Appendices

The following appendices provide additional information to the material presented in the main body of this report.

Appendix A. Estimating Baseline HFC and PFC Emissions from ODS Substitute Uses

Appendix B. List of IMAC Regions

Appendix C. Emission Baselines

Appendix D. IMAC methodologies

Appendix E. Additional Data on Abatement Options

Appendix F. Additional International Marginal Abatement Cost Curves

Appendix G. Global Warming Potential Values

Appendix H. List of Abbreviations

Appendix I. Glossary

Appendix A Estimating Baseline HFC and PFC Emissions from ODS Substitute Uses

High global warming potential (High GWP) gas emissions result from the use of substitutes for ozone-depleting substances (ODS) and from other industrial sectors. Until recently, few nations have made significant efforts to track and project use and emissions of HFCs, PFCs, and SF_6. If countries did present information on these gases it was often partial estimates or an aggregate estimate. These partial or aggregate estimates do not contain the level of detail required for this analysis, and thus in these cases the methodology described below was used to estimate emissions from ODS substitute uses.

A.1 Introduction

This Appendix provides further detail on how the baseline estimates were developed for the various ODS substitute end-use sectors, which include refrigeration/air-conditioning, aerosols, foams, fire extinguishing, and solvents. In general, a modeling approach was used to determine emissions, because, until recently, few nations have made significant efforts to track and project use and emissions of HFCs and PFCs from ODS substitutes. However, where ODS substitute emission information was available in sufficient detail, such as countries' submissions for the National Communication process under the United Nations Framework Convention on Climate Change (UNFCCC), each country's data was used as the basis for projecting future emissions.

In the absence of reported data, the following approach was used. First, a "Vintaging Model" of ODS-containing equipment and products is used to estimate the U.S. use and emissions of ODS substitutes. In the second step, emissions from non-U.S. countries were estimated. This was accomplished for each ODS consuming end-use in each country. In developing these estimates, it was initially assumed that the transition from ODSs to HFCs and other substitutes follow the same substitution patterns as the United States. These U.S.-based substitution scenarios were then customized to each region or country using adjustment factors that take into consideration differences in historical and projected economic growth, the timing of the phase-out, and the distribution of ODS and substitute use across end uses in each region or country. In some sectors, specific adjustments or methodologies were used that were specific only to that sector. The methodology used to estimate and adjust emissions is described in the following sections.

A.2 Estimating ODS Substitute Emissions in the United States

The Vintaging Model was developed as a tool for estimating the annual chemical emissions from industrial sectors that have historically used ODSs in their products. Under the terms of the Montreal Protocol and the United States' Clean Air Act Amendments of 1990, the domestic U.S. production of ODSs – chlorofluorocarbons (CFCs), halons, carbon tetrachloride, methyl chloroform, and hydrochlorofluorocarbons (HCFCs) – has been drastically reduced, forcing these industrial sectors to conserve these chemicals and transition to more ozone friendly chemicals. As these industries have moved toward ODS alternatives such as hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), the Vintaging Model has evolved into a tool for estimating the rise in consumption and emissions of these alternatives, and the decline of ODS consumption and emissions.

The Vintaging Model estimates emissions from the five ODS substitute end-use sectors mentioned above. Within these sectors, there are over 40 independently modeled end-uses. The model requires information on the market growth for each of the end-uses, as well as a history and projection of the market transition from ODS to alternatives. As ODS are phased out, a percentage of the market share originally filled by the ODS is allocated to each of its substitutes.

The model, named for its method of tracking the emissions of annual "vintages" of new equipment that enter into service, is a "bottom-up" model. It models the consumption of chemicals based on estimates of the quantity of equipment or products sold, serviced, and retired each year, and the amount of the chemical required to manufacture and/or maintain the equipment. The Vintaging Model makes use of this market information to build an inventory of the in-use stocks of the equipment and ODS and ODS substitute in each of the end-uses. The simulation is considered to be a "business-as-usual" baseline case, and does not incorporate measures to reduce or eliminate the emissions of these gases other than those regulated by U.S. law or otherwise common in the marketplace. Emissions are estimated by applying annual leak rates, service emission rates, and disposal emission rates to each population of equipment. By aggregating the emission and consumption output from the different end-uses, the model produces estimates of total annual use and emissions of each chemical.

The Vintaging Model synthesizes data from a variety of sources, including data from the ODS Tracking System maintained by the U.S. EPA Global Programs Division and information from submissions to the U.S. EPA under the Significant New Alternatives Policy (SNAP) program. Published sources include documents prepared by the United Nations Environment Programme (UNEP) Technical Options Committees, reports from the Alternative Fluorocarbons Environmental Acceptability Study (AFEAS), and conference proceedings from the Earth Technologies Forum. The U.S. EPA also coordinates extensively with numerous trade associations and individual companies. For example, the Alliance for Responsible Atmospheric Policy, the Air-Conditioning and Refrigeration Institute, the Association of Home Appliance Manufacturers, the American Automobile Manufacturers Association, and many of their member companies, have provided valuable information over the years. In some instances the unpublished information that the U.S. EPA uses in the model is classified as Confidential Business Information (CBI). The annual emissions inventories of chemicals are aggregated in such a way that CBI cannot be inferred. Full public disclosure of the inputs to the Vintaging Model would jeopardize the security of the CBI that has been entrusted to the U.S. EPA.

The following sections discuss the forms of the emission estimating equations used in the Vintaging Model for each broad end-use category. These equations are applied separately for each chemical used within each of the different end-uses. In the majority of these end-uses, more than one ODS substitute chemical is used.

In general, the modeled emissions are a function of the amount of chemical consumed in each end-use market. Estimates of the consumption of ODS alternatives can be inferred by extrapolating forward in time from the amount of regulated ODS used in the early 1990s, applying knowledge of current and likely future practices and preferences as explained below. Using data gleaned from a variety of sources, assessments are made regarding which alternatives will likely be used, and what fraction of the ODS market in each end-use will be captured by a given alternative. By combining this with estimates of the total end-use market growth, a consumption value can be estimated for each chemical used within each end-use.

A.2.1 Emission Equations

The Vintaging Model estimates the use and emissions of ODS alternatives by taking the following steps:

1. *Gather historical market data*. The Vintaging Model is populated with information on each end-use, taken from published sources and industry experts.

2. *Simulate the implementation of new, non-ODS technologies*. The Vintaging Model uses detailed characterizations of the existing uses of the ODSs, as well as data on how the substitutes are replacing the ODSs, to simulate the implementation of new technologies that ensure compliance with ODS phase-out policies. As part of this simulation, the ODS substitutes are introduced in each of the end-uses over time as needed to comply with the ODS phase-out and reflect actual market conditions.

3. *Estimate emissions of the ODS substitutes*. The chemical use is estimated from the amount of substitutes that are required each year for the manufacture, installation, use, or servicing of products. The emissions are estimated from the emission profile for each vintage of equipment or product in each end-use. By aggregating the emissions from each vintage, a time profile of emissions from each end-use is developed.

Each set of end uses is discussed in more detail in the following sections.

Refrigeration and Air-Conditioning

Vintaging Model Assumptions

The assumptions used by the Vintaging Model to trace the transition of each type of equipment away from ODS are presented in Table A-1, below. As new technologies replace older ones, it is generally assumed that there are improvements in their leak, service, and disposal emission rates. Additionally, the market for each equipment type is assumed to grow independently, according to annual growth rates, presented in Table A-1.

Table A-1: Refrigeration and Air-Conditioning Market Transition Assumptions

Initial Market Segment	Primary Substitute	Start Date	Date of Full Penetration in New Equipment	Maximum Market Penetration	Secondary Substitute	Start Date	Date of Full Penetration in New Equipment	Maximum Market Penetration	Growth Rate
Mobile Air Conditioners									
CFC-12	HFC-134a	1992	1994	100%	None				1.5%
Chillers									
CFC-11	HCFC-123	1993	1994	45%	HFC-134a	2015	2019	75%	0.5%
					HFC-245fa	2015	2019	25%	
	HCFC-22	1991	1994	16%	HFC-134a	2000	2009	70%	
					R-407C	2000	2009	30%	
	HFC-134a	1992	1994	39%	None				
CFC-12	HFC-134a	1992	1994	53%	None				0.5%
	HCFC-22	1991	1994	16%	HFC-134a	2000	2009	70%	
					R-407C	2000	2009	30%	
	HCFC-123	1993	1994	31%	HFC-134a	2015	2019	75%	
					HFC-245fa	2015	2019	25%	

Initial Market Segment	Primary Substitute	Start Date	Date of Full Penetration in New Equipment	Maximum Market Penetration	Secondary Substitute	Start Date	Date of Full Penetration in New Equipment	Maximum Market Penetration	Growth Rate
R-500	HFC-134a	1992	1994	53%	None				0.5%
	HCFC-22	1991	1994	16%	HFC-134a	2000	2009	70%	
					R-407C	2000	2009	30%	
	HCFC-123	1993	1994	31%	HFC-134a	2015	2019	75%	
					HFC-245fa	2015	2019	25%	
HCFC-22	HFC-134a	2000	2009	70%	None				0.5%
	R-407C	2000	2009	30%	R-407C	2009	2019	60%	
					R-410A	2009	2019	40%	
CFC-114	HFC-236fa	1997	1998	100%	R-134a	1998	2009	100%	0.2%
Retail Food									
CFC-12	HCFC-22	1990	1993	70%	R-404A	1996	2009	75%	1.7%
					R-507	1996	2009	25%	
	HFC-134a	1994	1996	30%	None				
HCFC-22	R-404A	1996	2009	60%	None				1.7%
	R-507	1996	2009	15%	None				
	HFC-134a	1999	2009	25%	None				
					None				
R-502	HCFC-22	1990	1993	40%	R-404A	2000	2009	75%	1.7%
					R-507	2000	2009	25%	
	R-404A	1993	1996	40%	None				
	R-507	1994	1996	10%	None				
	HFC-134a	1996	1996	10	None				
Dehumidifiers									
HCFC-22	HFC-134a	1997	1997	89%	None				0.5%
	R-410A	2007	2009	11%	None				
Cold Storage									
CFC-12	HCFC-22	1990	1993	65%	R-404A	1996	2009	75%	2.5%
					R-507	1996	2009	25%	
	HFC-134a	1994	1996	35%	None				
HCFC-22	R-404A	1996	2009	75%	None				2.5%
	R-507	1996	2009	25%	None				
R-502	HCFC-22	1990	1993	40%	R-404A	1996	2009	38%	2.5%
					R-507	1996	2009	12%	
					Non-ODP/GWP	1996	2009	50%	
	R-404A	1993	1996	45%	None				
	R-507	1994	1996	15%	None				
Transport Refrigeration									
CFC-12	HFC-134a	1993	1995	98%	None				2.5%
	HCFC-22	1993	1995	2%	HFC-134a	1995	1999	100%	
R-502	HFC-134a	1993	1995	55%	None				2.5%
	R-404A	1993	1995	45%	None				
Industrial Process Refrigeration									
CFC-11	HCFC-123	1992	1994	70%	HFC-134a	2015	2019	100%	2.5%
	HCFC-22	1991	1994	15%	HFC-134a	1995	2009	100%	
	HFC-134a	1992	1994	15%	None				
CFC-12	HFC-134a	1992	1994	50%	None				2.5%
	HCFC-22	1991	1994	10%	HFC-134a	1995	2009	15%	
					R-404A	1995	2009	50%	
					R-507	1995	2009	15%	
					R-410A	1999	2009	20%	

Initial Market Segment	Primary Substitute	Start Date	Date of Full Penetration in New Equipment	Maximum Market Penetration	Secondary Substitute	Start Date	Date of Full Penetration in New Equipment	Maximum Market Penetration	Growth Rate
	HCFC-123	1992	1994	35%	HFC-134a	2015	2019	100%	
	R-401A	1995	1996	5%	HFC-134a	1997	2000	100%	
HCFC-22	HFC-134a	1995	2009	15%	None				2.5%
	R-404A	1995	2009	50%	None				
	R-507	1995	2009	15%	None				
	R-410A	1999	2009	20%	None				
Ice Makers									
CFC-12	HFC-134a	1993	1995	100%	None				2.5%
Refrigerated Appliances									
CFC-12	HFC-134a	1994	1995	100%	None				0.5%
Window Units									
HCFC-22	R-407C	2003	2006	3%	None				0.1%
	R-410A	2003	2006	7%	None				
	R-407C	2006	2009	35%	None				
	R-410A	2006	2009	55%	None				
Residential Unitary Air Conditioners									
HCFC-22	R-410A	2000	2006	10%	None				1.9%
	R-407C	2006	2009	25%	None				
	R-410A	2006	2009	65%	None				
Commercial Unitary Air Conditioners									
HCFC-22	R-407C	2000	2006	5%	None				2.5%
	R-410A	2000	2006	5%	None				
	R-407C	2006	2009	25%	None				
	R-410A	2006	2009	45%	None				
	HFC-134a	2000	2009	20%	None				
Water-Source, Ground-Source and Unitary Heat Pumps; Packaged Terminal Air Conditioners and Heat Pumps									
HCFC-22	R-407C	2000	2006	5%	None				2.5%
	R-410A	2000	2006	5%	None				
	R-407C	2006	2009	25%	None				
	R-410A	2006	2009	45%	None				
	HFC-134a	2000	2009	20%	None				

Table A-2 presents the average equipment lifetimes for each end use assumed by the Vintaging Model.

Table A-2: Refrigeration and Air-Conditioning Lifetime Assumptions

End Use	Lifetime (Years)
Mobile Air Conditioners	12
Chillers	20 - 27
Retail Food	15 - 20
Cold Storage	20 - 25
Industrial Process Refrigeration	25
Transport Refrigeration	12
Ice Makers and Ice Rinks	20
Refrigerated Appliances	20
Residential Unitary A/C	15
Commercial Unitary A/C	15
Water & Ground Source Heat Pumps	20
PTAC/PTHP	12
Window Units	15

Methodology

For refrigeration and air-conditioning products, emission calculations are split into two categories: emissions during equipment lifetime, which arise from annual leakage and service losses, and disposal emissions, which occur at the time of discard. Equation 1 calculates the emissions from leakage and service, and Equation 2 calculates the emissions resulting from disposal of the equipment. These service/leakage emissions and disposal emissions are summed to calculate the total emissions from refrigeration and air-conditioning (Equation 3). As new technologies replace older ones, improvements in their leak, service, and disposal emission rates are assumed to occur.

Emissions from any piece of equipment include both the amount of chemical leaked during equipment operation and the amount emitted during service. Emissions from leakage and servicing can be expressed as follows:

$$Es_j = (l_a + l_s) \times \sum Qc_{j-i+1} \quad \text{for } i=1 \rightarrow k \qquad \text{Equation 1}$$

Where:

- Es = Emissions from Equipment Serviced. Emissions in year j from normal leakage and servicing of equipment.
- l_a = Annual Leak Rate. Average annual leak rate during normal equipment operation (expressed as a percentage of total chemical charge).
- l_s = Service Leak Rate. Average leakage during equipment servicing (expressed as a percentage of total chemical charge).
- Qc = Quantity of Chemical in New Equipment. Total amount of a specific chemical used to charge new equipment in a given year by weight.
- i = Counter, runs from 1 to lifetime (k).
- j = Year of emission.
- k = Lifetime. The average lifetime of the equipment.

Emissions also result at equipment disposal. The disposal emission equations assume that a certain percentage of the chemical charge will be emitted to the atmosphere when that vintage is discarded. Disposal emissions are thus a function of the quantity of chemical contained in the retiring equipment fleet and the proportion of chemical released at disposal:

$$Ed_j = Qc_{j-k+1} \times [1 - (rm \times rc)] \qquad \text{Equation 2}$$

Where:

- Ed = Emissions from Equipment Disposed. Emissions in year j from the disposal of equipment.
- Qc = Quantity of Chemical in New Equipment. Total amount of a specific chemical used to charge new equipment in year j-k+1, by weight.
- rm = Chemical Remaining. Amount of chemical remaining in equipment at the time of disposal (expressed as a percentage of total chemical charge).
- rc = Chemical Recovery Rate. Amount of chemical that is recovered just prior to disposal (expressed as a percentage of chemical remaining at disposal (rm)).
- j = Year of emission.
- k = Lifetime. The average lifetime of the equipment.

Finally, lifetime and disposal emissions are summed to provide an estimate of total emissions:

$$E_j = Es_j + Ed_j \qquad \text{Equation 3}$$

Where:

- E = Total Emissions. Emissions from refrigeration and air-conditioning equipment in year j.

Es = Emissions from Equipment Serviced. Emissions in year j from normal leakage and servicing (recharging) of equipment.
Ed = Emissions from Equipment Disposed. Emissions in year j from the disposal of equipment.
j = Year of emission.

Aerosols

Vintaging Model Assumptions

ODSs, HFCs and many other chemicals are used as propellant aerosols. Pressurized within a container, a nozzle releases the chemical, which allows the product within the can to also be released. Two types of aerosol products are modeled, including metered dose inhalers and consumer aerosols. In the United States, the use of ODSs in consumer aerosols was banned in 1977, and many products transitioned to "not-in-kind" technologies, such as solid deodorants and finger-pump hair sprays. Transition assumptions and growth rates for those items that use ODSs or HFCs as propellants, including vital medical devices and specialty consumer products, are presented below.

The first set of assumptions, shown in Table A-3, illustrates the market transitions currently used in the model for metered dose inhalers (MDIs). The U.S. had completely phased out of ODSs in consumer products before the 1985 start date of the Vintaging Model. Each MDI end-use assumes that 75 percent of the market transitions to HFC-134a, and 25 percent transitions to HFC-227ea, though the timing of these transitions differs between end-uses. These primary substitutes replace the initial market on a one-to-one ratio, while the entire market size is adjusted based on annual growth rates.

The annual growth rate assumptions that are currently used in the Vintaging Model are shown in Table A-4. These growth rates are held constant across the aerosols sector from 1985 through 1993 and from 1999 onwards. The growth rates from 1994 through 1998 were calculated based on production data obtained from IPAC. The United States had completely phased out of ODSs in consumer products before the 1985 start date of the Vintaging Model. The current HFC market for consumer specialty products is made up of HFC-134a and HFC-152a, and is growing at a rate of approximately 2 percent annually.

Table A-3: Current MDI Market Transitions

Initial Market	Primary Substitutes	Start Date	Date of Full Penetration	Maximum Market Penetration
CFC-11 MDIs	HFC-134a	1997	2004	75%
	HFC-227ea	1997	2004	25%
CFC-12 MDIs	HFC-134a	1997	2004	75%
	HFC-227ea	1997	2004	25%
CFC-114 MDIs	HFC-134a	1999	1999	75%
	HFC-227ea	1999	1999	25%

Table A-4: Current Annual Growth Rate Assumptions

	CFC-11 MDIs	CFC-12 MDIs	CFC-114 MDIs
1985-1993	5.0%	5.0%	5.0%
1994	11.0%	10.3%	27.1%
1995	10.1%	-5.1%	-42.7%
1996	-4.7%	9.5%	-2.8%

	CFC-11 MDIs	CFC-12 MDIs	CFC-114 MDIs
1997	31.4%	64.6%	177.8%
1998	5.6%	-5.3%	8.5%
1999 on	1.5%	1.5%	1.5%

All HFCs used in aerosols are assumed to be emitted in the year of manufacture. Since there is currently no aerosol recycling, all of the annual production of aerosol propellants is assumed to be released to the atmosphere.

Methodology

Equation 4 describes the emissions from the aerosols sector. For aerosols, two separate baseline emissions were created; one tracks HFC emissions from the MDI industry, while the other estimates HFC emissions from consumer and specialty products (i.e., non-MDI aerosols).

$$E_j = Qc_j \qquad \text{Equation 4}$$

Where:

E = Emissions. Total emissions of a specific chemical in year j from use in aerosol products, by weight.

Qc = Quantity of Chemical. Total quantity of a specific chemical contained in aerosol products sold in year j, by weight.

j = Year of emission.

Foam Blowing

Vintaging Model Assumptions

ODSs, HFCs, and other chemicals are used to produce foams, including such items as the foam insulation panels around refrigerators, insulation sprayed on buildings, etc. The chemical is used to create pockets of gas within a substrate, increasing the insulating properties of the item. The Vintaging Model contains 13 foam types, whose transition assumptions away from ODS and growth rates are presented in Table A-5. Each end-use transitions from a single original ODS chemical to one or more primary substitutes. Several end-uses go on to transition to secondary, or even tertiary substitutes. The annual growth rate assumptions that are currently used in the Vintaging Model are also shown in Table A-5. These growth rates are held constant across each foams end-use for all years estimated in the Vintaging Model, from 1985 onward.

Table A-5: Foam Blowing Marking Assumptions

Initial Market Segment	Primary Substitute	Start Date	Date of Full Penetration in New Products	Maximum Market Penetration	Secondary Substitute	Start Date	Date of Full Penetration in New Products	Maximum Market Penetration	Growth Rate
Flexible Polyurethane Foam									
CFC-11	Non-ODP/GWP	1992	1992	100%	None				2%
Polyisocyanurate Boardstock Foam									
CFC-11	HCFC-141b	1993	1996	100%	Non-ODP/GWP	2000	2003	95%	6%
					HFC-245fa/HC	2000	2003	5%	
Polyurethane Appliance Foam									
CFC-11	HCFC-141b	1993	1996	89%	HFC-134a	1996	2003	10%	3%
					HFC-245fa	2002	2003	85%	
					HC	2002	2003	5%	
	HCFC-22/142b blend	1993	1996	1%	HFC-245fa	2009	2010	50%	
					HFC-134a	2009	2010	50%	

Initial Market Segment	Primary Substitute	Start Date	Date of Full Penetration in New Products	Maximum Market Penetration	Secondary Substitute	Start Date	Date of Full Penetration in New Products	Maximum Market Penetration	Growth Rate
	HCFC-22	1993	1996	10%	HFC-134a	2009	2010	100%	
Polyurethane Spray Foam									
CFC-11	HCFC-141b	1989	1996	95%	HFC-245fa	2004	2005	30%	6%
					HFC-245fa/H_2O Blend	2004	2005	60%	
					HC	2003	2005	10%	
	CO2	1986	2003	5%	None				
Polyurethane Slabstock and Other Foams									
CFC-11	HCFC-141b	1989	1996	100%	Liquid CO_2	1999	2003	45%	2%
					Non-ODP/GWP	2001	2003	45%	
					HCFC-22*	2003	2003	10%	
Polyurethane Sheet/Insulation Board Foam									
CFC-12	CO2	1989	1994	1%	None				2%
	Non-ODP/GWP	1989	1994	99%	None				
Polystyrene Boardstock Foam									
CFC-12	HCFC-22/142b Blend	1989	1994	30%	HFC-134a	2009	2010	70%	4%
					HFC-152a	2009	2010	10%	
					CO_2	2009	2010	10%	
					HC	2009	2010	10%	
	HCFC-142b	1989	1994	70%	HFC-134a	2009	2010	70%	
					HFC-152a	2009	2010	10%	
					CO_2	2009	2010	10%	
					HC	2009	2010	10%	
Polyurethane Integral Skin Foam									
CFC-11	HCFC-141b	1989	1990	100%	HFC-134a	Varies**	1996	50%	2%
					CO_2	Varies**	1996	50%	
Polyolefin Foam									
CFC-114	HFC-152a	1989	1993	10%	Non-ODP/GWP	2005	2010	100%	2%
	HCFC-142b	1989	1993	90%	Non-ODP/GWP	1994	1996	100%	
Phenolic Foam									
CFC-11	HCFC-141b	1989	1990	100%	Non-ODP/GWP	1992	1992	100%	2%
PU Panel Foam									
CFC-11	HCFC-141b	1989	1996	82%	HFC-245fa/H_2O Blend	2002	2004	20%	6%
					HCFC-22/H_2O Blend	2001	2003	20%	
					Non-ODP/GWP	2001	2004	40%	
					HFC-134a	2002	2004	20%	
	HCFC-22	1989	1996	18%	245/CO_2 Blend	2009	2010	20%	
					Non-ODP/GWP	2009	2010	40%	
					CO_2	2009	2010	20%	
					HFC-134a	2009	2010	20%	
One Component Foam									
CFC-11	HCFC-22/142b blend	1989	1996	70%	Non-ODP/GWP	2009	2010	80%	6%
					HFC-134a	2009	2010	10%	
					HFC-152a	2009	2010	10%	
	HCFC-22	1989	1996	30%	Non-ODP/GWP	2009	2010	80%	
					HFC-134a	2009	2010	10%	
					HFC-152a	2009	2010	10%	

Initial Market Segment	Primary Substitute	Start Date	Date of Full Penetration in New Products	Maximum Market Penetration	Secondary Substitute	Start Date	Date of Full Penetration in New Products	Maximum Market Penetration	Growth Rate
Commercial Refrigeration Foam									
	HCFC-141b	1989	1996	40.32%	HFC-245fa	2002	2003	70%	6%
					Non-ODP/GWP	2002	2003	30%	
	HCFC-142b	1989	1996	8.06%	Non-ODP/GWP	2009	2010	80%	
					HFC-245fa	2009	2010	20%	
	HCFC-22	1989	1996	51.62%	Non-ODP/GWP	2009	2010	80%	
					HFC-245fa	2009	2010	20%	

*Note: A tertiary transition is assumed such that 100% of the HCFC-22 market transitions to a non-ODP/GWP substitute starting in 2009 and ending in 2010.

**Note: For Polyurethane integral skin foam, half of each substitute has a start date 1993 and the remaining half has a start date of 1994

The emission profiles of the foam types estimated in the Vintaging Model are shown in Table A-6. Emissions from the foam-blowing sector are calculated in three steps following the foam lifecycle, 1) first year emissions, including manufacturing and year one of operation, 2) lifetime emissions, which includes leakage during subsequent years of product use, and 3) disposal emissions at product decommissioning. Emissions are estimated for each foam type, and at each step in the lifecycle, though not all steps are assumed to occur for each foam type. For example, for open cell foams it is assumed that all of their blowing agent is released during the first year. Also, while closed cell foams all have first year and annual losses, not all of them are assumed to have blowing agent remaining at the end of the product life.

Table A-6: U.S. EPA Vintaging Model Emission Assumptions for Foams

Foams Sector	First Year Loss (%)	Annual Release Rate (%)	Release Lifetime (years)	Loss at Disposal (%)	Total
Flexible PU	100	0	0	0	100
Polyisocyanurate Boardstock	10	1.5	50	15	100
Rigid PU Integral Skin	95	2.5	2	0	100
Rigid PU Appliance	4	0.25	15	92.25	100
Rigid PU Commercial Refrigeration	6	0.25	15	90.25	100
Rigid PU Spray	15	1.5	57	1	100
One Component	100	0	0	0	100
Rigid PU Slabstock and Other	37.5	0.75	15	51.25	100
Phenolic	25	1.125	32	39	100
Polyolefin	95	2.5	2	0	100
XPS Sheet/Insulation Board*	40	2	25	0	90
XPS Boardstock	25	2.5	30	0	100
PU Sandwich Panel	10	0.5	50	65	100

*Note: In general, total emissions from foam end-uses are assumed to be 100 percent, although work is underway to investigate that assumption. In the XPS Sheet/Insulation Board end-use, the source of emission rates and lifetimes did not yield 100 percent emissions; this is currently being evaluated and may be updated in the future.

Methodology

Foams are given emission profiles depending on the foam type (open cell or closed cell). Open cell foams are assumed to be 100 percent emissive in the year of manufacture as described in Equation 7 below. Closed cell foams are assumed to emit a portion of their total HFC or PFC

content upon manufacture, a portion at a constant rate over the lifetime of the foam, and a portion at disposal as described in Equation 8 below.[1]

Emission Calculation from Open-Cell Foam:

$$E_j = Qc_j \qquad \text{Equation 7}$$

Where:

E = Emissions. Total emissions of a specific chemical in year j used for open-cell foam blowing, by weight.

Qc = Quantity of Chemical. Total amount of a specific chemical used for open-cell foam blowing, in year j, by weight.

j = Year of emission.

Emission Calculation from Closed-Cell Foam:

Emissions from closed-cell foams are calculated using the following equation. Equation 8 is calculated for a single year, accounting for emissions from foams blown in that year and emissions from existing vintages of foams. Emissions from each blowing agent are calculated separately.

$$E_j = \sum (ef_i \times Qc_{j-i+1}) \quad \text{for } i=1 \rightarrow k \qquad \text{Equation 8}$$

Where:

E = Emissions. Total emissions of a specific chemical in year *j* for closed-cell foam blowing, by weight.

ef = Emission Factor. Percent of foam's original charge emitted in each year ($1 \rightarrow k$). This emission factor is generally variable, including a rate for manufacturing emissions (occurs in the first year of foam life), annual emissions (every year throughout the foam lifetime), and disposal emissions (occurs during the final year of foam life).

Qc = Quantity of Chemical. Total amount of a specific chemical used in closed-cell foams in year ($j - i + 1$).

i = Counter, runs from 1 to lifetime (k).

j = Year of emission.

k = Lifetime. Average lifetime of foam product.

Fire Extinguishing

Vintaging Model Assumptions

ODSs, HFCs, PFCs and other chemicals are used as fire extinguishing agents, in both streaming and flooding applications. Emissions occur when the agent is discharged and, although systems are generally built to be leak-tight, some leaks do occur. Transition assumptions and growth rates for these two fire extinguishing types are presented in Table A-7, below.

[1] Emissions from foams may vary due to handling and disposal of the foam; shredding of foams may increase emissions, while landfilling of foams may abate some emissions. Average annual emissions are assumed in the model, which may not fully account for the range of foam handling and disposal practices.

Table A-7: Fire Extinguishing Marketing Transition Assumptions

Initial Market Segment	Primary Substitute	Start Date	Date of Full Penetration in New Equipment	Maximum Market Penetration	Secondary Substitute	Start Date	Date of Full Penetration in New Equipment	Maximum Market Penetration	Growth Rate
Streaming Agents									
Halon 1211	HFC-236fa	1997	1999	4%	Non-ODP/GWP	2010	2011	50%	3.0%
	Halotron	1995	1999	6%	Non-ODP/GWP	2010	2011	50%	
	Non-ODP/GWP	1993	1994	75%	None				
	Non-ODP/GWP	2005	2005	15%	None				
Flooding Agents*									
Halon 1301	HFC-23	1994	1994 or 1999	1%	None				2.2%
	HFC-227ea	1994	1994 or 1999	45%	None				
	Inergen	1994	1994 or 1999	4%	None				
	Non-ODP/GWP	1994	1994 or 1999	50%	None				

*Note: For flooding agents, 70 percent of each substitute is phased in during the first year and the remaining 30 percent is phased in over a six-year period.

Methodology

This analysis assumes that total emissions from servicing, leaks, accidental/false discharges, system decommissioning, and intentional discharges to extinguish fires, in aggregate, equal a percentage of the total quantity of chemical in operation at a given time. For modeling purposes, fire extinguishing agent is assumed to be released at a constant rate for an average equipment lifetime, as shown in the equation below. In streaming systems, emissions are assumed to be 2 percent of all chemical in use in each year, while in flooding systems 1.5 percent of the installed base of chemical is assumed to be emitted annually.

$$E_j = r \times \Sigma\, Qc_{j-i+1} \quad \text{for } i=1 \rightarrow k \qquad \text{Equation 6}$$

Where:

E = Emissions. Total emissions of a specific chemical in year j for fire extinguishing equipment, by weight.

r = Percent Released. The percentage of the total chemical in operation that is emitted to the atmosphere.

Qc = Quantity of Chemical. Total amount of a specific chemical used in new fire extinguishing equipment in a given year by weight.

k = Lifetime. The average lifetime of the equipment.

j = Year of emission.

The above equation is applied for a single year, accounting for all fire protection equipment in operation in that year. Each fire protection agent is modeled separately. In the Vintaging Model, streaming applications have a 10-year average lifetime and flooding applications have a 20-year average lifetime.

Solvents

Vintaging Model Assumptions

ODSs, HFCs, PFCs and other chemicals are used as solvents to clean items. For example, electronics may need to be cleaned after production to remove any manufacturing process oils or residues left. Solvents are applied by moving the item to be cleaned within a bath or stream of the

solvent. The transition assumptions and growth rates used within the Vintaging Model for electronics cleaning, metals cleaning, and precision cleaning, are presented below in Table A-8.

Table A-8: Current Solvent Market Transition Assumptions

Initial Market Segment	Primary Substitute	Start Date	Date of Full Penetration in New Uses	Maximum Market Penetration	Secondary Substitute	Start Date	Date of Full Penetration in New Uses	Maximum Market Penetration	Growth Rate
Electronics Cleaning									
CFC-113	Non-ODP/GWP	1992	1996	98.4%	None				2.0%
	HCFC-225ca/cb	1994	1995	0.2%	None				
	HFC-4310mee	1995	1996	0.7%	None				
	HFE-7100	1994	1995	0.7%	None				
CH_3CCl_3	Non-ODP/GWP	1996	1997	99.8%	None				
	PFC/PFPE	1996	1997	0.2%	Non-ODP/GWP	2000	2003	90%	
					Non-ODP/GWP	2005	2024	10%	
Metals Cleaning									
CH_3CCl_3	Non-ODP/GWP	1992	1996	100%	None				2.0%
CFC-113	Non-ODP/GWP	1992	1996	100%	None				
CCl_4	Non-ODP/GWP	1992	1996	100%	None				
Precision Cleaning									
CH_3CCl_3	Non-ODP/GWP	1995	1995	99.3%	None				2.0%
	HFC-4310mee	1995	1996	0.6%	None				
	PFC/PFPE	1995	1996	0.1%	Non-ODP/GWP	2000	2003	90%	
					Non-ODP/GWP	2005	2024	10%	
CFC-113	HFE-7100	1995	1996	3.3%	None				
	HCFC-225ca/cb	1995	1996	1.0%	None*				
	Non-ODP/GWP	1995	1996	95.7%	None				

* It is recognized that a secondary transition away from HCFC-225ca/cb will be needed to comply with the Montreal Protocol. This transition is not currently modeled.

Methodology

Generally, the emissions model assumes that some portion of solvent use is assumed to remain in the liquid phase and is not emitted as gas. Thus, emissions are considered "incomplete," and are set as a fraction of the amount of solvent consumed in a year. For solvent applications, a fixed percentage of the new chemical used in equipment is assumed emitted in that year with the remainder of the used solvent reused or disposed without being released to the atmosphere. The following emission equation calculates emissions from solvent applications:

$$E_j = l \times Qc_j \qquad \text{Equation 5}$$

Where:

E = Emissions. Total emissions of a specific chemical in year j from use in solvent applications, by weight.

l = Percent Leakage. The percentage of the total chemical that is leaked to the atmosphere, assumed to be 90 percent

Qc = Quantity of Chemical. Total quantity of a specific chemical sold for use in solvent applications in the year j, by weight.

j = Year of emission.

A.2.2 Model Output

By repeating these calculations for each year, the Vintaging Model creates annual profiles of use and emissions for ODS and ODS substitutes. The results can be shown for each year in two ways: 1) on a chemical-by-chemical basis, summed across the end-uses, or 2) on an end-use basis. Values for use and emissions are calculated both in metric tons and in million metric tons of carbon equivalents (MMTCE). The conversion of metric tons of chemical to MMTCE is accomplished through a linear scaling of tonnage by the global warming potential (GWP) of each chemical. The model uses 100-year GWP values published in the IPCC Second Assessment Report, except for HFC-245fa, for which the model uses the 100-year GWP value published in the IPCC Third Assessment Report because no value was available in the Second Assessment Report.

Throughout its development, the Vintaging Model has undergone modifications. As new or more accurate information becomes available, the model is adjusted in such a way that its estimates are often altered. Once emissions for the US have been determined the data are used to help estimate emissions for non-US countries as described below.

A.3 Estimating ODS Substitute Emissions in Other Countries

After U.S. emissions were calculated using the Vintaging Model, the following methodology was used to develop emission estimates for non-U.S. countries by building on the detailed assessment conducted for the United States. Details on the assumptions used at each step are included. The general steps that were performed are included below in the general methodology, though several sectors have modified the methodology where necessary. Specific deviations from this basic methodology are discussed following the general methodology description.

A.3.1 General Methodology

The following general steps were applied to estimate country-specific emissions. The Steps 1 through 6 result in preliminary emission estimates calculated by Equation 9, below. Then these preliminary estimates were adjusted based on a series of factors discussed in Steps 7 through 10.

1. *Estimate the base level consumption of ODS for each country or region, by chemical group, in unweighted metric tons.* UNEP (1999) provided estimates of 1986 and 1989-1998 ODS consumption in terms of ozone depletion potential (ODP) weighted totals for the major types of ozone depleting substances: CFCs, HCFCs, halons, carbon tetrachloride, and methyl chloroform. The data for 1989 was used because, in general, no substitution of ODS had taken place yet.

2. *Calculate the percent of unweighted base level ODS consumption of each chemical group used in each end-use sector.* The amount of ODS use in various industrial applications differs by country. For developed countries, data on the end-use distributions of ODS in 1990 were available for the United States from the Vintaging Model, the United Kingdom from *UK Use and Emissions of Selected Halocarbons,* prepared for the Department of the Environment (August 1996), and the Russian Federation from *Phaseout of Ozone Depleting Substances in Russia,* prepared for the Danish Environmental Protection Agency and the Ministry for Protection of the Environment and Natural Resources of The Russian Federation (August 1994). The 1990 end-use sector distribution for the United States was assumed to apply to Canada. The United Kingdom's distribution was applied

to the EU-15, Australia and New Zealand. The Russian Federation's distribution was applied to the Former Soviet Union countries and the non-EU-15 European countries. For developing countries, data on the consumption of ODS are available for many nations by sector and substance from the Multilateral Secretariat. For developing countries that do not have data available, a representative average was used.

3. *Calculate the Unweighted Base Level Consumption of ODS for each End-Use Sector (metric tons).* This step involves multiplying the amount of consumption of each chemical group from Step 1 by the end-use sector distribution percentages from Step 2.

4. *Calculate the Ratio of U.S. Unweighted ODS Substitute Consumption (metric tons) to U.S. Base Level Unweighted ODS Consumption (metric tons) for Each End-Use Sector.* The ratio was taken from the Vintaging Model output.

5. *Calculate the Ratio of U.S. GWP-Weighted Substitute Emissions (MMTCE) to U.S. Unweighted Substitute Consumption (metric tons) for Each End-Use Sector.* Similar to Step 4, this ratio was taken from the Vintaging Model output.

6. *Estimate GWP-weighted Substitute Emissions in a Given Year, in MMTCE.* This step involves multiplying the country-specific unweighted base level consumption of ODS (Step 3) by the ratio of U.S. unweighted ODS substitute consumption to U.S. base level unweighted ODS consumption (Step 4), and then multiplying that amount by the ratio of U.S. GWP-weighted substitute emissions to U.S. unweighted substitute consumption (Step 5), as shown in Equation 9. This calculation was performed for each of the end-use sectors to determine an estimate of the GWP-weighted substitute emissions in each year for each country.

Country-specific Substitute Emissions (MMTCE):

Equation 9

$$\text{Unweighted ODS Consumption} \times \frac{\text{Unweighted Substitute Consumption}}{\text{Unweighted ODS Consumption}} \times \frac{\text{Weighted Substitute Emissions}}{\text{Unweighted Subst. Consumption}}$$

(Country-Specific, step 3) (US-based, step 4) (US-based, step 5)

This step thus produces estimates based on the assumption that all countries will transition away from ODS in a similar manner as the United States (i.e., CFC-12 mobile air conditioners transitioned to HFC-134a beginning in 1994 in the United States, so, as a first estimation, it is assumed that CFC-12 mobile air conditioners transition to HFC-134a in other countries). In many cases, options for ODS substitutes in each end-use are technically limited to the same set of alternatives, regardless of geographic region. Furthermore, alternative technologies used in the United States are available and in many cases are used world-wide. These assumptions may be adjusted in later steps to account for differences between the United States and other countries, as explained below.

7. *Develop and Apply Adjustment Factors.* This analysis applied adjustment factors to modify the emission estimates for countries based on what is known qualitatively about how their substitution will likely differ from that of the United States. For example, adjustment factors less than one were applied to end-uses such as refrigerants, because some nations have been more likely to use hydrocarbon refrigerants than HFCs. Also, HFC use in foams may be adjusted in some cases because of the use of cyclopentane in lieu of HFCs. Adjustment factors greater than one were applied to the EU-15 countries for

fire extinguishing in some years to account for the rapid halon decommissioning that is occurring there. Table A-9 shows the adjustment factors used for each sector, and country grouping.

Table A-9: Adjustment Factors Applied in each Sector/Country

	Ref/AC	Aerosols	Foams	Solvents	Fire Ext.
Australia/New Zealand	0.90	1.00	0.50	1.00	1.00
European Union	0.70*	1.00	0.40	0.80	1.00*
Non-EU Europe	0.75	1.00	0.20	0.50	1.00
Canada	1.00	1.00	1.00	1.00	1.00
Japan	0.70	1.00	1.00	1.00	1.00
CEITs/Non-Annex I	0.80	1.00	0.20	0.50	1.00

* Some of the adjustment factors for the European Union vary by year and by region to account for European Regulation 2037/2000 on Substances that Deplete the Ozone Layer. These adjustments are discussed in the sector-specific methodologies section.

