipment end-of-life, the possibility of earning carbon credits through the voluntary carbon market presents a potentially significant financial incentive for recovery and destruction of unwanted ODS, which would likely otherwise be eventually released to the atmosphere. In addition, since the voluntary carbon market represents an independent source of financing wholly separate from the MLF, in theory the use of a voluntary market to fund ODS destruction has no financial implication for the MLF and the non-A5 country governments that replenish the Fund. In that sense, the voluntary market seems like a win-win opportunity; incentives are created for the recovery and destruction of ODS through the carbon credits that can be earned, and buyers pay for real and verifiable emission reductions from the destruction of ODS that would have otherwise been emitted. As the previous chapter has demonstrated, however, a number of perceived and real challenges exist to applying the voluntary market financing concept broadly across all countries, all project types, and project sizes.

This chapter lays out important elements for a possible global program or approach towards ODS destruction, first answering the fundamental question of whether there is or could be a market for ODS destruction from both an infrastructure and demand point-of-view, then describing the potential roles of the members of the Montreal Protocol community in facilitating such a program, next proposing several strategies for minimizing the cost of ODS destruction projects, and finally describing possible gaps in relying on the voluntary market for financing all ODS destruction projects.

10.1 Is There a Market for ODS Destruction?

This question is fundamental to whether the voluntary carbon market represents an opportunity for financing ODS destruction: there must be some basic market structure to support ODS destruction and sufficient demand in the market for carbon credits from ODS destruction projects in order for the scheme to succeed.

10.1.1 Basic Market Structure

At the most basic level, in order for ODS destruction projects to be credited, there must be GHG programs covering ODS—i.e., third-party voluntary standards that offer carbon credits for projects that destroy ODS—and methodologies to guide those ODS projects. As of February 2010, CCX, the Reserve and VCS all cover ODS destruction projects in their GHG programs.

Thus, there are three standards offering credits for ODS destruction projects. With regard to available methodologies, CCX already offers a project protocol to guide ODS destruction projects, as does the Reserve (two protocols in fact) to be used for ODS destruction. VCS will rely on the submission of ODS destruction methodologies by project proponents and other entities, and several methodologies have already been submitted.

While the basic market structure to support ODS destruction projects is now in place, some standards provide a more restricted opportunity for participation by all Parties to the Montreal Protocol, at least in the short-term. Under CCX, only projects carried out in the United States are eligible for crediting, although importing unwanted ODS material to the U.S. for destruction is also allowed. The Reserve also limits eligible projects to those carried out within the United States, although material imported from A5 countries to the United States for destruction are eligible under a separate project protocol. From the outset, VCS appears to be the most international in scope, as destruction is eligible in any country that can meet the technical requirements.

10.1.2 Demand for ODS Destruction Credits

With regard to whether there will be sufficient demand in the voluntary market for ODS destruction, it is important first to consider the relationship between the volume of ODS destruction projects that could be registered, and the overall projected size of the market. As discussed in Chapter 7, there could be a substantial amount of ODS available for destruction in both A5 and non-A5 countries, depending on the rate of recovery. Given currently low rates of recovery, ODS destruction could represent at most a quarter of the voluntary market volume in 2010 (assuming a recovery and destruction rate of 10%, which is likely optimistic for many A5 and even non-A5 countries, at least in the short term). Thus, ODS destruction projects are considered unlikely to overwhelm the voluntary market.

In addition, it seems highly unlikely that currently low rates of recovery will increase significantly in a short period of time, such as over a few years. For example, with the financial incentive provided through the CCX market for ODS destruction, 11 projects have been registered—for a total of 787,300 tCO_2e—since the addition of the ODS destruction protocol to the CCX in 2007. This amount represents less than a percent of the total amount of CFC refrigerant and halon estimated to be *recoverable* in the United States from 2007 to 2009, suggesting that U.S. recovery rates have not yet responded in the aggregate to this incentive. That said, as the opportunity to finance ODS destruction through the voluntary market expands and knowledge and capacity grows, participation and recovery rates could also rise over time. But even with increasing recovery rates, growth in the voluntary market and a decrease in the volume of reachable banks means that ODS destruction projects will be a small percentage of the market in later years.

Apart from volume concerns, another important aspect of ensuring that there is a market for ODS destruction projects will be to clearly differentiate ODS destruction projects from past industrial gas projects, such as the destruction of HFC-23, which have encountered criticism in the carbon markets. ODS destruction projects differ from HFC-23 destruction projects in several important ways (see Section 7.1.1). Indeed, ODS destruction has a compelling story: it extends the prior success of the Montreal Protocol in phasing out the consumption and production of ODS to cover the missing part—emissions—and, as such, ensures that the full lifecycle of ODS is addressed from initial production to end-of-life recovery and disposal. Highlighting these advantages will be important for creating a good reputation and demand for ODS destruction projects in the voluntary market.

It is also possible that in the early years of an ODS destruction program, some investors might be shy to venture into a new project type or ODS owners might have difficulty finding a project developer or an investor. Upfront financing from an organization with lending capabilities could play an important role in ensuring that such projects *do* initially get developed.

10.2 Capitalizing on the Existing Montreal Protocol Infrastructure

Capitalizing on the existing Montreal Protocol infrastructure can provide additional value and credibility for ODS destruction projects. Many of the roles and responsibilities already in place can be assembled in the form of a global program for facilitating the ODS destruction process. Table 20 below summarizes proposed strategies for improving the opportunity for financing ODS destruction through the voluntary market, as well as for the entities involved, as described in more detail in the remainder of this section. In addition to these entities, other Montreal Protocol stakeholders—such as NGOs and technology companies—could be mobilized to raise awareness about ODS destruction or provide incentives to promote the replacement of old ODS-containing equipment.

Table 20: Summary of Strategies for Improving the Opportunity for Financing ODS Destruction through the Voluntary Market, and Associated Roles

Strategies	Ozone Secretariat	Country Governments	MLF / Implementing Agencies	Technical Bodies
Develop and manage an international clearinghouse	✓	✓		
Track ODS imports/exports for destruction	✓	✓		
Assess taxes on the sale of VERs for ODS management		✓		
Remove or minimize regulatory, logistical, and technical barriers		✓	✓	
Provide upfront financing to initiate project development			✓	
Provide technical information that can lend credibility to methodologies				✓

10.2.1 Ozone Secretariat

In a global program for ODS destruction, the Montreal Protocol Parties may wish to consider expanding the role of the Ozone Secretariat in two important ways. First, as described in more detail in Section 9.5 above, the Ozone Secretariat could offer a clearinghouse-type function for connecting owners of ODS banks with project developers and investors by building on its current responsibilities for managing the Parties' data reporting under Article 7 of the Montreal Protocol. Such a clearinghouse could improve the ability of A5 countries to participate in the voluntary market by making available information on the country of origin of ODS banks, and thereby facilitating the project identification process.

Second, the Ozone Secretariat could play a role in managing a registry for tracking ODS imports and exports for destruction. This registry system could complement the verification procedures that would be undertaken for individual projects and allow for the Montreal Protocol community to keep a closer watch on the movement of ODS from country to country for destruction purposes. The information for the registry could be tracked and submitted by the country government focal points in collaboration with national trade authorities and could be used as a means to corroborate project data and offsets recorded in the registries of the relevant standards or programs. Keeping track of the amount of ODS sourced from each country for destruction also provides a reality check if, for instance, large amounts of ODS seem to coming from small countries thought to have small banks. As an added check to the system, this could serve to improve the credibility of the assets and overall market.

In addition, the Ozone Secretariat, with direction provided by the Parties, could potentially coordinate with other multilateral environmental agreements—such as the Basel Convention and Stockholm Convention—for streamlining or harmonizing requirements to facilitate ODS destruction.

10.2.2 Country Governments

Country governments would have critical roles to play in a global program or approach that facilitates a market for ODS destruction, both as owners of unwanted ODS (such as material confiscated through Customs) and as facilitators of the ODS destruction process in their countries. As owners of unwanted ODS, governments would need to pursue ODS destruction projects either on their own or by contracting a private company to undertake the project development process. As facilitators, governments could undertake a number of activities. First, governments could collect data from the private sector on existing ODS banks as an input to the clearinghouse managed by the Ozone Secretariat. Second, governments could track the movement of ODS across their borders—imports and exports—for the express purpose of destruction, and report this information to the Ozone Secretariat. Because countries already have experience in auditing and reporting data on an annual basis, the structure for gathering and reporting high-quality data is already in place. Maintaining information on the amount of ODS shipped for destruction and the destination (or origin) will help the Montreal Protocol community better understand the progress toward destroying unwanted ODS.

Third, as discussed in more detail in Chapter 9, governments could assess a tax on the sale of VERs generated by ODS destruction projects, similar to how the Chinese government levied a tax on the sale of CERs generated by HFC-23 destruction projects. The revenue from this taxation could be used by the government to provide upfront financing for less cost-effective projects, such as smaller volume projects or domestic appliance collection projects, or for ODS management more generally.

Finally, governments have an important role to play in removing or minimizing regulatory, logistical, or technical barriers, which exist independent of the source of financing. Regulatory impediments to exporting ODS for destruction or a lack of infrastructure for recovery and collection of ODS will challenge the success of any strategy for promoting ODS destruction. For example, regulations that prohibit or make it difficult to export unwanted ODS for destruction can limit a country's capacity to participate in the voluntary market. As a priority, governments should seek solutions to these and other barriers to improve access to the voluntary market.

10.2.3 Multilateral Fund and the Implementing Agencies

The Multilateral Fund and the Implementing Agencies could also play a role in helping countries to overcome barriers to ODS destruction—such as helping to build infrastructure for ODS recovery or training technicians in proper ODS recovery procedures—in order to create the enabling environment in A5 countries to manage ODS, which should in turn facilitate participation in ODS disposal projects. In addition, Agencies with financing capabilities should explore options for providing upfront carbon finance to ODS destruction projects to catalyze the market and to the extent possible, mainstream ODS disposal in waste management investment projects, as discussed previously.

10.2.4 Technical Bodies such as TEAP

Montreal Protocol technical advisory bodies, such as TEAP, are already playing an important role in developing the opportunity for financing ODS destruction through the voluntary market. For example, VCS' extension of scope refers to the report of the TEAP Task Force on Destruction Technologies as the source for screening criteria for destruction technologies and requirements for DRE. By relying on existing analysis and expert input developed by the TEAP, third-party standards and methodologies can help ensure that robust and real emission reductions are achieved through the destruction of ODS. TEAP and the Technical Options Committees could continue to provide such technical input to the process.

10.3 Strategies to Minimize Costs and Maximize Revenues

As discussed in Chapter 9, a significant challenge to developing some ODS destruction projects can be the high cost of project implementation combined with large transaction costs, particularly for low volume projects. Several strategies can be employed to minimize project costs and maximize the revenues earned.

A critical component of such strategies will be to combine ODS destruction projects with other activities or programs that are also eligible for crediting in the carbon market, such as equipment replacement for energy efficiency credits. For example, under the CDM methodology AMS0060, carbon credits can be earned for emission reductions associated with reduced electricity consumption from the use of more efficient building chillers. Thus, a project developer replacing old building chillers with more energy-efficient ones could at the same time recover the CFCs from the old building chillers and destroy them, and then apply for both energy efficiency and ODS destruction credits. Other methodologies, such as the CDM small-scale methodologies AMS III.X and II.C, provide opportunities for energy efficiency gains from household refrigerators and other refrigeration and AC equipment. Under VCS, which accepts CDM methodologies, such activities could also be combined into one project, thus reducing transaction costs and significantly boosting revenues. This strategy can also be highly effective to fund ongoing collection programs, such as municipal, utility, or retailer programs to collect refrigerators upon disposal, and to ensure that the ODS refrigerant and foam blowing agent are destroyed.