8. *Develop and Apply Timing Factors.* Since most developing countries and countries with economies in transition (CEIT) will transition to substitutes more slowly, the adjusted emission estimates were reduced by multiplying the results in each year by a timing factor to reflect the assumed delay in their transition. Timing factors for CEIT and non-EU Europe countries start at 25 percent in 1995 and increase by 25 percent at each 5-year interval, until they reach 100 percent in 2010, when they are assumed to have caught up to the other Annex I countries. Non-Annex I countries follow the same timing adjustments as CEIT and non-EU Europe for the CFC phaseout, but have an even further delayed phaseout of the HCFCs, to account for the fact that these countries can continue consuming new HCFCs through 2040. These factors are outlined in Table A-10.

Table A-10: Timing Factors Applied to ODS Substitute Emissions

Country or Region	1995	2000	2005	2010	2015	2020
CEITs/Non EU-Europe						
CFC	0.25	0.50	0.75	1.00	1.00	1.00
HCFC	0.25	0.50	0.75	1.00	1.00	1.00
Non-Annex I						
CFC	0.25	0.50	0.75	1.00	1.00	1.00
HCFC	0.00	0.00	0.125	0.25	0.375	0.50
All Other Countries						
HCFC	1.00	1.00	1.00	1.00	1.00	1.00
CFC	1.00	1.00	1.00	1.00	1.00	1.00

9. *Develop and Apply Economic Growth Factors*. Since other countries' economies are growing at different rates than the United States, emissions were altered based on comparisons between U.S. and regional historical and projected GDP growth rates. The historical regional percent changes in GDP are shown in Table A-11 (USDA 2002), and the projected regional growth rates are shown in Table A-12 (EIA 2001).

Table A-11: Annual Change in GDP Relative to Previous Year (Percent)

Region	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
United States	1.15	-1.04	2.75	2.46	3.74	2.37	3.40	4.40	4.40	4.10	4.10
Japan	5.08	3.80	1.02	0.31	0.64	1.47	3.92	0.85	-2.50	0.80	1.50
Western Europe	2.94	3.29	0.97	-0.40	2.83	2.49	1.60	2.45	2.70	2.47	3.38
Eastern Europe	-2.20	-10.01	-1.34	1.83	3.00	4.18	1.75	3.73	3.17	2.72	3.83
Former Soviet Union	-3.94	-6.03	-13.32	-10.19	-15.28	-6.05	-4.87	0.03	-4.25	2.45	7.75
China	3.80	9.20	14.20	13.50	12.60	10.50	9.60	8.80	7.80	7.10	8.00

Other Asia	7.93	5.73	5.60	5.82	7.14	7.16	6.46	4.77	-1.89	5.92	6.29
Latin America	-0.40	4.00	2.93	4.05	5.40	0.76	3.50	4.85	2.17	0.99	3.87
Middle East	6.84	4.30	6.61	3.79	0.91	4.54	6.56	3.97	2.41	2.32	6.01
Africa	0.69	1.22	0.91	0.88	2.48	3.49	5.14	2.53	2.63	2.83	3.35

Source: USDA (2002)

Table A-12: Projected Regional Annual Growth Rates from 2001-2020 (Percent)

	U.S.	Western Europe	Japan	China	Other Asia	Middle East	Africa	Latin America	Eastern Europe	Former Soviet Union
Rate	3.1	2.3	1.5	7.0	4.9	4.3	3.9	4.2	4.2	3.8

Source: EIA (2001)

10. *Estimate Adjusted GWP-weighted ODS Substitute Emissions in a Given Year by Region and Country.* By multiplying the estimates in Step 6 by the adjustment factors (Steps 7), the timing factors (Step 8), and the growth factor (Step 9), emissions and projections were estimated for each year.

A.3.2 Sector-Specific Adjustments to General Methodology

In addition to the adjustments discussed above, each sector had specific adjustments to the methodology to account for information that was available on a country or regional scale. These adjustments are discussed by sector in more detail below.

Refrigeration and Air-Conditioning

There were two sector-specific adjustments applied to the refrigeration and air-conditioning sector, described below. The first adjusts the emissions in the European Union to account for the accelerated phase-out of HCFCs, and the second adjusts emissions for those countries in which it is believed less recycling occurs than in the United States.

1. Countries in the European Union are assumed to be in full compliance with EC-Regulation No. 2037/2000, which stipulates that no new refrigeration and air-conditioning equipment be manufactured with HCFCs as of January 1, 2002. The EC regulation also bans the use of HCFCs in all equipment after January 1, 2015. Compliance with these regulations will likely lead to increased use of HFCs to replace HCFCs, and is assumed to correspond to increased emissions of 20 percent in 2005, 15 percent in 2010, and 15 percent in 2020, relative to what the EU baseline otherwise would be. These relative emission increases were determined by running a Vintaging Model scenario wherein the uses of HCFCs were assumed to comply with the regulation.

2. The emissions from developing (or "non-Annex I") countries, Countries with Economies in Transition (CEITs) and Turkey were increased by approximately 20 percent over initial estimates to reflect the assumed low levels of recovery and recycling of refrigerants from small end-uses (i.e., MVACs, commercial/residential air-conditioning, refrigerated transport, and other appliances), relative to the United States. This assumed increase in emissions from lower levels of recovery/recycling was derived based on Vintaging Model test runs, wherein emissions were first projected assuming an 80-percent baseline recovery rate (to reflect the assumed status quo in developed countries) and then projected again

assuming a 30-percent baseline recovery rate (to reflect the assumed status quo in developing countries). The resulting adjustment factors are shown in Table A-13.

Table A-13: Recycling Adjustment Applied to Refrigeration Emissions Estimates

Country Group/Year	2000	2005	2010	2015	2020
All Other Annex I	1.00	1.00	1.00	1.00	1.00
CEITs/Non-Annex I	1.22	1.22	1.20	1.18	1.20

Source: ICF Consulting (2002)

Aerosols

Since the ban on CFC use in non-MDI aerosols caused the United States to transition out of CFCs earlier than other countries, the United States consumption of ODS in 1989 for non-MDI aerosols is equal to zero. In order to determine a non-zero denominator for the ratio calculated in step 4, the unweighted U.S. consumption of non-MDI ODS substitutes (including a large market segment that transitioned into non-GWP, non-ODP substitutes) was used as a proxy for U.S. 1989 non-MDI ODS consumption. This assumption is valid if it is assumed that the market size of U.S. non-MDI aerosols was not affected by the transition from ODS to ODS substitutes. For countries other than the United States, it was then assumed that 15 percent of the non-MDI aerosols ODS consumption transitioned to HFCs, while the remainder is assumed to transition to NIK or hydrocarbon alternatives.

Foams

Most global emissions were estimated in the foam-blowing sector by developing Vintaging Model scenarios that were representative of country- or region-specific substitution and consumption patterns. To estimate baseline emissions, current and projected characterizations of international total foams markets were used to create country or region-specific versions of the Vintaging Model. The market information was obtained from Ashford (2004), based on research conducted on global foam markets. Scenarios were developed for Japan, Europe (both EU and non-EU countries combined), other developed countries (excluding Canada), CEITs, and China. It was assumed that other non-Annex I countries would not transition to HFCs during the scope of this analysis. Once the Vintaging Model scenarios had been run, the emissions were disaggregated to a country specific level based on estimated 1989 CFC consumption for foams developed for this analysis. Emission estimates were adjusted slightly to account for relative differences in countries' economic growth as compared to the United States (step 9, above).

Fire Extinguishing

Global emissions were adjusted in the fire extinguishing sector by region by developing Vintaging Model scenarios that were representative of country-specific substitution data. In addition, emissions were adjusted in the European Union to account for the rapid halon phase-out that is regulated there. Details of these adjustments include the following:

1. To estimate baseline emissions, information collected on current and projected market characterizations of international total flooding sectors was used to create country-specific versions of the Vintaging Model (i.e., country-specific ODS substitution patterns).

Information for Australia, Brazil, China, India, Japan, Russia, and the United Kingdom was obtained from HTOC members from those countries.[2] General information was also collected on Northern, Southern, and Eastern Europe. Baseline emission information from some of these countries was used to adjust the substitution patterns for all other non-U.S. countries, as described below:

- Eastern Europe: used as a proxy for the countries in the Former Soviet Union and CEITs except Poland and Russia, where specific information was available.
- Australia: used as proxy for New Zealand.
- Brazil: used as a proxy for countries in Latin America and the Caribbean.
- India: used as a proxy for all other developing countries.

For all other non-U.S. Annex I countries for which no country-level information was available, the U.S. ODS substitution pattern was used as a proxy.

2. An adjustment factor was applied to EU countries to account for European Regulation 2037/2000 on Substances that Deplete the Ozone Layer, which mandated the decommissioning of all halon systems and extinguishers in the EU by the end of 2003 (with the exception of those applications that are defined as critical uses) (Europa, 2003). To reflect this, the methodology assumes that all halon systems in the EU will be decommissioned by 2004.[3]

Solvents

It is assumed that PFC/PFPE solvents are only used in the United States. Therefore, the small quantity of U.S. emissions estimated for these compounds was removed prior to calculating ratios for other countries.

A.4 References

Asford, Paul. 2004. Peer review comments on U.S. EPA Draft Report, DRAFT Analysis of International Costs of Abating HFC Emissions from Foams. Caleb Management Services Ltd. March 3, 2004.

EIA. 2001. International Energy Outlook, Table 7. Comparison of Economic Growth Rates by Region, 1997-2020. United States Department of Energy, Energy Information Agency.

Europa. 2003. Regulation (EC) No 2037/2000 of the European Parliament and of the Council of 29 June 2000 on substances that deplete the ozone layer. *Europa*. 2003. Available online at

[2] Fire protection experts in these countries provided confidential information on the status of national halon transition markets and average costs to install the substitute extinguishing systems in use (on a per volume of protected space basis) for 2001 through 2020.

[3] It should be noted that the use of halon in marine applications is unlikely to meet the 2004 phase-out deadline, because these applications are also governed by regulations issued by the International Maritime Organization (IMO), and that many EU ships still contain Halon 1301 fire suppression systems. However, due to a lack of available data on emissions from marine-based fire protection systems as a percentage of the total EU fire extinguishing sector, this analysis assumes full compliance with the EU regulation.

<http://europa.eu.int/eur-lex/pri/en/oj/dat/2000/l_244/l_24420000929en00010024.pdf>. Accessed on October 13, 2003.

ICF Consulting. 2002. *Analysis on Combined Global Emission Estimates Scenarios* (U.S. EPA deliverable including revised analysis of the estimated level of recycling in other countries). Delivered to Casey Delhotal, Dave Godwin, Debbie Ottinger, U.S. EPA Global Programs Division, Washington, DC, August 23, 2002.

UNEP. 1999. Production and Consumption of Ozone Depleting Substances 1986-1998. United Nations Environment Programme, October 1999.

USDA 2002. Real GDP (2000 dollars) Historical. International Macroeconomic Data Set. Available online at: < http://www.ers.usda.gov/data/macroeconomics/>.

Appendix B List of IMAC Regions

The study supporting this document (and the IMAC model) uses country-specific data to aggregate baseline emissions, emission reductions, and abatement option costs and benefits into region-specific figures. The text of this document presents three regions in figures and tables – the United States, non-U.S. Annex I, and non-Annex I countries (i.e., all countries and territories listed below not included in the Annex I list). The following lists show all the countries included in the analysis, and their respective regional groupings.

Annex I

Commonwealth of Australia
Republic of Austria
Republic of Belarus
Kingdom of Belgium
Republic of Bulgaria
Canada
Republic of Croatia
Czech Republic
Kingdom of Denmark
Republic of Estonia
Republic of Finland
French Republic
Federal Republic of Germany
Hellenic Republic (Greece)
Republic of Hungary
Republic of Iceland
Ireland
Italian Republic
Japan
Republic of Latvia
Principality of Liechtenstein
Republic of Lithuania
Grand Duchy of Luxembourg
Principality of Monaco
Kingdom of the Netherlands
New Zealand
Kingdom of Norway
Republic of Poland
Portuguese Republic
Romania
Russian Federation
Slovak Republic
Republic of Slovenia
Kingdom of Spain
Kingdom of Sweden
Swiss Confederation
Republic of Turkey
Ukraine
United Kingdom of Great Britain and Northern Ireland
United States of America

Africa	People's Democratic Republic of Algeria	Republic of Liberia
	Republic of Angola	Great Socialist People's Libyan Arab Jamahiriya
	Republic of Benin	Republic of Madagascar
	Republic of Botswana	Republic of Malawi
	Burkina Faso	Republic of Mali
	Republic of Burundi	Islamic Republic of Mauritania
	Republic of Cameroon	Republic of Mauritius
	Republic of Cape Verde	Territorial Collectivity of Mayotte
	Central African Republic	Kingdom of Morocco
	Republic of Chad	Republic of Mozambique
	Union of the Comoros	Republic of Namibia
	Democratic Republic of the Congo (Kinshasa)	Republic of Niger
	Republic of the Congo (Brazzaville)	Federal Republic of Nigeria
	Republic of Cote d'Ivoire	Rwandese Republic
	Republic of Djibouti	Democratic Republic of Sao Tome and Principe
	Arab Republic of Egypt	Republic of Senegal
	Republic of Equatorial Guinea	Republic of Sierra Leone
	State of Eritrea	Somalia
	Federal Democratic Republic of Ethiopia	Republic of South Africa
	Gabonese Republic	Republic of The Sudan
	Republic of The Gambia	Kingdom of Swaziland
	Republic of Ghana	United Republic of Tanzania
	Republic of Guinea	Togolese Republic
	Republic of Guinea-Bissau	Tunisian Republic
	Republic of Kenya	Republic of Uganda
	Kingdom of Lesotho	Republic of Zambia
		Republic of Zimbabwe
Australia/NZ	Commonwealth of Australia	New Zealand
Brazil	Federal Republic of Brazil	
Canada	Canada	
China	People's Republic of China	Macau Special Administrative Region
	Hong Kong Special Administrative Region	
CIS	Republic of Armenia	Kyrgyz Republic
	Republic of Azerbaijan	Republic of Moldova
	Republic of Belarus	Russian Federation
	Georgia	Republic of Tajikistan
	Republic of Kazakhstan	Turkmenistan
		Ukraine
		Republic of Uzbekistan

Eastern Europe	Republic of Albania	The Former Yugoslav Republic of Macedonia
	Bosnia and Herzegovina	Republic of Poland
	Republic of Bulgaria	Romania
	Republic of Croatia	Slovak Republic
	Czech Republic	Republic of Slovenia
	Republic of Estonia	Former Republic of Yugoslavia (Serbia / Montenegro)
	Republic of Hungary	
	Republic of Latvia	
	Republic of Lithuania	
EU-15	Republic of Austria	Italian Republic
	Kingdom of Belgium	Grand Duchy of Luxembourg
	Kingdom of Denmark	Kingdom of the Netherlands
	Republic of Finland	Portuguese Republic
	French Republic	Kingdom of Spain
	Federal Republic of Germany	Kingdom of Sweden
	Hellenic Republic (Greece)	United Kingdom of Great Britain & Northern Ireland
	Ireland	
India	India	
Japan	Japan	
Korea, Rep.	Republic of Korea (South)	
Latin America	Antigua and Barbuda	Republic of Honduras
	Argentine Republic	Jamaica
	Aruba	Republic of the Marshall Islands
	Commonwealth of the Bahamas	United Mexican States
	Barbados	Netherlands Antilles
	Belize	Federal Republic of Nicaragua
	Bermuda	Republic of Panama
	Republic of Bolivia	Republic of Paraguay
	Federal Republic of Brazil	Republic of Peru
	Cayman Islands	Commonwealth of Puerto Rico
	Republic of Chile	Federation of St. Kitts and Nevis
	Republic of Colombia	St. Lucia
	Republic of Costa Rica	St. Vincent and the Grenadines
	Republic of Cuba	Republic of Suriname
	Commonwealth of Dominica	Republic of Trinidad and Tobago
	Dominican Republic	Oriental Republic of Uruguay
	Republic of Ecuador	Bolivarian Republic of Venezuela
	Republic of El Salvador	
	Grenada	
	Republic of Guatemala	
	Co-operative Republic of Guyana	
	Republic of Haiti	
México	United Mexican States	

Middle East	Kingdom of Bahrain	Sultanate of Oman
	Islamic Republic of Iran	State of Qatar
	Republic of Iraq	Kingdom of Saudi Arabia
	State of Israel	Syrian Arab Republic
	Hashemite Kingdom of Jordan	United Arab Emirates
	State of Kuwait	West Bank and Gaza
	Lebanese Republic	Republic of Yemen
Non-EU Western Europe	Principality of Andorra	Principality of Liechtenstein
	Channel Islands	Republic of Malta
	Republic of Cyprus	Principality of Monaco
	Faroe Islands	Kingdom of Norway
	Greenland	Republic of San Marino
	Republic of Iceland	Swiss Confederation
	Isle of Man	
Non-OECD Annex I	Republic of Belarus	Republic of Lithuania
	Republic of Bulgaria	Principality of Monaco
	Republic of Croatia	Romania
	Republic of Estonia	Russian Federation
	Republic of Latvia	Republic of Slovenia
	Principality of Liechtenstein	Ukraine
OECD	Commonwealth of Australia	Grand Duchy of Luxembourg
	Republic of Austria	United Mexican States
	Kingdom of Belgium	Kingdom of the Netherlands
	Canada	New Zealand
	Czech Republic	Kingdom of Norway
	Kingdom of Denmark	Republic of Poland
	Republic of Finland	Portuguese Republic
	French Republic	Slovak Republic
	Federal Republic of Germany	Kingdom of Spain
	Hellenic Republic (Greece)	Kingdom of Sweden
	Republic of Hungary	Swiss Confederation
	Republic of Iceland	Republic of Turkey
	Ireland	United Kingdom of Great Britain and Northern Ireland
	Italian Republic	
	Japan	
	Republic of Korea (South)	United States of America
OPEC	People's Democratic Republic of Algeria	Saudi Arabia
	Republic of Indonesia	United Arab Emirates
	Islamic Republic of Iran	
	Republic of Iraq	Bolivarian Republic of Venezuela
	State of Kuwait	
	Great Socialist People's Libyan Arab Jamahiriya	
	Nigeria	
	State of Qatar	

Russian Federation	Russian Federation	
South & SE Asia (excludes Japan)	Transitional Islamic State of Afghanistan	Republic of Maldives
	Territory of American Samoa	Federated States of Micronesia
	People's Republic of Bangladesh	Mongolia
	Kingdom of Bhutan	Union of Burma (Myanmar)
	Negara Brunei Darussalam	Kingdom of Nepal
	Kingdom of Cambodia	Territory of New Caledonia
	People's Republic of China	Commonwealth of the Northern Mariana Islands
	Hong Kong Special Administrative Region	Islamic Republic of Pakistan
	Macau Special Administrative Region	Republic of Palau
	Republic of the Fiji Islands	Independent States of Papua New Guinea
	Territory of French Polynesia	Republic of Philippines
	Territory of Guam	Independent State of Samoa
	India	Republic of Seychelles
	Republic of Indonesia	Republic of Singapore
	Republic of Kiribati	Solomon Islands
	Republic of Korea (South)	Democratic Socialist Republic of Sri Lanka
	Democratic People's Republic of Korea (North)	Kingdom of Thailand
	Lao People's Democratic Republic	Kingdom of Tonga
	Malaysia	Republic of Vanuatu
		Socialist Republic of Vietnam
Turkey	Republic of Turkey	
Ukraine	Ukraine	
USA	United States of America	United States Virgin Islands

Appendix C Emission Baselines

The study supporting this document (and the IMAC model) uses country-specific data to aggregate baseline emissions, emission reductions, and abatement option costs and benefits into region-specific figures. Following are baseline emissions for each country and region examined in the analysis and for the regional groupings shown in Appendix B. Total ODS Substitute emissions and emissions from each sector examined are shown. All emission estimates are presented in million metric tons of carbon equivalent (MMTCE).

Table C-1: Baseline ODS Substitute Emission Estimates by Country and Region (MMTCE)

Country/Region	2005	2010	2015	2020
Australia&NZ	0.91	1.24	1.57	1.93
Austria	0.28	0.34	0.40	0.51
Belgium	0.41	0.50	0.71	0.77
Brazil	1.00	1.85	2.40	3.08
Canada	1.77	2.66	3.57	4.67
China	3.52	7.42	11.25	16.86
Croatia	0.02	0.04	0.04	0.05
Denmark	0.27	0.33	0.47	0.51
Finland	0.11	0.13	0.15	0.20
France	2.84	3.58	4.88	5.30
Germany	3.45	4.16	5.93	6.48
Greece	0.20	0.22	0.31	0.34
Hungary	0.19	0.33	0.40	0.47
India	0.44	0.83	1.14	1.57
Ireland	0.10	0.12	0.17	0.18
Israel	0.55	1.05	1.43	1.95
Italy	2.58	2.93	4.07	4.43
Japan	8.56	11.04	13.09	14.98
Korea	2.60	4.92	6.52	8.50
Luxembourg	0.02	0.03	0.04	0.04
Malaysia	0.50	0.96	1.29	1.71
Mexico	1.06	1.92	2.45	3.09
Netherlands	0.60	0.72	1.03	1.12
Norway	0.07	0.12	0.16	0.21
Poland	0.22	0.40	0.53	0.67
Portugal	0.16	0.18	0.25	0.27
Romania	0.06	0.12	0.16	0.22
Russian Federation	1.87	3.32	4.26	5.35
Singapore	0.11	0.24	0.36	0.56
Slovakia	0.08	0.13	0.16	0.20
Slovenia	0.09	0.16	0.19	0.23
Spain	1.17	1.33	1.84	2.01
Sweden	0.17	0.23	0.30	0.41
Switzerland	0.17	0.26	0.30	0.35
Thailand	0.51	0.99	1.40	1.99
Turkey	0.19	0.36	0.46	0.58
Ukraine	0.08	0.14	0.18	0.22
United Kingdom	2.13	2.52	3.56	3.88
United States	32.87	48.12	63.92	82.65

Country/Region	2005	2010	2015	2020
Venezuela	0.43	0.79	1.02	1.31
Africa	2.02	3.59	4.47	5.49
CIS	0.24	0.43	0.53	0.63
Other Eastern Europe	0.51	0.86	1.04	1.25
Other Latin America	1.18	2.14	2.73	3.42
Other Middle East	1.08	1.98	2.56	3.28
Other Non-EU Western Europe	0.07	0.13	0.16	0.20
Other South-SE Asia	0.98	1.84	2.41	3.11
World (Total)	78.45	117.66	156.26	197.23
Annex I	62.22	86.69	114.26	140.63
Eastern Europe	1.19	2.04	2.53	3.09
EU-15	14.49	17.30	24.11	26.46
Latin America	3.67	6.70	8.59	10.90
Middle East	1.63	3.02	3.99	5.23
Non-EU Europe	0.31	0.51	0.62	0.75
Non-OECD Annex I	2.47	4.36	5.55	6.91
OECD	63.41	89.17	117.68	145.30
OPEC	1.67	3.04	3.90	4.96
Non-Annex I	16.23	30.96	42.00	56.60
Japan & Australia/NZ	9.47	12.27	14.66	16.90
Non-US Annex I	29.35	38.57	50.34	57.97
S/SE Asia, China, India, South Korea	8.66	17.20	24.38	34.30

Table C-2: Baseline HFC Emission Estimates from Refrigeration/AC by Country and Region (MMTCE)

Country/Region	2005	2010	2015	2020
Australia&NZ	0.57	0.84	1.12	1.39
Austria	0.15	0.19	0.23	0.26
Belgium	0.22	0.29	0.48	0.43
Brazil	0.97	1.79	2.33	3.01
Canada	1.59	2.36	3.17	3.98
China	3.05	6.53	9.92	15.02
Croatia	0.01	0.02	0.02	0.03
Denmark	0.15	0.19	0.31	0.28
Finland	0.05	0.07	0.09	0.11
France	1.36	2.15	3.34	3.08
Germany	1.85	2.43	3.98	3.60
Greece	0.09	0.12	0.20	0.18
Hungary	0.09	0.17	0.21	0.26
India	0.34	0.67	0.95	1.34
Ireland	0.05	0.07	0.11	0.10
Israel	0.52	1.00	1.37	1.88
Italy	1.23	1.62	2.66	2.40
Japan	6.83	8.86	10.51	11.73
Korea	2.54	4.81	6.36	8.28
Luxembourg	0.01	0.02	0.03	0.02
Malaysia	0.49	0.94	1.26	1.67
Mexico	0.93	1.72	2.22	2.82
Netherlands	0.32	0.42	0.69	0.62
Norway	0.02	0.06	0.10	0.13
Poland	0.11	0.22	0.31	0.42
Portugal	0.08	0.10	0.16	0.15
Romania	0.03	0.07	0.10	0.14
Russian Federation	0.88	1.81	2.52	3.35
Singapore	0.10	0.21	0.33	0.51
Slovakia	0.04	0.07	0.09	0.11
Slovenia	0.05	0.09	0.11	0.13
Spain	0.56	0.73	1.20	1.09
Sweden	0.08	0.13	0.18	0.24
Switzerland	0.06	0.12	0.14	0.17
Thailand	0.46	0.92	1.31	1.88
Turkey	0.19	0.35	0.45	0.57
Ukraine	0.04	0.08	0.10	0.13
United Kingdom	1.10	1.45	2.37	2.14
United States	26.87	40.08	53.95	67.84
Venezuela	0.42	0.78	1.01	1.29
Africa	1.85	3.33	4.18	5.16
CIS	0.23	0.40	0.50	0.60
Other Eastern Europe	0.26	0.48	0.61	0.75
Other Latin America	1.13	2.06	2.63	3.31
Other Middle East	1.00	1.85	2.41	3.11
Other Non-EU Western Europe	0.06	0.12	0.15	0.18
Other South-SE Asia	0.91	1.72	2.26	2.93
World (Total)	59.92	94.50	128.73	158.80

Country/Region	2005	2010	2015	2020
Annex I	44.98	65.74	89.65	105.94
Eastern Europe	0.59	1.11	1.45	1.84
EU-15	7.28	9.99	16.03	14.69
Latin America	3.45	6.35	8.19	10.43
Middle East	1.52	2.85	3.78	4.99
Non-EU Europe	0.15	0.29	0.39	0.48
Non-OECD Annex I	1.20	2.42	3.31	4.34
OECD	47.24	69.84	94.91	112.71
OPEC	1.52	2.80	3.62	4.63
Non-Annex I	14.94	28.77	39.08	52.86
Japan & Australia/NZ	7.40	9.70	11.63	13.12
Non-US Annex I	18.11	25.66	35.70	38.11
S/SE Asia, China, India, South Korea	7.88	15.79	22.38	31.63

Table C-3: Baseline HFC Estimates by MDI Aerosol by Country and Region (MMTCE)

Country/Region	2005	2010	2015	2020
Australia&NZ	0.08	0.09	0.10	0.11
Austria	0.02	0.02	0.02	0.02
Belgium	0.03	0.03	0.03	0.03
Brazil	0.02	0.03	0.04	0.05
Canada	0.09	0.10	0.11	0.12
China	0.23	0.41	0.55	0.74
Croatia	0.00	0.00	0.00	0.00
Denmark	0.02	0.02	0.02	0.02
Finland	0.01	0.01	0.01	0.01
France	0.18	0.19	0.20	0.21
Germany	0.25	0.26	0.28	0.29
Greece	0.01	0.01	0.01	0.01
Hungary	0.00	0.01	0.01	0.01
India	0.09	0.14	0.17	0.21
Ireland	0.01	0.01	0.01	0.01
Israel	0.02	0.04	0.05	0.06
Italy	0.17	0.18	0.18	0.19
Japan	0.60	0.60	0.59	0.59
Korea	0.00	0.01	0.01	0.02
Luxembourg	0.00	0.00	0.00	0.00
Malaysia	0.01	0.02	0.03	0.03
Mexico	0.12	0.19	0.21	0.24
Netherlands	0.04	0.05	0.05	0.05
Norway	0.02	0.03	0.03	0.03
Poland	0.03	0.04	0.05	0.05
Portugal	0.01	0.01	0.01	0.01
Romania	0.01	0.02	0.02	0.02
Russian Federation	0.22	0.34	0.39	0.44
Singapore	0.00	0.01	0.01	0.02
Slovakia	0.00	0.00	0.01	0.01
Slovenia	0.00	0.00	0.00	0.00
Spain	0.08	0.08	0.08	0.09
Sweden	0.03	0.03	0.03	0.03
Switzerland	0.01	0.02	0.02	0.02
Thailand	0.04	0.06	0.08	0.09
Turkey	0.00	0.01	0.01	0.01
Ukraine	0.01	0.01	0.01	0.01
United Kingdom	0.15	0.16	0.16	0.17
United States	1.58	1.70	1.84	1.98
Venezuela	0.01	0.01	0.01	0.01
Africa	0.16	0.24	0.27	0.31
CIS	0.01	0.01	0.01	0.01
Other Eastern Europe	0.02	0.03	0.03	0.03
Other Latin America	0.05	0.07	0.08	0.10
Other Middle East	0.08	0.13	0.15	0.17
Other Non-EU Western Europe	0.00	0.00	0.01	0.01
Other South-SE Asia	0.06	0.09	0.11	0.13
World (Total)	4.60	5.52	6.12	6.82

Country/Region	2005	2010	2015	2020
Annex I	3.70	4.06	4.32	4.61
Eastern Europe	0.06	0.10	0.11	0.13
EU-15	1.01	1.06	1.11	1.16
Latin America	0.19	0.30	0.35	0.41
Middle East	0.11	0.17	0.20	0.23
Non-EU Europe	0.03	0.05	0.05	0.06
Non-OECD Annex I	0.26	0.39	0.45	0.51
OECD	3.56	3.85	4.10	4.37
OPEC	0.14	0.22	0.25	0.29
Non-Annex I	0.90	1.47	1.79	2.21
Japan & Australia/NZ	0.68	0.69	0.69	0.70
Non-US Annex I	2.12	2.35	2.48	2.63
S/SE Asia, China, India, South Korea	0.44	0.75	0.96	1.25

Table C-4: Baseline HFC Emission Estimates by non-MDI Aerosol by Country and Region (MMTCE)

Country/Region	2005	2010	2015	2020
Australia&NZ	0.22	0.24	0.27	0.29
Austria	0.08	0.08	0.08	0.09
Belgium	0.09	0.10	0.10	0.11
Brazil	0.00	0.00	0.00	0.00
Canada	0.00	0.00	0.00	0.00
China	0.00	0.01	0.01	0.01
Croatia	0.01	0.01	0.02	0.02
Denmark	0.06	0.06	0.07	0.07
Finland	0.02	0.03	0.03	0.03
France	0.56	0.59	0.63	0.67
Germany	0.77	0.81	0.86	0.92
Greece	0.04	0.04	0.04	0.05
Hungary	0.09	0.14	0.16	0.19
India	0.00	0.00	0.00	0.00
Ireland	0.02	0.02	0.02	0.03
Israel	0.00	0.00	0.00	0.00
Italy	0.51	0.54	0.58	0.61
Japan	0.00	0.00	0.00	0.00
Korea	0.00	0.00	0.00	0.00
Luxembourg	0.00	0.01	0.01	0.01
Malaysia	0.00	0.00	0.00	0.00
Mexico	0.00	0.00	0.00	0.00
Netherlands	0.13	0.14	0.15	0.16
Norway	0.02	0.02	0.03	0.03
Poland	0.09	0.14	0.16	0.19
Portugal	0.03	0.03	0.04	0.04
Romania	0.02	0.04	0.04	0.05
Russian Federation	0.75	1.14	1.30	1.49
Singapore	0.00	0.00	0.00	0.00
Slovakia	0.04	0.06	0.07	0.08
Slovenia	0.04	0.07	0.08	0.09
Spain	0.23	0.25	0.26	0.28
Sweden	0.03	0.03	0.04	0.04
Switzerland	0.08	0.11	0.11	0.12
Thailand	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00
Ukraine	0.03	0.05	0.06	0.07
United Kingdom	0.46	0.48	0.51	0.55
United States	3.00	3.31	3.65	4.03
Venezuela	0.00	0.00	0.00	0.00
Africa	0.00	0.00	0.01	0.01
CIS	0.00	0.00	0.00	0.00
Other Eastern Europe	0.23	0.35	0.40	0.47
Other Latin America	0.00	0.00	0.00	0.00
Other Middle East	0.00	0.00	0.00	0.00
Other Non-EU Western Europe	0.00	0.00	0.00	0.00
Other South-SE Asia	0.00	0.00	0.00	0.00
World (Total)	7.66	8.92	9.80	10.78

Country/Region	2005	2010	2015	2020
Annex I	7.64	8.90	9.77	10.74
Eastern Europe	0.52	0.80	0.93	1.08
EU-15	3.03	3.22	3.42	3.63
Latin America	0.00	0.01	0.01	0.01
Middle East	0.00	0.00	0.00	0.00
Non-EU Europe	0.10	0.13	0.14	0.15
Non-OECD Annex I	0.98	1.50	1.72	1.97
OECD	6.66	7.40	8.06	8.78
OPEC	0.00	0.00	0.00	0.01
Non-Annex I	0.02	0.03	0.03	0.04
Japan & Australia/NZ	0.22	0.24	0.27	0.29
Non-US Annex I	4.65	5.59	6.12	6.71
S/SE Asia, China, India, South Korea	0.01	0.01	0.02	0.02

Table C-5: Baseline HFC Emission Estimates by Foams by Country and Region (MMTCE)

Country/Region	2005	2010	2015	2020
Australia&NZ	0.01	0.02	0.03	0.08
Austria	0.04	0.05	0.06	0.14
Belgium	0.05	0.06	0.08	0.19
Brazil	0.00	0.00	0.00	0.00
Canada	0.04	0.13	0.21	0.49
China	0.00	0.01	0.01	0.01
Croatia	0.00	0.00	0.00	0.00
Denmark	0.03	0.04	0.05	0.12
Finland	0.01	0.02	0.02	0.05
France	0.29	0.37	0.51	1.13
Germany	0.40	0.51	0.70	1.55
Greece	0.02	0.03	0.04	0.08
Hungary	0.00	0.00	0.00	0.00
India	0.00	0.00	0.00	0.00
Ireland	0.01	0.01	0.02	0.04
Israel	0.00	0.00	0.00	0.00
Italy	0.26	0.34	0.46	1.04
Japan	0.77	1.18	1.55	2.19
Korea	0.00	0.00	0.00	0.00
Luxembourg	0.00	0.00	0.00	0.01
Malaysia	0.00	0.00	0.00	0.00
Mexico	0.00	0.00	0.00	0.00
Netherlands	0.07	0.09	0.12	0.27
Norway	0.00	0.01	0.01	0.02
Poland	0.00	0.00	0.00	0.00
Portugal	0.02	0.02	0.03	0.06
Romania	0.00	0.00	0.00	0.00
Russian Federation	0.00	0.01	0.01	0.01
Singapore	0.00	0.00	0.00	0.00
Slovakia	0.00	0.00	0.00	0.00
Slovenia	0.00	0.00	0.00	0.00
Spain	0.12	0.16	0.21	0.47
Sweden	0.02	0.03	0.04	0.10
Switzerland	0.01	0.01	0.02	0.03
Thailand	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00
Ukraine	0.00	0.00	0.00	0.00
United Kingdom	0.24	0.31	0.41	0.92
United States	0.53	1.90	3.15	7.35
Venezuela	0.00	0.00	0.00	0.00
Africa	0.00	0.00	0.00	0.00
CIS	0.00	0.00	0.00	0.00
Other Eastern Europe	0.00	0.00	0.00	0.00
Other Latin America	0.00	0.00	0.00	0.00
Other Middle East	0.00	0.00	0.00	0.00
Other Non-EU Western Europe	0.00	0.00	0.00	0.00
Other South-SE Asia	0.00	0.00	0.00	0.00
World (Total)	2.94	5.30	7.76	16.38

Country/Region	2005	2010	2015	2020
Annex I	2.93	5.30	7.75	16.36
Eastern Europe	0.00	0.00	0.01	0.01
EU-15	1.57	2.04	2.76	6.17
Latin America	0.00	0.00	0.00	0.00
Middle East	0.00	0.00	0.00	0.00
Non-EU Europe	0.01	0.02	0.02	0.05
Non-OECD Annex I	0.00	0.01	0.01	0.02
OECD	2.93	5.29	7.74	16.35
OPEC	0.00	0.00	0.00	0.00
Non-Annex I	0.00	0.01	0.01	0.01
Japan & Australia/NZ	0.78	1.20	1.58	2.27
Non-US Annex I	2.40	3.40	4.59	9.01
S/SE Asia, China, India, South Korea	0.00	0.01	0.01	0.01

Table C-6: Baseline HFC Emission Estimates by Fire Extinguishing by Country and Region (MMTCE)

Country/Region	2005	2010	2015	2020
Australia&NZ	0.01	0.02	0.02	0.02
Austria	0.00	0.00	0.00	0.00
Belgium	0.02	0.01	0.01	0.01
Brazil	0.00	0.00	0.00	0.00
Canada	0.03	0.04	0.05	0.05
China	0.22	0.44	0.73	1.04
Croatia	0.00	0.00	0.00	0.00
Denmark	0.01	0.01	0.00	0.00
Finland	0.01	0.00	0.00	0.00
France	0.40	0.22	0.16	0.16
Germany	0.13	0.07	0.05	0.05
Greece	0.03	0.02	0.01	0.01
Hungary	0.01	0.01	0.01	0.02
India	0.01	0.01	0.02	0.02
Ireland	0.01	0.00	0.00	0.00
Israel	0.00	0.00	0.00	0.00
Italy	0.37	0.20	0.15	0.15
Japan	0.09	0.14	0.18	0.21
Korea	0.05	0.09	0.13	0.17
Luxembourg	0.00	0.00	0.00	0.00
Malaysia	0.00	0.00	0.00	0.00
Mexico	0.00	0.01	0.01	0.02
Netherlands	0.02	0.01	0.01	0.01
Norway	0.01	0.00	0.00	0.00
Poland	0.00	0.00	0.00	0.00
Portugal	0.02	0.01	0.01	0.01
Romania	0.00	0.00	0.00	0.00
Russian Federation	0.01	0.03	0.04	0.07
Singapore	0.01	0.01	0.02	0.03
Slovakia	0.00	0.00	0.00	0.00
Slovenia	0.00	0.00	0.00	0.00
Spain	0.17	0.09	0.07	0.07
Sweden	0.01	0.01	0.00	0.00
Switzerland	0.01	0.00	0.00	0.00
Thailand	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00
Ukraine	0.00	0.00	0.00	0.00
United Kingdom	0.15	0.09	0.06	0.06
United States	0.43	0.65	0.80	0.89
Venezuela	0.00	0.00	0.00	0.01
Africa	0.00	0.00	0.00	0.00
CIS	0.01	0.01	0.02	0.02
Other Eastern Europe	0.00	0.00	0.00	0.00
Other Latin America	0.00	0.01	0.01	0.01
Other Middle East	0.00	0.00	0.00	0.00
Other Non-EU Western Europe	0.00	0.00	0.00	0.00
Other South-SE Asia	0.01	0.02	0.03	0.05
World (Total)	2.26	2.26	2.65	3.19

Country/Region	2005	2010	2015	2020
Annex I	1.95	1.65	1.67	1.83
Eastern Europe	0.01	0.02	0.02	0.03
EU-15	1.36	0.75	0.54	0.55
Latin America	0.01	0.02	0.03	0.04
Middle East	0.00	0.00	0.00	0.00
Non-EU Europe	0.01	0.01	0.01	0.01
Non-OECD Annex I	0.01	0.03	0.05	0.08
OECD	1.99	1.72	1.76	1.94
OPEC	0.01	0.02	0.02	0.03
Non-Annex I	0.31	0.61	0.98	1.37
Japan & Australia/NZ	0.10	0.16	0.20	0.23
Non-US Annex I	1.51	1.00	0.87	0.94
S/SE Asia, China, India, South Korea	0.29	0.58	0.94	1.31

Table C-7: Baseline HFC and PFC Emission Estimates by Solvents by Country and Region (MMTCE)

Country/Region	2005	2010	2015	2020
Australia&NZ	0.02	0.02	0.03	0.03
Austria	0.00	0.00	0.00	0.00
Belgium	0.01	0.01	0.01	0.01
Brazil	0.01	0.02	0.02	0.02
Canada	0.02	0.03	0.03	0.03
China	0.01	0.02	0.02	0.03
Croatia	0.00	0.00	0.00	0.00
Denmark	0.00	0.00	0.01	0.01
Finland	0.00	0.00	0.00	0.00
France	0.04	0.05	0.05	0.05
Germany	0.06	0.06	0.06	0.06
Greece	0.00	0.00	0.00	0.00
Hungary	0.00	0.00	0.00	0.00
India	0.00	0.00	0.00	0.00
Ireland	0.00	0.00	0.00	0.00
Israel	0.00	0.01	0.01	0.01
Italy	0.04	0.04	0.04	0.04
Japan	0.27	0.26	0.26	0.25
Korea	0.01	0.02	0.02	0.03
Luxembourg	0.00	0.00	0.00	0.00
Malaysia	0.00	0.00	0.00	0.00
Mexico	0.00	0.00	0.00	0.00
Netherlands	0.01	0.01	0.01	0.01
Norway	0.00	0.00	0.00	0.00
Poland	0.00	0.00	0.00	0.00
Portugal	0.00	0.00	0.00	0.00
Romania	0.00	0.00	0.00	0.00
Russian Federation	0.00	0.00	0.00	0.00
Singapore	0.00	0.01	0.01	0.01
Slovakia	0.00	0.00	0.00	0.00
Slovenia	0.00	0.00	0.00	0.00
Spain	0.02	0.02	0.02	0.02
Sweden	0.00	0.00	0.00	0.00
Switzerland	0.00	0.00	0.00	0.00
Thailand	0.01	0.01	0.01	0.01
Turkey	0.00	0.00	0.00	0.00
Ukraine	0.00	0.00	0.00	0.00
United Kingdom	0.04	0.04	0.04	0.04
United States	0.45	0.49	0.52	0.57
Venezuela	0.00	0.00	0.00	0.00
Africa	0.00	0.01	0.01	0.01
CIS	0.00	0.00	0.00	0.00
Other Eastern Europe	0.00	0.00	0.00	0.00
Other Latin America	0.00	0.00	0.00	0.00
Other Middle East	0.00	0.00	0.00	0.00
Other Non-EU Western Europe	0.00	0.00	0.00	0.00
Other South-SE Asia	0.00	0.00	0.00	0.00
World (Total)	1.07	1.14	1.20	1.26

Country/Region	2005	2010	2015	2020
Annex I	1.01	1.06	1.10	1.14
Eastern Europe	0.00	0.00	0.00	0.01
EU-15	0.24	0.24	0.25	0.25
Latin America	0.01	0.02	0.02	0.02
Middle East	0.00	0.01	0.01	0.01
Non-EU Europe	0.00	0.00	0.00	0.01
Non-OECD Annex I	0.00	0.00	0.00	0.01
OECD	1.02	1.07	1.12	1.16
OPEC	0.00	0.00	0.00	0.00
Non-Annex I	0.06	0.09	0.10	0.12
Japan & Australia/NZ	0.29	0.29	0.28	0.28
Non-US Annex I	0.56	0.57	0.57	0.58
S/SE Asia, China, India, South Korea	0.04	0.06	0.07	0.08

Appendix D IMAC Methodologies

D.1 Introduction

The International Marginal Abatement Cost Curve (IMAC) is the final step in evaluating the emission reduction opportunities for each of the sectors analyzed in this report: refrigeration/air-conditioning, solvents, aerosols, foams and fire extinguishing. Each point on the marginal abatement cost curve compares the emissions reduced from the baseline due to use of abatement technologies or practices to the cost of achieving the reduction. Elements of the curve are estimated based on sector-specific inputs that represent emission reductions (expressed as percentages off baseline levels) for each of the abatement options. In addition, each abatement option has an associated cost. Methods used to calculate the cost of each option, expressed as $/TCE (dollars per metric ton of carbon equivalent), are discussed in this appendix.

A discounted cash flow analysis was used to estimate the cost of achieving emission reductions through instituting potential mitigation options available to each sector. Consistent with the approach EPA has used in developing high GWP gas and methane marginal abatement cost (MAC) curves for the United States, the practice of using discounted cash flow analysis reflects the decision-making process that manufacturers use when considering investments in emission reduction practices (EPA, 1999; EPA, 2001). This decision-making process is typically a cost-benefit analysis, where both costs and benefits are estimated for each potential mitigation option by comparing the positive costs (e.g., the financial burden associated with each option) with the negative costs (e.g., the financial savings and/or emission benefits associated with that option). Data to support estimates of both costs and benefits of options were available in most cases; where data were not available, the options were summarized qualitatively. Options for which no quantitative cost information is available, however, do not affect or appear in any of the MAC curves presented. All costs are presented in real year 2000 United States dollars.

D.2 Discounting Costs

Positive costs associated with abatement options are typically categorized as either one-time (capital) investment costs (e.g., costs incurred when installing new equipment or applying a retrofit option), or as annual costs (e.g., operation and maintenance (O&M) costs associated with labor, routine repairs, electricity or fuel use). Mitigation options may have one or both of these types of costs, and both affect the viability of the option. Where country-specific pricing information was not available (either as an absolute price or as a price relative to that in the United States), international costs were estimated from corresponding U.S. figures using adjustment factors. The nature of these factors varies by country and region, according to the most pertinent variable affecting the price of each option; factors used include relative labor rates (for labor-intensive options) and relative electricity prices (for energy-intensive options). Finally, some options and sources are considered in the context of an international market in which prices are not highly variable by country. In these cases, international costs are assumed to be the same as in the United States.

The process of “discounting” the positive costs described above involves calculating the present value (PV) of each cost incurred. The present value of an initial one-time cost is equal to the cost itself, since the one-time cost is assumed to be incurred at the initiation of the project. It is added to the present value of the stream of annual costs incurred.

The following equation calculates the present value of a stream of annual costs denoted by $C_0,...C_n$ paid out over the timeframe of n years, where r is the annual interest rate (or discount rate) and C_0 is the amount of one-time costs paid out in the first period.

$$PV[C_0,\ldots,C_n] = \sum_{i=0}^{n} \frac{C_i}{(1+r)^i}$$

Equation 1

D.3 Discounting Benefits

Benefits factored into the MAC curve represent savings achieved through reducing emissions of a product or by improving process efficiency. For example, where HFC emissions can be reduced by substituting other less expensive gases, the difference in the price of the HFC and its substitute is counted as a benefit. Where HFC emissions are reduced through equipment modifications, the benefit is the avoided cost of replacing the HFC gas that would otherwise have been emitted. In some cases, benefits occur indirectly as a result of process efficiencies that also lower other annual costs (e.g., costs associated with maintenance requirements or energy use).

The present value of benefits can be calculated similarly to that of costs, as shown in the previous section. In practice, however – for the purposes of this analysis – both costs and benefits associated with abatement options (raw, before discounting) serve as inputs to Equation 4 as presented below.

D.4 Tax Adjustments

In some scenarios, the present value calculations of costs and benefits are adjusted using an implied tax rate in addition to the discount rate (see section on *Discount and Tax Rate Scenarios*, below, for the specific discount rate and tax rate scenarios included in this analysis and further explanation of their significance). The present value of annual O&M costs and emission reduction benefits, calculated using Equation 1, requires additional manipulation when tax rates are considered. Because the taxable income of a particular entity is assumed to be reduced by the cost of an instituted mitigation option, introducing a tax rate multiplies the (financial and emissions-related) present value calculations by the factor *(1 – TR)*, where *TR* represents the applied tax rate. This, in effect, reduces the absolute present value of the annual financial costs or benefits associated with an option.

One-time costs are also affected by the introduction of a tax rate. This effect is quantified through an additional calculation that estimates potential tax savings realized as a result of the depreciation of capital. Depreciation measures the decline in value of any capital investment or asset, generally arriving from use, time, or obsolescence through technological or market changes. The depreciation period of a fixed asset is essentially the useful economic life of that asset. Generally, the depreciation period associated with each mitigation technology or option is equal to the number of years included in the time horizon of each option (i.e., the number of years that the specific practice change or technology is expected to last). Equation 2 presents the calculation for the depreciation of an investment.

$$\text{Depreciation (\$/yr)} = \frac{\text{Capital Cost (one-time investment)}}{\text{Depreciation Period (years)}}$$

Equation 2

Tax savings associated with one-time costs are can be estimated by multiplying the depreciation of the investment by the tax rate.

D.5 Calculating the Break-Even Price

The methodology used to account for costs, benefits, and tax adjustments is summarized by the following equation (adapted from EPA, 2003):

$$\sum_{t=1}^{T}\left[\frac{(P\times ER)(1-TR)+R(1-TR)+TB}{(1+DR)^{t}}\right]=CC_{0}+\sum_{t=1}^{T}\left[\frac{RC(1-TR)}{(1+DR)^{t}}\right] \qquad \text{Equation 3}$$

where: *P* is the break even price of the option in $/TCE
ER is the annual emissions reduction achieved by the technology, in TCE
TR is the tax rate
R is the revenue generated from energy production (scaled based on regional energy prices) or savings (e.g., from the use of less expensive ODS substitutes), in 2000 U.S. dollars
TB is the tax break equal to CC/T * TR
T is the option lifetime, in years
DR is the selected discount rate
CC_0 is the capital cost of the option, in 2000 U.S. dollars
RC is the recurring (O&M) cost of the option (scaled based on regional labor costs), in 2000 U.S. dollars

Solving for *P* and assuming that ER, RC, and R do not change on an annual basis yields:

$$P=\frac{CC_{0}}{ER(1-TR)\sum_{t=1}^{T}\frac{1}{(1-DR)^{t}}}+\frac{RC}{ER}-\frac{R}{ER}-\frac{CC_{0}}{ER\times T}\frac{TR}{(1-TR)} \qquad \text{Equation 4}$$

P, the "break-even price," represents the point at which an entity (individual, corporation, industry, etc.)—regardless of environmental, legal, or policy concerns—will be financially indifferent in deciding whether to institute an emission mitigation option. Where this cost is less than zero, adopting the measure is cost-efficient (i.e., the option will result in positive financial savings). Where this cost is positive, it will present a cost to the entity (and will most likely therefore only be introduced in response to policy or other requirements, or to meet other goals). In most cases, some external value of carbon must be introduced in order to make the investment economically viable.

D.6 Discount and Tax Rate Scenarios

The present value calculations described above effectively discount both costs and benefits over the time horizon specific to each option. The application of a tax rate accounts for the depreciation of capital and the reduced tax liability of an entity after having invested in an option. For the purposes of this report, results are reported using both four and 20 percent discount rates at zero and 40 percent tax rates, respectively. The four percent ("social") discount rate and zero tax rate scenario is useful for comparison with similar public sector studies conducted by EPA and several other countries, while the conservative

20 percent ("private") discount rate and 40 percent tax rate more closely aligns with the interest rates that affect private sector decision-making in the United States and internationally.[1] Both scenarios allow for comparison with EPA's MAC curves for methane emissions (EPA, 1999). A substantial quantity of economic literature is available on the appropriate discount rate to use in discounting public and private sector benefits and costs over time. The U.S. Office of Management and Budget (OMB) issued guidelines on this topic that suggest using "the opportunity cost of capital, as measured by the before-tax rate of return to incremental private investment" (e.g., about seven percent) (OMB, 2000). In addition, OMB encourages sensitivity analyses using the "social rate of time preference," for which many analysts use the average rate on long-term treasury bonds (about three percent in recent years). The two scenarios used in this analysis (i.e., the four percent discount rate and zero percent tax rate, and the 20 percent discount rate and 40 percent tax rate) offer the opportunity to examine the MAC under two more conservative scenarios—a low "social" discount rate and a high, riskier "private" discount rate.

D.7 Total Equivalent Warming Impact

The analyses in this report incorporate the "total equivalent warming impact" (TEWI) of emission reduction options. The concept of TEWI is based on the fact that replacing high GWP gases in some applications may lead to greater emissions of GHGs elsewhere in the economy. The net effect of some actions to lower high GWP gas emissions, therefore, could increase emissions overall, or at least reduce the net benefits. For example, substitutions for high GWP gases in various refrigeration or air-conditioning systems or insulating foam manufacturing could, in some cases, result in less efficient performance and higher energy use. This situation in turn would lead to greater energy consumption and higher CO_2 emissions from electricity generation. In some cases, the additional CO_2 emissions from increased energy consumption outweighs the emission reduction that could be expected from replacing a high GWP gas with one that has no or a very low GWP. In other cases, however, the TEWI is improved through substitution—such as is the case where alternatives to ODS substitutes are both more energy efficient and have lower GWPs than their predecessors. Evaluating the TEWI of an option, therefore, involves considering the difference between the direct effects (reduction of high GWP gas emissions) and indirect effects (increase or decrease of other greenhouse gases) of each option, where appropriate.

This issue is most apparent when evaluating reductions in ODS substitute emissions from the refrigeration and air-conditioning, foams, and fire extinguishing sectors. As described in the relevant chapters, TEWI has been incorporated into the analysis by including the incremental costs/cost savings and changes in indirect (CO_2) emissions that are associated with differences in electricity consumption. Energy use is an important consideration for the refrigeration/air-conditioning sector because for many applications, energy consumption results in a significant portion of total emissions. Similarly, heating and cooling requirements may be an important consideration for options in the fire extinguishing sector, as additional storage space is often needed to house alternative extinguishing agents.

[1] The term "discount rate" can be conceptually defined as the social opportunity cost of capital. While this social discount rate is usually assumed to be equal to the private-sector interest rate (that used by businesses in formulating decisions), a potential source of disparity between private and social discount rates may result from differences in social and private risk premiums (Tietenberg, 1996). The possibility of alternative discount rates influencing decisions regarding the institution of emission mitigation options is one factor contributing to EPA's decision to conduct this analysis using variable discount rates. For the purposes of this report, only a low case (four percent) and a high case (twenty percent) are presented. Calculations made using the higher discount rate also incorporate a tax adjustment equal to 40 percent, while no taxes are associated with the lower discount rate.

For abatement options in the refrigeration/air-conditioning and fire extinguishing sectors for which indirect (energy) costs were considered, annual costs or cost savings were calculated for the United States and were adjusted by regional electricity prices (average of 1994-1999) based on EIA (2000) to calculate cost or cost savings for other regions. Similarly, indirect (CO_2) emission benefits or penalties were calculated for the United States, and were adjusted by a ratio of U.S. to regional national average CO_2 emission rates for electricity production, based on Sand et al. (1997) to calculate indirect CO_2 emission benefits or penalties for other regions. In the foams sector, options are evaluated on an equivalent insulating value basis. If an option (such as replacement of an HFC blowing agent with a low or zero GWP agent) results in a decreased insulating value, then an increased thickness in the foam is assumed to be needed.

Although the economic analysis focuses on direct and some indirect costs, it does not incorporate indirect societal benefits associated with reducing emissions of greenhouse gases (i.e., it does not attempt to quantify the avoided costs of mitigating potential damages associated with the effects of increased emissions and concentrations of greenhouse gases).[2] In addition, due to data limitations, a full life cycle analysis was not possible. For example, in the refrigeration sector, the cost and emission impacts associated with (a) the manufacture of refrigerant and all system components, (b) the energy required for reclamation, and (c) the recycling of all system components at the end of equipment life were not assessed in this analysis. Also, while the economic analyses of reduction options in the relevant chapters do take TEWI into account, baseline emission estimates do not include indirect CO_2 emissions.

D.8 Marginal Abatement Cost Curves

All Model inputs are entered by country and then aggregated into regions. The MAC curve is derived by ranking individual reduction opportunities in ascending order by $/TCE and plotting the corresponding emission reductions cumulatively. Each point along the MAC curve shows the marginal cost of abating an incremental, additional amount of high GWP gas emissions. The break-even cost of each option determines its placement with respect to the y-axis. Moving away from the origin, each point on the curve represents a cumulative sum of emission reductions with respect to the x-axis. Points corresponding to a zero or negative $/TCE value along the y-axis represent a market in which the benefits of reducing the high GWP gas pay for themselves. These improvements, in many cases, have not yet been made due to various institutional or technical barriers and informational asymmetries that often prevent their implementation. As discussed above, these costs imply that it is cost-efficient to adopt the measure (i.e., the option will result in financial savings). Positive break-even values imply costs that could only result in a cost-efficient market solution if external benefits (e.g., tax or other incentives) were introduced.

Although few abatement options with costs greater than or equal to $200/TCE are included in this analysis, an analysis with a longer time horizon (e.g., to year 2100) might need to include these higher cost options. For example, after an initial short-term strategy, all negative-cost or low-cost options are likely to have already fully penetrated their respective markets, and additional greenhouse gas mitigation options will be sought. Additionally, as the impacts of climate change are increasingly felt over time, the elasticity of the market will likely expand, as national and/or international policies respond to growing concerns and require that more drastic mitigation efforts be made.

[2] For more information on these potential damages, see Pearce *et al.*, 1996.

D.9 References

EIA (Energy Information Administration). 2000. Electricity Prices for Industry. Energy Information Agency, Washington, D.C. http://www.eia.doe.gov/emeu/international/elecprii.html

EPA (Environmental Protection Agency). 2003. *International Analysis of Methane and Nitrous Oxide Abatement Opportunities: Report to Energy Modeling Forum*, Working Group 21, June 2003

EPA (Environmental Protection Agency). 2001. *U.S. High GWP Gas Emissions 1990-2010: Inventories, Projections, and Opportunities for Reductions.* U.S.EPA #000-F-97-000. Office of Air and Radiation, U.S. Environmental Protection Agency. Washington, DC, June 2001.

EPA (Environmental Protection Agency). 1999. *U.S. Methane Emissions 1990- 2020: Inventories, Projections, and Opportunities for Reductions*. U.S. EPA #430-R-99-013. Office of Air and Radiation, U.S. Environmental Protection Agency, Washington, DC, September 1999.

OMB (Office of Management and Budget). 2000. *Guidelines to Standardize Measures of Costs and Benefits and the Format of Accounting Statements*. Memorandum for the Heads of Departments and Agencies from Jacob Lew, OMB Director, March 22, 2000.

Pearce, D.W., W.R. Cline, A.N. Achanta, S. Fankhauser, R.K. Pachauri, R.S.J. Tol, and P. Vellinga 1996. "The Social Costs of Climate Change: Greenhouse Damage and the Benefits of Control," in J. Bruce, H. Lee, and E. Haites (eds.), *Climate Change 1995: Economic and Social Dimensions of Climate Change, Contribution of Working Group III to the Second Assessment Report of the IPCC*. World Meteorological Organization and United Nations Environment Programme, 1996.

Sand, J.R., S.K. Fischer, and V.D. Baxter. 1997. *Energy and Global Warming Impacts of HFC Refrigerants and Emerging Technologies*. Prepared for the Alternative Fluorocarbons Environmental Acceptability Study and U.S. Department of Energy. Oak Ridge National Laboratory. 1997.

Tietenberg, Tom. 1996. *Environmental and Natural Resource Economics*, Fourth edition. HarperCollins College Publishers, United States of America.

Appendix E Additional Data on Abatement Options

The study supporting this document (and the IMAC model) uses country-specific data to aggregate baseline emissions, emission reductions, and abatement option costs and benefits into region-specific figures. Following are break-even prices for each option for the World, the United States, and nine additional regions or country groupings. Costs vary by country/region based on one-time or annual adjustment factors (e.g., electricity price, fuel price, etc.); therefore, the lowest and highest costs for the region are shown. Also shown are the emission reductions for 2005, 2010, 2015 and 2020, under the market penetration and other assumptions presented in the report. All costs are shown in 2000 U.S. dollars per ton of carbon equivalent ($/TCE), and all emission reduction estimates are presented in million metric tons of carbon equivalent (MMTCE). Results are shown at both 4% discount rate with 0% tax rate and 20% discount rate with 40% tax rate for each of the following country/region groupings:

- World;
- United States;
- Non-US Annex I;
- Non-Annex I;
- Africa;
- Eastern Europe;
- EU-15;
- Latin America;
- Japan, Australia, and New Zealand;
- Middle East; and
- S/SE Asia, China, India, and Korea.

World Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.037	0.0%	0.037	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.383	0.5%	0.420	0.5%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.383	0.5%	0.803	1.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.543	0.7%	1.346	1.7%
Solvents	HFC to HFE	$ -	$ -	0.063	0.1%	1.409	1.8%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.974	1.2%	2.383	3.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	0.012	0.0%	2.395	3.1%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.021	0.0%	2.416	3.1%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.567	0.7%	2.983	3.8%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	2.983	3.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	2.983	3.8%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	2.983	3.8%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.042	0.1%	3.025	3.9%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	3.025	3.9%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	3.025	3.9%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 72.96	0.119	0.2%	3.144	4.0%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	3.144	4.0%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.007	0.0%	3.152	4.0%
Refrigeration/AC	Secondary Loop	$ 45.33	$ 173.22	0.109	0.1%	3.261	4.2%
Refrigeration/AC	Ammonia Secondary Loop	$ 55.34	$ 180.96	0.063	0.1%	3.324	4.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	3.324	4.2%
Refrigeration/AC	HFC-152a in MVACs	$ 55.55	$ 205.42	-	0.0%	3.324	4.2%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.75	0.003	0.0%	3.327	4.2%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	3.327	4.2%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (35.34)	$ 468.38	0.151	0.2%	3.479	4.4%
Fire Extinguishing	Inert Gases	$ 369.25	$ 505.32	0.007	0.0%	3.486	4.4%
Fire Extinguishing	Water Mist	$ 467.17	$ 781.28	0.001	0.0%	3.487	4.4%
Refrigeration/AC	CO2 for New MVACs	$ 422.48	$ 839.80	-	0.0%	3.487	4.4%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.038	0.0%	3.525	4.5%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	3.525	4.5%

World Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.037	0.0%	0.037	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.383	0.5%	0.420	0.5%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.383	0.5%	0.803	1.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	0.012	0.0%	0.815	1.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.543	0.7%	1.358	1.7%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	1.358	1.7%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	1.358	1.7%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (4.78)	0.119	0.2%	1.477	1.9%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	1.477	1.9%
Solvents	HFC to HFE	$ -	$ -	0.063	0.1%	1.540	2.0%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.974	1.2%	2.514	3.2%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.021	0.0%	2.535	3.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.567	0.7%	3.102	4.0%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.042	0.1%	3.144	4.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (275.47)	$ 7.02	0.151	0.2%	3.296	4.2%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	3.296	4.2%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	3.296	4.2%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	3.296	4.2%
Refrigeration/AC	HFC-152a in MVACs	$ (73.65)	$ 30.81	-	0.0%	3.296	4.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	3.296	4.2%
Fire Extinguishing	FK-5-1-12	$ 83.66	$ 85.22	0.003	0.0%	3.299	4.2%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.007	0.0%	3.306	4.2%
Refrigeration/AC	Ammonia Secondary Loop	$ 11.47	$ 123.84	0.063	0.1%	3.369	4.3%
Refrigeration/AC	Secondary Loop	$ 9.66	$ 125.39	0.109	0.1%	3.479	4.4%
Fire Extinguishing	Inert Gases	$ 71.10	$ 136.29	0.007	0.0%	3.486	4.4%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	3.486	4.4%
Refrigeration/AC	CO2 for New MVACs	$ (23.44)	$ 180.72	-	0.0%	3.486	4.4%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.038	0.0%	3.524	4.5%
Fire Extinguishing	Water Mist	$ 111.76	$ 287.80	0.001	0.0%	3.525	4.5%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	3.525	4.5%

World Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.005	0.0%	0.005	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.892	0.8%	0.897	0.8%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.892	0.8%	1.789	1.5%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	1.424	1.2%	3.213	2.7%
Solvents	HFC to HFE	$ -	$ -	0.175	0.1%	3.389	2.9%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	2.789	2.4%	6.177	5.3%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	0.055	0.0%	6.232	5.3%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.045	0.0%	6.278	5.3%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	1.651	1.4%	7.929	6.7%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	7.929	6.7%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	7.929	6.7%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.082	0.1%	8.011	6.8%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.090	0.1%	8.101	6.9%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	8.101	6.9%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	8.101	6.9%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 72.96	1.741	1.5%	9.842	8.4%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	0.666	0.6%	10.509	8.9%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.040	0.0%	10.548	9.0%
Refrigeration/AC	Secondary Loop	$ 45.33	$ 173.22	1.466	1.2%	12.015	10.2%
Refrigeration/AC	Ammonia Secondary Loop	$ 55.34	$ 180.96	0.935	0.8%	12.950	11.0%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	12.950	11.0%
Refrigeration/AC	HFC-152a in MVACs	$ 55.55	$ 205.42	0.693	0.6%	13.643	11.6%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.75	0.054	0.0%	13.697	11.6%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	0.009	0.0%	13.705	11.6%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (35.34)	$ 468.38	1.704	1.4%	15.409	13.1%
Fire Extinguishing	Inert Gases	$ 369.25	$ 505.32	0.067	0.1%	15.476	13.2%
Fire Extinguishing	Water Mist	$ 467.17	$ 781.28	0.009	0.0%	15.485	13.2%
Refrigeration/AC	CO2 for New MVACs	$ 422.48	$ 839.80	0.642	0.5%	16.126	13.7%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.102	0.1%	16.228	13.8%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.276	0.2%	16.504	14.0%

World Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.005	0.0%	0.005	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.892	0.8%	0.897	0.8%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.892	0.8%	1.789	1.5%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	0.055	0.0%	1.844	1.6%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	1.424	1.2%	3.268	2.8%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	3.268	2.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	3.268	2.8%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (4.78)	1.741	1.5%	5.010	4.3%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.082	0.1%	5.092	4.3%
Solvents	HFC to HFE	$ -	$ -	0.175	0.1%	5.267	4.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	2.789	2.4%	8.056	6.8%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.045	0.0%	8.101	6.9%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	1.651	1.4%	9.752	8.3%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.090	0.1%	9.842	8.4%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (275.47)	$ 7.02	1.704	1.4%	11.546	9.8%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	0.666	0.6%	12.212	10.4%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	0.009	0.0%	12.221	10.4%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	12.221	10.4%
Refrigeration/AC	HFC-152a in MVACs	$ (73.65)	$ 30.81	0.693	0.6%	12.915	11.0%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	12.915	11.0%
Fire Extinguishing	FK-5-1-12	$ 83.66	$ 85.22	0.054	0.0%	12.968	11.0%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.040	0.0%	13.008	11.1%
Refrigeration/AC	Ammonia Secondary Loop	$ 11.47	$ 123.84	0.935	0.8%	13.943	11.9%
Refrigeration/AC	Secondary Loop	$ 9.66	$ 125.39	1.466	1.2%	15.409	13.1%
Fire Extinguishing	Inert Gases	$ 71.10	$ 136.29	0.067	0.1%	15.476	13.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	15.476	13.2%
Refrigeration/AC	CO2 for New MVACs	$ (23.44)	$ 180.72	0.642	0.5%	16.118	13.7%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.102	0.1%	16.219	13.8%
Fire Extinguishing	Water Mist	$ 111.76	$ 287.80	0.009	0.0%	16.228	13.8%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.276	0.2%	16.504	14.0%

World Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.009	0.0%	0.009	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.980	0.6%	0.989	0.6%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.980	0.6%	1.969	1.3%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	2.575	1.6%	4.544	2.9%
Solvents	HFC to HFE	$ -	$ -	0.280	0.2%	4.824	3.1%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	4.621	3.0%	9.445	6.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	0.177	0.1%	9.623	6.2%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.070	0.0%	9.693	6.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	2.540	1.6%	12.233	7.8%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	12.233	7.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	12.233	7.8%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.106	0.1%	12.340	7.9%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.141	0.1%	12.480	8.0%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	0.045	0.0%	12.525	8.0%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	12.525	8.0%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 72.96	5.804	3.7%	18.329	11.7%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	1.008	0.6%	19.337	12.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.125	0.1%	19.462	12.5%
Refrigeration/AC	Secondary Loop	$ 45.33	$ 173.22	4.735	3.0%	24.197	15.5%
Refrigeration/AC	Ammonia Secondary Loop	$ 55.34	$ 180.96	3.119	2.0%	27.316	17.5%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	0.026	0.0%	27.342	17.5%
Refrigeration/AC	HFC-152a in MVACs	$ 55.55	$ 205.42	2.288	1.5%	29.630	19.0%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.75	0.202	0.1%	29.832	19.1%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	0.023	0.0%	29.855	19.1%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (35.34)	$ 468.38	3.778	2.4%	33.633	21.5%
Fire Extinguishing	Inert Gases	$ 369.25	$ 505.32	0.192	0.1%	33.824	21.6%
Fire Extinguishing	Water Mist	$ 467.17	$ 781.28	0.025	0.0%	33.850	21.7%
Refrigeration/AC	CO2 for New MVACs	$ 422.48	$ 839.80	2.295	1.5%	36.145	23.1%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.165	0.1%	36.310	23.2%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	1.223	0.8%	37.533	24.0%

World Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.009	0.0%	0.009	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.980	0.6%	0.989	0.6%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.980	0.6%	1.969	1.3%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	0.177	0.1%	2.147	1.4%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	2.575	1.6%	4.722	3.0%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	4.722	3.0%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	4.722	3.0%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (4.78)	5.804	3.7%	10.526	6.7%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.106	0.1%	10.632	6.8%
Solvents	HFC to HFE	$ -	$ -	0.280	0.2%	10.912	7.0%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	4.621	3.0%	15.533	9.9%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.070	0.0%	15.603	10.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	2.540	1.6%	18.143	11.6%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.141	0.1%	18.284	11.7%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (275.47)	$ 7.02	3.778	2.4%	22.062	14.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	1.008	0.6%	23.070	14.8%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	0.023	0.0%	23.093	14.8%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	0.045	0.0%	23.138	14.8%
Refrigeration/AC	HFC-152a in MVACs	$ (73.65)	$ 30.81	2.288	1.5%	25.426	16.3%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	25.426	16.3%
Fire Extinguishing	FK-5-1-12	$ 83.66	$ 85.22	0.202	0.1%	25.628	16.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.125	0.1%	25.753	16.5%
Refrigeration/AC	Ammonia Secondary Loop	$ 11.47	$ 123.84	3.119	2.0%	28.872	18.5%
Refrigeration/AC	Secondary Loop	$ 9.66	$ 125.39	4.735	3.0%	33.607	21.5%
Fire Extinguishing	Inert Gases	$ 71.10	$ 136.29	0.192	0.1%	33.799	21.6%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	0.026	0.0%	33.824	21.6%
Refrigeration/AC	CO2 for New MVACs	$ (23.44)	$ 180.72	2.295	1.5%	36.119	23.1%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.165	0.1%	36.285	23.2%
Fire Extinguishing	Water Mist	$ 111.76	$ 287.80	0.025	0.0%	36.310	23.2%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	1.223	0.8%	37.533	24.0%

World Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.013	0.0%	0.013	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	1.078	0.5%	1.091	0.6%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	1.078	0.5%	2.169	1.1%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	3.593	1.8%	5.761	2.9%
Solvents	HFC to HFE	$ -	$ -	0.426	0.2%	6.187	3.1%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	8.510	4.3%	14.697	7.5%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	0.457	0.2%	15.155	7.7%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.098	0.0%	15.253	7.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	3.991	2.0%	19.243	9.8%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	19.243	9.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	19.243	9.8%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.136	0.1%	19.379	9.8%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.196	0.1%	19.575	9.9%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	1.336	0.7%	20.912	10.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	20.912	10.6%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 72.96	11.108	5.6%	32.020	16.2%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	1.700	0.9%	33.719	17.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.343	0.2%	34.062	17.3%
Refrigeration/AC	Secondary Loop	$ 45.33	$ 173.22	8.993	4.6%	43.055	21.8%
Refrigeration/AC	Ammonia Secondary Loop	$ 55.34	$ 180.96	5.918	3.0%	48.972	24.8%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	0.793	0.4%	49.765	25.2%
Refrigeration/AC	HFC-152a in MVACs	$ 55.55	$ 205.42	4.921	2.5%	54.686	27.7%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.75	0.495	0.3%	55.181	28.0%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	0.039	0.0%	55.219	28.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (35.34)	$ 468.38	5.029	2.5%	60.248	30.5%
Fire Extinguishing	Inert Gases	$ 369.25	$ 505.32	0.396	0.2%	60.645	30.7%
Fire Extinguishing	Water Mist	$ 467.17	$ 781.28	0.057	0.0%	60.701	30.8%
Refrigeration/AC	CO2 for New MVACs	$ 422.48	$ 839.80	4.237	2.1%	64.938	32.9%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.225	0.1%	65.163	33.0%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	3.409	1.7%	68.572	34.8%

World Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.013	0.0%	0.013	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	1.078	0.5%	1.091	0.6%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	1.078	0.5%	2.169	1.1%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	0.457	0.2%	2.626	1.3%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	3.593	1.8%	6.219	3.2%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	6.219	3.2%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	6.219	3.2%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (4.78)	11.108	5.6%	17.327	8.8%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.136	0.1%	17.463	8.9%
Solvents	HFC to HFE	$ -	$ -	0.426	0.2%	17.889	9.1%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	8.510	4.3%	26.399	13.4%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.098	0.0%	26.497	13.4%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	3.991	2.0%	30.487	15.5%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.196	0.1%	30.683	15.6%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (275.47)	$ 7.02	5.029	2.5%	35.712	18.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	1.700	0.9%	37.412	19.0%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	0.039	0.0%	37.451	19.0%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	1.336	0.7%	38.787	19.7%
Refrigeration/AC	HFC-152a in MVACs	$ (73.65)	$ 30.81	4.921	2.5%	43.708	22.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	43.708	22.2%
Fire Extinguishing	FK-5-1-12	$ 83.66	$ 85.22	0.495	0.3%	44.203	22.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.343	0.2%	44.546	22.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 11.47	$ 123.84	5.918	3.0%	50.463	25.6%
Refrigeration/AC	Secondary Loop	$ 9.66	$ 125.39	8.993	4.6%	59.456	30.1%
Fire Extinguishing	Inert Gases	$ 71.10	$ 136.29	0.396	0.2%	59.852	30.3%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	0.793	0.4%	60.645	30.7%
Refrigeration/AC	CO2 for New MVACs	$ (23.44)	$ 180.72	4.237	2.1%	64.882	32.9%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.225	0.1%	65.107	33.0%
Fire Extinguishing	Water Mist	$ 111.76	$ 287.80	0.057	0.0%	65.163	33.0%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	3.409	1.7%	68.572	34.8%

United States Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.016	0.0%	0.016	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (35.34)	$ (35.34)	0.041	0.1%	0.057	0.2%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.150	0.5%	0.207	0.6%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.150	0.5%	0.357	1.1%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	0.012	0.0%	0.369	1.1%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.181	0.6%	0.550	1.7%
Solvents	HFC to HFE	$ -	$ -	0.037	0.1%	0.587	1.8%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.301	0.9%	0.888	2.7%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.006	0.0%	0.893	2.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.222	0.7%	1.115	3.4%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	1.115	3.4%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	1.115	3.4%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	1.115	3.4%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.011	0.0%	1.126	3.4%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	1.126	3.4%
Refrigeration/AC	HFC-152a in MVACs	$ 55.55	$ 55.55	-	0.0%	1.126	3.4%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	1.126	3.4%
Refrigeration/AC	Replace DX with Distributed System	$ 62.60	$ 62.60	0.047	0.1%	1.173	3.6%
Refrigeration/AC	Secondary Loop	$ 68.66	$ 68.66	0.049	0.2%	1.222	3.7%
Refrigeration/AC	Ammonia Secondary Loop	$ 78.79	$ 78.79	0.019	0.1%	1.241	3.8%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	1.241	3.8%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	1.241	3.8%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	1.241	3.8%
Fire Extinguishing	FK-5-1-12	$ 335.63	$ 335.63	0.001	0.0%	1.242	3.8%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	1.242	3.8%
Fire Extinguishing	Inert Gases	$ 410.54	$ 410.54	0.002	0.0%	1.243	3.8%
Refrigeration/AC	CO2 for New MVACs	$ 422.48	$ 422.48	-	0.0%	1.243	3.8%
Fire Extinguishing	Water Mist	$ 587.31	$ 587.31	0.000	0.0%	1.244	3.8%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	1.244	3.8%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	1.244	3.8%

United States Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (275.47)	$ (275.47)	0.041	0.1%	0.041	0.1%
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.016	0.0%	0.057	0.2%
Refrigeration/AC	HFC-152a in MVACs	$ (73.65)	$ (73.65)	-	0.0%	0.057	0.2%
Refrigeration/AC	CO2 for New MVACs	$ (23.44)	$ (23.44)	-	0.0%	0.057	0.2%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.150	0.5%	0.207	0.6%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.150	0.5%	0.357	1.1%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	0.012	0.0%	0.369	1.1%
Refrigeration/AC	Replace DX with Distributed System	$ (12.70)	$ (12.70)	0.047	0.1%	0.415	1.3%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.181	0.6%	0.597	1.8%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.597	1.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.597	1.8%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.597	1.8%
Solvents	HFC to HFE	$ -	$ -	0.037	0.1%	0.634	1.9%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.301	0.9%	0.934	2.8%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.006	0.0%	0.940	2.9%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.222	0.7%	1.162	3.5%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.011	0.0%	1.173	3.6%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	1.173	3.6%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	1.173	3.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	1.173	3.6%
Refrigeration/AC	Secondary Loop	$ 28.87	$ 28.87	0.049	0.2%	1.222	3.7%
Refrigeration/AC	Ammonia Secondary Loop	$ 30.19	$ 30.19	0.019	0.1%	1.241	3.8%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	1.241	3.8%
Fire Extinguishing	Inert Gases	$ 81.98	$ 81.98	0.002	0.0%	1.243	3.8%
Fire Extinguishing	FK-5-1-12	$ 83.96	$ 83.96	0.001	0.0%	1.243	3.8%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	1.243	3.8%
Fire Extinguishing	Water Mist	$ 146.97	$ 146.97	0.000	0.0%	1.244	3.8%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	1.244	3.8%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	1.244	3.8%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	1.244	3.8%

United States Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (35.34)	$ (35.34)	1.070	2.2%	1.070	2.2%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.331	0.7%	1.400	2.9%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.331	0.7%	1.731	3.6%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	0.043	0.1%	1.774	3.7%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.297	0.6%	2.071	4.3%
Solvents	HFC to HFE	$ -	$ -	0.121	0.3%	2.192	4.6%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.817	1.7%	3.009	6.3%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.012	0.0%	3.021	6.3%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.612	1.3%	3.633	7.6%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	3.633	7.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	3.633	7.6%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.009	0.0%	3.642	7.6%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.024	0.1%	3.666	7.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	3.666	7.6%
Refrigeration/AC	HFC-152a in MVACs	$ 55.55	$ 55.55	0.127	0.3%	3.793	7.9%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	3.793	7.9%
Refrigeration/AC	Replace DX with Distributed System	$ 62.60	$ 62.60	0.659	1.4%	4.453	9.3%
Refrigeration/AC	Secondary Loop	$ 68.66	$ 68.66	0.698	1.5%	5.151	10.7%
Refrigeration/AC	Ammonia Secondary Loop	$ 78.79	$ 78.79	0.247	0.5%	5.397	11.2%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	5.397	11.2%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.019	0.0%	5.416	11.3%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	5.416	11.3%
Fire Extinguishing	FK-5-1-12	$ 335.63	$ 335.63	0.018	0.0%	5.434	11.3%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	0.009	0.0%	5.443	11.3%
Fire Extinguishing	Inert Gases	$ 410.54	$ 410.54	0.022	0.0%	5.465	11.4%
Refrigeration/AC	CO2 for New MVACs	$ 422.48	$ 422.48	0.143	0.3%	5.608	11.7%
Fire Extinguishing	Water Mist	$ 587.31	$ 587.31	0.003	0.0%	5.611	11.7%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.025	0.1%	5.636	11.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.085	0.2%	5.721	11.9%

United States Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (275.47)	$ (275.47)	1.070	2.2%	1.070	2.2%
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	1.070	2.2%
Refrigeration/AC	HFC-152a in MVACs	$ (73.65)	$ (73.65)	0.127	0.3%	1.196	2.5%
Refrigeration/AC	CO2 for New MVACs	$ (23.44)	$ (23.44)	0.143	0.3%	1.339	2.8%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.331	0.7%	1.670	3.5%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.331	0.7%	2.000	4.2%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	0.043	0.1%	2.044	4.2%
Refrigeration/AC	Replace DX with Distributed System	$ (12.70)	$ (12.70)	0.659	1.4%	2.703	5.6%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.297	0.6%	3.000	6.2%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	3.000	6.2%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	3.000	6.2%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.009	0.0%	3.009	6.3%
Solvents	HFC to HFE	$ -	$ -	0.121	0.3%	3.129	6.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.817	1.7%	3.947	8.2%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.012	0.0%	3.959	8.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.612	1.3%	4.571	9.5%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.024	0.1%	4.595	9.5%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	4.595	9.5%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	0.009	0.0%	4.604	9.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	4.604	9.6%
Refrigeration/AC	Secondary Loop	$ 28.87	$ 28.87	0.698	1.5%	5.302	11.0%
Refrigeration/AC	Ammonia Secondary Loop	$ 30.19	$ 30.19	0.247	0.5%	5.549	11.5%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	5.549	11.5%
Fire Extinguishing	Inert Gases	$ 81.98	$ 81.98	0.022	0.0%	5.571	11.6%
Fire Extinguishing	FK-5-1-12	$ 83.96	$ 83.96	0.018	0.0%	5.589	11.6%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.019	0.0%	5.608	11.7%
Fire Extinguishing	Water Mist	$ 146.97	$ 146.97	0.003	0.0%	5.611	11.7%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	5.611	11.7%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.025	0.1%	5.636	11.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.085	0.2%	5.721	11.9%

United States Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (35.34)	$ (35.34)	2.966	4.6%	2.966	4.6%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.365	0.6%	3.331	5.2%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.365	0.6%	3.696	5.8%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	0.141	0.2%	3.837	6.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.673	1.1%	4.510	7.1%
Solvents	HFC to HFE	$ -	$ -	0.196	0.3%	4.706	7.4%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	1.088	1.7%	5.794	9.1%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.020	0.0%	5.814	9.1%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.946	1.5%	6.760	10.6%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	6.760	10.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	6.760	10.6%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.014	0.0%	6.774	10.6%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.039	0.1%	6.813	10.7%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	0.006	0.0%	6.819	10.7%
Refrigeration/AC	HFC-152a in MVACs	$ 55.55	$ 55.55	0.637	1.0%	7.456	11.7%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	7.456	11.7%
Refrigeration/AC	Replace DX with Distributed System	$ 62.60	$ 62.60	2.187	3.4%	9.643	15.1%
Refrigeration/AC	Secondary Loop	$ 68.66	$ 68.66	2.316	3.6%	11.960	18.7%
Refrigeration/AC	Ammonia Secondary Loop	$ 78.79	$ 78.79	1.022	1.6%	12.981	20.3%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	12.981	20.3%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.067	0.1%	13.049	20.4%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	0.025	0.0%	13.074	20.5%
Fire Extinguishing	FK-5-1-12	$ 335.63	$ 335.63	0.075	0.1%	13.149	20.6%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	0.023	0.0%	13.172	20.6%
Fire Extinguishing	Inert Gases	$ 410.54	$ 410.54	0.071	0.1%	13.243	20.7%
Refrigeration/AC	CO2 for New MVACs	$ 422.48	$ 422.48	0.562	0.9%	13.806	21.6%
Fire Extinguishing	Water Mist	$ 587.31	$ 587.31	0.009	0.0%	13.815	21.6%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.063	0.1%	13.878	21.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.367	0.6%	14.246	22.3%