ODS destruction activities could also be mainstreamed into larger programs and development projects, such as a comprehensive waste management program, as discussed above. By combining ODS destruction activities into these broader programs, other components necessary for the success of this opportunity—financing ODS through the voluntary market—might also be incorporated, such as more generalized technical assistance for strengthening country capacity in carbon finance, or strengthening countries' climate change and energy agendas.

Another strategy to minimize project costs is grouping or pooling projects[28] together to minimize transaction costs and to achieve economies of scale. For example, the VCS allows several projects to be included in a single project description, as long as the grouped project has a central GHG information system and controls associated with the project and its monitoring.

10.4 Gaps Remaining Through Reliance on the Voluntary Market

As the discussion in Chapter 9 illustrated, while there is a great opportunity for financing ODS destruction through the voluntary market, a number of challenges and gaps remain. The following are the main gaps that were identified:

- **ODS not covered by the voluntary market**—although the Montreal Protocol community is playing a direct and influential role in the development of eligibility criteria and project protocols for ODS destruction, there is

[28] The rules for grouping projects are dependent on the standard being sought. Under the VCS, a "grouped project" is "a number of projects and their related methodologies included in a single VCS Project Description (VCS PD) at the time of the validation." Under CCX, a "pooled project" is "the multiple projects that are represented in CCX by a single Aggregator." Under CDM, "bundling" and a "program of activities" also have specific definitions and rules.

no guarantee that the third-party standards will cover all ODS types in the full range of project circumstances. For example, while the CCX provides credits for halon destruction, the Reserve and VCS will not allow crediting for halon projects, at least initially. If halons are not widely covered by standards in the voluntary market, this may limit the opportunity for halon destruction and represent a gap that must be addressed through another means.

- **Countries with low volumes of ODS**—Some A5 countries, such as low-volume consuming countries, may have volumes of ODS that are not cost-effective to collect and destroy, even with the added financial incentive of the voluntary carbon market. This situation would need to be reviewed on a case-by-case basis, but represents a possible gap for what the voluntary market can offer.
- **Countries with limited carbon finance capacity**—Some A5 countries may not have the base carbon finance capacity needed to participate in the voluntary carbon market, especially in the early years of such a program. A number of institutions, such as the World Bank Institute's Carbon Finance Assist program or UNEP Risoe, are already working to build carbon finance capacity in developing countries. Some possible solutions, such as initial upfront financing from IFIs as suggested in Chapter 9, exist, but without a strong and concerted effort to address this potential gap, some countries could fall through the cracks.

These gaps are important to understand in order to design an overall strategy for ensuring the recovery and destruction of unwanted ODS since some of these gaps may require other approaches—beyond reliance on the voluntary market—to fully address ODS banks' management in an environmentally sound manner. Given these gaps, a natural conclusion might be that the voluntary market cannot serve as the *only* source of financing for ODS destruction. That said, using the voluntary carbon market to finance ODS destruction could be a highly successful and cost-effective approach in many cases, and certain strategies can be pursued for improving the opportunity for all Parties to the Montreal Protocol.

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Appendix A: Case Studies

As discussed in this report, stocks of ODS are found in a wide variety of circumstances around the world, facing numerous barriers for their destruction. In order to illustrate some of these challenges, five selected case studies are presented here to provide detailed insight into the project process. A few of these case studies illustrate the process for a successful destruction project, while a few others exemplify the challenges that ODS destruction projects often encounter. The case studies are presented in the following order:

- Indonesia: Upgrading a Cement Kiln to Destroy ODS
- Argentina: Efforts to Export CTC for Destruction
- Russia: Program to Collect and Destroy ODS in Domestic Refrigerated Appliances
- Gulf Cooperation Council: Destruction of ODS
- Earning Carbon Credits under CCX for the Destruction of ODS

Indonesia: Upgrading a Cement Kiln to Destroy ODS

In compliance with its ODS phaseout obligations under the Montreal Protocol, in 1998 Indonesia banned the production and importation of various ODS. Since that time, a number of ODS have been illegally imported into the country and seized by customs officials. However, the lack of funding and the lack of domestic ODS destruction facilities have hindered the disposal of such ODS. As this case study examines, a plan was developed with the Japanese Ministry of Environment to adapt an existing cement kiln in Jakarta, Indonesia to be capable of destroying ODS. The facility began destruction of ODS in 2007 and has since been used to destroy ODS stocks from several commercial clients.

This case study presents an example of modifying an existing destruction facility in an Article 5 country to accommodate ODS destruction. Indonesia's decision to utilize an existing facility in lieu of constructing a new, dedicated destruction facility was practical not only in terms of cost, but also given the low volumes of unwanted ODS present in the country. For other countries, the export of unwanted ODS to an existing facility in the region may represent a more attractive option.

1. Background

1.1 Regulation

Over the last decade, Indonesia has taken several regulatory actions to phase out ODS, including the enactment of multiple production/import bans. In particular, in 1998, Indonesia banned the production and import of carbon tetrachloride, halon, and methyl chloroform. In 2006, the Minister of Trade issued Decree No. 24/2006, banning the import of CFCs, R-500, R-502, trichloroethane, and methyl bromide (except in quarantine and pre-shipment applications). In 2007, Indonesia banned the use of all ODS in the manufacture of new products, effective July 1, 2008. Indonesian regulations require government approval for the export of any hazardous wastes, including unwanted ODS; in accordance with the Basel Convention, the recipient country must be contacted for approval of the shipment.

In addition, the import of HCFCs is subject to a number of regulatory checks. Specifically, permits are required for the import of ODS, which limit the amounts and time periods of import. Shipment must pass through one of six designated entry points in the country, and refrigerant identifiers are used to verify the contents of ODS imports (55 units were in service as of February 2009 with more planned for purchase).

According to Indonesian law, all CFCs, halons, and methyl bromide are classified as hazardous substances, and all types of ODS must be "properly managed" for their entire lifecycle—although destruction is not mandated, per se. National law also classifies all unwanted ODS as "hazardous waste" and requires that stocks be managed in accordance with hazardous waste laws (e.g., Regulation 85/1999 on hazardous waste management and transport, Regulation 18/2009 on permitting hazardous waste handlers).

1.2 The Need for ODS Destruction Capacity

In accordance with the country's import ban, Indonesian Customs officials have confiscated approximately 177 tonnes of ODS since February 2004, as shown in Table 21. Of this amount, approximately 79 tonnes of ODS have been re-exported; the remaining 98 tonnes are being stored in customs warehouses and are available for destruction. These confiscated stocks include CFC-12, CFC-11, and HCFC-141b, and are prohibited from use under Indonesian law. For most seized shipments, import declarations, bills of lading, invoices, and/or packing lists are available for documentation purposes.

Export for Destruction: An Example

Prior to having an Indonesian-based facility capable of destroying ODS, at least one known shipment of unwanted ODS was exported from Indonesia to Australia for the purpose of destruction. Specifically, in 2005, 21 tonnes of mixed CFC-12 and HCFC-22 stocks were recovered by an oil company in Indonesia and subsequently exported to Australia for destruction. In order to export the ODS, the oil company obtained a permit from the Indonesian government, who had in turn notified the Australian government of the export plan and received approval. The project costs totaled US$520,000, including transport by ship (US$20,000), insurance (US$220,000), and destruction (US$10.50/kg)—among other costs.

Table 21: ODS Seized by the Indonesian Customs Office

Port of Import	Date of Confiscation	Declared Contents	Identified Contents	Amount	Total ODS	Status
Tanjung Priok, Jakarta	Feb. 11, 2004	R-134a	R-12	745 cyl. @ 13.6 kg	10,132 kg	Storage
Tanjung Emas, Semarang, Central Java Province	Mar. 24, 2004	R-22	R-12	2,300 cyl. @ 13.6 kg	31,280 kg	Re-exported
Tanjung Emas, Semarang, Central Java Province	Sept. 3, 2007	R-134a	R-12 R-11 R-141	2,907 cyl. @ 13.6 kg 100 drums @ 40 kg 16 drums @ 250 kg	39,535.2 kg 4,000 kg 4,000 kg	Re-exported
Tanjung Balai, Karimun Island, Riau Islands Province	Oct.1, 2007	No manifest	R-12	248 cyl. @ 13.6 kg	3,372.8 kg	Storage
Tanjung Priok, Jakarta	Mar. 25, 2009	R-134a	R-12	1,140 cyl. @ 13.6 kg	15,504 kg	Storage
Merak, Banten Province	May 25, 2009	R-134a	R-12	3,962 cyl. @ 13.6 kg	53,883 kg	Storage
Pontianak, West Kalimantan Province	Jun 2, 2009	R-134a	R-22	1,145 cyl. @ 13.6 kg	15,572 kg	Storage

Both seized ODS and ODS recovered from retired equipment create unwanted stockpiles. As a result, there was a desire to develop in-country ODS destruction capacity.

2. Project Development

The process of finding a solution to Indonesia's ODS destruction needs began in 2005. With identified ODS stockpiles ready for destruction, the Indonesian Ministry of Environment (KLH) and the Japanese Ministry of Environment (MOE) held a workshop to collaborate on developing a pilot ODS destruction facility (Holcim 2009).

Project leaders soon determined that constructing a new, dedicated ODS destruction facility would not be financially attractive. In order to maintain a viable facility, a steady stream of ODS must be available for destruction, and such volumes were not expected in Indonesia.

Project developers determined that the more viable option was to modify an existing cement kiln such that it could destroy ODS as part of its normal operations. Cement kilns are used by the cement industry to convert limestone into clinker, a precursor to cement. They typically operate at temperatures of over 1,600°C (CKRC 2007). Because of their high temperatures and their need for fuel, cement kilns are co-utilized around the globe for the purposes of hazardous waste destruction, including ODS destruction. However, it is critical to closely monitor the feed rate of ODS, as excess fluorine in cement kilns can cause damage to the facility (Multilateral Fund 2008).

In 2005, during the early stages of project development, the KLH invited several companies operating cement kilns to meet and discuss the possibilities of retrofitting a cement kiln for ODS destruction. Only Holcim Indonesia expressed interest in the initiative. Holcim Indonesia TbK is the country's third largest cement producer, and is part of the multinational Holcim Group, which has cement operations in 70 countries. The company was seen as having sufficient resources to oversee and operate the facility well.

Figure 31: Holcim Indonesia's Narogong Plant

(Source: Holcim 2009)

Holcim Indonesia's Narogong facility, located in Jakarta, was the cement kiln selected for the project. The Narogong facility is one of Holcim's three cement and clinker production sites in Indonesia, and one of two hazardous waste-permitted destruction facilities owned by Holcim Indonesia. The Narogong facility in Jakarta was selected for destroying ODS over the other hazardous waste facility (in Cilacap [Central Java]) due to its proximity to sources of unwanted ODS in Indonesia.

Work on the cement kiln retrofit progressed according to the following schedule (Holcim 2009):

- *May 2006* – A Memorandum of Understanding was signed between KLH, the Japanese MOE, and Holcim Indonesia
- *September 2006* – A site study was conducted at Sumitomo Osaka Cement Japan
- *October 2006* – Engineering work on the Narogong facility underway
- *February 2007* – Cement kiln modifications were completed, and the KLH issued a permit for trial runs
- *April through July 2007* – Emissions tests were conducted
- *June 2007* – Technical experts from Sumitomo Osaka Cement conducted site inspections
- *August 2007* – The KLH issued a permit to begin ODS destruction at the plant

3. The Technology

At the time of project inception, Holcim's Narogong cement kiln was already a permitted hazardous waste destruction facility capable of destroying polychlorinated biphenyls (PCBs). Thus, to render it capable of destroying ODS, only the addition of an ODS injection system and performance testing were needed (see Figure 32).

This injection system was installed by Holcim beginning in October 2006. The additions consisted of an ODS feeding station, flowmeters, valves, a valve train, control valves, and piping to the main burner (see Figure 32).

Figure 32: The ODS injection piping (left) and connection into the burner (right)

(Source: Holcim 2009)

Tests were conducted to determine the facility's performance. CFC-11 was chosen, with 1.5 tonnes necessary for conducting the tests over a three-day period. The destruction and removal efficiency (DRE) was determined to exceed 99.9999%. The facility was also found to meet or exceed all national emissions standards for hazardous waste destruction facilities.

The cost of readying the facility for ODS destruction totaled nearly US$150,000. Approximately US$90,000 of this expense was spent on equipment modification, US$15,000 was used for detail engineering, and US$22,500 was spent on emission testing. Meetings, workshops, training, and travel cost approximately US$22,500.

All types of ODS can be destroyed at the Narogong facility, although the destruction of halon is not currently permitted.[29] The facility has an established procedure to ensure proper ODS destruction and efficient operations. Incoming ODS cylinders are weighed in an ODS station at ground level and checked by a flowmeter (see Figure 33). The cylinders are then connected to evacuation tubes, and the ODS is pumped up several stories and fed into the cement kiln. The cylinders are evacuated until zero pressure is reached.

Figure 33: ODS destruction at the Holcim Narogong cement kiln

Left: the flow meter in-feeding system; right: emptying a cylinder at the CFC feeding station.
(Source: Holcim 2009)

The kiln operates at temperatures of over 2,000°C, rapidly destroying the ODS. To prevent incomplete destruction, the injection system is designed to automatically shut down in the event of a significant temperature drop.

[29] While the facility is technically capable of destroying halon, it is not permitted to do so because it was not tested for halon destruction. This is because the destruction test requires 1.5 tonnes of halon, and such quantities are not available within Indonesia (and imports are prohibited).

The kiln has a total feed rate of 550 metric tons per hour. As part of this flow, approximately 50 to 80 kg of ODS can be fed into the kiln per hour, resulting in a capacity of 1 tonne of ODS per day. The energy use for destroying the ODS as part of cement operations is negligible, given that ODS destruction represents a maximum of 0.01% of the kiln's input feed on any given day, and that the kiln would operate regardless of whether ODS is destroyed or not. Indeed, the cement kiln is effectively in constant use, operating 24 hours a day over 320 days of the year.[30]

In regards to managing incoming ODS shipments, Holcim has limited storage capacity, so shipment arrivals are arranged to avoid conflicts. Cylinders are sent back to their owners after they have been emptied.

4. ODS Destruction Activity

4.1 ODS Destruction to Date

To date, the facility has destroyed more than 16 tonnes of ODS. The vast majority of this amount (96%) has been CFC-11, with the remainder being CFC-12, HCFC-22, and blends. Large shipments of ODS have been sent to the facility in drums, while smaller shipments have arrived in cans.

This ODS has been shipped for destruction from a variety of commercial sources that have decommissioned ODS equipment, namely: (1) Premier Oil, (2) Newmont Nusa Tenggara, (3) Tyco, (4) Kinden, (5) PPLI, (6) Ajinomoto, (7) Kodeco, (8) Star Energy, and (9) Magma Nusantara. With the exception of PPLI (a waste collector), all of these companies are foreign-owned and are believed to be destroying ODS in compliance with internal environmental policies. None of the companies listed have pursued carbon crediting on the voluntary market.

4.2 Verifying ODS Composition

To date, Holcim has relied on company-provided information to determine the types and quantities of ODS received by and destroyed at the facility. While the Narogong facility is equipped with gas chromatography (GC) equipment, there is no ODS standard by which to calibrate it, such that it could quantify the exact percentage of ODS (by type) that is received by the facility for destruction. However, because ODS imports are prohibited in Indonesia without a special permit, and insufficient quantities of virgin ODS exist in-country,[31] an ODS standard cannot readily be developed to calibrate the GC. The GC equipment is currently capable of qualitatively identifying the presence of ODS, but not the percent mix of gases in a cylinder.

An alternative to using gas chromatography for ODS identification could be use of refrigerant identifiers, such as those already in use by the Indonesia Customs Office, which are capable of identifying the types and percentages of ODS in a given cylinder.

4.3 Costs

ODS shipping costs vary widely based on volume and distance. However, Holcim estimates that the shipment of a 20-foot container containing an estimated nearly 5.5 tonnes of ODS, from Medan in North Sumatra to Narogong (roughly 2,000 km), would cost US$2,000 to US$2,500—or approximately US$0.00018 to US$0.00023/kg/km.

Destruction costs are approximately US$5 per kilogram, regardless of ODS type.

4.4 Testing

Holcim must renew its permit for ODS destruction on a periodic basis. Specifically, in order to receive a renewed permit, Holcim is required under Indonesian law to conduct testing on the facility every three months. Testing must demonstrate compliance with limits for the following emissions: particulates, sulfur dioxide, nitrogen

[30] Forty-five days are required each year for maintenance and cleaning operations, split into two separate three-week periods.
[31] CFC shipments confiscated by the customs agency is not permitted for use.

dioxide, hydrofluoric acid, hydrochloric acid, carbon monoxide, methane, arsenic, cadmium, chromium, lead, mercury, and thallium.

In addition, Holcim conducts regular testing under its own internal Environment Monitoring program. This includes testing for emissions that are not covered under regulatory tests, such as dioxins. All testing is conducted by an external lab under contract.

5. Future Outlook

Indonesian customs authorities have approximately 98 tonnes of confiscated ODS awaiting destruction. However, in some cases, legal proceedings must be completed before deeming the ODS illegal and thus suitable for destruction.

Looking ahead, the National Ozone Unit of Indonesia anticipates that greater quantities of ODS will become available for destruction. This is because Customs will continue to confiscate illegal imports that will require destruction. Further, a chiller replacement project and a new technician training program are both expected to result in additional quantities of unwanted ODS, which could be made available for destruction.

Argentina: Efforts to Export CTC for Destruction

This case study examines the efforts of an Argentine chemical company, Frío Industrias Argentinas, SA (FIASA), which sought to export and destroy a large stockpile of carbon tetrachloride (CTC) for carbon credits. In order to pursue carbon credits on the Chicago Climate Exchange, FIASA attempted to export the unwanted CTC stocks to the United States for destruction.

This case study illustrates some of the logistical hurdles and financial disincentives that can impede the export of ODS for destruction. The project also explores the effect of the voluntary market's trading price of carbon on the viability of ODS destruction projects, and highlights the importance of reducing logistical and regulatory impediments that effectively prevent ODS destruction projects from taking shape.

1. Background

1.1 Origins of ODS Stocks

FIASA is primarily a manufacturer and distributor of fluorocarbon refrigerants, but also distributes refrigeration and air conditioning equipment. In 2007, the company imported approximately 355 tonnes of CTC (426 ODP-weighted tonnes) into Argentina from Brazil and Spain, intended for use as a feedstock for CFC-11 and CFC-12 production. However, demand for CFCs rapidly decreased in Argentina and worldwide, and the Multilateral Fund worked in partnership with FIASA to phase out its production of CFC, with US$8.3 million approved for production closure, compensation, and technical assistance (Executive Committee of the Multilateral Fund 2007). Due to the limited demand for feedstock in the rest of Argentina and across Article 5 producing countries, FIASA had difficulty identifying a market for the surplus CTC. As a result, the CTC feedstock was deemed unwanted. FIASA considered its options for the unwanted stocks of CTC, and initially determined that it should be disposed of in a safe and environmentally sound manner (Project Concept Document 2008).

1.2 Regulatory Background

Production of ODS in Argentina has historically been limited, with refrigerant companies producing only three types of substances: CFC-11, CFC-12, and HCFC-22. As part of the country's ODS phaseout strategy, new companies intending to produce ODS were banned from establishing operations in Argentina starting in 2003. In addition, ODS imports are tightly controlled. An import and export licensing system was implemented in 2004, under which all planned imports and exports of ODS must receive prior authorization from the Ministry of Environment and Sustainable Development's Office of Ozone (OPROZ). A national ODS registry is used to monitor all imports and exports, with all records online and accessible to the public. To enforce these import regulations, OPROZ provided training to Customs officials on ODS regulations. This has resulted in the confiscation of several small illegal shipments of ODS to date. In addition, OPROZ does not authorize the export of ODS to countries that lack sufficient ODS management regulations.

In regards to unwanted stocks, Argentinean law holds the owner of the ODS responsible for its proper disposal. However, there is no specific requirement for destruction, since used ODS is in demand for servicing needs.

1.3 Capacity for ODS Destruction

Argentina does not have domestic facilities capable of destroying ODS. Efforts are underway to import equipment from Japan for the small-scale destruction of CFCs. Small-scale destruction capacity may be best suited to Argentina's needs, since there are no known large stockpiles of unwanted ODS in the country. No ODS is known to have been destroyed in the past in Argentina, nor has any ODS been shipped to another country for destruction.

2. Project Development

In determining what to do with the unwanted CTC, FIASA considered the following four potential options:

- Domestic use or export for laboratory applications;
- Export for use in Article 5 countries, a use that is not controlled by the Montreal Protocol

- Permanent storage in Argentina. This option poses the risk of leaking to the atmosphere, as well as the risk of illegal diversion to CFC production in future years if not monitored; or
- Destruction in Argentina or in another country.

During project development, FIASA learned from the World Bank that it would need to complete an audit of its phaseout commitment and also remove its CTC stockpile from Argentina, in order to receive the remaining phaseout assistance funding. FIASA felt that this narrowed its options for the CTC stockpile to destruction, either in Argentina or in another country, or export.

Having considered these options, FIASA determined that the best choice was export for destruction to the United States, since this would allow the company to register the project for carbon offset credits on the CCX—which required that destruction take place at a permitted destruction facility within the U.S.

Per CCX requirements, FIASA made arrangements to ensure that the destruction within the U.S. would take place at a facility meeting all U.S. legal requirements. To this end, FIASA made preliminary contacts with a number of U.S.-based destruction companies—including Clean Harbors, Perma-Fix, Ecoflo, and Veolia—in order to develop a destruction plan. All four companies had the facilities needed to destroy CTC at the CCX-required 99.99% DRE. FIASA also approached the World Bank for guidance to help facilitate the process, as well as Air Compliance Testing, Inc., to serve as a CCX-approved verifier on the proposed project. Because the U.S. allows ODS imports for the purpose of destruction (but not use), no legal barriers were at play.

A timeframe of six months was expected for the project, from the time a transportation carrier was retained to the time of receiving CCX credits. Total emissions avoided were estimated to be 489,417 tCO_2e, and the CCX credits to be received (after the 25% discounting) were estimated at 367,057 tCO_2e.

3. Outcome

Carbon offset credit prices on CCX are subject to market trends and fluctuations. Over the course of project development, the price of CCX credits reached historically low levels. As a result, the revenue that FIASA could have received from the sale of project offset credits was significantly lower than initially expected. Project costs would have thus likely exceeded the potential revenue.

For example, the destruction of 355 tonnes of ODS, at a cost of US$5/kilogram, would have cost US$1.78 million, not including the costs of transportation, shipping insurance, testing, verification, or validation. The destruction project would have resulted in carbon offset credits of approximately 367,000 tCO_2e (accounting for CCX's 25% discount factor, which existed in the project protocol at the time that FIASA was considering pursuing this project). At a carbon credit price of $0.25/$tCO_2e$, the price in CCX as of early September 2009, this would have brought FIASA only about US$91,800 in revenue.