United States Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (275.47)	$ (275.47)	2.966	4.6%	2.966	4.6%
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	2.966	4.6%
Refrigeration/AC	HFC-152a in MVACs	$ (73.65)	$ (73.65)	0.637	1.0%	3.603	5.6%
Refrigeration/AC	CO2 for New MVACs	$ (23.44)	$ (23.44)	0.562	0.9%	4.165	6.5%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.365	0.6%	4.530	7.1%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.365	0.6%	4.895	7.7%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	0.141	0.2%	5.037	7.9%
Refrigeration/AC	Replace DX with Distributed System	$ (12.70)	$ (12.70)	2.187	3.4%	7.223	11.3%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.673	1.1%	7.897	12.4%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	7.897	12.4%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	7.897	12.4%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.014	0.0%	7.910	12.4%
Solvents	HFC to HFE	$ -	$ -	0.196	0.3%	8.106	12.7%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	1.088	1.7%	9.194	14.4%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.020	0.0%	9.214	14.4%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.946	1.5%	10.160	15.9%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.039	0.1%	10.200	16.0%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	10.200	16.0%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	0.023	0.0%	10.222	16.0%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	0.006	0.0%	10.229	16.0%
Refrigeration/AC	Secondary Loop	$ 28.87	$ 28.87	2.316	3.6%	12.545	19.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 30.19	$ 30.19	1.022	1.6%	13.567	21.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	13.567	21.2%
Fire Extinguishing	Inert Gases	$ 81.98	$ 81.98	0.071	0.1%	13.638	21.3%
Fire Extinguishing	FK-5-1-12	$ 83.96	$ 83.96	0.075	0.1%	13.713	21.5%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.067	0.1%	13.781	21.6%
Fire Extinguishing	Water Mist	$ 146.97	$ 146.97	0.009	0.0%	13.790	21.6%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	0.025	0.0%	13.815	21.6%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.063	0.1%	13.878	21.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.367	0.6%	14.246	22.3%

United States Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (35.34)	$ (35.34)	4.511	5.5%	4.511	5.5%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.403	0.5%	4.914	5.9%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.403	0.5%	5.317	6.4%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	0.372	0.4%	5.689	6.9%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.834	1.0%	6.523	7.9%
Solvents	HFC to HFE	$ -	$ -	0.282	0.3%	6.805	8.2%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	2.086	2.5%	8.891	10.8%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.028	0.0%	8.920	10.8%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	1.492	1.8%	10.412	12.6%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	10.412	12.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	10.412	12.6%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.018	0.0%	10.430	12.6%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.057	0.1%	10.487	12.7%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	0.260	0.3%	10.747	13.0%
Refrigeration/AC	HFC-152a in MVACs	$ 55.55	$ 55.55	1.657	2.0%	12.404	15.0%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	12.404	15.0%
Refrigeration/AC	Replace DX with Distributed System	$ 62.60	$ 62.60	4.867	5.9%	17.271	20.9%
Refrigeration/AC	Secondary Loop	$ 68.66	$ 68.66	5.155	6.2%	22.426	27.1%
Refrigeration/AC	Ammonia Secondary Loop	$ 78.79	$ 78.79	2.737	3.3%	25.163	30.4%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	25.163	30.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.220	0.3%	25.384	30.7%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	0.784	0.9%	26.168	31.7%
Fire Extinguishing	FK-5-1-12	$ 335.63	$ 335.63	0.175	0.2%	26.343	31.9%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	0.039	0.0%	26.382	31.9%
Fire Extinguishing	Inert Gases	$ 410.54	$ 410.54	0.140	0.2%	26.522	32.1%
Refrigeration/AC	CO2 for New MVACs	$ 422.48	$ 422.48	1.091	1.3%	27.612	33.4%
Fire Extinguishing	Water Mist	$ 587.31	$ 587.31	0.020	0.0%	27.632	33.4%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.119	0.1%	27.751	33.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.989	1.2%	28.740	34.8%

United States Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (275.47)	$ (275.47)	4.511	5.5%	4.511	5.5%
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	4.511	5.5%
Refrigeration/AC	HFC-152a in MVACs	$ (73.65)	$ (73.65)	1.657	2.0%	6.168	7.5%
Refrigeration/AC	CO2 for New MVACs	$ (23.44)	$ (23.44)	1.091	1.3%	7.259	8.8%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.403	0.5%	7.662	9.3%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.403	0.5%	8.065	9.8%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	0.372	0.4%	8.437	10.2%
Refrigeration/AC	Replace DX with Distributed System	$ (12.70)	$ (12.70)	4.867	5.9%	13.304	16.1%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.834	1.0%	14.138	17.1%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	14.138	17.1%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	14.138	17.1%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.018	0.0%	14.156	17.1%
Solvents	HFC to HFE	$ -	$ -	0.282	0.3%	14.438	17.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	2.086	2.5%	16.525	20.0%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.028	0.0%	16.553	20.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	1.492	1.8%	18.045	21.8%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.057	0.1%	18.102	21.9%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	18.102	21.9%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	0.039	0.0%	18.141	21.9%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	0.260	0.3%	18.400	22.3%
Refrigeration/AC	Secondary Loop	$ 28.87	$ 28.87	5.155	6.2%	23.555	28.5%
Refrigeration/AC	Ammonia Secondary Loop	$ 30.19	$ 30.19	2.737	3.3%	26.293	31.8%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	26.293	31.8%
Fire Extinguishing	Inert Gases	$ 81.98	$ 81.98	0.140	0.2%	26.433	32.0%
Fire Extinguishing	FK-5-1-12	$ 83.96	$ 83.96	0.175	0.2%	26.608	32.2%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.220	0.3%	26.828	32.5%
Fire Extinguishing	Water Mist	$ 146.97	$ 146.97	0.020	0.0%	26.848	32.5%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	0.784	0.9%	27.632	33.4%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.119	0.1%	27.751	33.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.989	1.2%	28.740	34.8%

Non-US Annex I Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.020	0.1%	0.020	0.1%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.232	0.8%	0.252	0.9%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.232	0.8%	0.484	1.7%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.127	0.4%	0.611	2.1%
Solvents	HFC to HFE	$ -	$ -	0.023	0.1%	0.635	2.2%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.248	0.8%	0.883	3.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	-	0.0%	0.883	3.0%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.014	0.0%	0.897	3.1%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.344	1.2%	1.241	4.2%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	1.241	4.2%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	1.241	4.2%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	1.241	4.2%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.028	0.1%	1.269	4.3%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	1.269	4.3%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	1.269	4.3%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 69.97	0.036	0.1%	1.305	4.4%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	1.305	4.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.007	0.0%	1.313	4.5%
Refrigeration/AC	Secondary Loop	$ 53.67	$ 173.22	0.021	0.1%	1.334	4.5%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.61	$ 180.96	0.020	0.1%	1.354	4.6%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	1.354	4.6%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 205.42	-	0.0%	1.354	4.6%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.75	0.002	0.0%	1.356	4.6%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	1.356	4.6%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 468.38	0.110	0.4%	1.466	5.0%
Fire Extinguishing	Inert Gases	$ 369.25	$ 483.77	0.005	0.0%	1.471	5.0%
Fire Extinguishing	Water Mist	$ 467.17	$ 761.31	0.001	0.0%	1.472	5.0%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 839.80	-	0.0%	1.472	5.0%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.038	0.1%	1.510	5.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	1.510	5.1%

Non-US Annex I Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE)		Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
		Low	High				
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.020	0.1%	0.020	0.1%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.232	0.8%	0.252	0.9%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.232	0.8%	0.484	1.7%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	-	0.0%	0.484	1.7%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.127	0.4%	0.611	2.1%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.611	2.1%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.611	2.1%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (8.08)	0.036	0.1%	0.647	2.2%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.647	2.2%
Solvents	HFC to HFE	$ -	$ -	0.023	0.1%	0.671	2.3%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.248	0.8%	0.919	3.1%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.014	0.0%	0.933	3.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.344	1.2%	1.277	4.4%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.028	0.1%	1.305	4.4%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ 7.02	0.110	0.4%	1.415	4.8%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	1.415	4.8%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	1.415	4.8%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	1.415	4.8%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ 30.81	-	0.0%	1.415	4.8%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	1.415	4.8%
Fire Extinguishing	FK-5-1-12	$ 83.72	$ 85.22	0.002	0.0%	1.417	4.8%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.007	0.0%	1.425	4.9%
Refrigeration/AC	Ammonia Secondary Loop	$ 18.59	$ 123.84	0.020	0.1%	1.445	4.9%
Refrigeration/AC	Secondary Loop	$ 16.97	$ 125.39	0.021	0.1%	1.466	5.0%
Fire Extinguishing	Inert Gases	$ 71.10	$ 136.29	0.005	0.0%	1.471	5.0%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	1.471	5.0%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 180.72	-	0.0%	1.471	5.0%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.038	0.1%	1.510	5.1%
Fire Extinguishing	Water Mist	$ 111.76	$ 287.80	0.001	0.0%	1.510	5.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	1.510	5.1%

Non-US Annex I Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.559	1.4%	0.559	1.4%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.559	1.4%	1.118	2.9%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.254	0.7%	1.372	3.6%
Solvents	HFC to HFE	$ -	$ -	0.047	0.1%	1.419	3.7%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.656	1.7%	2.075	5.4%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	0.012	0.0%	2.087	5.4%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.029	0.1%	2.116	5.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	1.035	2.7%	3.151	8.2%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	3.151	8.2%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	3.151	8.2%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.068	0.2%	3.219	8.3%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.057	0.1%	3.276	8.5%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	3.276	8.5%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	3.276	8.5%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 69.97	0.500	1.3%	3.775	9.8%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	0.666	1.7%	4.441	11.5%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.021	0.1%	4.462	11.6%
Refrigeration/AC	Secondary Loop	$ 53.67	$ 173.22	0.286	0.7%	4.748	12.3%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.61	$ 180.96	0.280	0.7%	5.028	13.0%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	5.028	13.0%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 205.42	0.414	1.1%	5.442	14.1%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.75	0.027	0.1%	5.470	14.2%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	5.470	14.2%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 468.38	0.630	1.6%	6.100	15.8%
Fire Extinguishing	Inert Gases	$ 369.25	$ 483.77	0.034	0.1%	6.134	15.9%
Fire Extinguishing	Water Mist	$ 467.17	$ 761.31	0.005	0.0%	6.138	15.9%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 839.80	0.499	1.3%	6.637	17.2%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.077	0.2%	6.714	17.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.118	0.3%	6.831	17.7%

Non-US Annex I Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE)		Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
		Low	High				
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.559	1.4%	0.559	1.4%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.559	1.4%	1.118	2.9%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	0.012	0.0%	1.130	2.9%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.254	0.7%	1.384	3.6%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	1.384	3.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	1.384	3.6%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (8.08)	0.500	1.3%	1.884	4.9%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.068	0.2%	1.952	5.1%
Solvents	HFC to HFE	$ -	$ -	0.047	0.1%	1.999	5.2%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.656	1.7%	2.655	6.9%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.029	0.1%	2.684	7.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	1.035	2.7%	3.718	9.6%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.057	0.1%	3.775	9.8%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ 7.02	0.630	1.6%	4.405	11.4%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	0.666	1.7%	5.071	13.1%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	5.071	13.1%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	5.071	13.1%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ 30.81	0.414	1.1%	5.486	14.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	5.486	14.2%
Fire Extinguishing	FK-5-1-12	$ 83.72	$ 85.22	0.027	0.1%	5.513	14.3%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.021	0.1%	5.534	14.3%
Refrigeration/AC	Ammonia Secondary Loop	$ 18.59	$ 123.84	0.280	0.7%	5.814	15.1%
Refrigeration/AC	Secondary Loop	$ 16.97	$ 125.39	0.286	0.7%	6.100	15.8%
Fire Extinguishing	Inert Gases	$ 71.10	$ 136.29	0.034	0.1%	6.134	15.9%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	6.134	15.9%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 180.72	0.499	1.3%	6.633	17.2%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.077	0.2%	6.709	17.4%
Fire Extinguishing	Water Mist	$ 111.76	$ 287.80	0.005	0.0%	6.714	17.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.118	0.3%	6.831	17.7%

Non-US Annex I Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.612	1.2%	0.612	1.2%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.612	1.2%	1.224	2.4%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.555	1.1%	1.779	3.5%
Solvents	HFC to HFE	$ -	$ -	0.071	0.1%	1.850	3.7%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.924	1.8%	2.774	5.5%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	0.036	0.1%	2.810	5.6%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.043	0.1%	2.853	5.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	1.586	3.2%	4.439	8.8%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	4.439	8.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	4.439	8.8%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.085	0.2%	4.524	9.0%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.086	0.2%	4.610	9.2%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	0.038	0.1%	4.648	9.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	4.648	9.2%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 69.97	1.886	3.7%	6.534	13.0%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	1.008	2.0%	7.542	15.0%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.058	0.1%	7.600	15.1%
Refrigeration/AC	Secondary Loop	$ 53.67	$ 173.22	1.117	2.2%	8.717	17.3%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.61	$ 180.96	0.986	2.0%	9.703	19.3%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	0.000	0.0%	9.703	19.3%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 205.42	1.007	2.0%	10.710	21.3%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.75	0.081	0.2%	10.791	21.4%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	10.791	21.4%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 468.38	0.805	1.6%	11.596	23.0%
Fire Extinguishing	Inert Gases	$ 369.25	$ 483.77	0.077	0.2%	11.673	23.2%
Fire Extinguishing	Water Mist	$ 467.17	$ 761.31	0.010	0.0%	11.683	23.2%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 839.80	1.679	3.3%	13.361	26.5%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.102	0.2%	13.463	26.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.497	1.0%	13.960	27.7%

Non-US Annex I Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.612	1.2%	0.612	1.2%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.612	1.2%	1.224	2.4%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	0.036	0.1%	1.260	2.5%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.555	1.1%	1.815	3.6%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	1.815	3.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	1.815	3.6%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (8.08)	1.886	3.7%	3.701	7.4%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.085	0.2%	3.786	7.5%
Solvents	HFC to HFE	$ -	$ -	0.071	0.1%	3.857	7.7%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.924	1.8%	4.781	9.5%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.043	0.1%	4.824	9.6%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	1.586	3.2%	6.410	12.7%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.086	0.2%	6.496	12.9%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ 7.02	0.805	1.6%	7.300	14.5%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	1.008	2.0%	8.309	16.5%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	8.309	16.5%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	0.038	0.1%	8.347	16.6%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ 30.81	1.007	2.0%	9.354	18.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	9.354	18.6%
Fire Extinguishing	FK-5-1-12	$ 83.72	$ 85.22	0.081	0.2%	9.435	18.7%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.058	0.1%	9.492	18.9%
Refrigeration/AC	Ammonia Secondary Loop	$ 18.59	$ 123.84	0.986	2.0%	10.478	20.8%
Refrigeration/AC	Secondary Loop	$ 16.97	$ 125.39	1.117	2.2%	11.596	23.0%
Fire Extinguishing	Inert Gases	$ 71.10	$ 136.29	0.077	0.2%	11.672	23.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	0.000	0.0%	11.673	23.2%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 180.72	1.679	3.3%	13.351	26.5%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.102	0.2%	13.453	26.7%
Fire Extinguishing	Water Mist	$ 111.76	$ 287.80	0.010	0.0%	13.463	26.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.497	1.0%	13.960	27.7%

Non-US Annex I Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.671	1.2%	0.671	1.2%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.671	1.2%	1.342	2.3%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.644	1.1%	1.986	3.4%
Solvents	HFC to HFE	$ -	$ -	0.119	0.2%	2.105	3.6%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	1.525	2.6%	3.630	6.3%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	0.086	0.1%	3.716	6.4%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.058	0.1%	3.773	6.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	2.484	4.3%	6.258	10.8%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	6.258	10.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	6.258	10.8%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.106	0.2%	6.364	11.0%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.115	0.2%	6.479	11.2%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	1.076	1.9%	7.555	13.0%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	7.555	13.0%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 69.97	3.067	5.3%	10.622	18.3%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	1.700	2.9%	12.322	21.3%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.122	0.2%	12.444	21.5%
Refrigeration/AC	Secondary Loop	$ 53.67	$ 173.22	1.900	3.3%	14.344	24.7%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.61	$ 180.96	1.443	2.5%	15.787	27.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	0.008	0.0%	15.795	27.2%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 205.42	1.310	2.3%	17.106	29.5%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.75	0.186	0.3%	17.291	29.8%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	17.291	29.8%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 468.38	0.508	0.9%	17.799	30.7%
Fire Extinguishing	Inert Gases	$ 369.25	$ 483.77	0.149	0.3%	17.948	31.0%
Fire Extinguishing	Water Mist	$ 467.17	$ 761.31	0.021	0.0%	17.969	31.0%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 839.80	2.844	4.9%	20.813	35.9%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.106	0.2%	20.919	36.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	1.316	2.3%	22.235	38.4%

Non-US Annex I Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE)		Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
		Low	High				
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.671	1.2%	0.671	1.2%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.671	1.2%	1.342	2.3%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	0.086	0.1%	1.428	2.5%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.644	1.1%	2.072	3.6%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	2.072	3.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	2.072	3.6%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (8.08)	3.067	5.3%	5.138	8.9%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.106	0.2%	5.244	9.0%
Solvents	HFC to HFE	$ -	$ -	0.119	0.2%	5.363	9.3%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	1.525	2.6%	6.888	11.9%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.058	0.1%	6.946	12.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	2.484	4.3%	9.430	16.3%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.115	0.2%	9.546	16.5%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ 7.02	0.508	0.9%	10.054	17.3%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	1.700	2.9%	11.753	20.3%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	11.753	20.3%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	1.076	1.9%	12.830	22.1%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ 30.81	1.310	2.3%	14.140	24.4%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	14.140	24.4%
Fire Extinguishing	FK-5-1-12	$ 83.72	$ 85.22	0.186	0.3%	14.325	24.7%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.122	0.2%	14.448	24.9%
Refrigeration/AC	Ammonia Secondary Loop	$ 18.59	$ 123.84	1.443	2.5%	15.891	27.4%
Refrigeration/AC	Secondary Loop	$ 16.97	$ 125.39	1.900	3.3%	17.791	30.7%
Fire Extinguishing	Inert Gases	$ 71.10	$ 136.29	0.149	0.3%	17.940	30.9%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	0.008	0.0%	17.948	31.0%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 180.72	2.844	4.9%	20.792	35.9%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.106	0.2%	20.897	36.0%
Fire Extinguishing	Water Mist	$ 111.76	$ 287.80	0.021	0.0%	20.919	36.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	1.316	2.3%	22.235	38.4%

Non-Annex I Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.002	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.001	0.0%	0.003	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.001	0.0%	0.004	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.004	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.236	1.5%	0.239	1.5%
Solvents	HFC to HFE	$ -	$ -	0.002	0.0%	0.242	1.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.426	2.6%	0.667	4.1%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.001	0.0%	0.669	4.1%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.001	0.0%	0.670	4.1%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.670	4.1%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.670	4.1%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.670	4.1%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.003	0.0%	0.673	4.1%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.673	4.1%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.673	4.1%
Refrigeration/AC	Replace DX with Distributed System	$ 48.87	$ 70.09	0.036	0.2%	0.709	4.4%
Refrigeration/AC	Secondary Loop	$ 49.87	$ 104.49	0.039	0.2%	0.748	4.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 60.78	$ 114.41	0.024	0.2%	0.772	4.8%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.772	4.8%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.772	4.8%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.772	4.8%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	-	0.0%	0.772	4.8%
Fire Extinguishing	FK-5-1-12	$ 335.01	$ 336.18	0.000	0.0%	0.773	4.8%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.773	4.8%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	0.773	4.8%
Fire Extinguishing	Inert Gases	$ 414.31	$ 486.93	0.001	0.0%	0.773	4.8%
Fire Extinguishing	Water Mist	$ 529.82	$ 740.97	0.000	0.0%	0.773	4.8%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	-	0.0%	0.773	4.8%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.773	4.8%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.773	4.8%

Non-Annex I Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.002	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.001	0.0%	0.003	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.001	0.0%	0.004	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.004	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.004	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.236	1.5%	0.239	1.5%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.239	1.5%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.239	1.5%
Refrigeration/AC	Replace DX with Distributed System	$ (25.88)	$ (4.60)	0.036	0.2%	0.276	1.7%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.276	1.7%
Solvents	HFC to HFE	$ -	$ -	0.002	0.0%	0.278	1.7%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.426	2.6%	0.704	4.3%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.001	0.0%	0.705	4.3%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.001	0.0%	0.706	4.4%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.003	0.0%	0.709	4.4%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.709	4.4%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.709	4.4%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.709	4.4%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	-	0.0%	0.709	4.4%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.709	4.4%
Refrigeration/AC	Secondary Loop	$ 10.53	$ 59.19	0.039	0.2%	0.748	4.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 12.47	$ 59.61	0.024	0.2%	0.772	4.8%
Fire Extinguishing	FK-5-1-12	$ 83.74	$ 84.36	0.000	0.0%	0.773	4.8%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.773	4.8%
Fire Extinguishing	Inert Gases	$ 81.29	$ 114.30	0.001	0.0%	0.773	4.8%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	-	0.0%	0.773	4.8%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.773	4.8%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.773	4.8%
Fire Extinguishing	Water Mist	$ 126.10	$ 219.85	0.000	0.0%	0.773	4.8%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.773	4.8%

Non-Annex I Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.005	0.0%	0.005	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.003	0.0%	0.007	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.003	0.0%	0.010	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.010	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.875	2.8%	0.885	2.9%
Solvents	HFC to HFE	$ -	$ -	0.007	0.0%	0.893	2.9%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	1.318	4.3%	2.211	7.1%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.004	0.0%	2.215	7.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.005	0.0%	2.220	7.2%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	2.220	7.2%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	2.220	7.2%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.006	0.0%	2.225	7.2%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.009	0.0%	2.234	7.2%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	2.234	7.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	2.234	7.2%
Refrigeration/AC	Replace DX with Distributed System	$ 48.87	$ 70.09	0.583	1.9%	2.817	9.1%
Refrigeration/AC	Secondary Loop	$ 49.87	$ 104.49	0.483	1.6%	3.300	10.7%
Refrigeration/AC	Ammonia Secondary Loop	$ 60.78	$ 114.41	0.409	1.3%	3.709	12.0%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	3.709	12.0%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	3.709	12.0%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	3.709	12.0%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.152	0.5%	3.861	12.5%
Fire Extinguishing	FK-5-1-12	$ 335.01	$ 336.18	0.008	0.0%	3.870	12.5%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	3.870	12.5%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	3.870	12.5%
Fire Extinguishing	Inert Gases	$ 414.31	$ 486.93	0.010	0.0%	3.880	12.5%
Fire Extinguishing	Water Mist	$ 529.82	$ 740.97	0.001	0.0%	3.881	12.5%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	-	0.0%	3.881	12.5%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	3.881	12.5%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.073	0.2%	3.955	12.8%

Non-Annex I Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.005	0.0%	0.005	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.003	0.0%	0.007	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.003	0.0%	0.010	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.010	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.010	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.875	2.8%	0.885	2.9%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.885	2.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.885	2.9%
Refrigeration/AC	Replace DX with Distributed System	$ (25.88)	$ (4.60)	0.583	1.9%	1.468	4.7%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.006	0.0%	1.474	4.8%
Solvents	HFC to HFE	$ -	$ -	0.007	0.0%	1.481	4.8%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	1.318	4.3%	2.799	9.0%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.004	0.0%	2.804	9.1%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.005	0.0%	2.808	9.1%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.009	0.0%	2.817	9.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	2.817	9.1%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	2.817	9.1%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	2.817	9.1%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.152	0.5%	2.969	9.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	2.969	9.6%
Refrigeration/AC	Secondary Loop	$ 10.53	$ 59.19	0.483	1.6%	3.452	11.1%
Refrigeration/AC	Ammonia Secondary Loop	$ 12.47	$ 59.61	0.409	1.3%	3.861	12.5%
Fire Extinguishing	FK-5-1-12	$ 83.74	$ 84.36	0.008	0.0%	3.870	12.5%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	3.870	12.5%
Fire Extinguishing	Inert Gases	$ 81.29	$ 114.30	0.010	0.0%	3.880	12.5%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	-	0.0%	3.880	12.5%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	3.880	12.5%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	3.880	12.5%
Fire Extinguishing	Water Mist	$ 126.10	$ 219.85	0.001	0.0%	3.881	12.5%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.073	0.2%	3.955	12.8%

Non-Annex I Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.009	0.0%	0.009	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.003	0.0%	0.012	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.003	0.0%	0.015	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.015	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	1.350	3.2%	1.365	3.3%
Solvents	HFC to HFE	$ -	$ -	0.013	0.0%	1.378	3.3%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	2.616	6.2%	3.994	9.5%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.008	0.0%	4.002	9.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.008	0.0%	4.010	9.5%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	4.010	9.5%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	4.010	9.5%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.009	0.0%	4.019	9.6%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.015	0.0%	4.034	9.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	4.034	9.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	4.034	9.6%
Refrigeration/AC	Replace DX with Distributed System	$ 48.87	$ 70.09	1.730	4.1%	5.764	13.7%
Refrigeration/AC	Secondary Loop	$ 49.87	$ 104.49	1.302	3.1%	7.066	16.8%
Refrigeration/AC	Ammonia Secondary Loop	$ 60.78	$ 114.41	1.111	2.6%	8.177	19.5%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	8.177	19.5%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	8.177	19.5%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	8.177	19.5%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.645	1.5%	8.822	21.0%
Fire Extinguishing	FK-5-1-12	$ 335.01	$ 336.18	0.046	0.1%	8.868	21.1%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	8.868	21.1%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	8.868	21.1%
Fire Extinguishing	Inert Gases	$ 414.31	$ 486.93	0.044	0.1%	8.912	21.2%
Fire Extinguishing	Water Mist	$ 529.82	$ 740.97	0.006	0.0%	8.917	21.2%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	0.053	0.1%	8.970	21.4%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	8.970	21.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.359	0.9%	9.329	22.2%

Non-Annex I Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.009	0.0%	0.009	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.003	0.0%	0.012	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.003	0.0%	0.015	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.015	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.015	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	1.350	3.2%	1.365	3.3%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	1.365	3.3%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	1.365	3.3%
Refrigeration/AC	Replace DX with Distributed System	$ (25.88)	$ (4.60)	1.730	4.1%	3.095	7.4%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.009	0.0%	3.104	7.4%
Solvents	HFC to HFE	$ -	$ -	0.013	0.0%	3.117	7.4%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	2.616	6.2%	5.733	13.7%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.008	0.0%	5.740	13.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.008	0.0%	5.748	13.7%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.015	0.0%	5.764	13.7%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	5.764	13.7%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	5.764	13.7%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	5.764	13.7%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.645	1.5%	6.409	15.3%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	6.409	15.3%
Refrigeration/AC	Secondary Loop	$ 10.53	$ 59.19	1.302	3.1%	7.711	18.4%
Refrigeration/AC	Ammonia Secondary Loop	$ 12.47	$ 59.61	1.111	2.6%	8.822	21.0%
Fire Extinguishing	FK-5-1-12	$ 83.74	$ 84.36	0.046	0.1%	8.868	21.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	8.868	21.1%
Fire Extinguishing	Inert Gases	$ 81.29	$ 114.30	0.044	0.1%	8.912	21.2%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	0.053	0.1%	8.965	21.3%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	8.965	21.3%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	8.965	21.3%
Fire Extinguishing	Water Mist	$ 126.10	$ 219.85	0.006	0.0%	8.970	21.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.359	0.9%	9.329	22.2%

Non-Annex I Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.013	0.0%	0.013	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.004	0.0%	0.016	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.004	0.0%	0.020	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.020	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	2.120	3.7%	2.140	3.8%
Solvents	HFC to HFE	$ -	$ -	0.025	0.0%	2.165	3.8%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	4.911	8.7%	7.076	12.5%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.012	0.0%	7.088	12.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.014	0.0%	7.101	12.5%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	7.101	12.5%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	7.101	12.5%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.014	0.0%	7.115	12.6%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.024	0.0%	7.139	12.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	7.139	12.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	7.139	12.6%
Refrigeration/AC	Replace DX with Distributed System	$ 48.87	$ 70.09	3.169	5.6%	10.308	18.2%
Refrigeration/AC	Secondary Loop	$ 49.87	$ 104.49	1.934	3.4%	12.242	21.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 60.78	$ 114.41	1.736	3.1%	13.978	24.7%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	13.978	24.7%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	13.978	24.7%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	13.978	24.7%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	1.957	3.5%	15.936	28.2%
Fire Extinguishing	FK-5-1-12	$ 335.01	$ 336.18	0.135	0.2%	16.070	28.4%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	16.070	28.4%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	16.070	28.4%
Fire Extinguishing	Inert Gases	$ 414.31	$ 486.93	0.108	0.2%	16.178	28.6%
Fire Extinguishing	Water Mist	$ 529.82	$ 740.97	0.015	0.0%	16.194	28.6%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	0.302	0.5%	16.496	29.1%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	16.496	29.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	1.103	1.9%	17.599	31.1%

Non-Annex I Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.013	0.0%	0.013	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.004	0.0%	0.016	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.004	0.0%	0.020	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.020	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.020	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	2.120	3.7%	2.140	3.8%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	2.140	3.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	2.140	3.8%
Refrigeration/AC	Replace DX with Distributed System	$ (25.88)	$ (4.60)	3.169	5.6%	5.309	9.4%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.014	0.0%	5.323	9.4%
Solvents	HFC to HFE	$ -	$ -	0.025	0.0%	5.348	9.4%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	4.911	8.7%	10.258	18.1%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.012	0.0%	10.270	18.1%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.014	0.0%	10.284	18.2%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.024	0.0%	10.308	18.2%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	10.308	18.2%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	10.308	18.2%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	10.308	18.2%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	1.957	3.5%	12.266	21.7%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	12.266	21.7%
Refrigeration/AC	Secondary Loop	$ 10.53	$ 59.19	1.934	3.4%	14.200	25.1%
Refrigeration/AC	Ammonia Secondary Loop	$ 12.47	$ 59.61	1.736	3.1%	15.936	28.2%
Fire Extinguishing	FK-5-1-12	$ 83.74	$ 84.36	0.135	0.2%	16.070	28.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	16.070	28.4%
Fire Extinguishing	Inert Gases	$ 81.29	$ 114.30	0.108	0.2%	16.178	28.6%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	0.302	0.5%	16.480	29.1%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	16.480	29.1%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	16.480	29.1%
Fire Extinguishing	Water Mist	$ 126.10	$ 219.85	0.015	0.0%	16.496	29.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	1.103	1.9%	17.599	31.1%

Africa Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.000	0.0%	0.000	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.000	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.030	1.5%	0.030	1.5%
Solvents	HFC to HFE	$ -	$ -	0.000	0.0%	0.031	1.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.050	2.5%	0.081	4.0%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.000	0.0%	0.081	4.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.000	0.0%	0.081	4.0%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.081	4.0%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.081	4.0%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.081	4.0%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.000	0.0%	0.081	4.0%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.081	4.0%
Refrigeration/AC	Secondary Loop	$ 51.25	$ 51.25	0.005	0.2%	0.086	4.3%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.086	4.3%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.07	$ 62.07	0.003	0.2%	0.089	4.4%
Refrigeration/AC	Replace DX with Distributed System	$ 69.58	$ 69.58	0.005	0.2%	0.094	4.7%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.094	4.7%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.094	4.7%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.094	4.7%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	-	0.0%	0.094	4.7%
Fire Extinguishing	FK-5-1-12	$ 335.54	$ 335.54	0.000	0.0%	0.094	4.7%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.094	4.7%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	0.094	4.7%
Fire Extinguishing	Inert Gases	$ 451.12	$ 451.12	0.000	0.0%	0.094	4.7%
Fire Extinguishing	Water Mist	$ 648.41	$ 648.41	0.000	0.0%	0.094	4.7%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	-	0.0%	0.094	4.7%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.094	4.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.094	4.7%

Africa Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.000	0.0%	0.000	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.000	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.000	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.030	1.5%	0.030	1.5%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.030	1.5%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.030	1.5%
Refrigeration/AC	Replace DX with Distributed System	$ (5.23)	$ (5.23)	0.005	0.2%	0.035	1.7%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.035	1.7%
Solvents	HFC to HFE	$ -	$ -	0.000	0.0%	0.035	1.7%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.050	2.5%	0.085	4.2%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.000	0.0%	0.085	4.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.000	0.0%	0.086	4.2%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.000	0.0%	0.086	4.3%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.086	4.3%
Refrigeration/AC	Secondary Loop	$ 11.98	$ 11.98	0.005	0.2%	0.091	4.5%
Refrigeration/AC	Ammonia Secondary Loop	$ 13.86	$ 13.86	0.003	0.2%	0.094	4.7%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.094	4.7%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.094	4.7%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	-	0.0%	0.094	4.7%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.094	4.7%
Fire Extinguishing	Inert Gases	$ 82.30	$ 82.30	0.000	0.0%	0.094	4.7%
Fire Extinguishing	FK-5-1-12	$ 83.77	$ 83.77	0.000	0.0%	0.094	4.7%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.094	4.7%
Fire Extinguishing	Water Mist	$ 140.15	$ 140.15	0.000	0.0%	0.094	4.7%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	-	0.0%	0.094	4.7%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.094	4.7%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.094	4.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.094	4.7%

Africa Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.000	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.000	0.0%	0.001	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.001	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.103	2.9%	0.104	2.9%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.105	2.9%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.149	4.1%	0.254	7.1%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.000	0.0%	0.254	7.1%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.001	0.0%	0.255	7.1%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.255	7.1%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.255	7.1%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.255	7.1%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.001	0.0%	0.255	7.1%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.255	7.1%
Refrigeration/AC	Secondary Loop	$ 51.25	$ 51.25	0.057	1.6%	0.312	8.7%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.312	8.7%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.07	$ 62.07	0.048	1.3%	0.360	10.0%
Refrigeration/AC	Replace DX with Distributed System	$ 69.58	$ 69.58	0.068	1.9%	0.429	11.9%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.429	11.9%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.429	11.9%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.429	11.9%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.016	0.4%	0.445	12.4%
Fire Extinguishing	FK-5-1-12	$ 335.54	$ 335.54	0.000	0.0%	0.445	12.4%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.445	12.4%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	0.445	12.4%
Fire Extinguishing	Inert Gases	$ 451.12	$ 451.12	0.000	0.0%	0.445	12.4%
Fire Extinguishing	Water Mist	$ 648.41	$ 648.41	0.000	0.0%	0.445	12.4%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	-	0.0%	0.445	12.4%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.445	12.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.012	0.3%	0.457	12.7%

Africa Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.000	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.000	0.0%	0.001	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.001	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.001	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.103	2.9%	0.104	2.9%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.104	2.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.104	2.9%
Refrigeration/AC	Replace DX with Distributed System	$ (5.23)	$ (5.23)	0.068	1.9%	0.173	4.8%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.173	4.8%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.173	4.8%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.149	4.1%	0.322	9.0%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.000	0.0%	0.322	9.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.001	0.0%	0.323	9.0%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.001	0.0%	0.324	9.0%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.324	9.0%
Refrigeration/AC	Secondary Loop	$ 11.98	$ 11.98	0.057	1.6%	0.381	10.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 13.86	$ 13.86	0.048	1.3%	0.429	11.9%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.429	11.9%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.429	11.9%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.016	0.4%	0.445	12.4%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.445	12.4%
Fire Extinguishing	Inert Gases	$ 82.30	$ 82.30	0.000	0.0%	0.445	12.4%
Fire Extinguishing	FK-5-1-12	$ 83.77	$ 83.77	0.000	0.0%	0.445	12.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.445	12.4%
Fire Extinguishing	Water Mist	$ 140.15	$ 140.15	0.000	0.0%	0.445	12.4%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	-	0.0%	0.445	12.4%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.445	12.4%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.445	12.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.012	0.3%	0.457	12.7%

Africa Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.001	0.0%	0.002	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.002	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.144	3.2%	0.146	3.3%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.147	3.3%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.280	6.3%	0.427	9.6%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.001	0.0%	0.428	9.6%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.001	0.0%	0.429	9.6%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.429	9.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.429	9.6%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.429	9.6%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.001	0.0%	0.430	9.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.430	9.6%
Refrigeration/AC	Secondary Loop	$ 51.25	$ 51.25	0.139	3.1%	0.569	12.7%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.569	12.7%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.07	$ 62.07	0.119	2.7%	0.688	15.4%
Refrigeration/AC	Replace DX with Distributed System	$ 69.58	$ 69.58	0.185	4.1%	0.873	19.5%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.873	19.5%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.873	19.5%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.873	19.5%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.069	1.5%	0.943	21.1%
Fire Extinguishing	FK-5-1-12	$ 335.54	$ 335.54	0.000	0.0%	0.943	21.1%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.943	21.1%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	0.943	21.1%
Fire Extinguishing	Inert Gases	$ 451.12	$ 451.12	0.000	0.0%	0.943	21.1%
Fire Extinguishing	Water Mist	$ 648.41	$ 648.41	0.000	0.0%	0.943	21.1%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	0.006	0.1%	0.949	21.2%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.949	21.2%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.055	1.2%	1.003	22.4%

Africa Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.001	0.0%	0.002	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.002	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.002	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.144	3.2%	0.146	3.3%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.146	3.3%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.146	3.3%
Refrigeration/AC	Replace DX with Distributed System	$ (5.23)	$ (5.23)	0.185	4.1%	0.331	7.4%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.331	7.4%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.332	7.4%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.280	6.3%	0.612	13.7%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.001	0.0%	0.613	13.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.001	0.0%	0.614	13.7%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.001	0.0%	0.615	13.8%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.615	13.8%
Refrigeration/AC	Secondary Loop	$ 11.98	$ 11.98	0.139	3.1%	0.755	16.9%
Refrigeration/AC	Ammonia Secondary Loop	$ 13.86	$ 13.86	0.119	2.7%	0.873	19.5%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.873	19.5%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.873	19.5%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.069	1.5%	0.943	21.1%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.943	21.1%
Fire Extinguishing	Inert Gases	$ 82.30	$ 82.30	0.000	0.0%	0.943	21.1%
Fire Extinguishing	FK-5-1-12	$ 83.77	$ 83.77	0.000	0.0%	0.943	21.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.943	21.1%
Fire Extinguishing	Water Mist	$ 140.15	$ 140.15	0.000	0.0%	0.943	21.1%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	0.006	0.1%	0.949	21.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.949	21.2%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.949	21.2%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.055	1.2%	1.003	22.4%

Africa Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.001	0.0%	0.002	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.002	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.204	3.7%	0.206	3.8%
Solvents	HFC to HFE	$ -	$ -	0.002	0.0%	0.208	3.8%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.487	8.9%	0.695	12.7%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.001	0.0%	0.696	12.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.002	0.0%	0.698	12.7%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.698	12.7%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.698	12.7%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.698	12.7%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.002	0.0%	0.700	12.8%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.700	12.8%
Refrigeration/AC	Secondary Loop	$ 51.25	$ 51.25	0.186	3.4%	0.886	16.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.886	16.2%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.07	$ 62.07	0.167	3.0%	1.053	19.2%
Refrigeration/AC	Replace DX with Distributed System	$ 69.58	$ 69.58	0.305	5.6%	1.358	24.8%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	1.358	24.8%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	1.358	24.8%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	1.358	24.8%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.209	3.8%	1.567	28.6%
Fire Extinguishing	FK-5-1-12	$ 335.54	$ 335.54	0.000	0.0%	1.568	28.6%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	1.568	28.6%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	1.568	28.6%
Fire Extinguishing	Inert Gases	$ 451.12	$ 451.12	0.000	0.0%	1.568	28.6%
Fire Extinguishing	Water Mist	$ 648.41	$ 648.41	0.000	0.0%	1.568	28.6%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	0.032	0.6%	1.600	29.2%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	1.600	29.2%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.155	2.8%	1.755	32.0%

Africa Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.001	0.0%	0.002	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.002	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.002	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.204	3.7%	0.206	3.8%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.206	3.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.206	3.8%
Refrigeration/AC	Replace DX with Distributed System	$ (5.23)	$ (5.23)	0.305	5.6%	0.511	9.3%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.511	9.3%
Solvents	HFC to HFE	$ -	$ -	0.002	0.0%	0.513	9.4%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.487	8.9%	1.000	18.2%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.001	0.0%	1.001	18.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.002	0.0%	1.003	18.3%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.002	0.0%	1.005	18.3%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	1.005	18.3%
Refrigeration/AC	Secondary Loop	$ 11.98	$ 11.98	0.186	3.4%	1.191	21.7%
Refrigeration/AC	Ammonia Secondary Loop	$ 13.86	$ 13.86	0.167	3.0%	1.358	24.8%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	1.358	24.8%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	1.358	24.8%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.209	3.8%	1.567	28.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	1.567	28.6%
Fire Extinguishing	Inert Gases	$ 82.30	$ 82.30	0.000	0.0%	1.567	28.6%
Fire Extinguishing	FK-5-1-12	$ 83.77	$ 83.77	0.000	0.0%	1.568	28.6%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	1.568	28.6%
Fire Extinguishing	Water Mist	$ 140.15	$ 140.15	0.000	0.0%	1.568	28.6%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	0.032	0.6%	1.600	29.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	1.600	29.2%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	1.600	29.2%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.155	2.8%	1.755	32.0%