As a result, the destruction of ODS and subsequent sale of CCX credits was not pursued. Instead, the CTC was exported to Brazil and Mexico for use as a feedstock, a more financially attractive alternative for FIASA (Argentina Oficina Programa Ozono 2009).

Russia: Program to Collect and Destroy ODS in Domestic Refrigerators

To assess the potential for ODS recovery and destruction from ODS banks in Russia, the Nordic Environmental Financing Corporation (NEFCO) is planning a pilot project in Moscow. Under the pilot project, disposed household refrigerators will be collected and shipped to a demanufacturing facility in Finland, and ODS from both the refrigeration circuit and the insulating foam will be recovered and destroyed.

This case study examines the planning and development of this pilot project. Lessons learned from this experience can be applied to projects in other countries that lack in-country infrastructure for safely managing household refrigerators at end-of-life.

1. Background

1.1 Project Development

NEFCO has undertaken an initiative to create an ODS management system that will recover and destroy unwanted ODS in Russia. NEFCO's long-term strategy is to support and finance the development of viable enterprises that can recover and destroy ODS stocks in Russia both cost-effectively and in accordance with the highest environmental standards. Currently, however, no regulations or incentives exist in Russia to promote the collection and proper disposal of household refrigerators at end-of-life. Moreover, no appliance demanufacturing facilities exist within Russia to process such equipment (Brüning 2009).

As a first step, therefore, NEFCO is developing an ODS destruction pilot project with technical and financial support from the Swedish Environmental Protection Agency and the Finnish Ministry of Environment. Specifically, the project will collect refrigerators from households in Russia and export them to Finland for metal recycling and recovery/destruction of ODS refrigerants and foams. The intent is that the sale of carbon credits will help finance the project (Brüning 2009).

Through this project, developers seek to shed light on the feasibility of managing end-of-life refrigerators in countries that lack in-country infrastructure, as well as to provide practical experience for other potential project proponents, and to generate dialogue among stakeholders on the project process. The project developers also seek to gain experience in developing an ODS destruction project that is approved through the voluntary carbon market, per an existing emissions reduction project methodology for ODS destruction projects.

Should NEFCO succeed in implementing the project, it will demonstrate the feasibility of collecting and handling old equipment and hazardous waste, which will further international dialogue related to the development of an integrated strategy for waste management, including ODS (Swedish Environmental Protection Agency 2009). Indeed, Russia is currently in the process of developing a waste electronic and electric equipment strategy, using the European Union's legislation as a model; the success of a waste appliance collection and recovery project can effectively support national efforts to implement a more comprehensive waste management regulation. Current regulations in Russia require only the recovery of ODS contained in certain commercial refrigeration/air conditioning units (see text box).

Current ODS Collection Efforts in Russia

Russia has regulatory requirements in place to collect refrigerant from large refrigeration/air conditioning units at hotels, grocery stores, and restaurants. During the maintenance of ODS-based units at these sites, refrigeration technicians are prohibited from venting the ODS and thus must recover it. Old CFC at such establishments must be replaced with alternative refrigerants, although there is no requirement for destroying the recovered ODS. As a result, Russia has an established network of technicians that are well-trained in refrigeration technology and maintenance, which may be potentially useful for future ODS destruction/replacement projects.

1.2 Scope and Emissions Reductions

The NEFCO pilot project aims to collect approximately 10,000 retired refrigerators in the greater Moscow area. Assuming each refrigerator contains a total of 500 grams of ODS refrigerant and foam, 5 tonnes of ODS will be recovered, leading to emission reductions of roughly 35,000 tCO_2e (Brüning 2009). This preliminary estimate is based on the assumption that CFC-11 will comprise approximately two-thirds of the ODS recovered from the units, while CFC-12 will represent the remaining one-third.

1.3 Carbon Financing

Project developers are using the EOS Climate methodology to structure the project design and required project documentation. The project developers may partner with the methodology developers in using the project for supporting methodology validation, if needed. Developers eventually plan to register the project with a third-party voluntary carbon standard, such as the VCS. It is envisioned that the project will meet the requirements of a soon-to-be accepted methodology, such that no additional time or cost will be required to develop and submit a new ODS destruction project methodology for approval under a given standard.

2. Project Design

The collection of refrigerators will be managed by a Russian subsidiary of a Nordic manufacturer and selected local retailers. The program will likely be in the form of an appliance swap system, with retailers collecting old refrigerators at the time new units are delivered. The collected refrigerators will then be stored in a central logistical facility in the greater Moscow area.

Currently, trucks are used to deliver new refrigerators from Finland to Russia, and many of the trucks currently return empty to Finland. This pilot project seeks to utilize this idle capacity to ship the end-of-life refrigerators to Finland. The refrigerators will be shipped as whole units, without prior disassembly or refrigerant/foam evacuation in Russia.

Once transported to Finland, the refrigerators will be disassembled at a facility that currently disposes a large number of refrigerators annually for Finnish retailers and can easily accommodate an additional 10,000 units from Russia (Brüning 2009). During the demanufacturing process, the refrigerant is evacuated from each unit and fed directly into the incinerator. The refrigerators are then manually broken down into metal components and plastics; the metals are recycled and the plastics are incinerated. The cabinet, or refrigerator frame, is then crushed in an airtight crushing chamber to release ODS from the foam, which is then siphoned directly to the incinerator. Currently, there is no measurement of the removed ODS refrigerant or blowing agent prior to incineration.

3. Challenges Anticipated

As this pilot project readies for implementation, a number of challenges are foreseen. First, the transport of end-of-life units across international borders may pose an obstacle. The refrigerators must be classified as used electric and electronic equipment for cross-border shipment under the Basel and Rotterdam Conventions, which may trigger a variety of administrative hurdles. In addition, Russian authorities may have to provide permits for the export of the refrigerators (Brüning 2009, Swedish Environmental Protection Agency 2009).

In addition, the refrigerant and blowing agent recovered from appliances is currently neither identified (for type of ODS) nor measured at the demanufacturing facility. This is because there has not previously been a need for such quantification (Brüning 2009). Thus, a measurement system for reporting and verification purposes will need to be developed to meet the requirements of any future approved methodology. One option for conducting such measurement is to use a material balance formula; under this approach, the weight of the unit would be measured before and after crushing (taking into account the air volume in the crushing chamber). However, based on a preliminary assessment, the cost and technical challenges associated with this approach are significant. Project developers are in ongoing discussion with methodology experts to understand the flexibility that the methodology may offer for the means of measurement.

Other challenges include timing the project in regards to the cyclic nature of collecting and shipping units at different times of the year (e.g., the ease of transport during the summer versus the winter) and determining the destruction efficiency of the destruction plant. In addition, coordination among the diverse stakeholders involved in the process (e.g., NEFCO, Russian retailers, the demanufacturing facility, and relevant government authorities) is critical, but can also pose challenges. The process for overcoming these challenges will be thoroughly documented in order to guide future projects and maximize efficiency and success.

Gulf Cooperation Council: Destruction of ODS

The Gulf Cooperation Council (GCC; also known as the Cooperation Council for the Arab States of the Gulf) is a regional cooperative group consisting of the countries of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. As part of its ODS phaseout program, the GCC prohibits the import or export of ODS. However, no regulatory mandate for the destruction of unwanted ODS has been implemented. To help facilitate destruction in the region, RemTec International, a U.S. company specailizing in the management of hazardous waste, and Pan Gulf Industrial Systems, a Saudi Arabian company specializing in industrial fire protection and instrumentation, are planning to collaborate on the Pan Gulf ODS Destruction Project to recover, consolidate, and destroy ODS at a dedicated plasma arc facility to be constructed in Saudi Arabia. To finance the project, it is intended that carbon credits will be generated under a validated Climate Action Reserve or Voluntary Carbon Standard methodology.

Thus, this case study presents a look at the ongoing planning and development of an ODS destruction project intended to be funded in part by the sale of carbon offset credits. In addition, this case study provides an example of regional cooperation on ODS destruction initiatives, with a central facility being used to meet the needs of several countries.

1. Background

1.1 Regulation

In accordance with the Montreal Protocol, GCC member countries are working to phase out ODS. To meet their phaseout obligations, the GCC countries prohibit the export of used or surplus ODS, with no execption for destruction. In addition, the import of ODS from countries not in the GCC is prohibited.

Currently, there is no regulatory mandate in place in the GCC for the destruction of unwanted ODS. Thus, unwanted ODS is indefinitely kept in storage (see Figure 34) or vented.

Figure 34: ODS stockpile stored in cylinders

1.2 Existing Banks of Unwanted ODS

In addition to the absence of a regulatory mandate to destroy unwanted ODS and the current ban on ODS export for the purpose of destruction, there is very little capacity or expertise in the region for ODS destruction. As a result, common practice in the industrial sector is to store surplus/used ODS indefinitely, until appropriate means of disposal become available. According to project developers, inventoried ODS banks in the region, including both refrigerant stored in containers and that installed in obsolete equipment, total 2,627 tonnes (see

Table 22). Detailed inventories for most of these stockpiles, including the original sources of the material, have been provided to the project proponents, with the intention of facilitating the carbon crediting process.

Table 22: ODS Identified Stockpiles in the Gulf Region

ODS Type	Amount (tonnes)	Location
CFC-12	1,000	Saudi Arabia
CFC-11	1,000	Saudi Arabia
Halon 1301	360	Kuwait
Halon 1301	267	Saudi Arabia

Further, an estimated 1,400 tonnes of additional ODS are installed in equipment still in operation within the GCC, as detailed in Table 23. The inventoried banks listed in these two tables consist primarily of ODS installed in and recovered from fire systems and chillers, and do not include ODS banks installed in domestic appliances. In addition, ODS banks have not been inventoried for all GCC member countries, so more ODS installations and stockpiles likely exist in the region.

Table 23: Estimated ODS Banks in Equipment in the Gulf Region

ODS Type	Estimated Volume (tonnes)	Location	Type of Equipment
CFC-12	500	Saudi Arabia	Chillers
CFC-11	500	Saudi Arabia	Chillers
Halon 1301	250	UAE	Fire Systems
CFC-11	150	UAE	Chillers

1.3 Existing Facilities

Current capacity for destroying these ODS stocks within the region is very limited. One incineration facility, Bee A'h, located in Jubail, Saudi Arabia, is designed to destroy petrochemical sludge and waste. The facility has processed a small amount of ODS, but its capacity to destroy significant volumes of ODS is highly limited as it is not designed to handle the hydrochloric acid and hydrofluoric acid that are produced during ODS destruction. These acids can easily damage incineration facilities that are not specifically designed to be resistant to such byproducts. The focus of the disposal at Bee A'h is petrochemical sludge and waste streams. The possibility of retrofitting the facility such that it could handle larger volumes of ODS was determined not to be a cost-effective option. As export to a country outside of the GCC is currently prohibited, the only viable option for ODS disposal within the current legal framework is to construct a new facility.

2. Project Development

2.1 Project Proponents

In order to address the need for ODS destruction within the GCC, RemTec International, a halocarbon specialist headquarted in Ohio, USA, in collaboration with Pan Gulf Industrial Systems, headquartered in Al-Khobar, Kingdom of Saudia Arabia is developing a project to recover and store or destroy ODS from GCC member countries. Known as the *Pan Gulf ODS Destruction Project,* at its core is the proposed construction and operation of a Halocarbon Plant in the eastern province of Saudi Arabia. The proposed facility is to be the first facility of its kind in the region, and will be designed with state-of-the-art technology for halocarbon handling, reclamation, and disposal.

RemTec will develop the facility and then operate it jointly with Pan Gulf Industrial Systems. The project owner is registered as a joint venture between Pan Gulf Holdings and RemTec International. The project is currently under approval by the relevant government bodies in Saudi Arabia.

Once the facility is up and running, a certain amount of the recovered ODS will be decanted into storage vessels and reclaimed and stored in a dedicated storage facility for future critical use needs, while the rest will be targeted for destruction. The project developers intend to register the destruction of ODS for carbon credits under the Reserve or VCS and generate funds from the sale of carbon offsets. It is envisioned that the project will be privately funded with project costs re-paid in part or in full through earned carbon offset credits.

2.2 The Facility

The proposed Pan Gulf Halocarbon Plant will feature a PLASCON® argon plasma arc for ODS destruction (see Figure 35). This technology has been approved by TEAP and has been shown to destroy ODS with a 99.9999% DRE. It is used for large-scale ODS destruction in Australia, where it was first commercialized, and in the U.S. Project developers expect the capacity of a single PLASCON® plasma arc destruction system to be 500 MT of ODS per year and to be scalable with additonal PLASCON® units. The system will accept a 100% ODS waste stream feed. The facility will also be designed to allow for one to two additional plasma arc destruction systems if further capacity is needed in the future.

Figure 35: A PLASCON® plasma arc destruction unit

In order to ensure safe operations and minimize exhaust emissions, the plasma arc destruction system will be monitored by a computer control system, with stack temperatures, stack flow, acidity, and alkalinity being continuously monitored and recorded. Samples of destruction effluent will also be regularly tested to ensure thoroughness of destruction and, for verification purposes, could be compared to gas chromotography readings for individual batches of ODS fed into the unit. The PLASCON® arc will be tested at least once a year, following the initial full validation, to ensure that TEAP standards are being met. The facility will be directly managed by RemTec International, which will provide training to the local staff.

In addition, the facility's location will allow for both port and rail connections for easy access to ODS shipment from other GCC countries (see Figure 36). Consolidation, testing and weighing of the received shipments of ODS will take place at the facility.

Figure 36: One of RemTec's multimodal shipping tanks, used for shipping refrigerant by rail, ship, or truck

3. Expected Outcomes

3.1 Operations

Following planning and construction, it is expected that operation of the new destruction facility will begin by the end of 2010 or early 2011, depending on the timing of the Reserve or VCS application and subsequent approval (excluding halon). Few challenges are expected in construction and operation, since Pan Gulf has extensive experience with the operation of industrial facilities in the region.

Per the import ban, only ODS recovered in the GCC will be destroyed, and few challenges are expected in transporting ODS from these member countries into Saudi Arabia. Given the inventory of stocks in the Gulf region, project developers are anticipating that 600 to 1,000 tonnes of ODS will be decommissioned, stored, and reclaimed or destroyed each year, over the next five to eight years. Since the capacity of the the destruction facility is expected to be 650 to 1,000 tonnes per year, the facility will likely be able to handle the vast majority of the destruction needs of the region. In the future, additional facilities could be built in the United Arab Emirates or Kuwait, as needed. In the future, the facility will be able to handle HCFCs and HFCs, as these materials come offline.

3.2 Meeting the Criteria for Carbon Offset Credits

Since project developers are planning on destroying significant volumes of ODS, they intend to register for carbon offset credits with the Reserve or VCS. It is anticipated that the project wll be developed using the Reserve's ODS destruction protocol or a methodology validated under VCS. Accordingly, all project details are expected to be in compliance with the Reserve or VCS' criteria.

In particular, only ODS that are eligible for carbon credits will be destroyed, including all refrigerant gases that have been phased out under the Montreal Protocol. Other ODS will be stored until such a time as those materials would be eligible under the Reserve, VCS, or other protocol.

When applying for project approval through the Reserve or VCS, letters from country officials will be obtained to certify that current regulations do not require ODS destruction—i.e., that all ODS destruction performed at the facility is indeed additional, and that all ODS would have been eventually leaked to the atmosphere in the absence of the project. This is an appropriate baseline scenario, as there is currently no incentive in the GCC for destroying ODS.

Additionally, a certificate of destruction that includes the GPS location of the destruction and a date/time code will be used to help ensure that destruction for another emissions reduction project is not being double-counted.

A certificate will also be provided to show that no other form of environmental credit was generated by this project.

3.3 Quantification of Emissions Reductions

It is expected that all necessary data for registering carbon offsets under the Reserve or VCS will easily be obtained, given the precautions taken to carefully measure and verify activities throughout the project pathway. For example, during the destruction process, the quantity of ODS being destroyed will be measured using scales and flow meters. Likewise, the contents of ODS shipments will be verified by gas chromatography and mass spectrometry, while data on the destruction process itself, such as arc temperature, will be provided by the computerized measurement devices associated with the modular PLASCON® unit.

Process emissions from destruction will be the result of electricity usage, as no fossil fuels are used by the plasma arc.

Leakage is expected to be zero, as there is no transportation involved after quantification and consolidation, which will take place at the destruction facility.

Earning Carbon Credits under CCX for the Destruction of ODS

An international chemical company's (hereafter, Company) successful destruction of refrigerant stocks, collected from clients and in-house facilities, was the first ODS destruction project approved under the Chicago Climate Exchange (CCX). Company earned CCX Carbon Financial Instrument (CFI) credits by using the approved CCX ODS destruction methodology and a CCX-approved verification company. Credits for Phase I of this project were issued in October 2008. Company's overall project entailed the destruction of 18,867 kg of mixed refrigerant, including CFCs, HCFCs, HFCs, and hydrocarbons. CFIs were received for only the eligible CFC portion of the mixture, but all of the materials were destroyed to TEAP specifications.

This case study provides insight into how an ODS destruction methodology can be followed to convert unwanted ODS stored in bulk into climate financial credits. In addition, the role of Company, an international company with the ability to undertake such projects utilizing best practices, provides a template on how to undertake ODS destruction projects in an environmentally-sound manner.

4. Background

Company, a multinational chemical company, operates a buyback program for its refrigerant customers, wherein they offer a market-competitive price for the return of recovered refrigerants, including unwanted ODS. As a result of this buyback program, as well as through the collection of ODS from its internal operations, Company was in possession of 18,867 kg of mixed refrigerant. The stocks comprised four types of HCFCs, five types of CFCs, five types of HFCs, and 2-butene.

Company decided to pilot an effort to destroy these stocks and pursue voluntary carbon offset credits under the CCX for the destruction of the eligible portion of the recovered refrigerant volume (i.e., the CFC portion). Through this project, Company sought to promote the responsible use and disposal of refrigerants in the industry.

5. Project Development

5.1 The Destruction Process

Once the decision was made to destroy the ODS per the CCX methodology, Company registered the project with CCX to obtain approval that the project would be valid under the criteria outlined in CCX's ODS Destruction Project Guidelines. Company then interviewed several approved third-party verification companies before deciding on Air Compliance Testing, Inc. (ACT).

Once the preliminary approval was obtained, Company's team proceeded to follow the CCX protocol and destroy the stocks; destruction took place in two phases since the material resided at two facilities. At each of these two locations, mixed refrigerant was consolidated and transported separately to a destruction facility. Phase 1 contained 8,806 kg of mixed refrigerants, of which 5,725 kg were CFCs. Phase II contained 10,062 kg of mixed refrigerants; of which 4,432 kilograms were CFCs. Thus, between the two phases, a total of 18,867 kg of mixed refrigerants were sent for destruction. All mixed refrigerants and ODS were destroyed in 2008.

5.2 Collection and Consolidation

The mixed refrigerant (including CFCs) was collected from in-house facilities and customer sites (the buyback partners) in a variety of container sizes, with all shipments received at the Company facility or at its reclaim and packaging facilities. Each incoming shipment was tested to determine volume and content by chemical type. After testing, the ODS was consolidated into 1 MT tanks.

5.3 Destruction

The 1 MT tanks of refrigerant were then readied for shipment to a destruction facility. Fourteen tanks were used in the Phase I shipment, either partly or completely full. A manifest of the tank contents was developed using gas chromatography and was attached to the shipment.

For Phase I, Company then sent the tanks by truck to a permitted hazardous waste incinerator operated by Clean Harbors, Inc. and located in El Dorado, Arkansas. The destruction facility is used for the disposal of various hazardous wastes, using two rotary kilns (see Figure 19) (Clean Harbors 2009). In rotary kilns, the flow of ODS must be carefully controlled and limited to prevent damage to the facility from high hydrofluoric acid levels.

After destruction was complete, Company estimated that the ODS losses incurred during the whole project, from collection, consolidation, transportation, and destruction, amounted to 1.5 to 2% of the original amount collected from customers.

Figure 37: Rotary Kiln at Clean Harbors' Facility

5.4 Verification

For both the Phase I and Phase II projects, Company enlisted the services of an approved CCX project verifier to confirm that the project met CCX standards. ACT, the approved verifier, monitored the project from the consolidation point through transport and destruction by Clean Harbors, and undertook analysis of emissions data from destruction, known as a Stack Emissions Monitoring Systems (SEMS) report. ACT also documented the purity of the materials destroyed. After completing this process, a certificate of treatment and destruction was provided to Company and CCX.

5.5 Costs

Based on the experience of both the Phase I and Phase II projects, an assessment of project costs was undertaken. Approximate project costs for collection, transportation, analysis, verification, and destruction are described in Table 24, with a total cost rate of US$36.18/kg for the 18,867 kg destroyed by Company.

Table 24: Costs for the Destruction of Unwanted ODS

Process	Cost per Kilogram (in US$)
Buyback (reference case: CFC-12)	$22.05
Collection and transfer	$2.20
Consolidation	$2.20
Transportation	$2.88
Purity analysis	$0.11
Third-party verification	$0.42
Destruction	$5.51
Other (initial feasibility assessment, project documents, validation and registration process, CFI offset rate)	$0.80
Total	**$36.18**

5.6 Voluntary Carbon Credits

With Phase I and II completed, Company's next step was to register carbon reduction credits with the CCX. A 25% discount was applied to the emissions reductions, per CCX's calculation methodology. As part of the Verification Findings report, ACT independently calculated the quantity of ODS destroyed and corresponding CFIs utilizing the Company tank weight sheets and gas chromatography analysis. ACT calculations were utilized in cases of data discrepancies. All calculations were checked for data reduction errors. Once the third party verifiers findings were reviewed and confirmed by CCX, vintage 2008 CFIs were posted to Company CCX Registry account related to Phase I of the Ozone Depleting Substance Destruction offset project submission. Phase II supporting documents have been submitted to ACT and are awaiting final verification.

6. Lessons Learned

The Company's experience in destroying bulk quantities of unwanted ODS for credits through CCX can provide important guidance for other potential project proponents. First, the use of a buyback program is an effective way to recover ODS from commercial and industrial users; it is also a good example of leadership in producer responsibility. Such a program allows for ODS consolidation and creates economies of scale whereby the costs of ODS collection, transport, and destruction are minimized, as are administrative project costs.

In addition, Company's extensive recordkeeping procedures facilitated a relatively straightforward project verification and development process with CCX.

Furthermore, the project indicated how the value of carbon offsets is an important consideration in the project feasibility assessment. As the value of the carbon credits decreases, as it has recently with CCX, the incentive to take on a project decreases, since pursuing the gathering and destruction of ODS would incur a cost with nearly no opportunity to offset the costs.

Appendix B: Terms of Reference for the Study

ELEMENTS OF TERMS OF REFERENCE FOR A STUDY ON FINANCING THE DESTRUCTION OF UNWANTED ODS

Purpose

1. Both developed and developing countries have or are in the process of eliminating the production and consumption of the most potent ozone depleting substances (ODS) that fall under the control of the1987 Montreal Protocol. However, the definition of ODS consumption – import plus production minus export – means that the Protocol does not control ODS existing in stockpiles and banks in countries (whether it be in equipment or cylinders). This includes unwanted ODS that no longer can be recovered or used.