Eastern Europe Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.026	2.2%	0.026	2.2%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.026	2.2%	0.052	4.4%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.052	4.4%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.010	0.8%	0.061	5.2%
Solvents	HFC to HFE	$ -	$ -	0.000	0.0%	0.061	5.2%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.016	1.3%	0.077	6.5%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.000	0.0%	0.077	6.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.038	3.2%	0.116	9.7%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.116	9.7%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.116	9.7%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.116	9.7%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.000	0.0%	0.116	9.8%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.116	9.8%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.116	9.8%
Refrigeration/AC	Replace DX with Distributed System	$ 59.49	$ 62.26	0.001	0.1%	0.117	9.9%
Refrigeration/AC	Secondary Loop	$ 70.45	$ 76.11	0.002	0.1%	0.119	10.0%
Refrigeration/AC	Ammonia Secondary Loop	$ 81.83	$ 86.07	0.001	0.1%	0.120	10.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.120	10.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.120	10.1%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 164.88	-	0.0%	0.120	10.1%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.120	10.1%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 299.69	-	0.0%	0.120	10.1%
Fire Extinguishing	FK-5-1-12	$ 335.56	$ 336.01	0.000	0.0%	0.120	10.1%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.120	10.1%
Fire Extinguishing	Inert Gases	$ 447.55	$ 483.77	0.000	0.0%	0.120	10.1%
Fire Extinguishing	Water Mist	$ 566.46	$ 761.31	0.000	0.0%	0.120	10.1%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 763.86	-	0.0%	0.120	10.1%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.120	10.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.120	10.1%

Eastern Europe Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ (161.67)	-	0.0%	-	0.0%
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.026	2.2%	0.026	2.2%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.026	2.2%	0.052	4.4%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.052	4.4%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.010	0.8%	0.061	5.2%
Refrigeration/AC	Replace DX with Distributed System	$ (15.72)	$ (9.80)	0.001	0.1%	0.063	5.3%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.063	5.3%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.063	5.3%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ (4.59)	-	0.0%	0.063	5.3%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.063	5.3%
Solvents	HFC to HFE	$ -	$ -	0.000	0.0%	0.063	5.3%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.016	1.3%	0.079	6.6%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.000	0.0%	0.079	6.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.038	3.2%	0.117	9.9%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.000	0.0%	0.117	9.9%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.117	9.9%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.117	9.9%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.117	9.9%
Refrigeration/AC	Secondary Loop	$ 25.82	$ 35.70	0.002	0.1%	0.119	10.0%
Refrigeration/AC	Ammonia Secondary Loop	$ 27.39	$ 36.81	0.001	0.1%	0.120	10.1%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.120	10.1%
Fire Extinguishing	FK-5-1-12	$ 84.00	$ 84.04	0.000	0.0%	0.120	10.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.120	10.1%
Fire Extinguishing	Inert Gases	$ 94.40	$ 96.74	0.000	0.0%	0.120	10.1%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 113.91	-	0.0%	0.120	10.1%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.120	10.1%
Fire Extinguishing	Water Mist	$ 149.01	$ 181.56	0.000	0.0%	0.120	10.1%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.120	10.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.120	10.1%

Eastern Europe Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.080	3.9%	0.080	3.9%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.080	3.9%	0.160	7.8%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.160	7.8%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.034	1.7%	0.194	9.5%
Solvents	HFC to HFE	$ -	$ -	0.000	0.0%	0.195	9.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.050	2.4%	0.244	12.0%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.000	0.0%	0.245	12.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.148	7.3%	0.393	19.2%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.393	19.2%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.393	19.2%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.003	0.2%	0.396	19.4%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.000	0.0%	0.397	19.4%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.397	19.4%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.397	19.4%
Refrigeration/AC	Replace DX with Distributed System	$ 59.49	$ 62.26	0.023	1.1%	0.419	20.6%
Refrigeration/AC	Secondary Loop	$ 70.45	$ 76.11	0.019	0.9%	0.438	21.5%
Refrigeration/AC	Ammonia Secondary Loop	$ 81.83	$ 86.07	0.016	0.8%	0.454	22.3%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	0.000	0.0%	0.455	22.3%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.455	22.3%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 164.88	0.005	0.3%	0.460	22.5%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.460	22.5%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 299.69	-	0.0%	0.460	22.5%
Fire Extinguishing	FK-5-1-12	$ 335.56	$ 336.01	0.000	0.0%	0.460	22.6%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.460	22.6%
Fire Extinguishing	Inert Gases	$ 447.55	$ 483.77	0.001	0.0%	0.461	22.6%
Fire Extinguishing	Water Mist	$ 566.46	$ 761.31	0.000	0.0%	0.461	22.6%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 763.86	-	0.0%	0.461	22.6%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.461	22.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.005	0.2%	0.466	22.8%

Eastern Europe Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ (161.67)	-	0.0%	-	0.0%
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.080	3.9%	0.080	3.9%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.080	3.9%	0.160	7.8%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.160	7.8%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.034	1.7%	0.194	9.5%
Refrigeration/AC	Replace DX with Distributed System	$ (15.72)	$ (9.80)	0.023	1.1%	0.217	10.6%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.217	10.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.217	10.6%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ (4.59)	0.005	0.3%	0.223	10.9%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.003	0.2%	0.226	11.1%
Solvents	HFC to HFE	$ -	$ -	0.000	0.0%	0.226	11.1%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.050	2.4%	0.276	13.5%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.000	0.0%	0.276	13.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.148	7.3%	0.424	20.8%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.000	0.0%	0.425	20.8%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	0.000	0.0%	0.425	20.8%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.425	20.8%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.425	20.8%
Refrigeration/AC	Secondary Loop	$ 25.82	$ 35.70	0.019	0.9%	0.444	21.8%
Refrigeration/AC	Ammonia Secondary Loop	$ 27.39	$ 36.81	0.016	0.8%	0.460	22.5%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.460	22.5%
Fire Extinguishing	FK-5-1-12	$ 84.00	$ 84.04	0.000	0.0%	0.460	22.6%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.460	22.6%
Fire Extinguishing	Inert Gases	$ 94.40	$ 96.74	0.001	0.0%	0.461	22.6%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 113.91	-	0.0%	0.461	22.6%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.461	22.6%
Fire Extinguishing	Water Mist	$ 149.01	$ 181.56	0.000	0.0%	0.461	22.6%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.461	22.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.005	0.2%	0.466	22.8%

Eastern Europe Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.093	3.7%	0.093	3.7%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.093	3.7%	0.186	7.3%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.186	7.3%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.050	2.0%	0.236	9.3%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.236	9.3%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.097	3.8%	0.334	13.2%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.000	0.0%	0.334	13.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.241	9.5%	0.575	22.7%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.575	22.7%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.575	22.7%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.005	0.2%	0.579	22.9%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.001	0.0%	0.580	22.9%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.580	22.9%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.580	22.9%
Refrigeration/AC	Replace DX with Distributed System	$ 59.49	$ 62.26	0.064	2.5%	0.644	25.5%
Refrigeration/AC	Secondary Loop	$ 70.45	$ 76.11	0.048	1.9%	0.693	27.4%
Refrigeration/AC	Ammonia Secondary Loop	$ 81.83	$ 86.07	0.041	1.6%	0.734	29.0%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	0.000	0.0%	0.734	29.0%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.734	29.0%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 164.88	0.024	1.0%	0.758	30.0%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.758	30.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 299.69	-	0.0%	0.758	30.0%
Fire Extinguishing	FK-5-1-12	$ 335.56	$ 336.01	0.002	0.1%	0.760	30.1%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.760	30.1%
Fire Extinguishing	Inert Gases	$ 447.55	$ 483.77	0.002	0.1%	0.763	30.1%
Fire Extinguishing	Water Mist	$ 566.46	$ 761.31	0.000	0.0%	0.763	30.1%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 763.86	0.002	0.1%	0.765	30.2%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.765	30.2%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.023	0.9%	0.788	31.1%

Eastern Europe Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ (161.67)	-	0.0%	-	0.0%
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.093	3.7%	0.093	3.7%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.093	3.7%	0.186	7.3%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.186	7.3%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.050	2.0%	0.236	9.3%
Refrigeration/AC	Replace DX with Distributed System	$ (15.72)	$ (9.80)	0.064	2.5%	0.300	11.9%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.300	11.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.300	11.9%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ (4.59)	0.024	1.0%	0.324	12.8%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.005	0.2%	0.329	13.0%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.329	13.0%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.097	3.8%	0.427	16.9%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.000	0.0%	0.427	16.9%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.241	9.5%	0.668	26.4%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.001	0.0%	0.668	26.4%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	0.000	0.0%	0.669	26.4%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.669	26.4%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.669	26.4%
Refrigeration/AC	Secondary Loop	$ 25.82	$ 35.70	0.048	1.9%	0.717	28.3%
Refrigeration/AC	Ammonia Secondary Loop	$ 27.39	$ 36.81	0.041	1.6%	0.758	30.0%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.758	30.0%
Fire Extinguishing	FK-5-1-12	$ 84.00	$ 84.04	0.002	0.1%	0.760	30.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.760	30.1%
Fire Extinguishing	Inert Gases	$ 94.40	$ 96.74	0.002	0.1%	0.763	30.1%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 113.91	0.002	0.1%	0.765	30.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.765	30.2%
Fire Extinguishing	Water Mist	$ 149.01	$ 181.56	0.000	0.0%	0.765	30.2%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.765	30.2%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.023	0.9%	0.788	31.1%

Eastern Europe Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.108	3.5%	0.108	3.5%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.108	3.5%	0.216	7.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.216	7.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.073	2.4%	0.288	9.3%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.289	9.4%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.174	5.6%	0.463	15.0%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.001	0.0%	0.464	15.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.399	12.9%	0.863	27.9%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.863	27.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.863	27.9%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.006	0.2%	0.869	28.1%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.001	0.0%	0.870	28.2%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.870	28.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.870	28.2%
Refrigeration/AC	Replace DX with Distributed System	$ 59.49	$ 62.26	0.109	3.5%	0.979	31.7%
Refrigeration/AC	Secondary Loop	$ 70.45	$ 76.11	0.066	2.1%	1.045	33.8%
Refrigeration/AC	Ammonia Secondary Loop	$ 81.83	$ 86.07	0.060	1.9%	1.105	35.8%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	0.000	0.0%	1.105	35.8%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	1.105	35.8%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 164.88	0.074	2.4%	1.179	38.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	1.179	38.2%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 299.69	-	0.0%	1.179	38.2%
Fire Extinguishing	FK-5-1-12	$ 335.56	$ 336.01	0.005	0.2%	1.185	38.4%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	1.185	38.4%
Fire Extinguishing	Inert Gases	$ 447.55	$ 483.77	0.004	0.1%	1.189	38.5%
Fire Extinguishing	Water Mist	$ 566.46	$ 761.31	0.001	0.0%	1.190	38.5%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 763.86	0.011	0.4%	1.201	38.9%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	1.201	38.9%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.066	2.1%	1.267	41.0%

Eastern Europe Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ (161.67)	-	0.0%	-	0.0%
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.108	3.5%	0.108	3.5%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.108	3.5%	0.216	7.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.216	7.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.073	2.4%	0.288	9.3%
Refrigeration/AC	Replace DX with Distributed System	$ (15.72)	$ (9.80)	0.109	3.5%	0.397	12.9%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.397	12.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.397	12.9%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ (4.59)	0.074	2.4%	0.472	15.3%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.006	0.2%	0.478	15.5%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.479	15.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.174	5.6%	0.653	21.1%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.001	0.0%	0.653	21.1%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.399	12.9%	1.052	34.1%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.001	0.0%	1.053	34.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	0.000	0.0%	1.053	34.1%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	1.053	34.1%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	1.053	34.1%
Refrigeration/AC	Secondary Loop	$ 25.82	$ 35.70	0.066	2.1%	1.120	36.2%
Refrigeration/AC	Ammonia Secondary Loop	$ 27.39	$ 36.81	0.060	1.9%	1.179	38.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	1.179	38.2%
Fire Extinguishing	FK-5-1-12	$ 84.00	$ 84.04	0.005	0.2%	1.185	38.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	1.185	38.4%
Fire Extinguishing	Inert Gases	$ 94.40	$ 96.74	0.004	0.1%	1.189	38.5%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 113.91	0.011	0.4%	1.201	38.9%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	1.201	38.9%
Fire Extinguishing	Water Mist	$ 149.01	$ 181.56	0.001	0.0%	1.201	38.9%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	1.201	38.9%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.066	2.1%	1.267	41.0%

EU-15 Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.008	0.1%	0.008	0.1%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.152	1.0%	0.160	1.1%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.152	1.0%	0.312	2.2%
Foams	Spray HFC-245fa/CO2 to HC	$ (7.25)	$ (7.25)	-	0.0%	0.312	2.2%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.040	0.3%	0.352	2.4%
Solvents	HFC to HFE	$ -	$ -	0.010	0.1%	0.362	2.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.095	0.7%	0.457	3.2%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.006	0.0%	0.463	3.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.225	1.6%	0.688	4.7%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.688	4.7%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.688	4.7%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.688	4.7%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.012	0.1%	0.700	4.8%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.700	4.8%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.700	4.8%
Refrigeration/AC	Replace DX with Distributed System	$ 37.46	$ 69.97	0.013	0.1%	0.712	4.9%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.712	4.9%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.003	0.0%	0.715	4.9%
Refrigeration/AC	Secondary Loop	$ 53.67	$ 128.94	0.007	0.0%	0.722	5.0%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.61	$ 137.88	0.007	0.0%	0.729	5.0%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 164.88	-	0.0%	0.729	5.0%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.729	5.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 299.69	0.059	0.4%	0.788	5.4%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.40	0.002	0.0%	0.790	5.5%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.790	5.5%
Fire Extinguishing	Inert Gases	$ 369.25	$ 459.80	0.005	0.0%	0.795	5.5%
Fire Extinguishing	Water Mist	$ 467.17	$ 751.93	0.001	0.0%	0.796	5.5%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 763.86	-	0.0%	0.796	5.5%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.030	0.2%	0.826	5.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.826	5.7%

EU-15 Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ (161.67)	0.059	0.4%	0.059	0.4%
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.008	0.1%	0.068	0.5%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.152	1.0%	0.219	1.5%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.152	1.0%	0.371	2.6%
Foams	Spray HFC-245fa/CO2 to HC	$ (16.74)	$ (16.74)	-	0.0%	0.371	2.6%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.040	0.3%	0.411	2.8%
Refrigeration/AC	Replace DX with Distributed System	$ (36.26)	$ (11.11)	0.013	0.1%	0.424	2.9%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.424	2.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.424	2.9%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ (4.59)	-	0.0%	0.424	2.9%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.424	2.9%
Solvents	HFC to HFE	$ -	$ -	0.010	0.1%	0.434	3.0%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.095	0.7%	0.529	3.6%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.006	0.0%	0.535	3.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.225	1.6%	0.760	5.2%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.012	0.1%	0.772	5.3%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.772	5.3%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.772	5.3%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.772	5.3%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.772	5.3%
Refrigeration/AC	Ammonia Secondary Loop	$ 21.75	$ 83.07	0.007	0.0%	0.778	5.4%
Refrigeration/AC	Secondary Loop	$ 20.38	$ 83.41	0.007	0.0%	0.785	5.4%
Fire Extinguishing	FK-5-1-12	$ 83.72	$ 84.66	0.002	0.0%	0.787	5.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.003	0.0%	0.790	5.5%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 113.91	-	0.0%	0.790	5.5%
Fire Extinguishing	Inert Gases	$ 71.10	$ 118.60	0.005	0.0%	0.795	5.5%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.795	5.5%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.030	0.2%	0.825	5.7%
Fire Extinguishing	Water Mist	$ 111.76	$ 232.33	0.001	0.0%	0.826	5.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.826	5.7%

EU-15 Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.322	1.9%	0.322	1.9%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.322	1.9%	0.644	3.7%
Foams	Spray HFC-245fa/CO2 to HC	$ (7.25)	$ (7.25)	0.004	0.0%	0.649	3.7%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.062	0.4%	0.711	4.1%
Solvents	HFC to HFE	$ -	$ -	0.020	0.1%	0.731	4.2%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.240	1.4%	0.971	5.6%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.012	0.1%	0.983	5.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.596	3.4%	1.580	9.1%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	1.580	9.1%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	1.580	9.1%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.049	0.3%	1.629	9.4%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.024	0.1%	1.654	9.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	1.654	9.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	1.654	9.6%
Refrigeration/AC	Replace DX with Distributed System	$ 37.46	$ 69.97	0.179	1.0%	1.832	10.6%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	0.384	2.2%	2.216	12.8%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.008	0.0%	2.224	12.9%
Refrigeration/AC	Secondary Loop	$ 53.67	$ 128.94	0.095	0.5%	2.318	13.4%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.61	$ 137.88	0.096	0.6%	2.414	14.0%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 164.88	0.224	1.3%	2.639	15.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	2.639	15.2%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 299.69	0.302	1.7%	2.941	17.0%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.40	0.021	0.1%	2.962	17.1%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	2.962	17.1%
Fire Extinguishing	Inert Gases	$ 369.25	$ 459.80	0.026	0.1%	2.988	17.3%
Fire Extinguishing	Water Mist	$ 467.17	$ 751.93	0.003	0.0%	2.991	17.3%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 763.86	0.302	1.7%	3.293	19.0%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.050	0.3%	3.343	19.3%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.053	0.3%	3.396	19.6%

EU-15 Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ (161.67)	0.302	1.7%	0.302	1.7%
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	0.302	1.7%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.322	1.9%	0.625	3.6%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.322	1.9%	0.947	5.5%
Foams	Spray HFC-245fa/CO2 to HC	$ (16.74)	$ (16.74)	0.004	0.0%	0.951	5.5%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.062	0.4%	1.013	5.9%
Refrigeration/AC	Replace DX with Distributed System	$ (36.26)	$ (11.11)	0.179	1.0%	1.192	6.9%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	1.192	6.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	1.192	6.9%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ (4.59)	0.224	1.3%	1.416	8.2%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.049	0.3%	1.465	8.5%
Solvents	HFC to HFE	$ -	$ -	0.020	0.1%	1.485	8.6%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.240	1.4%	1.726	10.0%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.012	0.1%	1.738	10.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.596	3.4%	2.334	13.5%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.024	0.1%	2.359	13.6%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	0.384	2.2%	2.743	15.9%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	2.743	15.9%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	2.743	15.9%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	2.743	15.9%
Refrigeration/AC	Ammonia Secondary Loop	$ 21.75	$ 83.07	0.096	0.6%	2.839	16.4%
Refrigeration/AC	Secondary Loop	$ 20.38	$ 83.41	0.095	0.5%	2.933	17.0%
Fire Extinguishing	FK-5-1-12	$ 83.72	$ 84.66	0.021	0.1%	2.954	17.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.008	0.0%	2.962	17.1%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 113.91	0.302	1.7%	3.264	18.9%
Fire Extinguishing	Inert Gases	$ 71.10	$ 118.60	0.026	0.1%	3.290	19.0%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	3.290	19.0%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.050	0.3%	3.340	19.3%
Fire Extinguishing	Water Mist	$ 111.76	$ 232.33	0.003	0.0%	3.343	19.3%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.053	0.3%	3.396	19.6%

EU-15 Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.342	1.4%	0.342	1.4%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.342	1.4%	0.684	2.8%
Foams	Spray HFC-245fa/CO2 to HC	$ (7.25)	$ (7.25)	0.014	0.1%	0.699	2.9%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.206	0.9%	0.905	3.8%
Solvents	HFC to HFE	$ -	$ -	0.031	0.1%	0.936	3.9%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.313	1.3%	1.249	5.2%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.019	0.1%	1.267	5.3%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.887	3.7%	2.154	8.9%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	2.154	8.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	2.154	8.9%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.061	0.3%	2.215	9.2%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.037	0.2%	2.252	9.3%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	0.025	0.1%	2.277	9.4%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	2.277	9.4%
Refrigeration/AC	Replace DX with Distributed System	$ 37.46	$ 69.97	0.875	3.6%	3.152	13.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	0.558	2.3%	3.710	15.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.023	0.1%	3.733	15.5%
Refrigeration/AC	Secondary Loop	$ 53.67	$ 128.94	0.502	2.1%	4.235	17.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.61	$ 137.88	0.445	1.8%	4.680	19.4%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 164.88	0.414	1.7%	5.094	21.1%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	5.094	21.1%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 299.69	0.342	1.4%	5.436	22.6%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.40	0.050	0.2%	5.486	22.8%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	5.486	22.8%
Fire Extinguishing	Inert Gases	$ 369.25	$ 459.80	0.048	0.2%	5.534	23.0%
Fire Extinguishing	Water Mist	$ 467.17	$ 751.93	0.006	0.0%	5.540	23.0%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 763.86	1.027	4.3%	6.567	27.2%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.067	0.3%	6.634	27.5%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.222	0.9%	6.856	28.4%

EU-15 Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ (161.67)	0.342	1.4%	0.342	1.4%
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	0.342	1.4%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.342	1.4%	0.684	2.8%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.342	1.4%	1.027	4.3%
Foams	Spray HFC-245fa/CO2 to HC	$ (16.74)	$ (16.74)	0.014	0.1%	1.041	4.3%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.206	0.9%	1.247	5.2%
Refrigeration/AC	Replace DX with Distributed System	$ (36.26)	$ (11.11)	0.875	3.6%	2.122	8.8%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	2.122	8.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	2.122	8.8%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ (4.59)	0.414	1.7%	2.537	10.5%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.061	0.3%	2.597	10.8%
Solvents	HFC to HFE	$ -	$ -	0.031	0.1%	2.628	10.9%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.313	1.3%	2.941	12.2%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.019	0.1%	2.960	12.3%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.887	3.7%	3.847	16.0%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.037	0.2%	3.884	16.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	0.558	2.3%	4.442	18.4%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	4.442	18.4%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	0.025	0.1%	4.467	18.5%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	4.467	18.5%
Refrigeration/AC	Ammonia Secondary Loop	$ 21.75	$ 83.07	0.445	1.8%	4.912	20.4%
Refrigeration/AC	Secondary Loop	$ 20.38	$ 83.41	0.502	2.1%	5.413	22.5%
Fire Extinguishing	FK-5-1-12	$ 83.72	$ 84.66	0.050	0.2%	5.463	22.7%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.023	0.1%	5.486	22.8%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 113.91	1.027	4.3%	6.513	27.0%
Fire Extinguishing	Inert Gases	$ 71.10	$ 118.60	0.048	0.2%	6.561	27.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	6.561	27.2%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.067	0.3%	6.628	27.5%
Fire Extinguishing	Water Mist	$ 111.76	$ 232.33	0.006	0.0%	6.634	27.5%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.222	0.9%	6.856	28.4%

EU-15 Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.363	1.4%	0.363	1.4%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.363	1.4%	0.727	2.7%
Foams	Spray HFC-245fa/CO2 to HC	$ (7.25)	$ (7.25)	0.037	0.1%	0.763	2.9%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.189	0.7%	0.952	3.6%
Solvents	HFC to HFE	$ -	$ -	0.052	0.2%	1.005	3.8%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.430	1.6%	1.434	5.4%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.025	0.1%	1.460	5.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	1.345	5.1%	2.805	10.6%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	2.805	10.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	2.805	10.6%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.075	0.3%	2.880	10.9%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.051	0.2%	2.930	11.1%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	0.821	3.1%	3.752	14.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	3.752	14.2%
Refrigeration/AC	Replace DX with Distributed System	$ 37.46	$ 69.97	1.261	4.8%	5.012	18.9%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	0.930	3.5%	5.943	22.5%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.053	0.2%	5.995	22.7%
Refrigeration/AC	Secondary Loop	$ 53.67	$ 128.94	0.783	3.0%	6.778	25.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.61	$ 137.88	0.580	2.2%	7.358	27.8%
Refrigeration/AC	HFC-152a in MVACs	$ 164.88	$ 164.88	0.294	1.1%	7.652	28.9%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	7.652	28.9%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 299.69	$ 299.69	0.130	0.5%	7.782	29.4%
Fire Extinguishing	FK-5-1-12	$ 334.91	$ 336.40	0.108	0.4%	7.890	29.8%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	7.890	29.8%
Fire Extinguishing	Inert Gases	$ 369.25	$ 459.80	0.087	0.3%	7.977	30.1%
Fire Extinguishing	Water Mist	$ 467.17	$ 751.93	0.012	0.0%	7.989	30.2%
Refrigeration/AC	CO2 for New MVACs	$ 763.86	$ 763.86	1.532	5.8%	9.521	36.0%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.084	0.3%	9.605	36.3%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.582	2.2%	10.187	38.5%

EU-15 Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (161.67)	$ (161.67)	0.130	0.5%	0.130	0.5%
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	0.130	0.5%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.363	1.4%	0.493	1.9%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.363	1.4%	0.857	3.2%
Foams	Spray HFC-245fa/CO2 to HC	$ (16.74)	$ (16.74)	0.037	0.1%	0.893	3.4%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.189	0.7%	1.082	4.1%
Refrigeration/AC	Replace DX with Distributed System	$ (36.26)	$ (11.11)	1.261	4.8%	2.343	8.9%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	2.343	8.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	2.343	8.9%
Refrigeration/AC	HFC-152a in MVACs	$ (4.59)	$ (4.59)	0.294	1.1%	2.637	10.0%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.075	0.3%	2.711	10.2%
Solvents	HFC to HFE	$ -	$ -	0.052	0.2%	2.764	10.4%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.430	1.6%	3.194	12.1%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.025	0.1%	3.219	12.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	1.345	5.1%	4.564	17.3%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.051	0.2%	4.615	17.4%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	0.930	3.5%	5.545	21.0%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	5.545	21.0%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	0.821	3.1%	6.366	24.1%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	6.366	24.1%
Refrigeration/AC	Ammonia Secondary Loop	$ 21.75	$ 83.07	0.580	2.2%	6.947	26.3%
Refrigeration/AC	Secondary Loop	$ 20.38	$ 83.41	0.783	3.0%	7.729	29.2%
Fire Extinguishing	FK-5-1-12	$ 83.72	$ 84.66	0.108	0.4%	7.838	29.6%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.053	0.2%	7.890	29.8%
Refrigeration/AC	CO2 for New MVACs	$ 113.91	$ 113.91	1.532	5.8%	9.422	35.6%
Fire Extinguishing	Inert Gases	$ 71.10	$ 118.60	0.087	0.3%	9.509	35.9%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	9.509	35.9%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.084	0.3%	9.592	36.3%
Fire Extinguishing	Water Mist	$ 111.76	$ 232.33	0.012	0.0%	9.605	36.3%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.582	2.2%	10.187	38.5%

Japan & Australia&NZ Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.010	0.1%	0.010	0.1%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.011	0.1%	0.021	0.2%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.011	0.1%	0.032	0.3%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.049	0.5%	0.081	0.9%
Solvents	HFC to HFE	$ -	$ -	0.012	0.1%	0.093	1.0%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.084	0.9%	0.177	1.9%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	-	0.0%	0.177	1.9%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.007	0.1%	0.185	1.9%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.016	0.2%	0.201	2.1%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.201	2.1%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.201	2.1%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.201	2.1%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.015	0.2%	0.215	2.3%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.215	2.3%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.215	2.3%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 58.08	0.016	0.2%	0.231	2.4%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.231	2.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.004	0.0%	0.235	2.5%
Refrigeration/AC	Secondary Loop	$ 80.60	$ 173.22	0.008	0.1%	0.244	2.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 90.98	$ 180.96	0.009	0.1%	0.252	2.7%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.252	2.7%
Refrigeration/AC	HFC-152a in MVACs	$ 169.35	$ 205.42	-	0.0%	0.252	2.7%
Fire Extinguishing	FK-5-1-12	$ 335.91	$ 336.75	0.000	0.0%	0.252	2.7%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.252	2.7%
Fire Extinguishing	Inert Gases	$ 423.50	$ 427.65	0.000	0.0%	0.253	2.7%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 320.18	$ 468.38	0.047	0.5%	0.300	3.2%
Fire Extinguishing	Water Mist	$ 641.66	$ 699.59	0.000	0.0%	0.300	3.2%
Refrigeration/AC	CO2 for New MVACs	$ 778.80	$ 839.80	-	0.0%	0.300	3.2%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.007	0.1%	0.306	3.2%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.306	3.2%

Japan & Australia&NZ Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.010	0.1%	0.010	0.1%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.011	0.1%	0.021	0.2%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.011	0.1%	0.032	0.3%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (15.59)	0.016	0.2%	0.048	0.5%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	-	0.0%	0.048	0.5%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.049	0.5%	0.097	1.0%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.097	1.0%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.097	1.0%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.097	1.0%
Solvents	HFC to HFE	$ -	$ -	0.012	0.1%	0.109	1.2%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.084	0.9%	0.193	2.0%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.007	0.1%	0.200	2.1%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.016	0.2%	0.217	2.3%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.015	0.2%	0.231	2.4%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (154.16)	$ 7.02	0.047	0.5%	0.278	2.9%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.278	2.9%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.278	2.9%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.278	2.9%
Refrigeration/AC	HFC-152a in MVACs	$ (1.72)	$ 30.81	-	0.0%	0.278	2.9%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.278	2.9%
Fire Extinguishing	FK-5-1-12	$ 84.10	$ 85.22	0.000	0.0%	0.278	2.9%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.004	0.0%	0.282	3.0%
Refrigeration/AC	Ammonia Secondary Loop	$ 38.93	$ 123.84	0.009	0.1%	0.291	3.1%
Refrigeration/AC	Secondary Loop	$ 37.84	$ 125.39	0.008	0.1%	0.299	3.2%
Fire Extinguishing	Inert Gases	$ 89.48	$ 136.29	0.000	0.0%	0.300	3.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.300	3.2%
Refrigeration/AC	CO2 for New MVACs	$ 119.91	$ 180.72	-	0.0%	0.300	3.2%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.007	0.1%	0.306	3.2%
Fire Extinguishing	Water Mist	$ 169.90	$ 287.80	0.000	0.0%	0.306	3.2%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.306	3.2%

Japan & Australia&NZ Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.024	0.2%	0.024	0.2%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.024	0.2%	0.048	0.4%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.071	0.6%	0.119	1.0%
Solvents	HFC to HFE	$ -	$ -	0.024	0.2%	0.143	1.2%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.201	1.6%	0.344	2.8%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	0.007	0.1%	0.351	2.9%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.014	0.1%	0.365	3.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.045	0.4%	0.410	3.3%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.410	3.3%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.410	3.3%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.008	0.1%	0.419	3.4%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.029	0.2%	0.447	3.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.447	3.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.447	3.6%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 58.08	0.205	1.7%	0.652	5.3%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	0.279	2.3%	0.931	7.6%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.012	0.1%	0.944	7.7%
Refrigeration/AC	Secondary Loop	$ 80.60	$ 173.22	0.109	0.9%	1.052	8.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 90.98	$ 180.96	0.110	0.9%	1.163	9.5%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	1.163	9.5%
Refrigeration/AC	HFC-152a in MVACs	$ 169.35	$ 205.42	0.159	1.3%	1.322	10.8%
Fire Extinguishing	FK-5-1-12	$ 335.91	$ 336.75	0.004	0.0%	1.326	10.8%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	1.326	10.8%
Fire Extinguishing	Inert Gases	$ 423.50	$ 427.65	0.005	0.0%	1.331	10.8%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 320.18	$ 468.38	0.233	1.9%	1.564	12.7%
Fire Extinguishing	Water Mist	$ 641.66	$ 699.59	0.001	0.0%	1.564	12.7%
Refrigeration/AC	CO2 for New MVACs	$ 778.80	$ 839.80	0.179	1.5%	1.743	14.2%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.020	0.2%	1.763	14.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.034	0.3%	1.798	14.6%

Japan & Australia&NZ Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.024	0.2%	0.024	0.2%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.024	0.2%	0.048	0.4%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (15.59)	0.205	1.7%	0.253	2.1%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	0.007	0.1%	0.261	2.1%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.071	0.6%	0.331	2.7%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.331	2.7%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.331	2.7%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.008	0.1%	0.340	2.8%
Solvents	HFC to HFE	$ -	$ -	0.024	0.2%	0.364	3.0%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.201	1.6%	0.565	4.6%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.014	0.1%	0.579	4.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.045	0.4%	0.624	5.1%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.029	0.2%	0.652	5.3%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (154.16)	$ 7.02	0.233	1.9%	0.885	7.2%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	0.279	2.3%	1.164	9.5%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	1.164	9.5%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	1.164	9.5%
Refrigeration/AC	HFC-152a in MVACs	$ (1.72)	$ 30.81	0.159	1.3%	1.323	10.8%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	1.323	10.8%
Fire Extinguishing	FK-5-1-12	$ 84.10	$ 85.22	0.004	0.0%	1.327	10.8%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.012	0.1%	1.340	10.9%
Refrigeration/AC	Ammonia Secondary Loop	$ 38.93	$ 123.84	0.110	0.9%	1.450	11.8%
Refrigeration/AC	Secondary Loop	$ 37.84	$ 125.39	0.109	0.9%	1.558	12.7%
Fire Extinguishing	Inert Gases	$ 89.48	$ 136.29	0.005	0.0%	1.564	12.7%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	1.564	12.7%
Refrigeration/AC	CO2 for New MVACs	$ 119.91	$ 180.72	0.179	1.5%	1.743	14.2%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.020	0.2%	1.763	14.4%
Fire Extinguishing	Water Mist	$ 169.90	$ 287.80	0.001	0.0%	1.763	14.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.034	0.3%	1.798	14.6%

Japan & Australia&NZ Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.027	0.2%	0.027	0.2%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.027	0.2%	0.053	0.4%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.145	1.0%	0.199	1.4%
Solvents	HFC to HFE	$ -	$ -	0.035	0.2%	0.234	1.6%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.234	1.6%	0.468	3.2%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	0.020	0.1%	0.488	3.3%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.021	0.1%	0.510	3.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.069	0.5%	0.579	3.9%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.579	3.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.579	3.9%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.010	0.1%	0.589	4.0%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.043	0.3%	0.631	4.3%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	0.011	0.1%	0.642	4.4%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.642	4.4%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 58.08	0.619	4.2%	1.261	8.6%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	0.445	3.0%	1.706	11.6%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.032	0.2%	1.738	11.9%
Refrigeration/AC	Secondary Loop	$ 80.60	$ 173.22	0.355	2.4%	2.093	14.3%
Refrigeration/AC	Ammonia Secondary Loop	$ 90.98	$ 180.96	0.315	2.1%	2.408	16.4%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	0.000	0.0%	2.408	16.4%
Refrigeration/AC	HFC-152a in MVACs	$ 169.35	$ 205.42	0.476	3.2%	2.884	19.7%
Fire Extinguishing	FK-5-1-12	$ 335.91	$ 336.75	0.019	0.1%	2.903	19.8%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	2.903	19.8%
Fire Extinguishing	Inert Gases	$ 423.50	$ 427.65	0.018	0.1%	2.921	19.9%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 320.18	$ 468.38	0.300	2.0%	3.221	22.0%
Fire Extinguishing	Water Mist	$ 641.66	$ 699.59	0.002	0.0%	3.223	22.0%
Refrigeration/AC	CO2 for New MVACs	$ 778.80	$ 839.80	0.600	4.1%	3.824	26.1%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.024	0.2%	3.848	26.3%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.139	0.9%	3.987	27.2%

Japan & Australia&NZ Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.027	0.2%	0.027	0.2%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.027	0.2%	0.053	0.4%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (15.59)	0.619	4.2%	0.672	4.6%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	0.020	0.1%	0.693	4.7%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.145	1.0%	0.838	5.7%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.838	5.7%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.838	5.7%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.010	0.1%	0.848	5.8%
Solvents	HFC to HFE	$ -	$ -	0.035	0.2%	0.883	6.0%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.234	1.6%	1.117	7.6%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.021	0.1%	1.139	7.8%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.069	0.5%	1.208	8.2%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.043	0.3%	1.250	8.5%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (154.16)	$ 7.02	0.300	2.0%	1.550	10.6%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	0.445	3.0%	1.996	13.6%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	1.996	13.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	0.011	0.1%	2.006	13.7%
Refrigeration/AC	HFC-152a in MVACs	$ (1.72)	$ 30.81	0.476	3.2%	2.482	16.9%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	2.482	16.9%
Fire Extinguishing	FK-5-1-12	$ 84.10	$ 85.22	0.019	0.1%	2.501	17.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.032	0.2%	2.534	17.3%
Refrigeration/AC	Ammonia Secondary Loop	$ 38.93	$ 123.84	0.315	2.1%	2.848	19.4%
Refrigeration/AC	Secondary Loop	$ 37.84	$ 125.39	0.355	2.4%	3.203	21.9%
Fire Extinguishing	Inert Gases	$ 89.48	$ 136.29	0.018	0.1%	3.221	22.0%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	0.000	0.0%	3.221	22.0%
Refrigeration/AC	CO2 for New MVACs	$ 119.91	$ 180.72	0.600	4.1%	3.821	26.1%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.024	0.2%	3.846	26.2%
Fire Extinguishing	Water Mist	$ 169.90	$ 287.80	0.002	0.0%	3.848	26.3%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.139	0.9%	3.987	27.2%

Japan & Australia&NZ Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.029	0.2%	0.029	0.2%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.029	0.2%	0.059	0.3%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.162	1.0%	0.221	1.3%
Solvents	HFC to HFE	$ -	$ -	0.058	0.3%	0.279	1.6%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.402	2.4%	0.680	4.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ 1.53	0.046	0.3%	0.726	4.3%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.028	0.2%	0.754	4.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.109	0.6%	0.863	5.1%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.863	5.1%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.863	5.1%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.012	0.1%	0.875	5.2%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.056	0.3%	0.931	5.5%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	0.198	1.2%	1.129	6.7%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	1.129	6.7%
Refrigeration/AC	Replace DX with Distributed System	$ 15.99	$ 58.08	1.083	6.4%	2.212	13.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	0.761	4.5%	2.973	17.6%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	0.066	0.4%	3.039	18.0%
Refrigeration/AC	Secondary Loop	$ 80.60	$ 173.22	0.672	4.0%	3.711	22.0%
Refrigeration/AC	Ammonia Secondary Loop	$ 90.98	$ 180.96	0.499	3.0%	4.210	24.9%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	0.001	0.0%	4.211	24.9%
Refrigeration/AC	HFC-152a in MVACs	$ 169.35	$ 205.42	0.688	4.1%	4.899	29.0%
Fire Extinguishing	FK-5-1-12	$ 335.91	$ 336.75	0.046	0.3%	4.945	29.3%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	4.945	29.3%
Fire Extinguishing	Inert Gases	$ 423.50	$ 427.65	0.037	0.2%	4.982	29.5%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 320.18	$ 468.38	0.160	0.9%	5.142	30.4%
Fire Extinguishing	Water Mist	$ 641.66	$ 699.59	0.005	0.0%	5.147	30.5%
Refrigeration/AC	CO2 for New MVACs	$ 778.80	$ 839.80	1.191	7.0%	6.338	37.5%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	0.016	0.1%	6.354	37.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.351	2.1%	6.705	39.7%

Japan & Australia&NZ Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	-	0.0%	-	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.029	0.2%	0.029	0.2%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.029	0.2%	0.059	0.3%
Refrigeration/AC	Replace DX with Distributed System	$ (57.61)	$ (15.59)	1.083	6.4%	1.142	6.8%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (15.13)	0.046	0.3%	1.188	7.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.162	1.0%	1.350	8.0%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	1.350	8.0%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	1.350	8.0%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.012	0.1%	1.362	8.1%
Solvents	HFC to HFE	$ -	$ -	0.058	0.3%	1.420	8.4%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.402	2.4%	1.821	10.8%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.028	0.2%	1.849	10.9%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.109	0.6%	1.958	11.6%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.056	0.3%	2.014	11.9%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (154.16)	$ 7.02	0.160	0.9%	2.174	12.9%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	0.761	4.5%	2.934	17.4%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	2.934	17.4%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	0.198	1.2%	3.133	18.5%
Refrigeration/AC	HFC-152a in MVACs	$ (1.72)	$ 30.81	0.688	4.1%	3.821	22.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	3.821	22.6%
Fire Extinguishing	FK-5-1-12	$ 84.10	$ 85.22	0.046	0.3%	3.867	22.9%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	0.066	0.4%	3.933	23.3%
Refrigeration/AC	Ammonia Secondary Loop	$ 38.93	$ 123.84	0.499	3.0%	4.431	26.2%
Refrigeration/AC	Secondary Loop	$ 37.84	$ 125.39	0.672	4.0%	5.104	30.2%
Fire Extinguishing	Inert Gases	$ 89.48	$ 136.29	0.037	0.2%	5.141	30.4%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	0.001	0.0%	5.142	30.4%
Refrigeration/AC	CO2 for New MVACs	$ 119.91	$ 180.72	1.191	7.0%	6.333	37.5%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	0.016	0.1%	6.349	37.6%
Fire Extinguishing	Water Mist	$ 169.90	$ 287.80	0.005	0.0%	6.354	37.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.351	2.1%	6.705	39.7%

Latin America Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (20% DR / 40% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.000	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.000	0.0%	0.001	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.001	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.050	1.4%	0.051	1.4%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.051	1.4%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.114	3.1%	0.165	4.5%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.000	0.0%	0.166	4.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.000	0.0%	0.166	4.5%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.166	4.5%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.166	4.5%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.166	4.5%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.001	0.0%	0.167	4.5%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.167	4.5%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.167	4.5%
Refrigeration/AC	Replace DX with Distributed System	$ 53.09	$ 69.41	0.008	0.2%	0.174	4.8%
Refrigeration/AC	Secondary Loop	$ 54.38	$ 86.82	0.008	0.2%	0.182	5.0%
Refrigeration/AC	Ammonia Secondary Loop	$ 63.53	$ 95.42	0.005	0.1%	0.188	5.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.188	5.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.188	5.1%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.188	5.1%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	-	0.0%	0.188	5.1%
Fire Extinguishing	FK-5-1-12	$ 335.01	$ 335.44	0.000	0.0%	0.188	5.1%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.188	5.1%
Fire Extinguishing	Inert Gases	$ 414.31	$ 435.01	0.000	0.0%	0.188	5.1%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	0.188	5.1%
Fire Extinguishing	Water Mist	$ 529.82	$ 573.69	0.000	0.0%	0.188	5.1%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	-	0.0%	0.188	5.1%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.188	5.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.188	5.1%

Latin America Reductions in 2005 and Annualized Costs for ODS Substitutes (4% DR / 0% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.000	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.000	0.0%	0.001	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.001	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.001	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.050	1.4%	0.051	1.4%
Refrigeration/AC	Replace DX with Distributed System	$ (25.88)	$ (10.71)	0.008	0.2%	0.059	1.6%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.059	1.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.059	1.6%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.059	1.6%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.059	1.6%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.114	3.1%	0.173	4.7%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.000	0.0%	0.173	4.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.000	0.0%	0.174	4.7%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.001	0.0%	0.174	4.8%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.174	4.8%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.174	4.8%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.174	4.8%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	-	0.0%	0.174	4.8%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.174	4.8%
Refrigeration/AC	Secondary Loop	$ 20.30	$ 49.94	0.008	0.2%	0.182	5.0%
Refrigeration/AC	Ammonia Secondary Loop	$ 21.70	$ 50.54	0.005	0.1%	0.188	5.1%
Fire Extinguishing	FK-5-1-12	$ 83.74	$ 84.17	0.000	0.0%	0.188	5.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.188	5.1%
Fire Extinguishing	Inert Gases	$ 81.29	$ 101.99	0.000	0.0%	0.188	5.1%
Fire Extinguishing	Water Mist	$ 126.10	$ 169.97	0.000	0.0%	0.188	5.1%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	-	0.0%	0.188	5.1%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.188	5.1%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.188	5.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.188	5.1%

Latin America Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (20% DR / 40% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.001	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.001	0.0%	0.002	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.002	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.184	2.7%	0.186	2.8%
Solvents	HFC to HFE	$ -	$ -	0.002	0.0%	0.187	2.8%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.317	4.7%	0.504	7.5%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.001	0.0%	0.505	7.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.001	0.0%	0.506	7.6%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.506	7.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.506	7.6%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.506	7.6%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.002	0.0%	0.508	7.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.508	7.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.508	7.6%
Refrigeration/AC	Replace DX with Distributed System	$ 53.09	$ 69.41	0.122	1.8%	0.630	9.4%
Refrigeration/AC	Secondary Loop	$ 54.38	$ 86.82	0.101	1.5%	0.732	10.9%
Refrigeration/AC	Ammonia Secondary Loop	$ 63.53	$ 95.42	0.086	1.3%	0.818	12.2%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.818	12.2%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.818	12.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.818	12.2%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.046	0.7%	0.863	12.9%
Fire Extinguishing	FK-5-1-12	$ 335.01	$ 335.44	0.000	0.0%	0.864	12.9%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.864	12.9%
Fire Extinguishing	Inert Gases	$ 414.31	$ 435.01	0.000	0.0%	0.864	12.9%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	0.864	12.9%
Fire Extinguishing	Water Mist	$ 529.82	$ 573.69	0.000	0.0%	0.864	12.9%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	-	0.0%	0.864	12.9%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.864	12.9%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.015	0.2%	0.879	13.1%

Latin America Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (4% DR / 0% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.001	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.001	0.0%	0.002	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.002	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.002	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.184	2.7%	0.186	2.8%
Refrigeration/AC	Replace DX with Distributed System	$ (25.88)	$ (10.71)	0.122	1.8%	0.308	4.6%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.308	4.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.308	4.6%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.308	4.6%
Solvents	HFC to HFE	$ -	$ -	0.002	0.0%	0.310	4.6%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.317	4.7%	0.627	9.4%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.001	0.0%	0.627	9.4%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.001	0.0%	0.628	9.4%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.002	0.0%	0.630	9.4%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.630	9.4%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.630	9.4%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.630	9.4%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.046	0.7%	0.676	10.1%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.676	10.1%
Refrigeration/AC	Secondary Loop	$ 20.30	$ 49.94	0.101	1.5%	0.778	11.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 21.70	$ 50.54	0.086	1.3%	0.863	12.9%
Fire Extinguishing	FK-5-1-12	$ 83.74	$ 84.17	0.000	0.0%	0.864	12.9%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.864	12.9%
Fire Extinguishing	Inert Gases	$ 81.29	$ 101.99	0.000	0.0%	0.864	12.9%
Fire Extinguishing	Water Mist	$ 126.10	$ 169.97	0.000	0.0%	0.864	12.9%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	-	0.0%	0.864	12.9%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.864	12.9%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.864	12.9%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.015	0.2%	0.879	13.1%

Latin America Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (20% DR / 40% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.002	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.001	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.001	0.0%	0.003	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.003	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.283	3.3%	0.286	3.3%
Solvents	HFC to HFE	$ -	$ -	0.003	0.0%	0.289	3.4%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.547	6.4%	0.836	9.7%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.002	0.0%	0.838	9.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.002	0.0%	0.839	9.8%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.839	9.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.839	9.8%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.839	9.8%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.003	0.0%	0.842	9.8%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.842	9.8%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.842	9.8%
Refrigeration/AC	Replace DX with Distributed System	$ 53.09	$ 69.41	0.363	4.2%	1.205	14.0%
Refrigeration/AC	Secondary Loop	$ 54.38	$ 86.82	0.273	3.2%	1.479	17.2%
Refrigeration/AC	Ammonia Secondary Loop	$ 63.53	$ 95.42	0.233	2.7%	1.712	19.9%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	1.712	19.9%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	1.712	19.9%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	1.712	19.9%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.134	1.6%	1.846	21.5%
Fire Extinguishing	FK-5-1-12	$ 335.01	$ 335.44	0.001	0.0%	1.847	21.5%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	1.847	21.5%
Fire Extinguishing	Inert Gases	$ 414.31	$ 435.01	0.001	0.0%	1.848	21.5%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	1.848	21.5%
Fire Extinguishing	Water Mist	$ 529.82	$ 573.69	0.000	0.0%	1.848	21.5%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	0.011	0.1%	1.859	21.6%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	1.859	21.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.070	0.8%	1.929	22.4%

Latin America Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (4% DR / 0% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.002	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.001	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.001	0.0%	0.003	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.003	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.003	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.283	3.3%	0.286	3.3%
Refrigeration/AC	Replace DX with Distributed System	$ (25.88)	$ (10.71)	0.363	4.2%	0.649	7.6%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.649	7.6%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.649	7.6%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.649	7.6%
Solvents	HFC to HFE	$ -	$ -	0.003	0.0%	0.652	7.6%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.547	6.4%	1.199	14.0%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.002	0.0%	1.201	14.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.002	0.0%	1.202	14.0%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.003	0.0%	1.205	14.0%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	1.205	14.0%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	1.205	14.0%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	1.205	14.0%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.134	1.6%	1.339	15.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	1.339	15.6%
Refrigeration/AC	Secondary Loop	$ 20.30	$ 49.94	0.273	3.2%	1.612	18.8%
Refrigeration/AC	Ammonia Secondary Loop	$ 21.70	$ 50.54	0.233	2.7%	1.846	21.5%
Fire Extinguishing	FK-5-1-12	$ 83.74	$ 84.17	0.001	0.0%	1.847	21.5%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	1.847	21.5%
Fire Extinguishing	Inert Gases	$ 81.29	$ 101.99	0.001	0.0%	1.848	21.5%
Fire Extinguishing	Water Mist	$ 126.10	$ 169.97	0.000	0.0%	1.848	21.5%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	0.011	0.1%	1.859	21.6%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	1.859	21.6%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	1.859	21.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.070	0.8%	1.929	22.4%

Latin America Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (20% DR / 40% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.002	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.001	0.0%	0.003	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.001	0.0%	0.004	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.004	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.441	4.0%	0.445	4.1%
Solvents	HFC to HFE	$ -	$ -	0.005	0.0%	0.449	4.1%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.902	8.3%	1.351	12.4%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.002	0.0%	1.354	12.4%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.003	0.0%	1.356	12.4%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	1.356	12.4%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	1.356	12.4%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	1.356	12.4%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.005	0.0%	1.361	12.5%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	1.361	12.5%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	1.361	12.5%
Refrigeration/AC	Replace DX with Distributed System	$ 53.09	$ 69.41	0.659	6.0%	2.020	18.5%
Refrigeration/AC	Secondary Loop	$ 54.38	$ 86.82	0.402	3.7%	2.422	22.2%
Refrigeration/AC	Ammonia Secondary Loop	$ 63.53	$ 95.42	0.361	3.3%	2.783	25.5%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	2.783	25.5%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	2.783	25.5%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	2.783	25.5%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.240	2.2%	3.023	27.7%
Fire Extinguishing	FK-5-1-12	$ 335.01	$ 335.44	0.004	0.0%	3.027	27.8%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	3.027	27.8%
Fire Extinguishing	Inert Gases	$ 414.31	$ 435.01	0.003	0.0%	3.029	27.8%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	3.029	27.8%
Fire Extinguishing	Water Mist	$ 529.82	$ 573.69	0.000	0.0%	3.030	27.8%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	0.037	0.3%	3.067	28.1%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	3.067	28.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.203	1.9%	3.269	30.0%

Latin America Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (4% DR / 0% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.002	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.001	0.0%	0.003	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.001	0.0%	0.004	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.004	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.004	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.441	4.0%	0.445	4.1%
Refrigeration/AC	Replace DX with Distributed System	$ (25.88)	$ (10.71)	0.659	6.0%	1.103	10.1%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	1.103	10.1%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	1.103	10.1%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	1.103	10.1%
Solvents	HFC to HFE	$ -	$ -	0.005	0.0%	1.108	10.2%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.902	8.3%	2.010	18.4%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.002	0.0%	2.012	18.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.003	0.0%	2.015	18.5%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.005	0.0%	2.020	18.5%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	2.020	18.5%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	2.020	18.5%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	2.020	18.5%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.240	2.2%	2.260	20.7%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	2.260	20.7%
Refrigeration/AC	Secondary Loop	$ 20.30	$ 49.94	0.402	3.7%	2.662	24.4%
Refrigeration/AC	Ammonia Secondary Loop	$ 21.70	$ 50.54	0.361	3.3%	3.023	27.7%
Fire Extinguishing	FK-5-1-12	$ 83.74	$ 84.17	0.004	0.0%	3.027	27.8%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	3.027	27.8%
Fire Extinguishing	Inert Gases	$ 81.29	$ 101.99	0.003	0.0%	3.029	27.8%
Fire Extinguishing	Water Mist	$ 126.10	$ 169.97	0.000	0.0%	3.030	27.8%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	0.037	0.3%	3.067	28.1%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	3.067	28.1%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	3.067	28.1%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.203	1.9%	3.269	30.0%

Middle East Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.000	0.0%	0.000	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.000	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.025	1.5%	0.025	1.5%
Solvents	HFC to HFE	$ -	$ -	0.000	0.0%	0.025	1.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.041	2.5%	0.066	4.1%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.000	0.0%	0.066	4.1%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.000	0.0%	0.066	4.1%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.066	4.1%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.066	4.1%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.066	4.1%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.000	0.0%	0.067	4.1%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.067	4.1%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.067	4.1%
Refrigeration/AC	Replace DX with Distributed System	$ 56.17	$ 57.45	0.004	0.2%	0.070	4.3%
Refrigeration/AC	Secondary Loop	$ 80.93	$ 85.62	0.004	0.2%	0.074	4.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 90.77	$ 95.92	0.003	0.2%	0.077	4.7%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.077	4.7%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.077	4.7%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.077	4.7%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	-	0.0%	0.077	4.7%
Fire Extinguishing	FK-5-1-12	$ 335.76	$ 335.97	-	0.0%	0.077	4.7%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.077	4.7%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	0.077	4.7%
Fire Extinguishing	Inert Gases	$ 459.85	$ 475.70	-	0.0%	0.077	4.7%
Fire Extinguishing	Water Mist	$ 658.05	$ 713.51	-	0.0%	0.077	4.7%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	-	0.0%	0.077	4.7%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.077	4.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.077	4.7%

Middle East Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.000	0.0%	0.000	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.000	0.0%
Refrigeration/AC	Replace DX with Distributed System	$ (17.67)	$ (17.30)	0.004	0.2%	0.004	0.3%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.004	0.3%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.025	1.5%	0.029	1.8%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.029	1.8%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.029	1.8%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.029	1.8%
Solvents	HFC to HFE	$ -	$ -	0.000	0.0%	0.029	1.8%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.041	2.5%	0.070	4.3%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.000	0.0%	0.070	4.3%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.000	0.0%	0.070	4.3%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.000	0.0%	0.070	4.3%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.070	4.3%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.070	4.3%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.070	4.3%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	-	0.0%	0.070	4.3%
Refrigeration/AC	Secondary Loop	$ 40.15	$ 42.24	0.004	0.2%	0.074	4.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 41.12	$ 43.19	0.003	0.2%	0.077	4.7%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.077	4.7%
Fire Extinguishing	FK-5-1-12	$ 84.10	$ 84.15	-	0.0%	0.077	4.7%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.077	4.7%
Fire Extinguishing	Inert Gases	$ 99.64	$ 103.07	-	0.0%	0.077	4.7%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	-	0.0%	0.077	4.7%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.077	4.7%
Fire Extinguishing	Water Mist	$ 177.44	$ 192.40	-	0.0%	0.077	4.7%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.077	4.7%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.077	4.7%

Middle East Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.000	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.000	0.0%	0.001	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.001	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.088	2.9%	0.089	2.9%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.089	3.0%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.127	4.2%	0.217	7.2%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.000	0.0%	0.217	7.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.001	0.0%	0.217	7.2%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.217	7.2%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.217	7.2%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.217	7.2%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.001	0.0%	0.218	7.2%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.218	7.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.218	7.2%
Refrigeration/AC	Replace DX with Distributed System	$ 56.17	$ 57.45	0.059	1.9%	0.277	9.1%
Refrigeration/AC	Secondary Loop	$ 80.93	$ 85.62	0.049	1.6%	0.325	10.7%
Refrigeration/AC	Ammonia Secondary Loop	$ 90.77	$ 95.92	0.041	1.4%	0.366	12.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.366	12.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.366	12.1%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.366	12.1%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.014	0.4%	0.380	12.6%
Fire Extinguishing	FK-5-1-12	$ 335.76	$ 335.97	-	0.0%	0.380	12.6%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.380	12.6%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	0.380	12.6%
Fire Extinguishing	Inert Gases	$ 459.85	$ 475.70	-	0.0%	0.380	12.6%
Fire Extinguishing	Water Mist	$ 658.05	$ 713.51	-	0.0%	0.380	12.6%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	-	0.0%	0.380	12.6%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.380	12.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.008	0.3%	0.388	12.8%

Middle East Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.000	0.0%	0.000	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.000	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.000	0.0%	0.001	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.001	0.0%
Refrigeration/AC	Replace DX with Distributed System	$ (17.67)	$ (17.30)	0.059	1.9%	0.059	2.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.059	2.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.088	2.9%	0.147	4.9%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.147	4.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.147	4.9%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.147	4.9%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.148	4.9%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.127	4.2%	0.275	9.1%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.000	0.0%	0.275	9.1%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.001	0.0%	0.276	9.1%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.001	0.0%	0.277	9.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.277	9.1%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.277	9.1%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.277	9.1%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.014	0.4%	0.290	9.6%
Refrigeration/AC	Secondary Loop	$ 40.15	$ 42.24	0.049	1.6%	0.339	11.2%
Refrigeration/AC	Ammonia Secondary Loop	$ 41.12	$ 43.19	0.041	1.4%	0.380	12.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.380	12.6%
Fire Extinguishing	FK-5-1-12	$ 84.10	$ 84.15	-	0.0%	0.380	12.6%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.380	12.6%
Fire Extinguishing	Inert Gases	$ 99.64	$ 103.07	-	0.0%	0.380	12.6%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	-	0.0%	0.380	12.6%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.380	12.6%
Fire Extinguishing	Water Mist	$ 177.44	$ 192.40	-	0.0%	0.380	12.6%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.380	12.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.008	0.3%	0.388	12.8%

Middle East Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.000	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.000	0.0%	0.001	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.001	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.131	3.3%	0.132	3.3%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.133	3.3%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.253	6.4%	0.386	9.7%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.001	0.0%	0.386	9.7%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.001	0.0%	0.387	9.7%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.387	9.7%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.387	9.7%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.387	9.7%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.001	0.0%	0.388	9.7%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.388	9.7%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.388	9.7%
Refrigeration/AC	Replace DX with Distributed System	$ 56.17	$ 57.45	0.167	4.2%	0.556	13.9%
Refrigeration/AC	Secondary Loop	$ 80.93	$ 85.62	0.126	3.2%	0.681	17.1%
Refrigeration/AC	Ammonia Secondary Loop	$ 90.77	$ 95.92	0.107	2.7%	0.789	19.8%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.789	19.8%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.789	19.8%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.789	19.8%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.063	1.6%	0.851	21.4%
Fire Extinguishing	FK-5-1-12	$ 335.76	$ 335.97	-	0.0%	0.851	21.4%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.851	21.4%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	0.851	21.4%
Fire Extinguishing	Inert Gases	$ 459.85	$ 475.70	-	0.0%	0.851	21.4%
Fire Extinguishing	Water Mist	$ 658.05	$ 713.51	-	0.0%	0.851	21.4%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	0.005	0.1%	0.857	21.5%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.857	21.5%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.039	1.0%	0.896	22.5%

Middle East Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE)		Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
		Low	High				
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.000	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.000	0.0%	0.001	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.001	0.0%
Refrigeration/AC	Replace DX with Distributed System	$ (17.67)	$ (17.30)	0.167	4.2%	0.169	4.2%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.169	4.2%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.131	3.3%	0.299	7.5%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.299	7.5%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.299	7.5%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.299	7.5%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.300	7.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.253	6.4%	0.553	13.9%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.001	0.0%	0.554	13.9%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.001	0.0%	0.555	13.9%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.001	0.0%	0.556	13.9%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.556	13.9%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.556	13.9%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.556	13.9%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.063	1.6%	0.618	15.5%
Refrigeration/AC	Secondary Loop	$ 40.15	$ 42.24	0.126	3.2%	0.744	18.7%
Refrigeration/AC	Ammonia Secondary Loop	$ 41.12	$ 43.19	0.107	2.7%	0.851	21.4%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.851	21.4%
Fire Extinguishing	FK-5-1-12	$ 84.10	$ 84.15	-	0.0%	0.851	21.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.851	21.4%
Fire Extinguishing	Inert Gases	$ 99.64	$ 103.07	-	0.0%	0.851	21.4%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	0.005	0.1%	0.857	21.5%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.857	21.5%
Fire Extinguishing	Water Mist	$ 177.44	$ 192.40	-	0.0%	0.857	21.5%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.857	21.5%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.039	1.0%	0.896	22.5%

Middle East Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (20% Discount Rate / 40% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.000	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.000	0.0%	0.002	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.002	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.197	3.8%	0.199	3.8%
Solvents	HFC to HFE	$ -	$ -	0.002	0.0%	0.201	3.8%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.471	9.0%	0.672	12.8%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.001	0.0%	0.673	12.9%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.001	0.0%	0.674	12.9%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.674	12.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.674	12.9%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.674	12.9%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.002	0.0%	0.676	12.9%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.676	12.9%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.676	12.9%
Refrigeration/AC	Replace DX with Distributed System	$ 56.17	$ 57.45	0.295	5.6%	0.971	18.6%
Refrigeration/AC	Secondary Loop	$ 80.93	$ 85.62	0.180	3.4%	1.151	22.0%
Refrigeration/AC	Ammonia Secondary Loop	$ 90.77	$ 95.92	0.162	3.1%	1.313	25.1%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	1.313	25.1%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	1.313	25.1%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	1.313	25.1%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.202	3.9%	1.514	28.9%
Fire Extinguishing	FK-5-1-12	$ 335.76	$ 335.97	-	0.0%	1.514	28.9%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	1.514	28.9%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	1.514	28.9%
Fire Extinguishing	Inert Gases	$ 459.85	$ 475.70	-	0.0%	1.514	28.9%
Fire Extinguishing	Water Mist	$ 658.05	$ 713.51	-	0.0%	1.514	28.9%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	0.031	0.6%	1.546	29.5%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	1.546	29.5%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.116	2.2%	1.662	31.8%

Middle East Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (4% Discount Rate / 0% Tax Rate)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.000	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.000	0.0%	0.002	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.002	0.0%
Refrigeration/AC	Replace DX with Distributed System	$ (17.67)	$ (17.30)	0.295	5.6%	0.297	5.7%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.297	5.7%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.197	3.8%	0.494	9.4%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.494	9.4%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.494	9.4%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.494	9.4%
Solvents	HFC to HFE	$ -	$ -	0.002	0.0%	0.496	9.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.471	9.0%	0.967	18.5%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.001	0.0%	0.968	18.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.001	0.0%	0.969	18.5%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.002	0.0%	0.971	18.6%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.971	18.6%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.971	18.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.971	18.6%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.202	3.9%	1.173	22.4%
Refrigeration/AC	Secondary Loop	$ 40.15	$ 42.24	0.180	3.4%	1.353	25.9%
Refrigeration/AC	Ammonia Secondary Loop	$ 41.12	$ 43.19	0.162	3.1%	1.514	28.9%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	1.514	28.9%
Fire Extinguishing	FK-5-1-12	$ 84.10	$ 84.15	-	0.0%	1.514	28.9%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	1.514	28.9%
Fire Extinguishing	Inert Gases	$ 99.64	$ 103.07	-	0.0%	1.514	28.9%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	0.031	0.6%	1.546	29.5%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	1.546	29.5%
Fire Extinguishing	Water Mist	$ 177.44	$ 192.40	-	0.0%	1.546	29.5%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	1.546	29.5%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.116	2.2%	1.662	31.8%

S/SE Asia, China, India, South Korea Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (20% DR / 40% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.000	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.000	0.0%	0.002	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.002	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.127	1.5%	0.129	1.5%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.131	1.5%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.214	2.5%	0.345	4.0%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.001	0.0%	0.346	4.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.001	0.0%	0.346	4.0%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	0.346	4.0%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	0.346	4.0%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	-	0.0%	0.346	4.0%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.002	0.0%	0.348	4.0%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	0.348	4.0%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	0.348	4.0%
Refrigeration/AC	Replace DX with Distributed System	$ 48.87	$ 69.34	0.020	0.2%	0.368	4.2%
Refrigeration/AC	Secondary Loop	$ 52.41	$ 104.49	0.021	0.2%	0.388	4.5%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.88	$ 114.41	0.013	0.2%	0.402	4.6%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	0.402	4.6%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	0.402	4.6%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	0.402	4.6%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	-	0.0%	0.402	4.6%
Fire Extinguishing	FK-5-1-12	$ 335.45	$ 336.18	0.000	0.0%	0.402	4.6%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	0.402	4.6%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	0.402	4.6%
Fire Extinguishing	Inert Gases	$ 444.46	$ 486.93	0.001	0.0%	0.402	4.6%
Fire Extinguishing	Water Mist	$ 624.23	$ 740.97	0.000	0.0%	0.402	4.6%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	-	0.0%	0.402	4.6%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	0.402	4.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.402	4.6%

S/SE Asia, China, India, South Korea Emission Reductions in 2005 and Annualized Costs for ODS Substitutes (4% DR / 0% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.001	0.0%	0.001	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.000	0.0%	0.002	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.000	0.0%	0.002	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.002	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.002	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.127	1.5%	0.129	1.5%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.129	1.5%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.129	1.5%
Refrigeration/AC	Replace DX with Distributed System	$ (24.13)	$ (6.19)	0.020	0.2%	0.149	1.7%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	-	0.0%	0.149	1.7%
Solvents	HFC to HFE	$ -	$ -	0.001	0.0%	0.151	1.7%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.214	2.5%	0.364	4.2%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.001	0.0%	0.365	4.2%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.001	0.0%	0.366	4.2%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.002	0.0%	0.368	4.2%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	0.368	4.2%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	0.368	4.2%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	0.368	4.2%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	-	0.0%	0.368	4.2%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	0.368	4.2%
Refrigeration/AC	Secondary Loop	$ 14.10	$ 59.19	0.021	0.2%	0.388	4.5%
Refrigeration/AC	Ammonia Secondary Loop	$ 15.87	$ 59.61	0.013	0.2%	0.402	4.6%
Fire Extinguishing	FK-5-1-12	$ 83.77	$ 84.36	0.000	0.0%	0.402	4.6%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	0.402	4.6%
Fire Extinguishing	Inert Gases	$ 82.43	$ 114.30	0.001	0.0%	0.402	4.6%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	-	0.0%	0.402	4.6%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	0.402	4.6%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	0.402	4.6%
Fire Extinguishing	Water Mist	$ 137.95	$ 219.85	0.000	0.0%	0.402	4.6%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	-	0.0%	0.402	4.6%

S/SE Asia, China, India, South Korea Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (20% DR / 40% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.003	0.0%	0.003	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.001	0.0%	0.004	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.001	0.0%	0.006	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.006	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.487	2.8%	0.493	2.9%
Solvents	HFC to HFE	$ -	$ -	0.005	0.0%	0.498	2.9%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.705	4.1%	1.203	7.0%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.003	0.0%	1.206	7.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.002	0.0%	1.208	7.0%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	1.208	7.0%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	1.208	7.0%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.006	0.0%	1.214	7.1%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.006	0.0%	1.220	7.1%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	1.220	7.1%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	1.220	7.1%
Refrigeration/AC	Replace DX with Distributed System	$ 48.87	$ 69.34	0.325	1.9%	1.544	9.0%
Refrigeration/AC	Secondary Loop	$ 52.41	$ 104.49	0.269	1.6%	1.813	10.5%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.88	$ 114.41	0.228	1.3%	2.041	11.9%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	2.041	11.9%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	2.041	11.9%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	2.041	11.9%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.075	0.4%	2.116	12.3%
Fire Extinguishing	FK-5-1-12	$ 335.45	$ 336.18	0.008	0.0%	2.124	12.3%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	2.124	12.3%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	2.124	12.3%
Fire Extinguishing	Inert Gases	$ 444.46	$ 486.93	0.010	0.1%	2.134	12.4%
Fire Extinguishing	Water Mist	$ 624.23	$ 740.97	0.001	0.0%	2.135	12.4%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	-	0.0%	2.135	12.4%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	2.135	12.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.037	0.2%	2.172	12.6%

S/SE Asia, China, India, South Korea Emission Reductions in 2010 and Annualized Costs for ODS Substitutes (4% DR / 0% TR)

SECTOR	Option Name	Break-Even Price ($/TCE)		Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
		Low	High				
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.003	0.0%	0.003	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.001	0.0%	0.004	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.001	0.0%	0.006	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.006	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.006	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.487	2.8%	0.493	2.9%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.493	2.9%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.493	2.9%
Refrigeration/AC	Replace DX with Distributed System	$ (24.13)	$ (6.19)	0.325	1.9%	0.818	4.8%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.006	0.0%	0.823	4.8%
Solvents	HFC to HFE	$ -	$ -	0.005	0.0%	0.828	4.8%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	0.705	4.1%	1.534	8.9%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.003	0.0%	1.536	8.9%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.002	0.0%	1.539	8.9%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.006	0.0%	1.544	9.0%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	1.544	9.0%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	1.544	9.0%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	1.544	9.0%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.075	0.4%	1.619	9.4%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	1.619	9.4%
Refrigeration/AC	Secondary Loop	$ 14.10	$ 59.19	0.269	1.6%	1.888	11.0%
Refrigeration/AC	Ammonia Secondary Loop	$ 15.87	$ 59.61	0.228	1.3%	2.116	12.3%
Fire Extinguishing	FK-5-1-12	$ 83.77	$ 84.36	0.008	0.0%	2.124	12.3%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	2.124	12.3%
Fire Extinguishing	Inert Gases	$ 82.43	$ 114.30	0.010	0.1%	2.134	12.4%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	-	0.0%	2.134	12.4%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	2.134	12.4%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	2.134	12.4%
Fire Extinguishing	Water Mist	$ 137.95	$ 219.85	0.001	0.0%	2.135	12.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.037	0.2%	2.172	12.6%

S/SE Asia, China, India, South Korea Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (20% DR / 40% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.006	0.0%	0.006	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.002	0.0%	0.007	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.002	0.0%	0.009	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.009	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	0.773	3.2%	0.782	3.2%
Solvents	HFC to HFE	$ -	$ -	0.008	0.0%	0.790	3.2%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	1.499	6.2%	2.290	9.4%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.005	0.0%	2.295	9.4%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.004	0.0%	2.299	9.4%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	2.299	9.4%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	2.299	9.4%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.009	0.0%	2.308	9.5%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.010	0.0%	2.318	9.5%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	2.318	9.5%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	2.318	9.5%
Refrigeration/AC	Replace DX with Distributed System	$ 48.87	$ 69.34	0.991	4.1%	3.309	13.6%
Refrigeration/AC	Secondary Loop	$ 52.41	$ 104.49	0.746	3.1%	4.054	16.6%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.88	$ 114.41	0.636	2.6%	4.691	19.2%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	4.691	19.2%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	4.691	19.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	4.691	19.2%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	0.370	1.5%	5.061	20.8%
Fire Extinguishing	FK-5-1-12	$ 335.45	$ 336.18	0.044	0.2%	5.105	20.9%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	5.105	20.9%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	5.105	20.9%
Fire Extinguishing	Inert Gases	$ 444.46	$ 486.93	0.042	0.2%	5.146	21.1%
Fire Extinguishing	Water Mist	$ 624.23	$ 740.97	0.006	0.0%	5.152	21.1%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	0.030	0.1%	5.182	21.3%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	5.182	21.3%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.193	0.8%	5.375	22.0%

S/SE Asia, China, India, South Korea Emission Reductions in 2015 and Annualized Costs for ODS Substitutes (4% DR / 0% TR)

SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.006	0.0%	0.006	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.002	0.0%	0.007	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.002	0.0%	0.009	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.009	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.009	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	0.773	3.2%	0.782	3.2%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	0.782	3.2%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	0.782	3.2%
Refrigeration/AC	Replace DX with Distributed System	$ (24.13)	$ (6.19)	0.991	4.1%	1.773	7.3%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.009	0.0%	1.782	7.3%
Solvents	HFC to HFE	$ -	$ -	0.008	0.0%	1.790	7.3%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	1.499	6.2%	3.289	13.5%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.005	0.0%	3.294	13.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.004	0.0%	3.299	13.5%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.010	0.0%	3.309	13.6%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	3.309	13.6%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	3.309	13.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	3.309	13.6%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	0.370	1.5%	3.679	15.1%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	3.679	15.1%
Refrigeration/AC	Secondary Loop	$ 14.10	$ 59.19	0.746	3.1%	4.425	18.2%
Refrigeration/AC	Ammonia Secondary Loop	$ 15.87	$ 59.61	0.636	2.6%	5.061	20.8%
Fire Extinguishing	FK-5-1-12	$ 83.77	$ 84.36	0.044	0.2%	5.105	20.9%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	5.105	20.9%
Fire Extinguishing	Inert Gases	$ 82.43	$ 114.30	0.042	0.2%	5.146	21.1%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	0.030	0.1%	5.177	21.2%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	5.177	21.2%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	5.177	21.2%
Fire Extinguishing	Water Mist	$ 137.95	$ 219.85	0.006	0.0%	5.182	21.3%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.193	0.8%	5.375	22.0%

S/SE Asia, China, India, South Korea Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (20% DR / 40% TR)

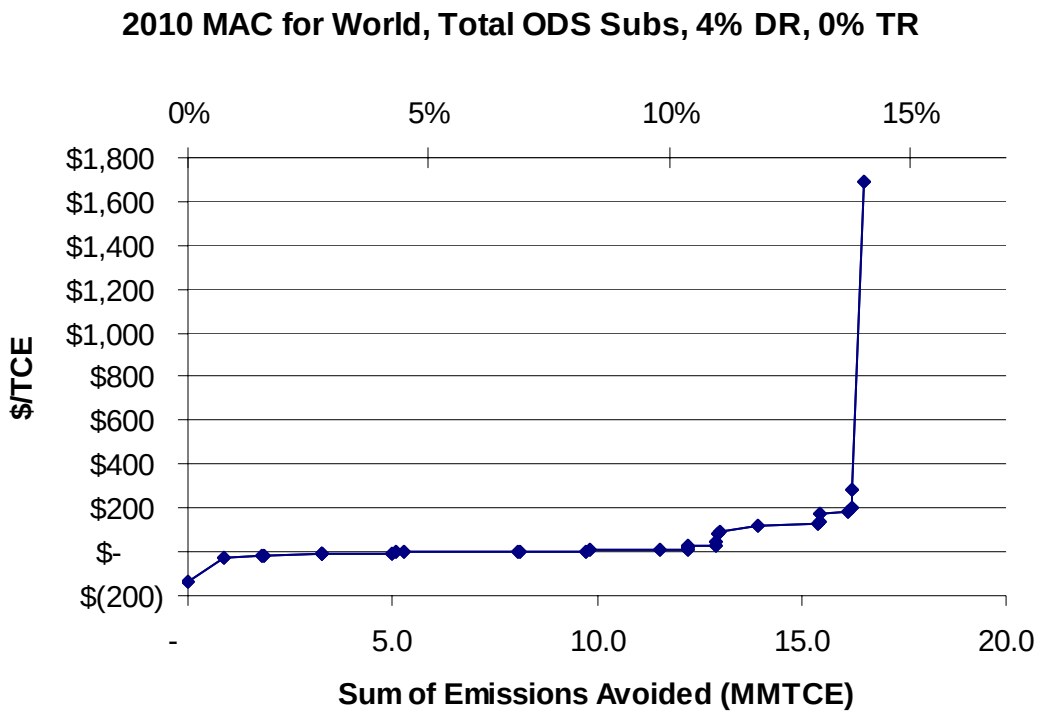
SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (132.14)	$ (132.14)	0.008	0.0%	0.008	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (21.95)	$ (21.95)	0.002	0.0%	0.010	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (20.75)	$ (20.75)	0.002	0.0%	0.013	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (13.98)	$ (13.98)	-	0.0%	0.013	0.0%
Refrigeration/AC	Leak Repair	$ (3.78)	$ (3.78)	1.252	3.6%	1.264	3.7%
Solvents	HFC to HFE	$ -	$ -	0.017	0.0%	1.281	3.7%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	2.988	8.7%	4.269	12.4%
Solvents	NIK Semi-Aqueous	$ 2.14	$ 2.14	0.008	0.0%	4.277	12.5%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 2.49	$ 2.49	0.008	0.0%	4.285	12.5%
Foams	PU One Component HFC-152a to HC	$ 2.77	$ 2.77	-	0.0%	4.285	12.5%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ 12.82	$ 12.82	-	0.0%	4.285	12.5%
Foams	PU One Component HFC-134a to HC	$ 14.08	$ 14.08	0.014	0.0%	4.298	12.5%
Solvents	NIK Aqueous	$ 17.89	$ 17.89	0.016	0.0%	4.315	12.6%
Foams	Appliance: Automated Process / Foam Landfilling	$ 37.16	$ 37.16	-	0.0%	4.315	12.6%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 56.26	$ 56.26	-	0.0%	4.315	12.6%
Refrigeration/AC	Replace DX with Distributed System	$ 48.87	$ 69.34	1.871	5.5%	6.186	18.0%
Refrigeration/AC	Secondary Loop	$ 52.41	$ 104.49	1.142	3.3%	7.328	21.4%
Refrigeration/AC	Ammonia Secondary Loop	$ 62.88	$ 114.41	1.025	3.0%	8.353	24.4%
Foams	XPS: HFC-134a/CO2 to CO2	$ 122.09	$ 122.09	-	0.0%	8.353	24.4%
Foams	Spray HFC-245fa/CO2 to CO2	$ 122.55	$ 122.55	-	0.0%	8.353	24.4%
Foams	Appliance: Manual Process with Foam Incineration	$ 191.65	$ 191.65	-	0.0%	8.353	24.4%
Refrigeration/AC	HFC-152a in MVACs	$ 200.58	$ 200.58	1.280	3.7%	9.632	28.1%
Fire Extinguishing	FK-5-1-12	$ 335.45	$ 336.18	0.129	0.4%	9.762	28.5%
Foams	Appliance HFC-134a to HC	$ 404.45	$ 404.45	-	0.0%	9.762	28.5%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ 448.24	$ 448.24	-	0.0%	9.762	28.5%
Fire Extinguishing	Inert Gases	$ 444.46	$ 486.93	0.103	0.3%	9.865	28.8%
Fire Extinguishing	Water Mist	$ 624.23	$ 740.97	0.015	0.0%	9.880	28.8%
Refrigeration/AC	CO2 for New MVACs	$ 830.74	$ 830.74	0.197	0.6%	10.077	29.4%
Foams	Appliance HFC-245fa to HC	$ 1,115.58	$ 1,115.58	-	0.0%	10.077	29.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.623	1.8%	10.700	31.2%

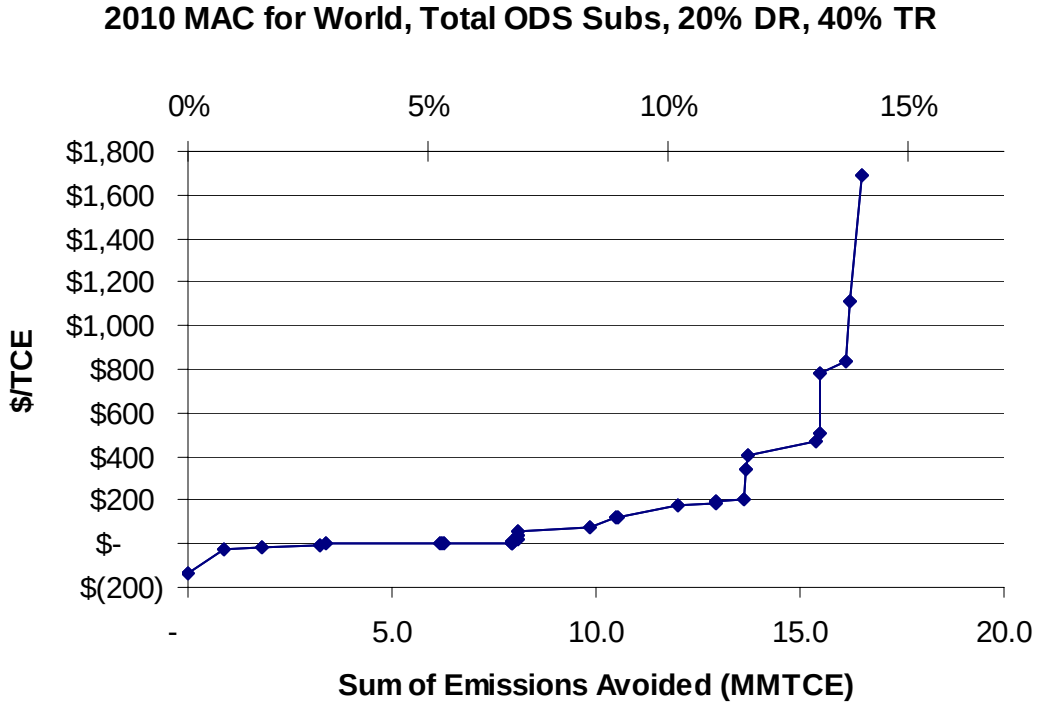
S/SE Asia, China, India, South Korea Emission Reductions in 2020 and Annualized Costs for ODS Substitutes (4% DR / 0% TR)