2. As the complete phaseout date for Annex A and B chemicals is approaching, an increasing number of CFC equipment and products are being decommissioned. ODS from these outdated products, if left unmanaged, could place an increasing threat to the ozone layer protection. Since these chemicals also have high Global Warming Potential (GWP) in comparison with carbon dioxide, it is a concomitant threat to the climate. In responding to this threat, the Parties to the Montreal Protocol and the MLF have in the recent years increased their efforts to prevent releases of these unwanted ODS to the atmosphere. The MLF Secretariat convened an "Experts Meeting to Assess the Extent of Current and Future Requirements for the Collection and Disposition of Non-Reusable and Unwanted ODS in Article 5 countries" on 13–15 March 2006, and there have been a series of regional consultations held on different aspects of disposal and destruction issues involving Article 5 countries, the Secretariat, and bilateral and implementing agencies. A study for effective options to manage unwanted ODS was commissioned by the MLF and the draft report was presented at the 54th Meeting of the MLF Executive Committee. The MLF Executive Committee has consequently endorsed a proposal by the World Bank to conduct a study on how to develop a strategy to obtain funding through voluntary carbon markets for destruction of unwanted ODS, which would also include a methodology for the validation and verification of ODS disposal.

Background

3. Article 5 countries are currently in the compliance period of the Montreal Protocol and are expected to completely phase out the production and consumption of CFCs, halons and CTC by 2010. As these countries advance in implementation of MP obligations, they are increasingly faced with the reality long understood in non-Article 5 countries – that banks of ODS will have accumulated and continue to exist, posing an ongoing threat to the environment. This is particularly the case for ODS that cannot be recovered nor reclaimed either for technical reasons or in a cost-effective manner.

4. Unwanted ODS and the need for destruction capacity or choices has consequently become an increased subject of debate in meetings of the Parties and the MLF Executive Committee. Both bodies commissioned the development of terms of references for studies on environmentally sound destruction of ODS. In 2006, the Parties requested the Executive Committee to conduct one study on the collection and treatment of unwanted ODS in both Article 5 and non-Article 5 countries. This study is expected to be finalized for the July 2008 Open-ended Working Group Meeting.

5. The environmental risks of emissive uses of ODS extend beyond the ozone layer. At the 19th Meeting of the Parties, in September 2007, the Parties adopted a decision that acknowledges the direct link between ODS and adverse effects on the climate. In particular, the Parties asked that the MLF give priority to projects that focused on alternatives that minimized other impacts to the environment, including on the climate.

6. Thus, alongside the increasing calls from Article 5 countries for assistance to manage their unwanted ODS accumulating in equipment, ports, reclamation centers, etc., the Implementing Agencies have been considering innovative approaches to financing ODS disposal/destruction under the climate change regime. Voluntary carbon markets provide an opportunity for generating financing for ODS destruction as they are not bound to compliance markets and because ODS, that can have extremely high GWPs would be an attractive source of emission reduction credits. To date, only one market exists that issues credits for ODS destruction, the Chicago

Climate Exchange (CCX); however, other markets such as those adopted by the Voluntary Carbon Standard 2007 (VCS) are not necessarily restricted to the six (6) Kyoto gases and therefore could potentially become markets for destruction of unwanted ODS if a methodology was proposed and approved.

7. Comparative analyses on the voluntary markets report that over the last few years, about a dozen of voluntary markets have been developed, each presenting different standards and focus areas. Some markets closely mirror the standards of compliance markets, while others adopted less stringent rules and flexible approaches in order to reduce the administrative burden, the transaction costs and enable the generation of as many credits as possible on the market. These comparative studies have not so far looked specifically at how different markets actually, or potentially, address GHGs that are not directly controlled by Kyoto. In particular, there is a need to look at elements such as the project cycles, the rules for acceptability of new project types and new methodologies approval, the countries eligible for offset projects to determine how the special issues/requirements surrounding ODS and the Montreal Protocol can be incorporated on the one hand, and on the other, what considerations countries must take into account when exploring opportunities for financing through existing markets such as CCX.

Objectives

8. At its 54th Meeting, the Executive Committee endorsed a proposal in the World Bank's 2008-2010 Business Plan to conduct a study on ODS destruction. According to the proposal, the Bank plans to 1) describe opportunities for funding through voluntary carbon markets for destruction of unwanted ODS and which would 2) include a methodology for validation and verification of ODS disposal and 3) develop specific case studies.

9. As per Decision 54/10(d) these Terms of Reference are being developed in collaboration with Executive Committee members, the MLF Implementing Agencies and the World Bank.

Scope of Work

10. The study will approach voluntary carbon market opportunities from a concrete, simple, and workable perspective around a specific investment vehicle. The study should elaborate on the structure and operational procedures for proposed unwanted ODS disposal projects that maximize the amount of ODS destroyed.

11. The Consultant will be responsible for 1) researching and developing universal but flexible approaches, or strategies for companies of Article 5 countries to access funding through voluntary carbon markets and for 2) proposing corresponding disposal methodologies, based on best practice from existing approaches and illustrated through case studies (where applicable).

12. In order to inform this work, the Study should include a short and concise analyses on voluntary carbon markets, rules of voluntary markets and other carbon markets, as well as dedicated work on ODS destruction (options, costs, assessment of the scale/existing banks). See Annex I for a list of minimum works to draw from. The Study will include elements that are expected to be validated including operational efficacy of ongoing case studies (under e.g., CCX). The Study will explore, in consultation with stakeholders, NOUs in key Article 5 countries, additional opportunities to launch pilot projects in other Article 5 countries.

13. Some of the consultations with NOUs in Article 5 countries will be done during the UNEP Ozone Network Regional meetings in order to maximize the number of stakeholders consulted and feedback received on the study. This will require one consultant to travel for 2-4 days to regional workshops in Bangkok, Quito and Dubai (to all be confirmed) between April and May 2009. In addition, the Consultant will present the findings of the study to the 59th Executive Committee Meeting in Sharm el Sheikh (tentatively late October 2009).

<u>Elements of the Study</u>

- Develop and/or adopt a select number of emission reduction methodologies to be used for the disposal of unwanted ODS;

- Utilize practical experiences from existing and/or planned ODS emission reduction projects in Article 5 and non-Article 5 countries in shaping the design of the strategy and methodologies;

- Generate robust, transparent and homogeneous emission reductions from disposal of unwanted ODS; and

- Explore how to capitalize on the credibility of the Montreal Protocol Institutions including the Multilateral Fund Secretariat, the Ozone Secretariat, and the UNEP TEAP.

Process/Project Approach

- Examine (comparative analysis) the Clean Development Mechanism (CDM) and possibly Joint Implementation (JI), the rules sets in various voluntary markets (existing and under development), including any market to date that has ODS destruction projects in its portfolio of emission reduction projects, with a view to determining and comparing:

    - Market scope, volume, share, growth
    - Management structure and stakeholders
    - Transaction cost ($ per t CO2e), price of offsets
    - Transaction units
    - Type/ categories of projects eligible
    - Restricted or not to the Kyoto gases
    - Project cycle and actors involved at each steps
    - Average time required before the generation of credits
    - Quality controls systems, including verification/ validation mechanisms, frequency, third party review requirements
    - Transparency of the system (e.g. on elements such as the decision making process, transactions, etc.)
    - Process for the approval of project activity
    - Countries eligible for offset projects
    - Rules for new methodology approval
    - Degree of flexibility in the voluntary markets for adapting methodologies/approaches and for introducing new project types
    - Additionality requirements and/or criteria used to demonstrated that the project activity is not the baseline, including the use of investment analyses, barriers analyses, sectoral benchmarks
    - Registry of emissions and/or control processes put in place to avoid double counting of emission reduction.
    - Impact of supply of unwanted ODS (as determined by projecting future volumes and a sensitivity analysis)

14. For markets covering ODS projects, describe and compare in more details the rules, the methodologies for such projects including elements such as criteria for project eligibility, factors accounted in the calculations of emission reductions including emission reduction offset ration, technical requirements for the destruction facilities, and etc.

15. Based upon the investigation and interviews, the Study will:

- Determine and elaborate on possible concrete, simple and workable modalities/scenarios; options for standardized methodologies including validation of ODS disposal given in light of variables;

- Determine and recommend favorable elements / quality / minimum requirements for eligibility;

- Determine the applicability of existing and potential Article 5 and non-Article 5 markets dealing with unwanted ODS in order to apply to companies of Article 5 countries (market conditions, nature of the regulatory/policy framework, institutional capacity);

- Using the information of the comparative analyses and rules of each market, determine the feasibility for markets that are not dealing with unwanted ODS to include these project type and describe the process that is required;

- Assess predictability and availability of resources from voluntary carbon markets in comparison with other financing modalities, such as the MLF;

- Provide recommendations on key measures to safeguard any leakage of unwanted ODS at each transaction step towards final disposal based on best practice from existing approaches and illustrated through case studies;

- Provide recommendations on capturing additionality and effective marketing of the scheme; and

- Recommend opportunities or potential markets for unwanted ODS management to ensure that financial benefits would be used for covering other costs associated with collection, transportation, extraction, and etc. in order to avoid any perverse incentives.

Financing/Cost Considerations

- Identify possible options, mechanisms and schemes for financing upfront costs (administrative costs, transportation) based on current practice in the voluntary market such as futures market, revolving funds, etc;

- Financing Streams (options/schedule of payments) and additional support to companies of Article 5 countries if necessary;

- Ranking of candidates for ODS destruction taking into account ODS substances, purity/quality, source, environmental risks (as pertains to cost); and

- Identify any difference in rules and methodologies for project eligibility in voluntary carbon markets with those required by the MLF for funding ODS phaseout.

Disposal Methodology

- Utilize existing CCX case study (Argentina CTC) or any other studies to detail methodology;

- Review based on existing information from other countries, if any, (preferably small consuming countries) to develop case studies to support the development of the methodology; and

- Identify best practice throughout project cycle to ensure optimum results at destruction (from packaging to transport, storage, validation of purity of substance, destruction removal efficiency (DRE), types of facilities/registration and certification, etc)

Tentative Work Plan and Schedule

Task	Tentative Date
Inception Report	March 2009
Draft Report	July 2009
Final Report	December 2009

Appendix I

Background Documents
(To be used as a basis for the study and further data collection)

1. "Final Draft Study on the Collection and Treatment of Unwanted Ozone-depleting Substances in Article 5 and Non-article 5 Countries," ICF International, March 2008. UNEP/OzL.Pro/ExCom/54/Inf.3.

2. "2002 Report of the Task Force on Destruction Technologies," (Technology and Economic Assessment Panel (TEAP)) and other related TEAP reports.

3. Report of the Meeting of Experts to Assess the Extent of Current and Future Requirements for the Collection and Disposal of Non-reusable and Unwanted ODS in Article 5 Countries, MLF 2006.

4. Relevant reports of the MP Meetings of the Parties (where ODS destruction had been included in the meeting agenda).

5. Studies with Comparative Analyses of Carbon Markets:

   "Making Sense of the Voluntary Carbon Market: A Comparison of Carbon Offset Standards" WWF Germany, March 2008.

   "The World Bank State and Trends of the Carbon Market 2007" Capoor and Ambrosi, World Bank, 2008.

   "State of the Voluntary Carbon Markets 2008" Hamilton, Sjardin, Marcello, Xu, Ecosystem Marketplace & New Carbon Finance, 2008.

6. Standards and rules of the Kyoto and voluntary markets:

   "Voluntary Carbon Standard - Specification for the project-level quantification, monitoring and reporting as well as validation and verification of greenhouse gas emission reductions or removals", VCS 2007.

   CCX rules and protocols for destruction of ODS, available at: http://www.chicagoclimatex.com/

   CDM rules and protocols, available at: www.unfccc.int.

Appendix C: Methodology for Estimating ODS Potentially Available for Destruction from Retired Equipment at End-of-Life

This appendix presents the methodology, data sources, and assumptions used to estimate the amount of ODS potentially recoverable for destruction from retired equipment at end-of-life in the United States, European Union Member States, other non-A5 countries, and A5 countries. Broad assumptions were made about the amount of ODS remaining at end-of-life that is actually recovered; specifically, a range of 1%, 10%, and 50% recovered was applied to estimate a high and low bound of amounts recovered.[32]

United States:
U.S. estimates for the refrigeration/AC, foams, and fire protection sectors are provided by chemical type (i.e., CFCs, HCFCs, and halons) from 2010 to 2050 (in five year increments) based on EPA-provided data from the U.S. EPA's Vintaging Model, which ICF manipulated for this study. The yearly estimates were then converted to GWP-weighted tCO_2e based on 100-year GWPs presented in IPCC's Fourth Assessment Report (AR4) (2007). An average GWP was also calculated for each sector/chemical type (which was later used as proxy for converting from tonnes to tCO_2e in the other geographic regions).

European Union:
EU estimates for the refrigeration/AC, foams, and fire protection sectors are provided by chemical type (i.e., CFCs, HCFCs, and halons) from 2010 to 2050 (in five year increments), based on a draft banking model developed for the European Commission by ICF International (EC ODS Banking Model 8.25.09).[33]

Other Non-Article 5 Countries:
Other Non-A5 (excluding the U.S. and EU) estimates for the refrigeration/AC, foams, and fire protection sectors are estimated by chemical type (i.e., CFCs, HCFCs, and halons) from 2010 to 2050 (in five year increments), calculated based on U.S. and EU estimates (explained above) and the proportion of ODS consumption other non-A5 countries represent. This proportion was based on a five-year average of data reported under Article 7 to the Ozone Secretariat from 1989-1993; these data showed that other non-A5 countries accounted for an average of 32% CFC consumption in all non-A5 countries, as well as 15% of HCFC consumption, and 36% of halon consumption.[34] A simple and broad assumption was made that other non-A5 countries were assumed to represent the same proportion of ODS potentially available for destruction in future years, and were inferred based on U.S. and EU estimates.

Article 5 Countries:
A5 estimates of CFCs (blowing agent and refrigerant separately) and halons potentially recoverable in 2010 from retired equipment at EOL are estimated in the *Report of the Meeting of Experts to Assess the Extent of Current and Future Requirements for the Collection and Disposition of Non-reusable and Unwanted ODS in Article 5 Countries* (UNEP 2006b)—as commissioned by the ExCom in Decision 47/52.[35]

The CFC refrigerant estimate was assumed to decline linearly from 2010 to 2015 at a rate of roughly 5%, based on data from UNEP (2006b). From 2016-2020, CFC refrigerant recoverable was assumed to decline linearly at a rate of approximately 12%, based on data from TEAP (2009). Beyond 2020, it was assumed to decline linearly such that the potential amount recoverable at EOL reached zero ten years later, representing a ten year lag from the United States.

UNEP (2006b) also provided estimates of CFC blowing agent reaching EOL in years 2010 and 2015. The estimate was declined using a trend function (based on the 2010 and 2015 data points), reaching zero in

[32] The actual amount of refrigerant that is recovered at equipment EOL depends on a number of factors, including (a) the refrigerant charge remaining at time of disposal, (b) losses during the recovery process, (c) residual refrigerant remaining in the system ("heel"), and importantly (d) the extent to which technicians actually collect ODS from equipment.
[33] Note that the EC ODS Banking Model is currently in draft form. As such, estimates may be subject to revision.
[34] 1989-1993 ODS consumption data was used as consumption would not yet be impacted by the start of ODS phaseout in developed countries.
[35] Data for HCFCs is not available for developing countries.

2019.[36] UNEP (2006b) noted that the 2010 and 2015 estimates did not include foam products from building applications (i.e., construction foams) since these foam products had much longer lifetimes and would not be reaching EOL until well after 2015. Thus, it was assumed that construction foams begin reaching EOL in A5 countries in 2045, based on an assumed lag off the U.S. estimates.[37] To grow the construction foam estimate from 2045 to 2050, a proxy growth trend was calculated based on the trend of CFC blowing agents from construction foams reaching EOL annually in the United States. Based on the U.S. trend, the A5 construction foam estimate is assumed to grow from 2045 to 2048 at a rate of approximately 4%, and then decrease linearly at a rate of approximately 10% per year.

To grow the halon estimate to 2050, a proxy growth trend was calculated using U.S. estimates relative to the first year of ODS phaseout in developed countries (i.e., 1994), assuming that halon phaseout will occur in 2010 in developing countries.[38] Based on the U.S. growth trend of halons potentially recoverable from retired equipment at EOL in each year, it is assumed that in A5 countries, recoverable halon will grow for ten years after phaseout (2010), at a rate of approximately 6% per year. After peaking in year 2020, it is assumed that quantities of halons recoverable will decrease linearly at approximately 3% per year, reaching zero in 2055.

[36] The quantities reaching EOL from 2010-2019 are assumed to be appliance foams.

[37] This analysis assumes that the ratio of construction foam to appliance foam in A5 countries is approximately 48% (Ashford 2001). Therefore, the quantity of construction foam reaching EOL in 2045 represents 48% of the appliance foam reaching EOL in 2010.

[38] Due to a lack of accessible data for developing countries, using the U.S. growth trend as a proxy for calculating total recoverable halon bank in A5 countries was deemed the best methodology available. However, it should be noted that in reality, the growth profiles of the U.S., as a mature market, and A5 countries, as developing markets, are likely to differ. The short-term growth of recoverable banks in the U.S. after 1994 is a result of significant development prior to the mandate of ODS phaseout in developed countries. Conversely, since ODS phaseout was mandated later in developing countries, many of the countries may not experience significant development until after the ODS phaseout has begun; as such, the short-term growth following the first year of phaseout may not be as significant for A5 countries.

Appendix D: Applicable Templates for Developing ODS Destruction Projects

Some templates have already been developed that could be applicable for the project development process for ODS destruction offsets in the voluntary market. Two of these are reproduced below as examples: first, a Project Idea Note (PIN) template, developed by the Carbon Finance Unit of the World Bank (available at: http://wbcarbonfinance.org/Router.cfm?Page=DocLib&CatalogID=28153), and the second, the Project Description template that should be used to describe projects being submitted to the VCS (available at: http://www.v-c-s.org/policydocs.html).

PROJECT IDEA NOTE (PIN)

Name of Project: ____________________________

Date submitted: ____________________________

Description of size and quality expected of a PIN

Basically a PIN will consist of approximately 5-10 pages providing indicative information on:

- the type and size of the project
- its location
- the anticipated total amount of greenhouse gas (GHG) reduction compared to the "business-as-usual" scenario (which will be elaborated in the baseline later on at Project Design Document (PDD) level)
- the suggested crediting life time
- the suggested Certified Emission Reductions (CERs)/Emission Reduction Units (ERUs)/Verified Emission Reduction (VERs) price in US$ or € /ton CO_2e reduced
- the financial structuring (indicating which parties are expected to provide the project's financing)
- the project's other socio-economic or environmental effects/benefits

While every effort should be made to provide as complete and extensive information as possible, it is recognised that full information on every item listed in the template will not be available at all times for every project.

NOTE: For forestry projects, please use the PIN Template for LULUCF projects available at www.carbonfinance.org.

A. PROJECT DESCRIPTION, TYPE, LOCATION AND SCHEDULE

OBJECTIVE OF THE PROJECT *Describe in not more than 5 lines*	
PROJECT DESCRIPTION AND PROPOSED ACTIVITIES *About ½ page*	
TECHNOLOGY TO BE EMPLOYED[39] *Describe in not more than 5 lines*	
TYPE OF PROJECT	
Greenhouse gases targeted CO_2/CH_4/N_2O/HFCs/PFCs/SF_6 *(mention what is applicable)*	
Type of activities Abatement/CO_2 sequestration	
Field of activities *(mention what is applicable)* *See annex 1 for examples*	
LOCATION OF THE PROJECT	
Country	
City	
Brief description of the location of the project *No more than 3-5 lines*	
PROJECT PARTICIPANT	
Name of the Project Participant	
Role of the Project Participant	a. Project Operator b. Owner of the site or project c. Owner of the emission reductions d. Seller of the emission reductions e. Project advisor/consultant f. Project investor g. Other, please specify:_________________
Organizational category	a. Government b. Government agency c. Municipality d. Private company e. Non Governmental Organization f. Other, please specify: _________________
Contact person	
Address	
Telephone/Fax	
E-mail and web address, if any	
Main activities *Describe in not more than 5 lines*	
Summary of the financials *Summarize the financials (total assets, revenues, profit, etc.) in not more than 5 lines*	
Summary of the relevant	

[39] Please note that support can only be provided to projects that employ commercially available technology. It would be useful to provide a few examples of where the proposed technology has been employed.

experience of the Project Participant *Describe in not more than 5 lines*	
PROJECT PARTICIPANT	
Name of the Project Participant	
Role of the Project Participant	a. Project Operator b. Owner of the site or project c. Owner of the emission reductions d. Seller of the emission reductions e. Project advisor/consultant f. Project investor g. Other, please specify: ________________
Organizational category	a. Government b. Government agency c. Municipality d. Private company e. Non Governmental Organization f. Other, please specify: ________________
Contact person	
Address	
Telephone/Fax	
E-mail and web address, if any	
Main activities *Describe in not more than 5 lines*	
Summary of the financials *Summarize the financials (total assets, revenues, profit, etc.) in not more than 5 lines*	
Summary of the relevant experience of the Project Participant *Describe in not more than 5 lines*	
Please insert information for additional Project Participants as necessary.	
EXPECTED SCHEDULE	
Earliest project start date *Year in which the plant/project activity will be operational*	
Estimate of time required before becoming operational after approval of the PIN	Time required for financial commitments: __ months Time required for legal matters: __ months Time required for construction: __ months
Expected first year of CER/ERU/VERs delivery	
Project lifetime *Number of years*	
For CDM projects: Expected Crediting Period *7 years twice renewable or 10 years fixed* For JI projects: Period within which ERUs are to be earned *(up to and including 2012)*	
Current status or phase of the project	

Identification and pre-selection phase/opportunity study finished/pre-feasibility study finished/feasibility study finished/negotiations phase/contracting phase etc. (mention what is applicable and indicate the documentation)	
Current status of acceptance of the Host Country *Letter of No Objection/Endorsement is available; Letter of No Objection/Endorsement is under discussion or available; Letter of Approval is under discussion or available (mention what is applicable)*	
The position of the Host Country with regard to the Kyoto Protocol	Has the Host Country ratified/acceded to the Kyoto Protocol? ___________NO / YES, YEAR________ Has the Host Country established a CDM Designated National Authority / JI Designated Focal Point? ___________NO / YES, YEAR________

B. METHODOLOGY AND ADDITIONALITY

ESTIMATE OF GREENHOUSE GASES ABATED/ CO_2 SEQUESTERED *In metric tons of CO_2-equivalent, please attach calculations*	Annual (if varies annually, provide schedule): ___ tCO_2-equivalent Up to and including 2012: ___ tCO_2-equivalent Up to a period of 10 years: ___ tCO_2-equivalent Up to a period of 7 years: ___ tCO_2-equivalent
BASELINE SCENARIO CDM/JI projects must result in GHG emissions being lower than "business-as-usual" in the Host Country. At the PIN stage questions to be answered are at least: • Which emissions are being reduced by the proposed CDM/JI project? • What would the future look like without the proposed CDM/JI project? *About ¼ - ½ page*	
ADDITIONALITY Please explain which additionality arguments apply to the project: (i) there is no regulation or incentive scheme in place	

covering the project (ii) the project is financially weak or not the least cost option (iii) country risk, new technology for country, other barriers (iv) other	
SECTOR BACKGROUND Please describe the laws, regulations, policies and strategies of the Host Country that are of central relevance to the proposed project, as well as any other major trends in the relevant sector. Please in particular explain if the project is running under a public incentive scheme (e.g. preferential tariffs, grants, Official Development Assistance) or is required by law. If the project is already in operation, please describe if CDM/JI revenues were considered in project planning.	
METHODOLOGY Please choose from the following options: For CDM projects: (i) project is covered by an existing Approved CDM Methodology or Approved CDM Small-Scale Methodology (ii) project needs a new methodology (iii) projects needs modification of existing Approved CDM Methodology For JI projects: (iv) project will use a baseline and monitoring plan in accordance with Appendix B of the JI Guidelines and further JISC guidance (V) project will use Approved CDM or CDM Small-Scale Methodology	

C. FINANCE

TOTAL CAPITAL COST ESTIMATE (PRE-OPERATIONAL)	
Development costs	___ US$ million (Feasibility studies, resource studies, etc.)
Installed costs	___ US$ million (Property plant, equipment, etc.)