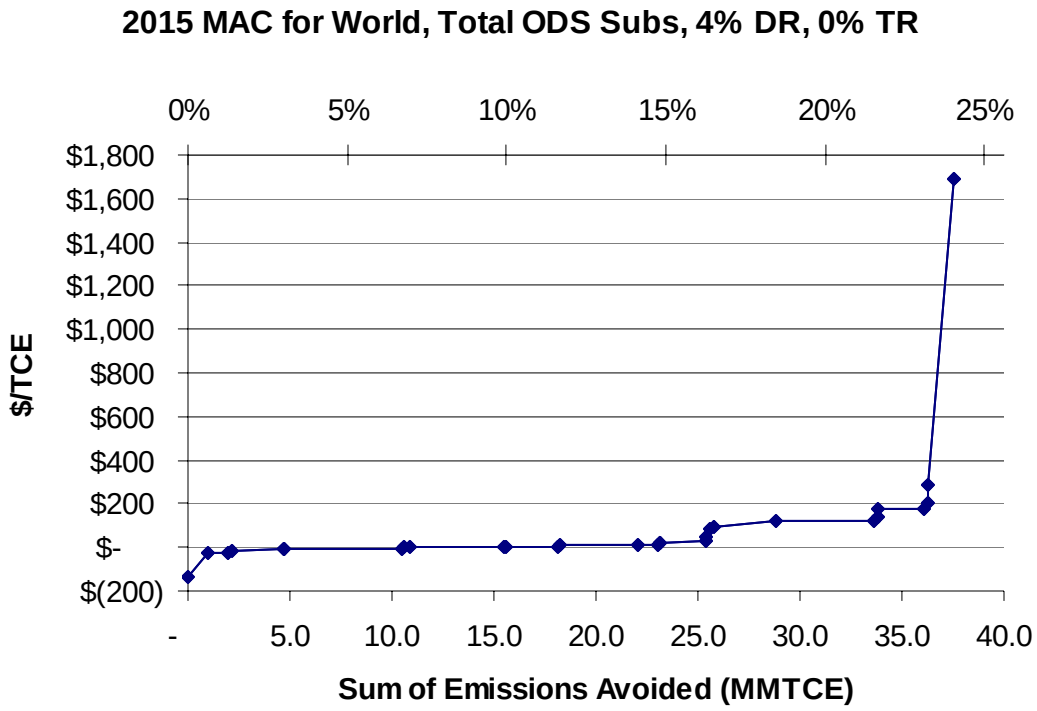
SECTOR	Option Name	Break-Even Price ($/TCE) Low	Break-Even Price ($/TCE) High	Emission Reduction of Option (MMTCE)	Reduction off Baseline (Percent)	Running Sum of Reductions (MMTCE)	Cumulative % Reduction from 2020 Baseline
Solvents	Retrofit	$ (134.18)	$ (134.18)	0.008	0.0%	0.008	0.0%
Aerosols (Non-MDI)	HFC to HC	$ (22.76)	$ (22.76)	0.002	0.0%	0.010	0.0%
Aerosols (Non-MDI)	HFC to NIK	$ (21.37)	$ (21.37)	0.002	0.0%	0.013	0.0%
Foams	Spray HFC-245fa/CO2 to HC	$ (17.97)	$ (17.97)	-	0.0%	0.013	0.0%
Refrigeration/AC	Enhanced HFC-134a in MVACs	$ (13.12)	$ (13.12)	-	0.0%	0.013	0.0%
Refrigeration/AC	Leak Repair	$ (11.74)	$ (11.74)	1.252	3.6%	1.264	3.7%
Foams	PU One Component HFC-152a to HC	$ (9.40)	$ (9.40)	-	0.0%	1.264	3.7%
Foams	XPS: HFC-134a/CO2 to CO2/Alcohol	$ (8.50)	$ (8.50)	-	0.0%	1.264	3.7%
Refrigeration/AC	Replace DX with Distributed System	$ (24.13)	$ (6.19)	1.871	5.5%	3.135	9.1%
Foams	PU One Component HFC-134a to HC	$ (0.07)	$ (0.07)	0.014	0.0%	3.149	9.2%
Solvents	HFC to HFE	$ -	$ -	0.017	0.0%	3.166	9.2%
Refrigeration/AC	Recovery (REFRIG)	$ 0.49	$ 0.49	2.988	8.7%	6.154	17.9%
Solvents	NIK Semi-Aqueous	$ 0.80	$ 0.80	0.008	0.0%	6.162	18.0%
Aerosols (Non-MDI)	HFC-134a to 152a	$ 1.91	$ 1.91	0.008	0.0%	6.170	18.0%
Solvents	NIK Aqueous	$ 6.67	$ 6.67	0.016	0.0%	6.186	18.0%
Foams	XPS: HFC-134a/CO2 to CO2	$ 11.48	$ 11.48	-	0.0%	6.186	18.0%
Foams	Appliance HFC-134a to HC	$ 17.35	$ 17.35	-	0.0%	6.186	18.0%
Foams	Appliance: Automated Process / Foam Landfilling	$ 23.82	$ 23.82	-	0.0%	6.186	18.0%
Refrigeration/AC	HFC-152a in MVACs	$ 26.58	$ 26.58	1.280	3.7%	7.465	21.8%
Foams	PU Continuous and Discontinuous HFC-134a to HC	$ 43.83	$ 43.83	-	0.0%	7.465	21.8%
Refrigeration/AC	Secondary Loop	$ 14.10	$ 59.19	1.142	3.3%	8.607	25.1%
Refrigeration/AC	Ammonia Secondary Loop	$ 15.87	$ 59.61	1.025	3.0%	9.632	28.1%
Fire Extinguishing	FK-5-1-12	$ 83.77	$ 84.36	0.129	0.4%	9.762	28.5%
Foams	Spray HFC-245fa/CO2 to CO2	$ 96.45	$ 96.45	-	0.0%	9.762	28.5%
Fire Extinguishing	Inert Gases	$ 82.43	$ 114.30	0.103	0.3%	9.865	28.8%
Refrigeration/AC	CO2 for New MVACs	$ 172.75	$ 172.75	0.197	0.6%	10.062	29.3%
Foams	Appliance: Manual Process with Foam Incineration	$ 175.09	$ 175.09	-	0.0%	10.062	29.3%
Foams	Appliance HFC-245fa to HC	$ 201.80	$ 201.80	-	0.0%	10.062	29.3%
Fire Extinguishing	Water Mist	$ 137.95	$ 219.85	0.015	0.0%	10.077	29.4%
Aerosols (MDI)	DPI	$ 1,691.25	$ 1,691.25	0.623	1.8%	10.700	31.2%

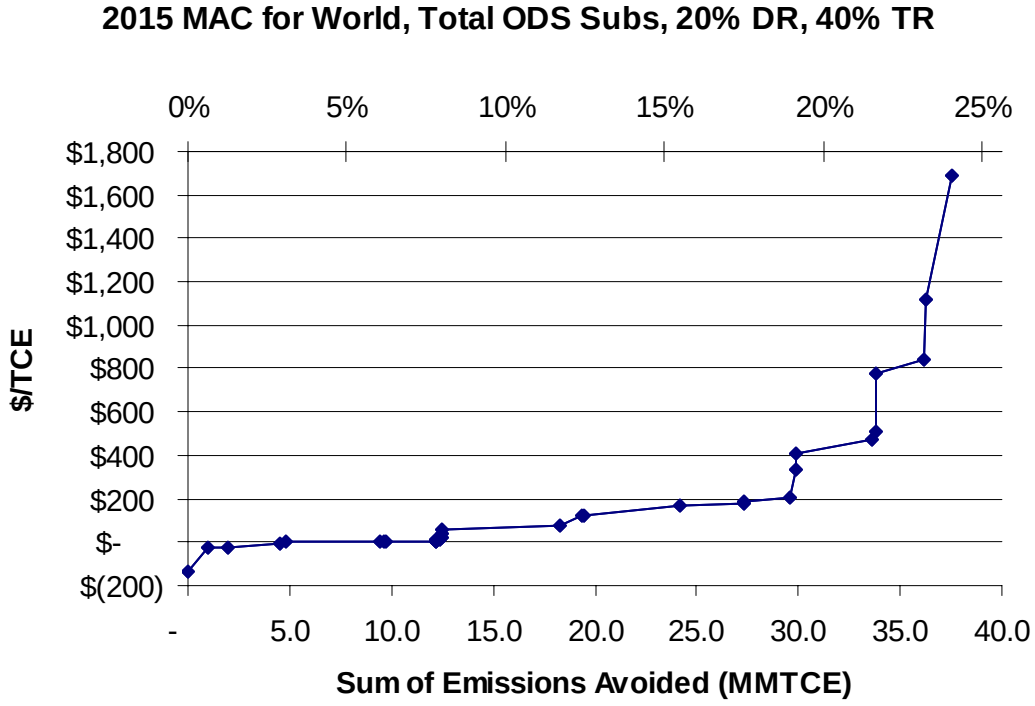
Appendix F Additional International Marginal Abatement Cost Curves

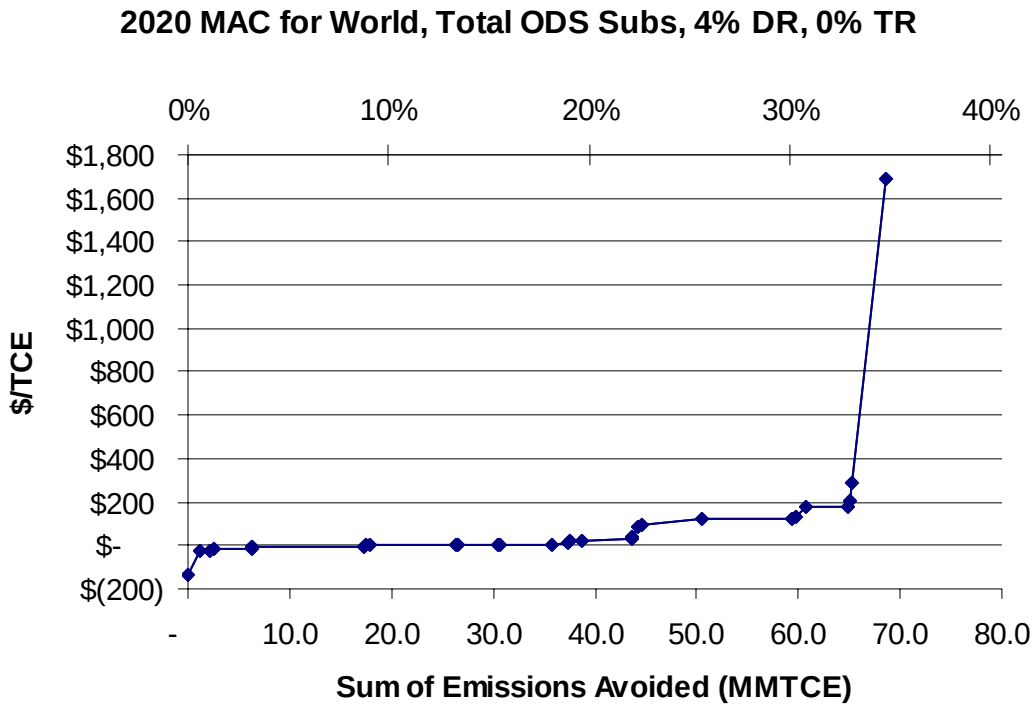
The study supporting this document (and the IMAC model) uses country-specific data to aggregate baseline emissions, emission reductions, and abatement option costs and benefits into region-specific figures. By rank ordering individual reduction opportunities by cost per emission reduction, a marginal abatement cost curve is drawn to graphically display the cost of reductions ($/TCE) against the total abatable emissions in either millions of metric tons of carbon equivalent (MMTCE) or as a percentage of the applicable baseline emissions. Following are marginal abatement cost curves for the World and the three countries/regions examined in the report (U.S., non-U.S. Annex I, and non-Annex I) for 2010, 2015 and 2020. Composite MAC curves are presented below for the World and the three countries/regions, and include all five sectors covered in the report. These are followed by sector-specific curves, again for the World and the three countries/regions.

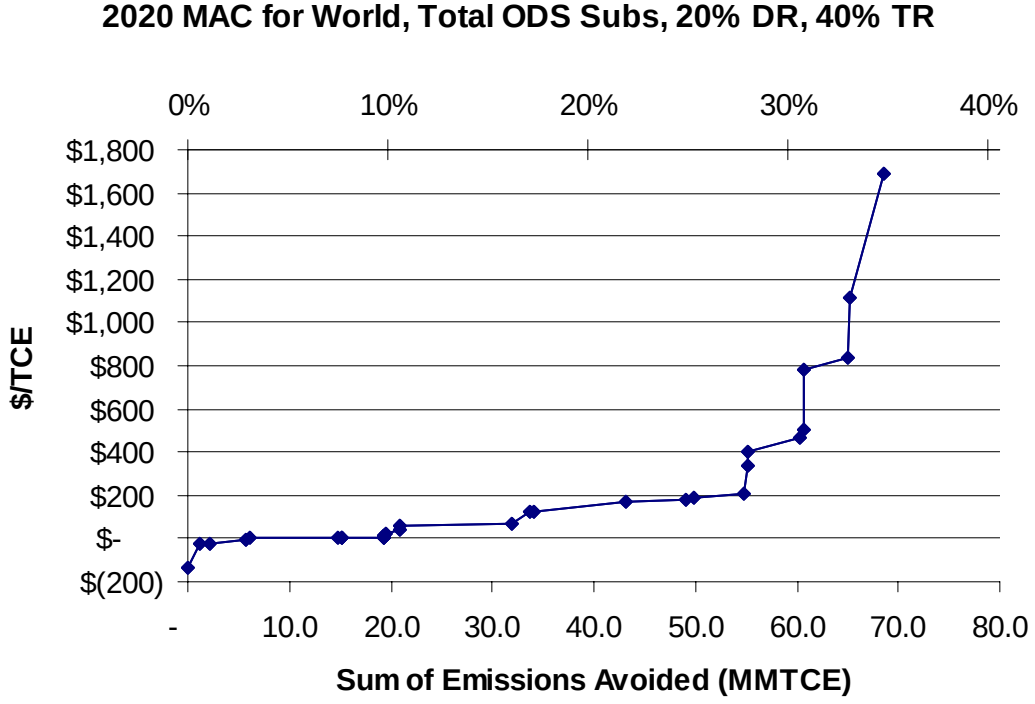

2010 MAC for World, Total ODS Subs, 4% DR, 0% TR
0%
5%
10%
15%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
5.0
10.0
15.0
20.0
Sum of Emissions Avoided (MMTCE)

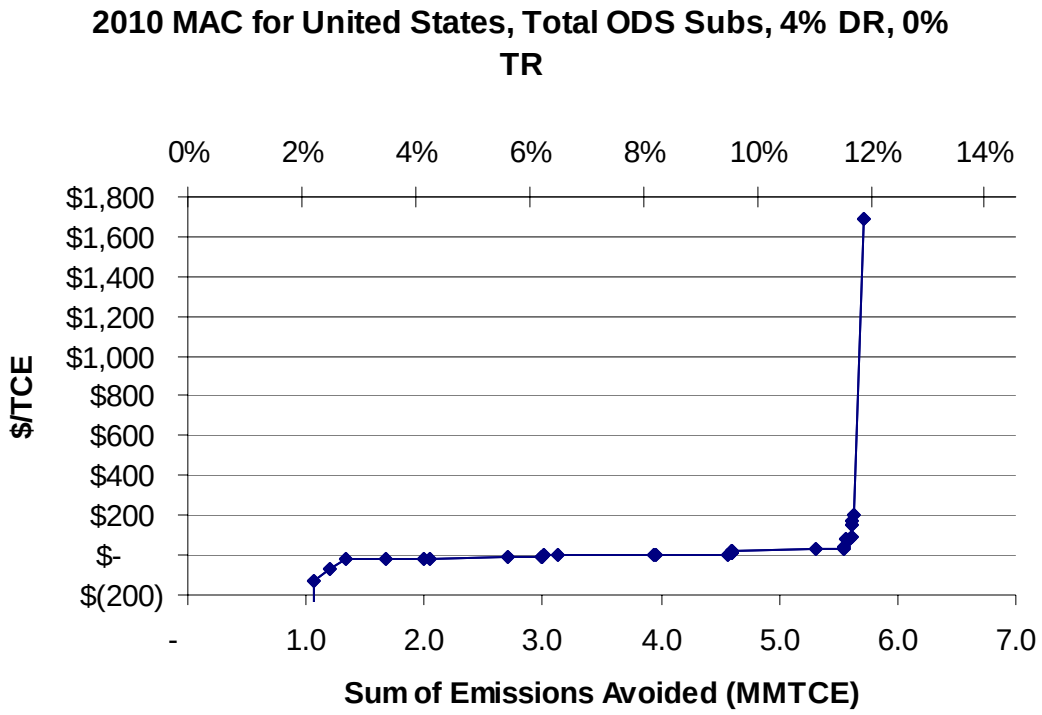

2010 MAC for World, Total ODS Subs, 20% DR, 40% TR
0%
5%
10%
15%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
5.0
10.0
15.0
20.0
Sum of Emissions Avoided (MMTCE)

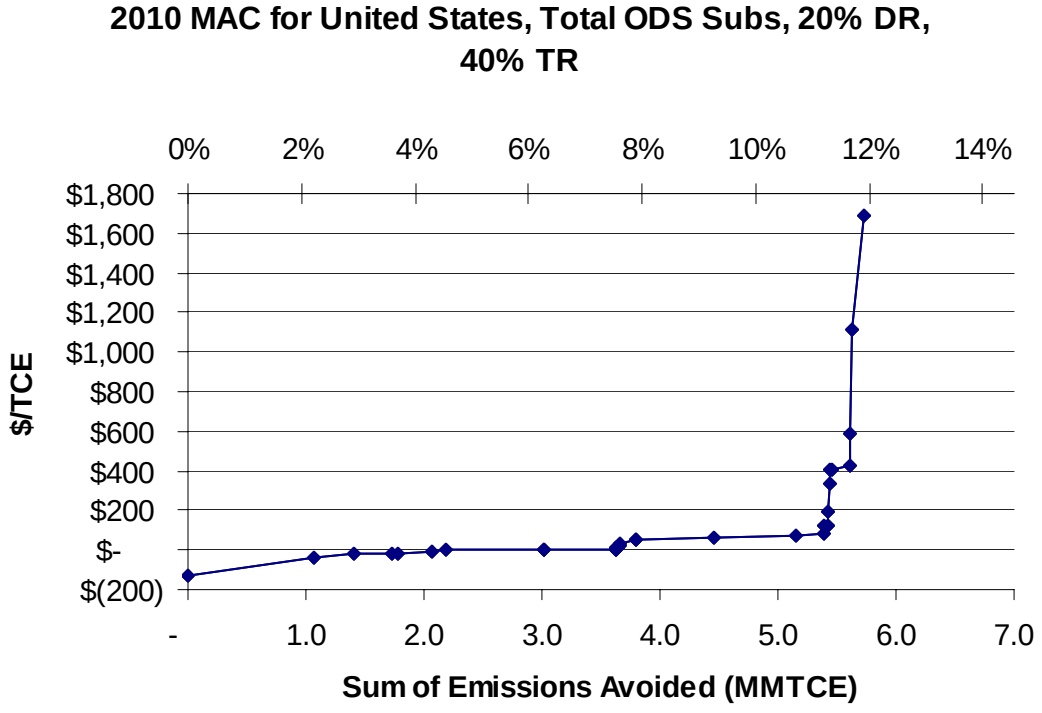

2015 MAC for World, Total ODS Subs, 4% DR, 0% TR
0%
5%
10%
15%
20%
25%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Sum of Emissions Avoided (MMTCE)

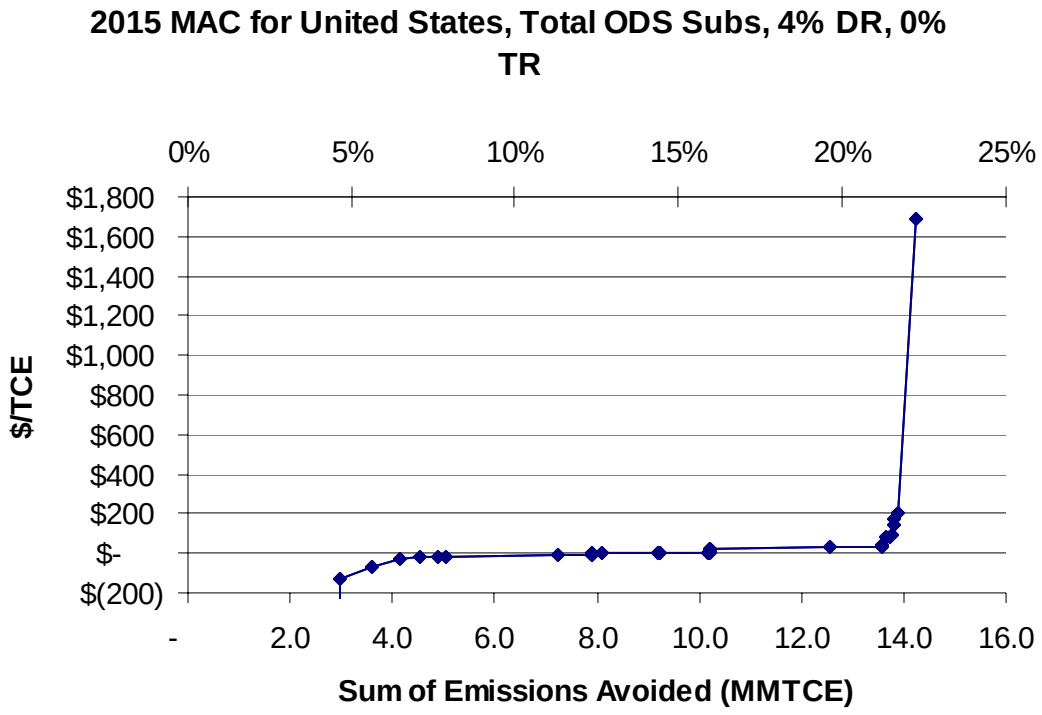

2015 MAC for World, Total ODS Subs, 20% DR, 40% TR
0%
5%
10%
15%
20%
25%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Sum of Emissions Avoided (MMTCE)

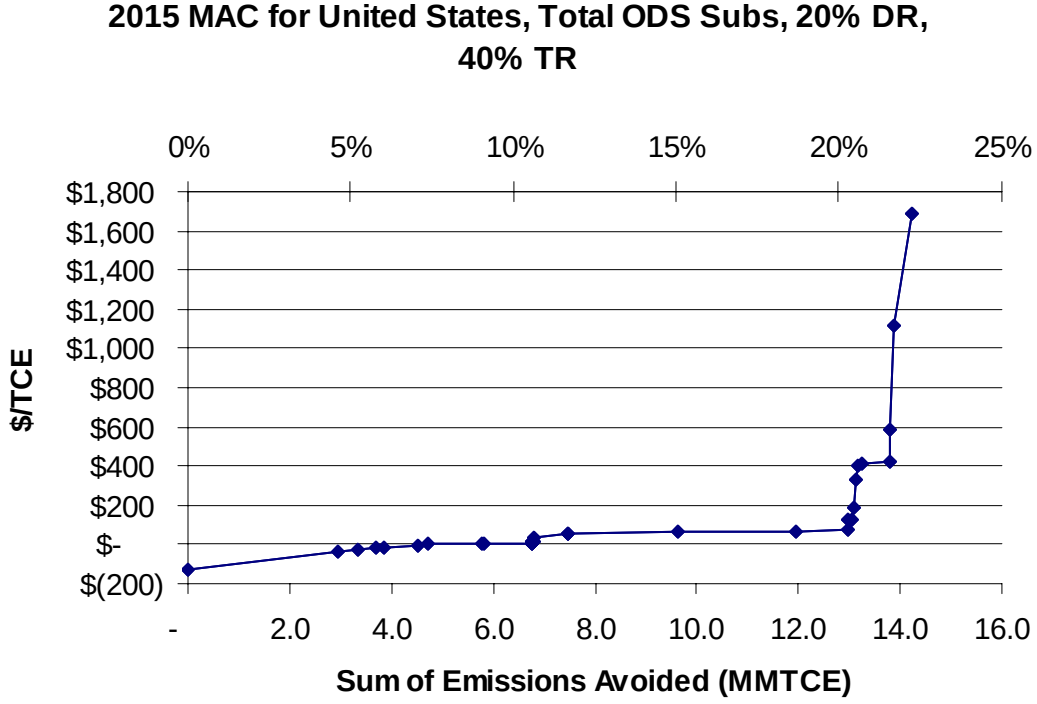

2020 MAC for World, Total ODS Subs, 4% DR, 0% TR
0%
10%
20%
30%
40%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
Sum of Emissions Avoided (MMTCE)

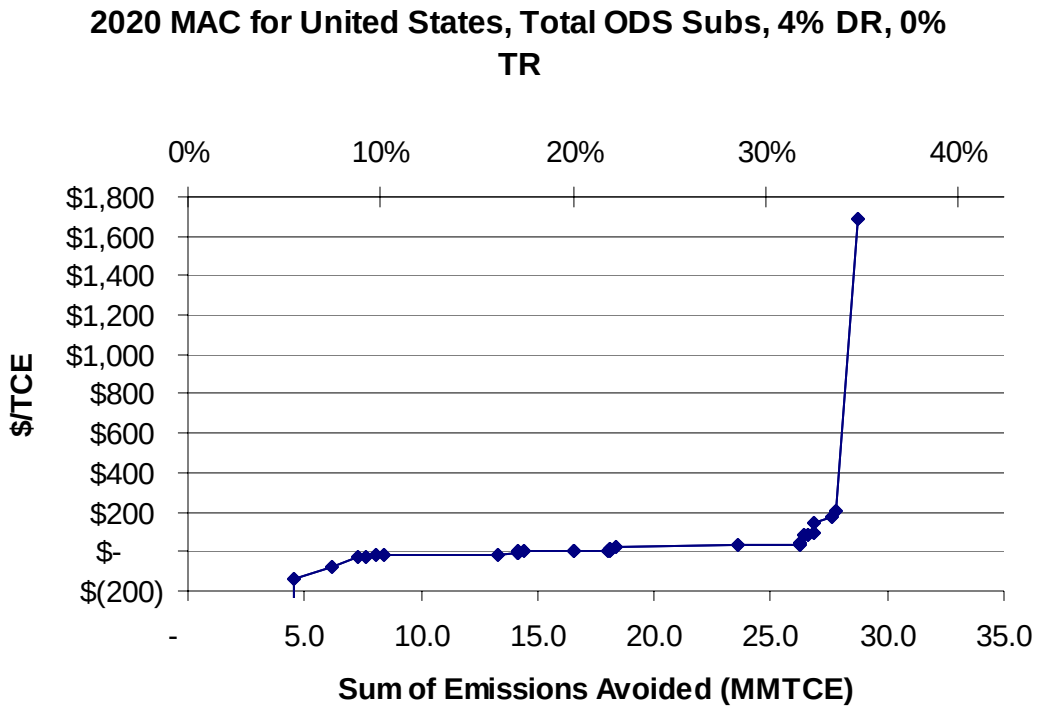

2020 MAC for World, Total ODS Subs, 20% DR, 40% TR
0%
10%
20%
30%
40%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
Sum of Emissions Avoided (MMTCE)

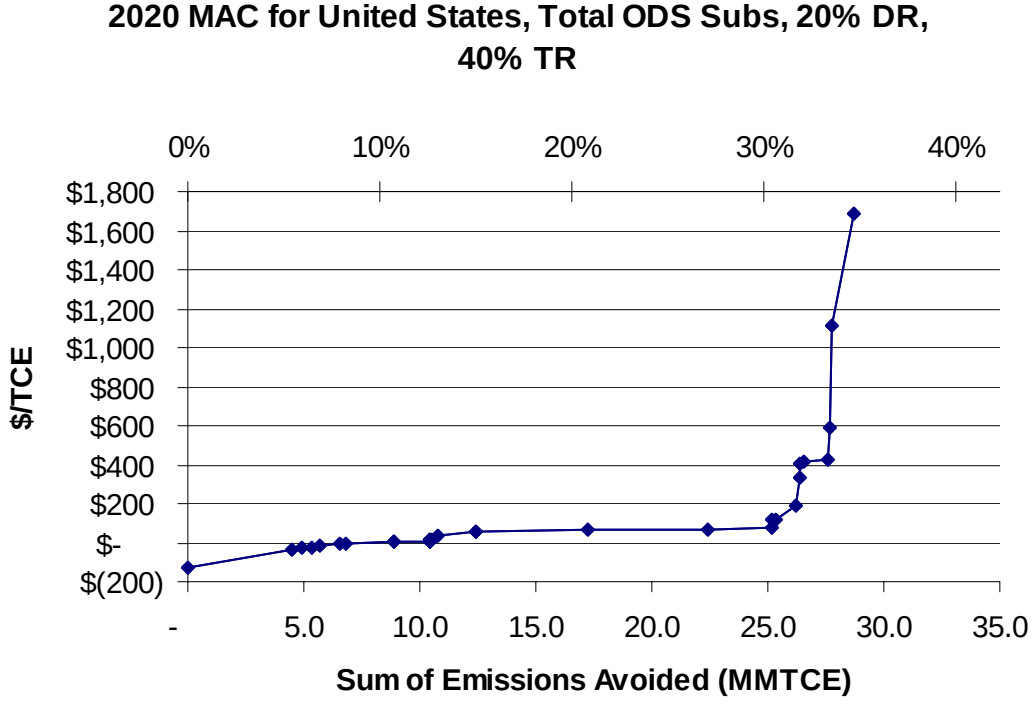

2010 MAC for United States, Total ODS Subs, 4% DR, 0% TR
0%
2%
4%
6%
8%
10%
12%
14%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Sum of Emissions Avoided (MMTCE)


2010 MAC for United States, Total ODS Subs, 20% DR, 40% TR
0%
2%
4%
6%
8%
10%
12%
14%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Sum of Emissions Avoided (MMTCE)

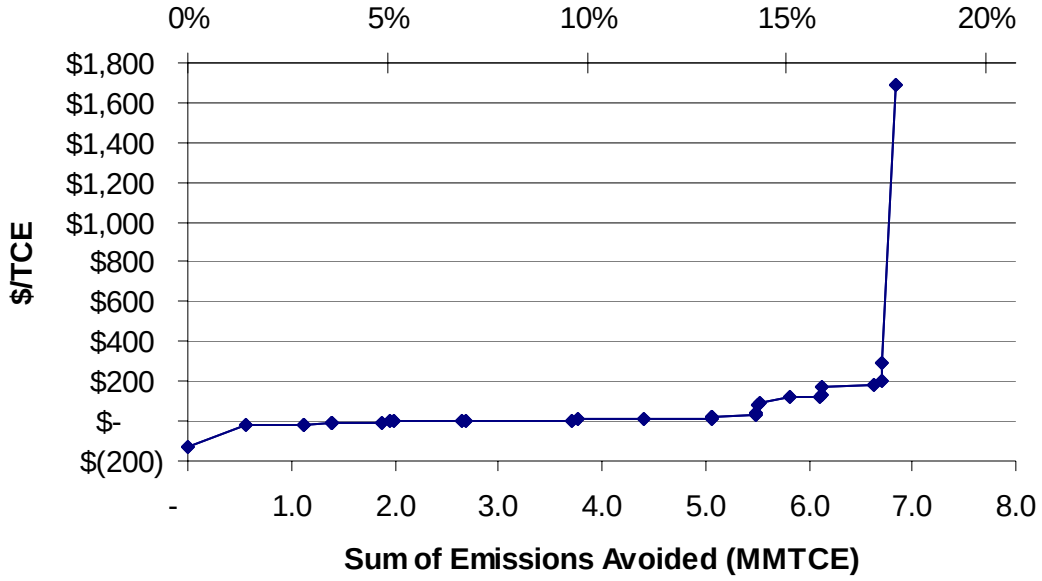

2015 MAC for United States, Total ODS Subs, 4% DR, 0% TR
0%
5%
10%
15%
20%
25%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Sum of Emissions Avoided (MMTCE)


2015 MAC for United States, Total ODS Subs, 20% DR, 40% TR
0%
5%
10%
15%
20%
25%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Sum of Emissions Avoided (MMTCE)

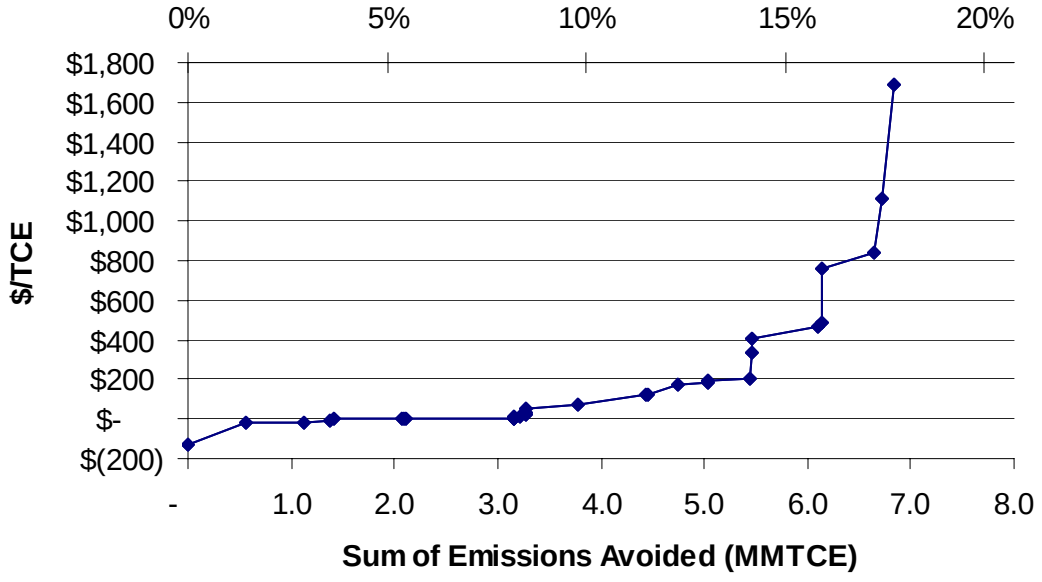

2020 MAC for United States, Total ODS Subs, 4% DR, 0% TR
0%
10%
20%
30%
40%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
5.0
10.0
15.0
20.0
25.0
30.0
35.0
Sum of Emissions Avoided (MMTCE)


2020 MAC for United States, Total ODS Subs, 20% DR, 40% TR
0%
10%
20%
30%
40%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
5.0
10.0
15.0
20.0
25.0
30.0
35.0
Sum of Emissions Avoided (MMTCE)

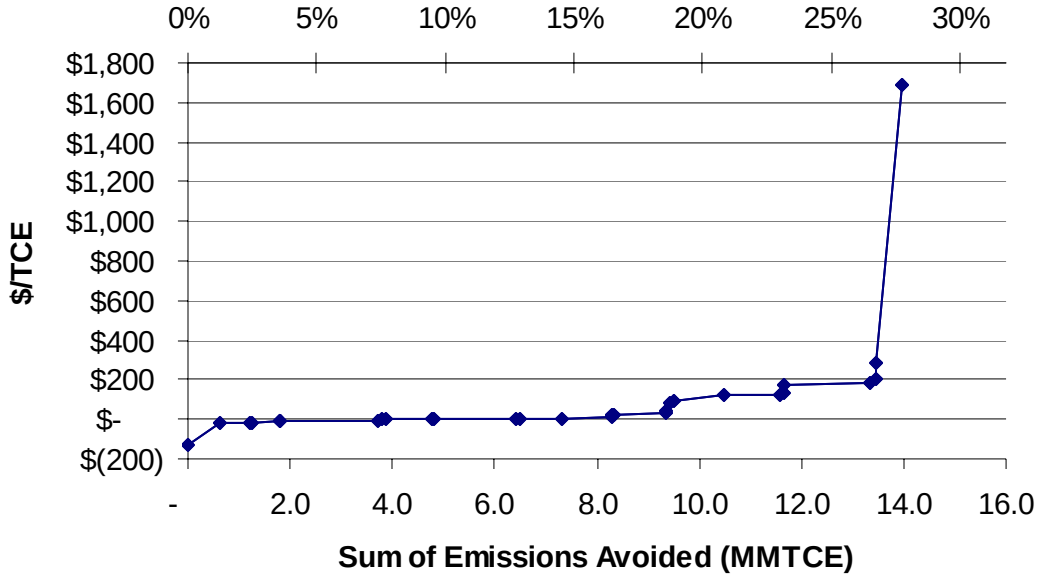
2010 MAC for Non-US Annex I, Total ODS Subs, 4% DR, 0% TR



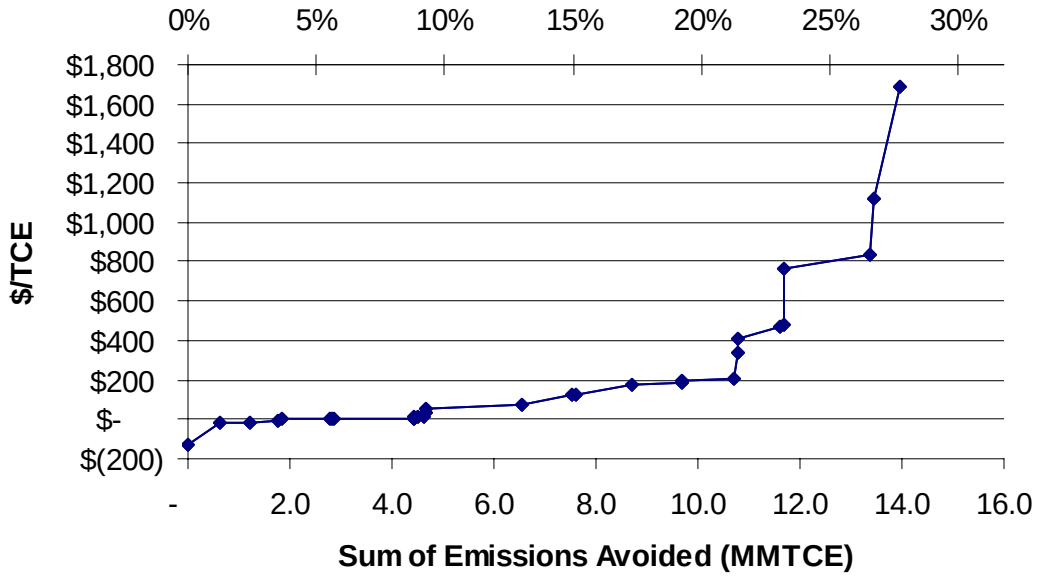
2010 MAC for Non-US Annex I, Total ODS Subs, 20% DR, 40% TR



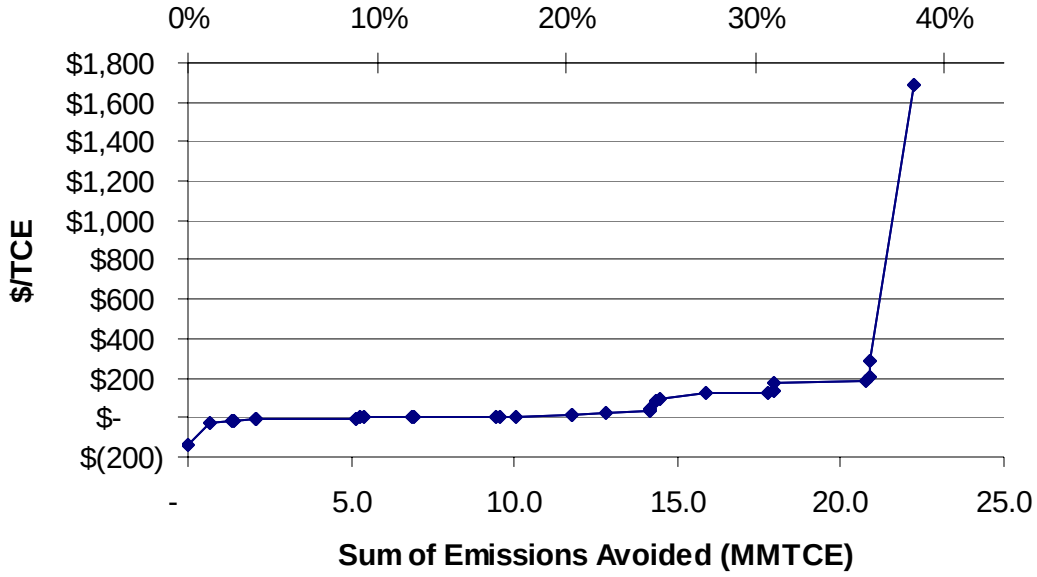
2015 MAC for Non-US Annex I, Total ODS Subs, 4% DR, 0% TR



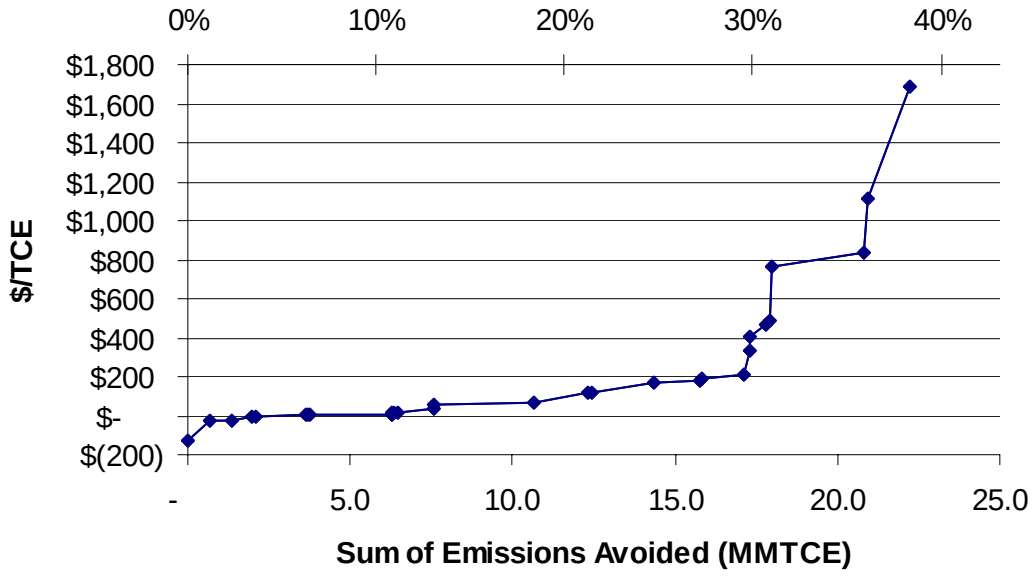
2015 MAC for Non-US Annex I, Total ODS Subs, 20% DR, 40% TR