Land	___ US$ million
Other costs (please specify)	___ US$ million (Legal, consulting, etc.)
Total project costs	___ US$ million
SOURCES OF FINANCE TO BE SOUGHT OR ALREADY IDENTIFIED	
Equity Name of the organizations, status of financing agreements and finance (in US$ million)	
Debt – Long-term Name of the organizations, status of financing agreements and finance (in US$ million)	
Debt – Short term Name of the organizations, status of financing agreements and finance (in US$ million)	
Carbon finance advance payments[40] sought from the World Bank carbon funds. (US$ million and a brief clarification, not more than 5 lines)	
SOURCES OF CARBON FINANCE Name of carbon financiers other than any of the World Bank carbon funds that your are contacting (if any)	
INDICATIVE CER/ERU/VER PRICE PER tCO_2e[41] *Price is subject to negotiation. Please indicate VER or CER preference if known.*[42]	
TOTAL EMISSION REDUCTION PURCHASE AGREEMENT (ERPA) VALUE	
A period until 2012 (end of the first commitment period)	___ US$ / €
A period of 10 years	___ US$ / €
A period of 7 years	___ US$ / €

[40] Advance payment subject to appropriate guarantees may be considered.
[41] Please also use this figure as the carbon price in the PIN Financial Analysis Model (cell C94).
[42] The World Bank Carbon Finance Unit encourages the seller to make an informed decision based on sufficient understanding of the relative risks and price trade-offs of selling VERs vs. CERs. In VER contracts, buyers assume all carbon-specific risks described above, and payment is made once the ERs are verified by the UN-accredited verifier. In CER/ERU contracts, the seller usually assumes a larger component - if not all – of the carbon risks. In such contracts, payment is typically being made upon delivery of the CER/ERU. For more information about Pricing and Risk, see "Risk and Pricing in CDM/JI Market, and Implications on Bank Pricing Guidelines for Emission Reductions".

Please provide a financial analysis for the proposed CDM/JI activity, including the forecast financial internal rate of return for the project with and without the Emission Reduction revenues. Provide the financial rate of return at the Emission Reduction price indicated in section "Indicative CER/ERU/VER Price". DO NOT assume any up-front payment from the Carbon Finance Unit at the World Bank in the financial analysis that includes World Bank carbon revenue stream. Provide a spreadsheet to support these calculations. The PIN Financial Analysis Model available at www.carbonfinance.org is recommended.

D. EXPECTED ENVIRONMENTAL AND SOCIAL BENEFITS

LOCAL BENEFITS E.g. impacts on local air, water and other pollution.	
GLOBAL BENEFITS Describe if other global benefits than greenhouse gas emission reductions can be attributed to the project.	
SOCIO-ECONOMIC ASPECTS	
What social and economic effects can be attributed to the project and which would not have occurred in a comparable situation without that project? Indicate the communities and the number of people that will benefit from this project. *About ¼ page*	
What are the possible direct effects (e.g. employment creation, provision of capital required, foreign exchange effects)? *About ¼ page*	
What are the possible other effects (e.g. training/education associated with the introduction of new processes, technologies and products and/or the effects of a project on other industries)? *About ¼ page*	
ENVIRONMENTAL STRATEGY/ PRIORITIES OF THE HOST COUNTRY A brief description of the project's consistency with the environmental strategy and priorities of the Host Country *About ¼ page*	

ANNEX I - Technologies

1. Renewables
   1a Biomass
   1b. Biogas
   1c. Bagasse
   1d. Wind
   1e. Hydro
   1f. Geothermal
   1g. Photovoltaic
   1h. Solar Thermal
2. Fossil Fuel Switch
3. Energy Efficiency
   3a. Cement Efficiency Improvement
   3b. Construction material
   3c. District heating
   3d. Steel Gas Recovery
   3e. Other Energy Efficiency
4. Waste Management
   4a. Landfill Gas recovery/utilization
   4b. Composting
   4c. Recycling
   4d. Biodigestor
   4e. Wastewater Management
5. Coalmine/Coalbed Methane
6. Oil and Gas Sector
   6a. Flared Gas Reduction
   6b. Reduction of technical losses in distribution system
7. N_2O removal
8. HFC23 Destruction
9. SF6 Recovery
10. Transportation
   9a. Fuel switch
   9b. Modal switch
11. Others

Voluntary Carbon Standard
Project Description Template

19 November 2007

[Date of the VCS PD]

[Table of Contents]

1 Description of Project:

1.1 Project title

1.2 Type/Category of the project

- *Project category which is part of a GHG program that has been approved by the VCS Board.*
- *Specify here if the project is a Grouped project*

1.3 Estimated amount of emission reductions over the crediting period including project size:

- *Micro project: Less than 5,000 tonnes CO2 equivalent emissions reductions per year.*
- *Mega Project: More than 1,000,000 tonnes CO2 equivalent emissions reductions per year*

1.4 A brief description of the project:

1.5 Project location including geographic and physical information allowing the unique identification and delineation of the specific extent of the project:

Include GPS project boundaries.

1.6 Duration of the project activity/crediting period:

- *Project start date: Date on which a financial commitment was made to the project and the project reached financial closure.*
- *Crediting period start date: the date the first monitoring period commenced*
    - *VCS project crediting period:* A maximum of ten years which may be renewed at most two times

1.7 Conditions prior to project initiation:

1.8 A description of how the project will achieve GHG emission reductions and/or removal enhancements:

1.9 Project technologies, products, services and the expected level of activity:

1.10 Compliance with relevant local laws and regulations related to the project:

The VCS PD shall include identification of relevant local laws and regulations related to the project and demonstration of compliance with them.

1.11 Identification of risks that may substantially affect the project's GHG emission reductions or removal enhancements:

1.12 Demonstration to confirm that the project was not implemented to create GHG emissions primarily for the purpose of its subsequent removal or destruction.

1.13 Demonstration that the project has not created another form of environmental credit (for example renewable energy certificates).

If the project has created another form of environmental credit, the proponent must provide a letter from the program operator that the credit has not been used and has been cancelled from the relevant program.

1.14 Project rejected under other GHG programs (if applicable):

Projects rejected by other GHG programs, due to procedural or eligibility requirements where the GHG program applied have been approved by the VCS Board; can be considered for VCU but project proponents for such a project shall:

- *clearly state in its VCS PD all GHG programs for which the project has applied for credits and why the project was rejected, such information shall not be deemed commercially sensitive information; and*
- *provide the VCS verifier and Registry with the actual rejection document(s) including explanation; and*
- *have the project validated against VCS program requirements.*

1.15 Project proponents roles and responsibilities, including contact information of the project proponent, other project participants:

1.16 Any information relevant for the eligibility of the project and quantification of emission reductions or removal enhancements, including legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and temporal information.):

1.17 List of commercially sensitive information (if applicable):

Any commercially sensitive information that has been excluded from the public version of the VCS PD that will be displayed on the VCS Project Database shall be listed by the project proponent.

2 VCS Methodology:

2.1 Title and reference of the VCS methodology applied to the project activity and explanation of methodology choices:

Projects shall use one of the VCS program approved project methodologies and provide information relevant to methodology deviations or methodology revisions.

2.2 Justification of the choice of the methodology and why it is applicable to the project activity:

2.3 Identifying GHG sources, sinks and reservoirs for the baseline scenario and for the project:

2.4 Description of how the baseline scenario is identified and description of the identified baseline scenario:

The project proponent shall select the most reasonable baseline scenario for the project. This shall reflect what most likely would have occurred in the absence of the project.

2.5 Description of how the emissions of GHG by source in baseline scenario are reduced below those that would have occurred in the absence of the project activity (assessment and demonstration of additionality):

The project proponent shall in the VCS PD, in addition to describing how the project meets the VCS methodology, demonstrate that the project is additional based on one of the tests, the project test, the performance test, and technology test.

3 Monitoring:

3.1 Title and reference of the VCS methodology (which includes the monitoring requirements) applied to the project activity and explanation of methodology choices:

3.2 Monitoring, including estimation, modelling, measurement or calculation approaches:

- *Purpose of monitoring*
- *Types of data and information to be reported, including units of measurement*
- *Origin of the data)*
- *Monitoring, including estimation, modelling, measurement or calculation approaches*
- *Monitoring times and periods, considering the needs of intended users*
- *Monitoring roles and responsibilities*
- *Managing data quality*

3.3 Data and parameters monitored / Selecting relevant GHG sources, sinks and reservoirs for monitoring or estimating GHG emissions and removals:

Describe each data and parameter using this table.

Data / Parameter:	
Data unit:	
Description:	
Source of data to be used:	
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	

3.4 Description of the monitoring plan

4 GHG Emission Reductions:

4.1 Explanation of methodological choice:

4.2 Quantifying GHG emissions and/or removals for the baseline scenario:

4.3 Quantifying GHG emissions and/or removals for the project:

4.4 Quantifying GHG emission reductions and removal enhancements for the GHG project:

See ISO 14064-2: 5.2.k for quantifying GHG emission reductions or removal enhancements.

5 Environmental Impact:

A summary environmental impact assessment when such an assessment is required by applicable legislation or regulation

6 Stakeholders comments:

Relevant outcomes from stakeholder consultations and mechanisms for on-going communication.

7 Schedule:

Chronological plan for the date of initiating project activities, date of terminating the project, frequency of monitoring and reporting and the project period, including relevant project activities in each step of the GHG project cycle.

8 Ownership:

8.1 Proof of Title:

Provide evidence of proof of title through one of the following:

- *a legislative right;*
- *a right under local common law;*
- *Ownership of the plant, equipment and/or process generating the reductions/removals;*
- *A contractual arrangement with the owner of the plant, equipment or process that grants all reductions/removals to the proponent*

8.2 Projects that reduce GHG emissions from activities that participate in an emissions trading program (if applicable):

Project proponents of projects that reduce GHG emissions from activities that:

- are included in an emissions trading Program; or
- take place in a jurisdiction or sector in which binding limits are established on GHG emissions;

shall provide evidence that the reductions or removals generated by the project have or will not be used in the Program or jurisdiction for the purpose of demonstrating compliance. The evidence could include:

- a letter from the Program operator or designated national authority that emissions allowances (or other GHG credits used in the Program) equivalent to the reductions/removals generated by the project have been cancelled from the Program; or national cap as applicable or;
- purchase and cancellation of GHG allowances equivalent to the reductions/removals generated by the project related to the Program or national cap.