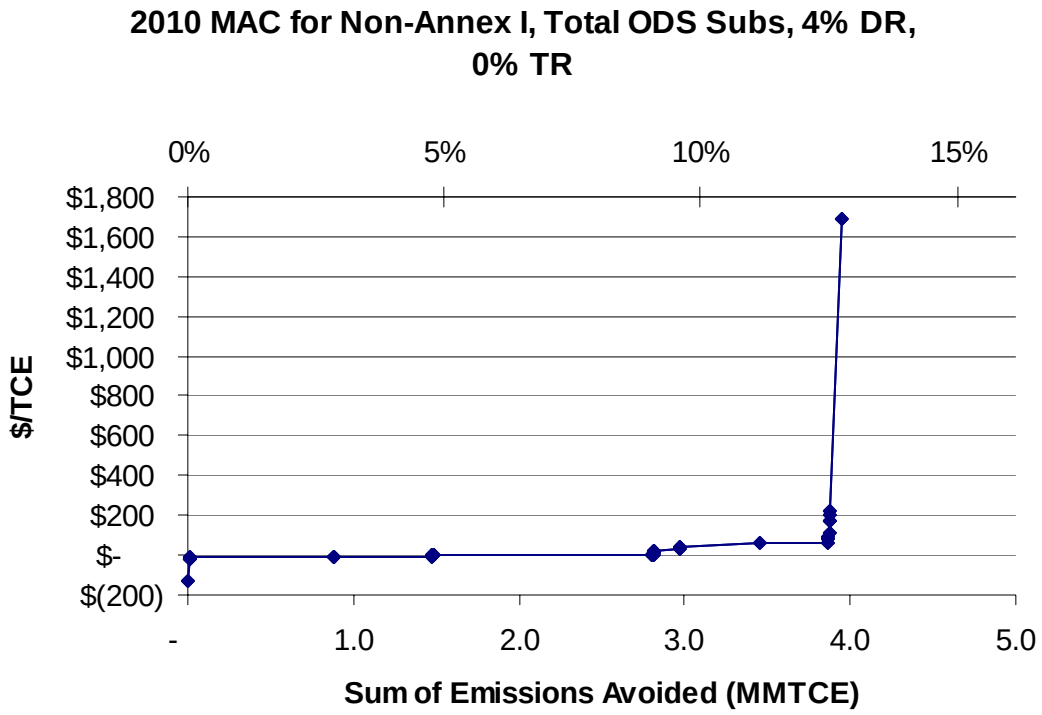


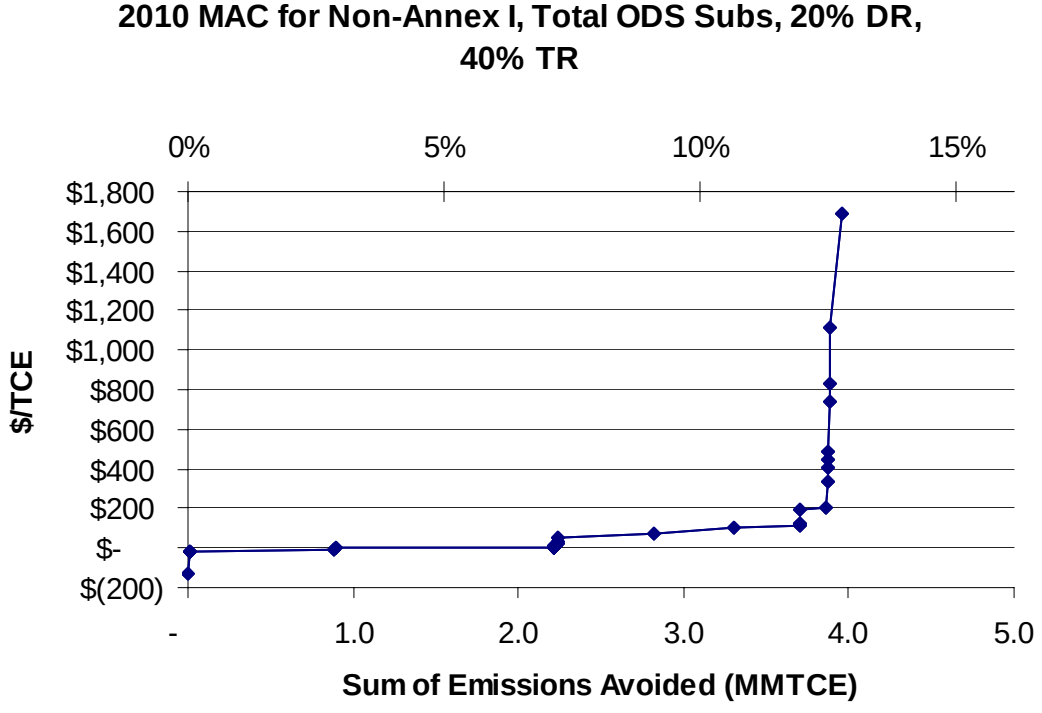
2020 MAC for Non-US Annex I, Total ODS Subs, 4% DR, 0% TR

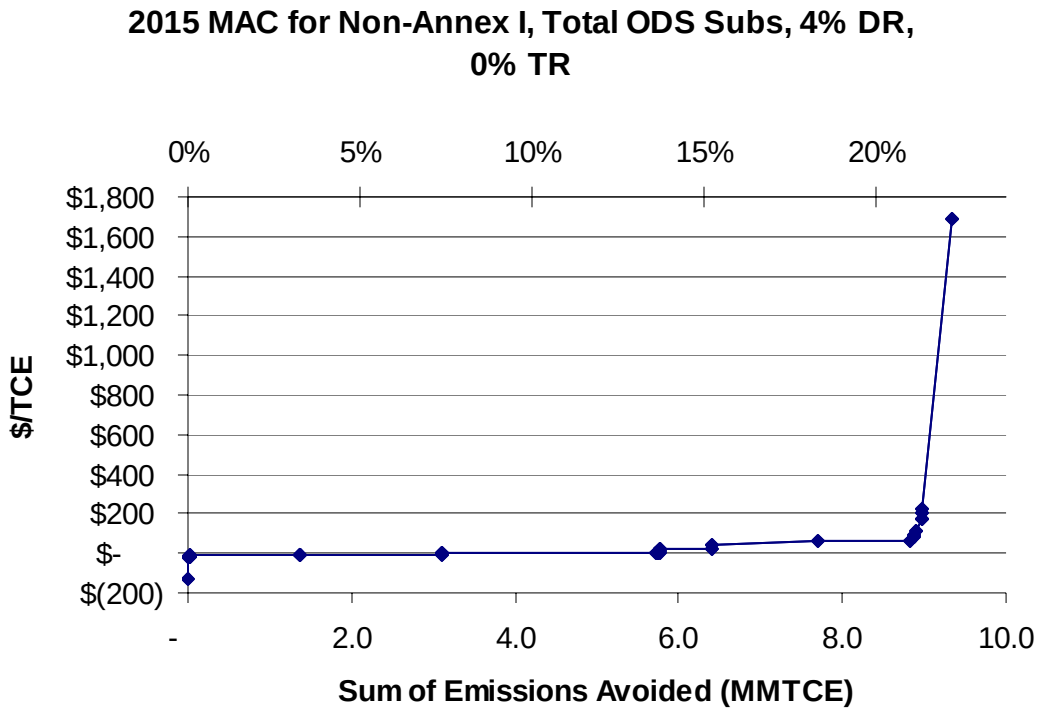


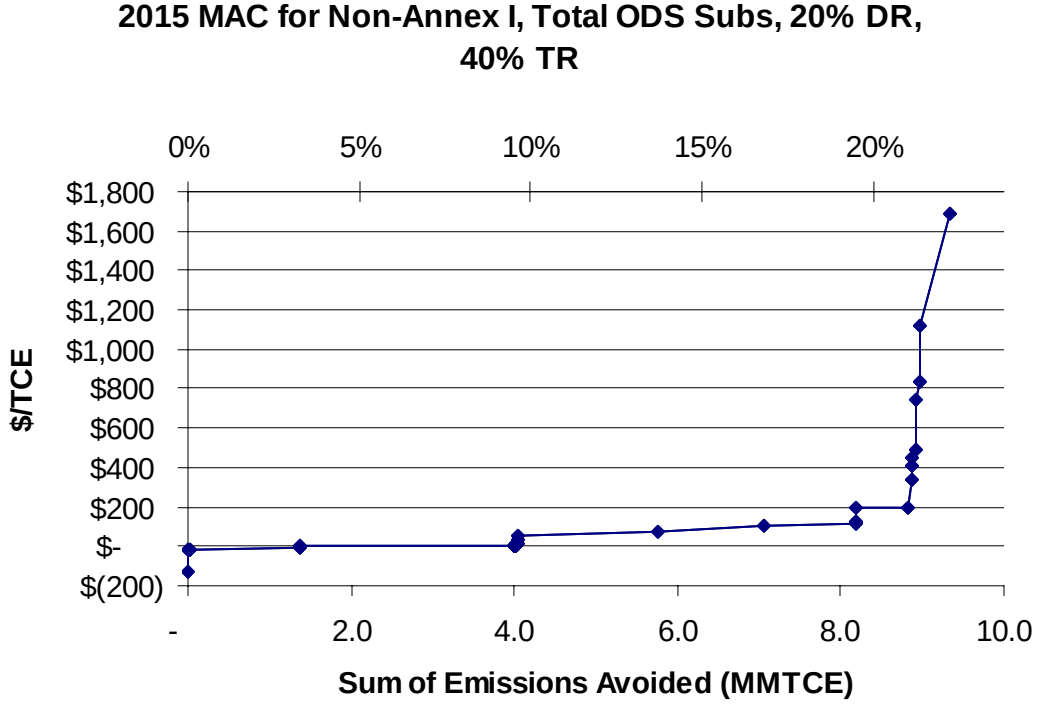
2020 MAC for Non-US Annex I, Total ODS Subs, 20% DR, 40% TR

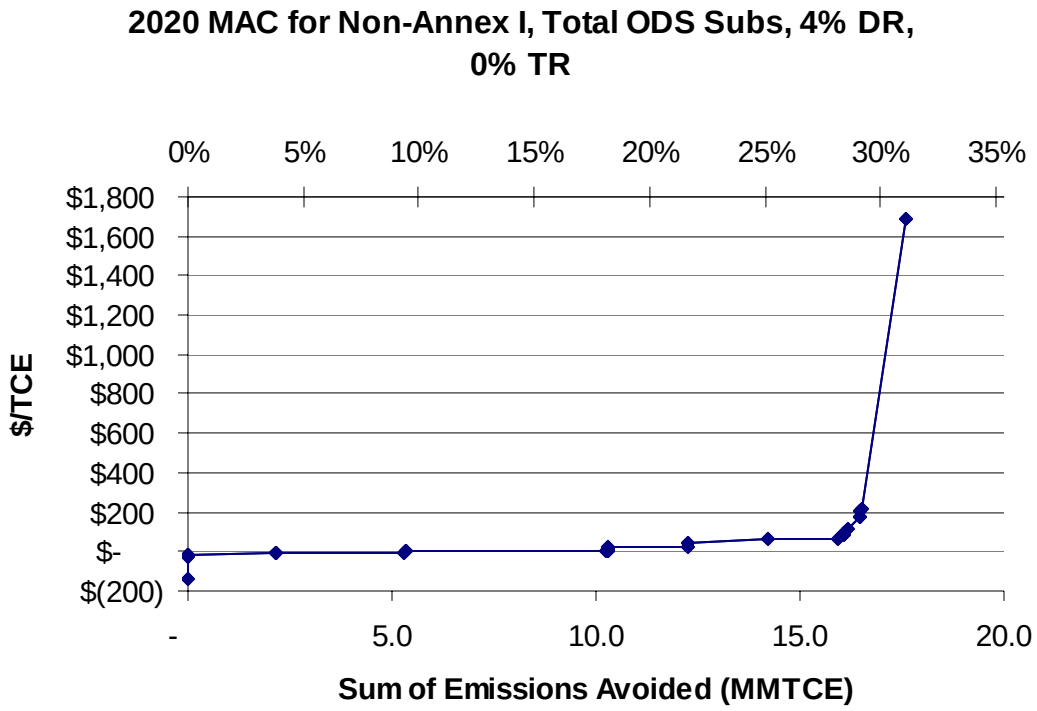


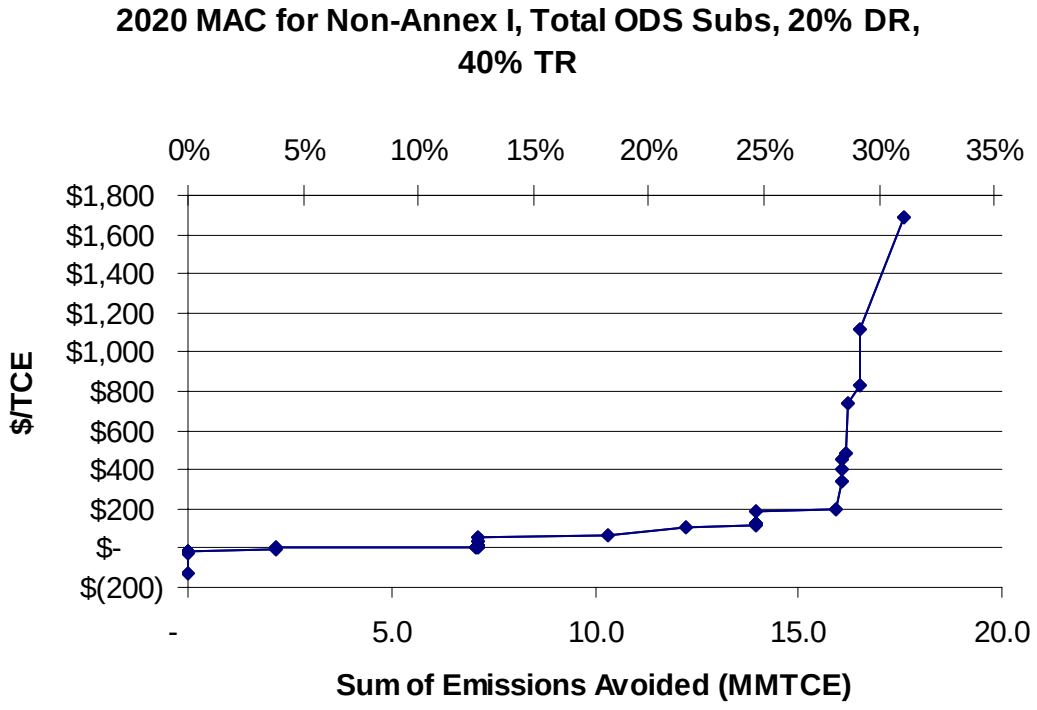

2010 MAC for Non-Annex I, Total ODS Subs, 4% DR, 0% TR
0%
5%
10%
15%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
1.0
2.0
3.0
4.0
5.0
Sum of Emissions Avoided (MMTCE)

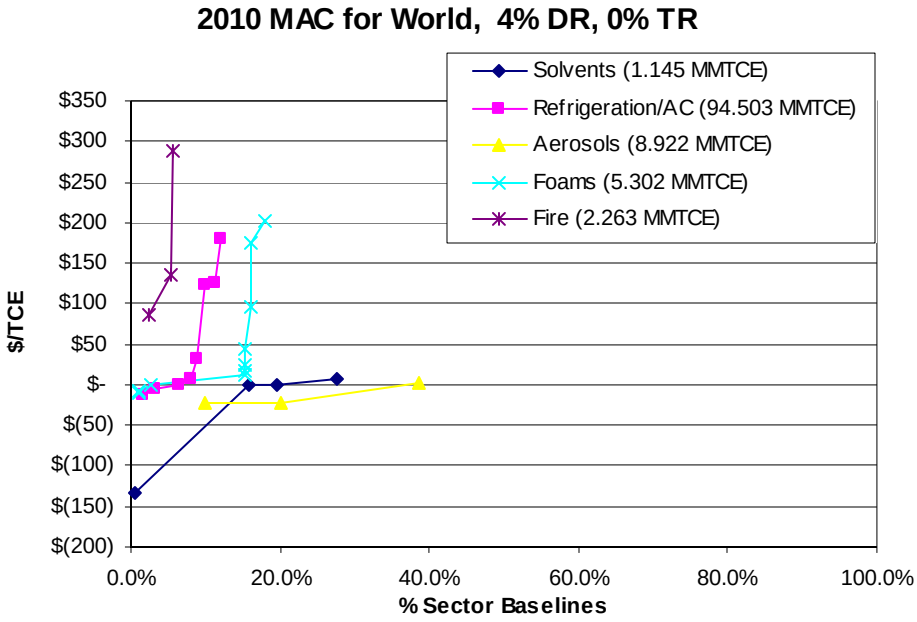

2010 MAC for Non-Annex I, Total ODS Subs, 20% DR, 40% TR
0%
5%
10%
15%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
1.0
2.0
3.0
4.0
5.0
Sum of Emissions Avoided (MMTCE)

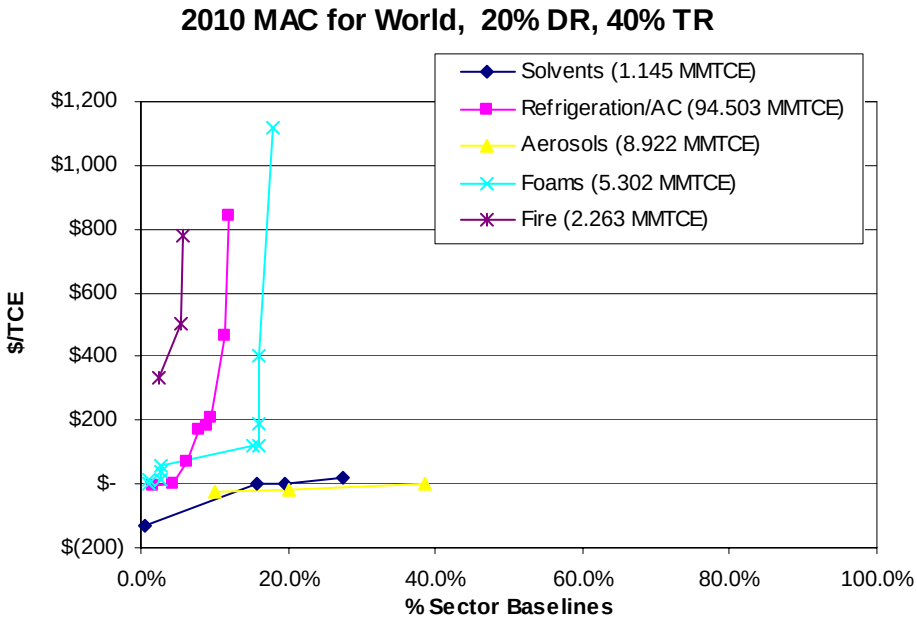

2015 MAC for Non-Annex I, Total ODS Subs, 4% DR, 0% TR
0%
5%
10%
15%
20%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
2.0
4.0
6.0
8.0
10.0
Sum of Emissions Avoided (MMTCE)

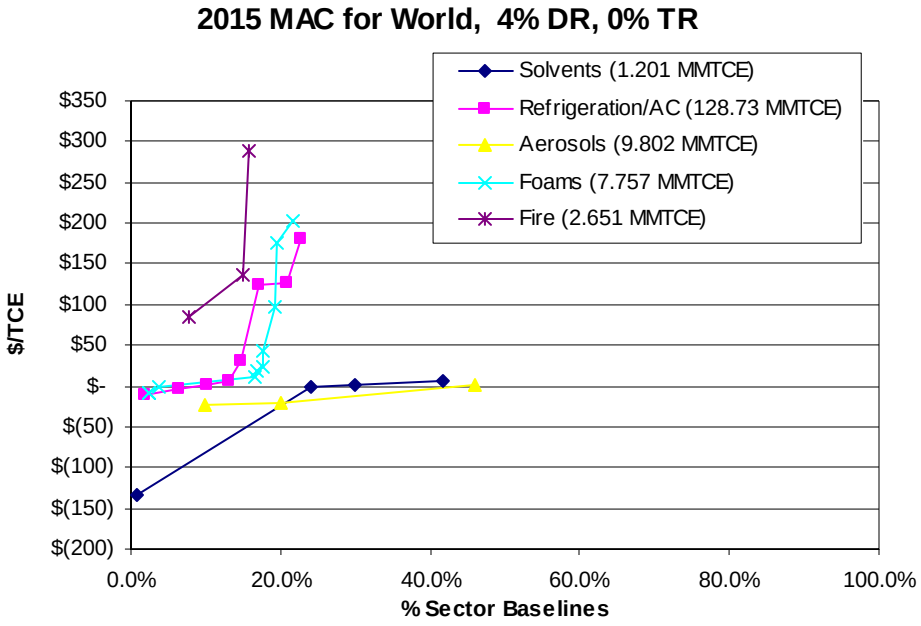

2015 MAC for Non-Annex I, Total ODS Subs, 20% DR, 40% TR
0%
5%
10%
15%
20%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
2.0
4.0
6.0
8.0
10.0
Sum of Emissions Avoided (MMTCE)

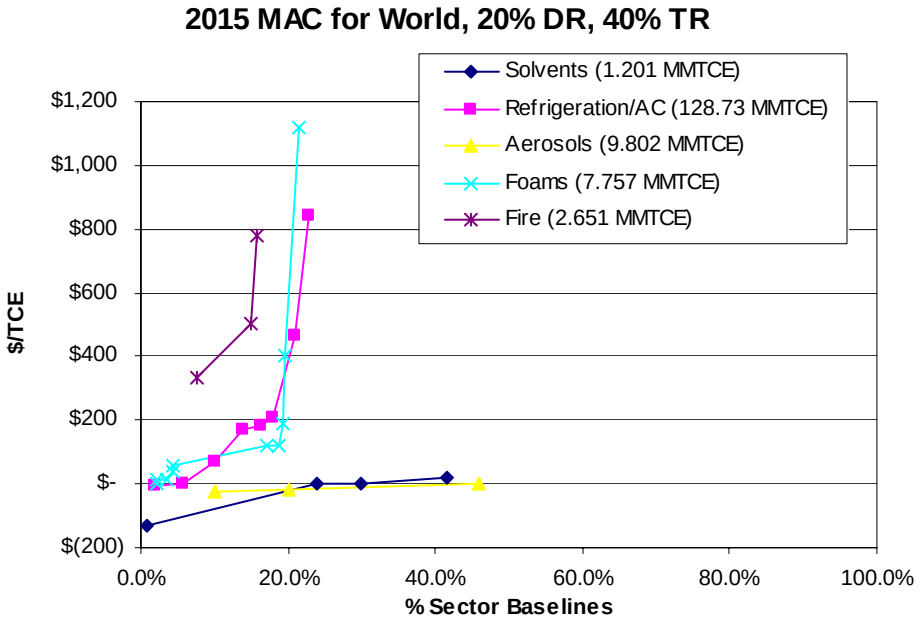

2020 MAC for Non-Annex I, Total ODS Subs, 4% DR, 0% TR
0%
5%
10%
15%
20%
25%
30%
35%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
5.0
10.0
15.0
20.0
Sum of Emissions Avoided (MMTCE)

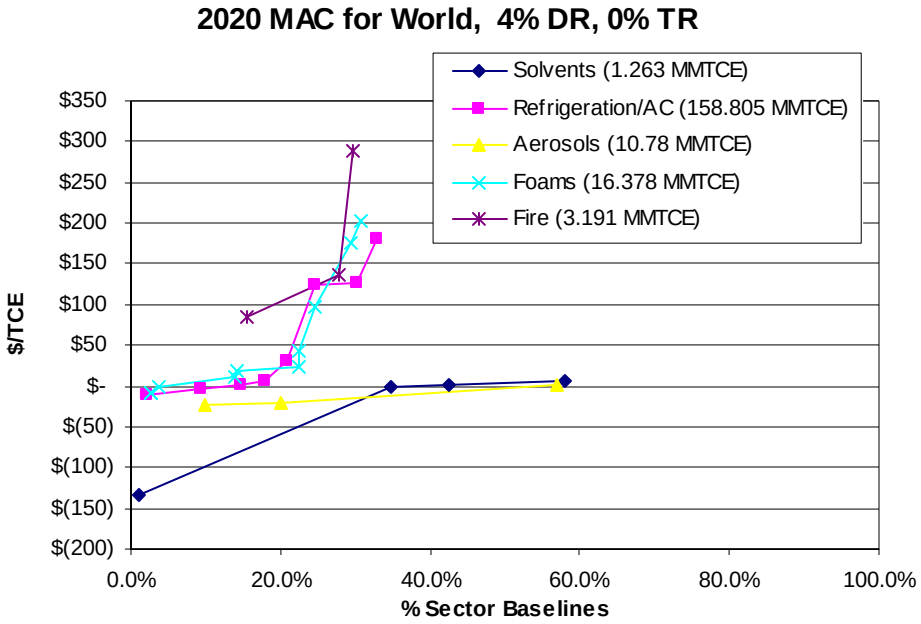

2020 MAC for Non-Annex I, Total ODS Subs, 20% DR, 40% TR
0%
5%
10%
15%
20%
25%
30%
35%
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
-
5.0
10.0
15.0
20.0
Sum of Emissions Avoided (MMTCE)

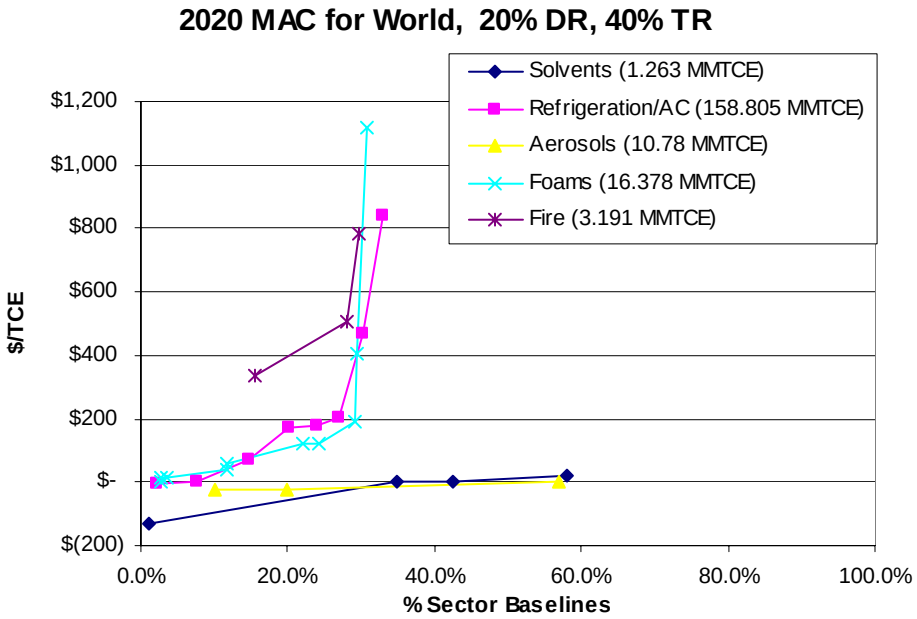

2010 MAC for World, 4% DR, 0% TR
Solvents (1.145 MMTCE)
Refrigeration/AC (94.503 MMTCE)
Aerosols (8.922 MMTCE)
Foams (5.302 MMTCE)
Fire (2.263 MMTCE)
$350
$300
$250
$200
$150
$100
$50
$-
$(50)
$(100)
$(150)
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

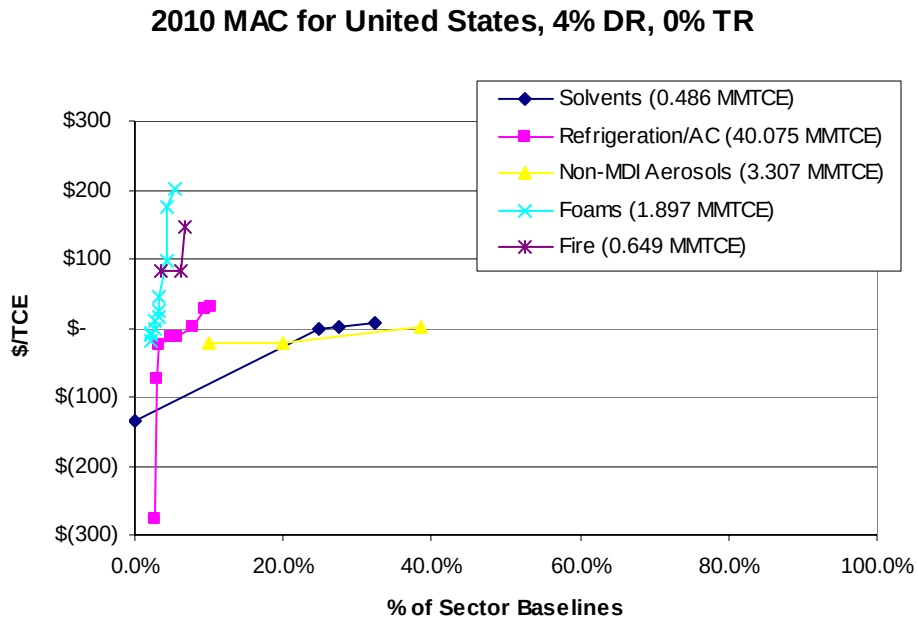

2010 MAC for World, 20% DR, 40% TR
Solvents (1.145 MMTCE)
Refrigeration/AC (94.503 MMTCE)
Aerosols (8.922 MMTCE)
Foams (5.302 MMTCE)
Fire (2.263 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

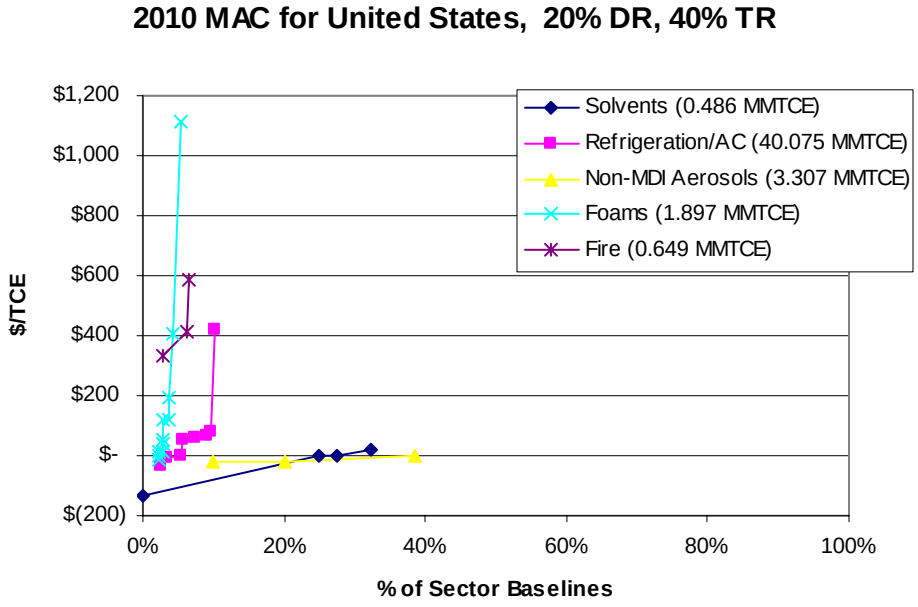

2015 MAC for World, 4% DR, 0% TR
Solvents (1.201 MMTCE)
Refrigeration/AC (128.73 MMTCE)
Aerosols (9.802 MMTCE)
Foams (7.757 MMTCE)
Fire (2.651 MMTCE)
$350
$300
$250
$200
$150
$100
$50
$-
$(50)
$(100)
$(150)
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

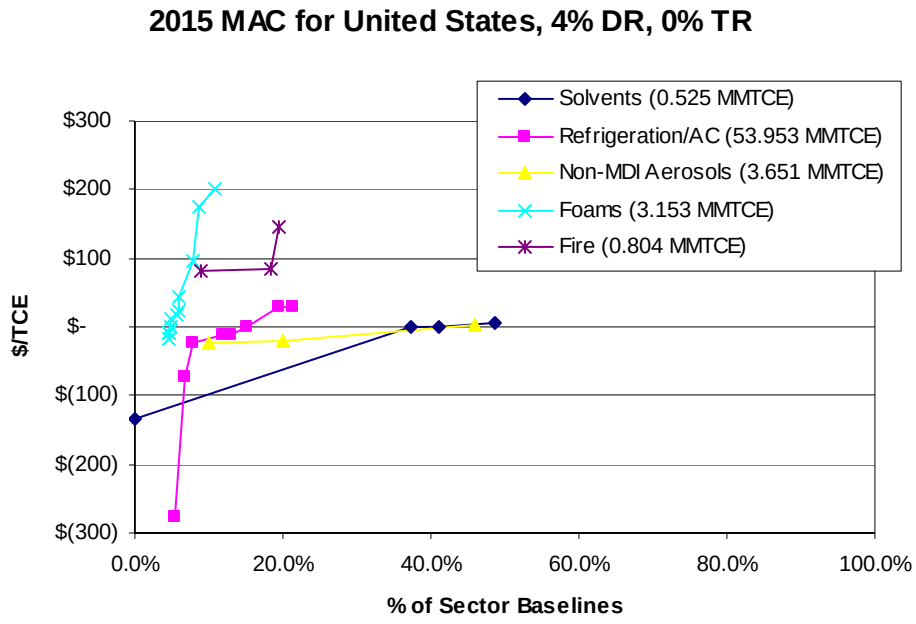

2015 MAC for World, 20% DR, 40% TR
Solvents (1.201 MMTCE)
Refrigeration/AC (128.73 MMTCE)
Aerosols (9.802 MMTCE)
Foams (7.757 MMTCE)
Fire (2.651 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

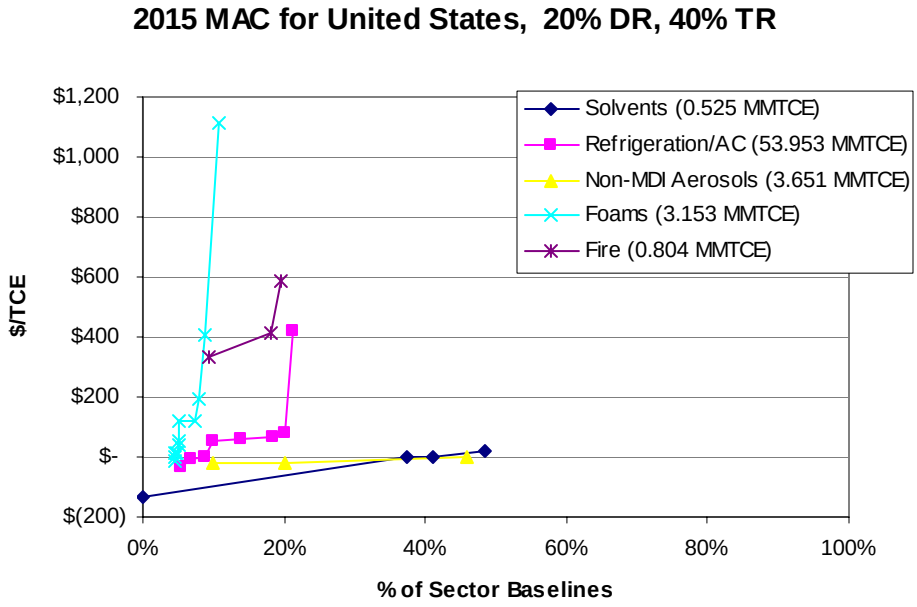

2020 MAC for World, 4% DR, 0% TR
Solvents (1.263 MMTCE)
Refrigeration/AC (158.805 MMTCE)
Aerosols (10.78 MMTCE)
Foams (16.378 MMTCE)
Fire (3.191 MMTCE)
$350
$300
$250
$200
$150
$100
$50
$-
$(50)
$(100)
$(150)
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

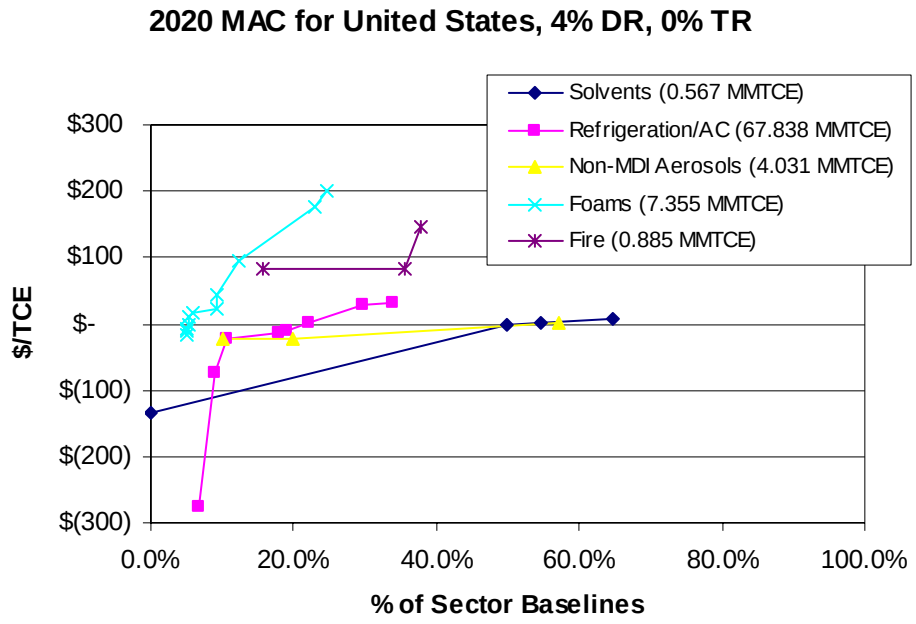

2020 MAC for World, 20% DR, 40% TR
Solvents (1.263 MMTCE)
Refrigeration/AC (158.805 MMTCE)
Aerosols (10.78 MMTCE)
Foams (16.378 MMTCE)
Fire (3.191 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

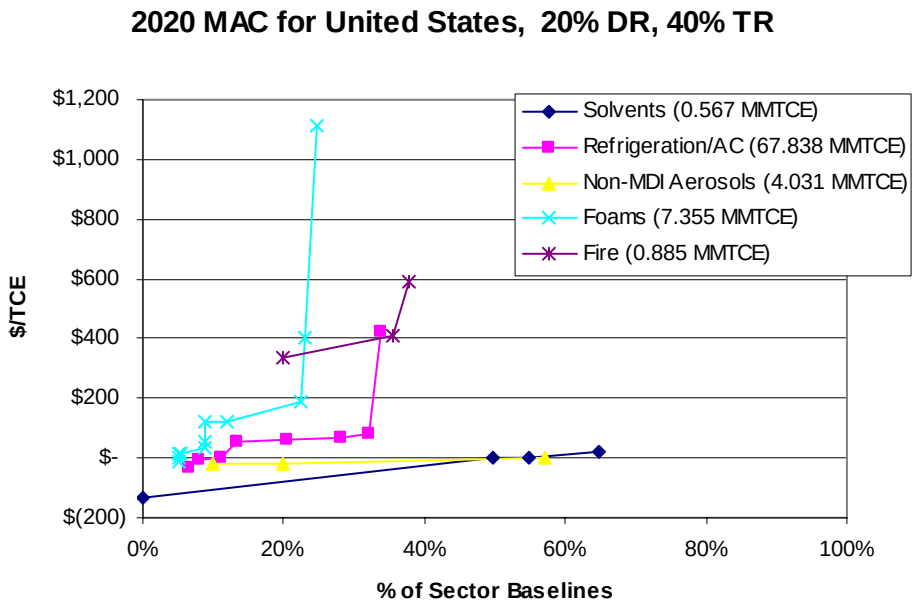

2010 MAC for United States, 4% DR, 0% TR
Solvents (0.486 MMTCE)
Refrigeration/AC (40.075 MMTCE)
Non-MDI Aerosols (3.307 MMTCE)
Foams (1.897 MMTCE)
Fire (0.649 MMTCE)
$300
$200
$100
$-
$(100)
$(200)
$(300)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% of Sector Baselines

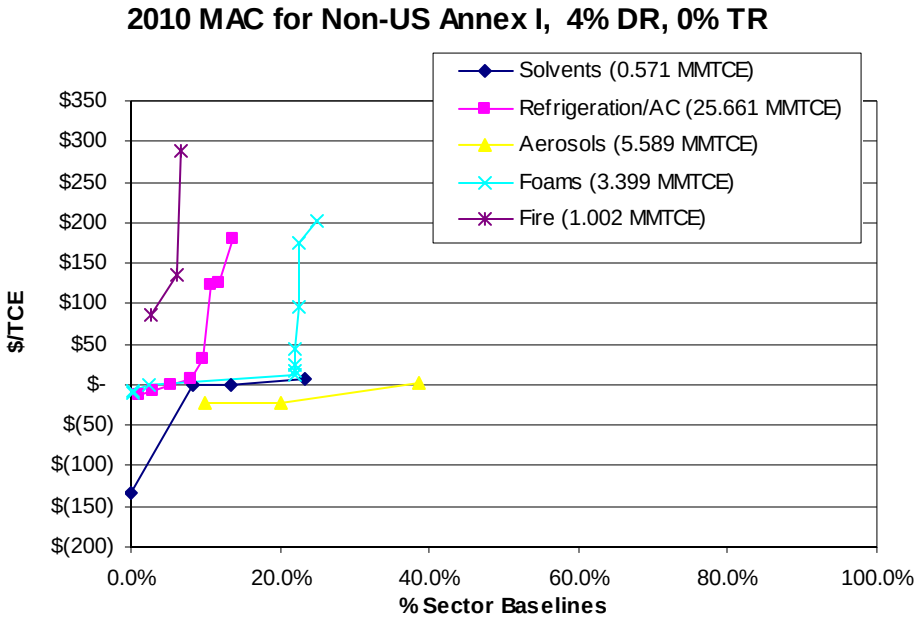

2010 MAC for United States, 20% DR, 40% TR
Solvents (0.486 MMTCE)
Refrigeration/AC (40.075 MMTCE)
Non-MDI Aerosols (3.307 MMTCE)
Foams (1.897 MMTCE)
Fire (0.649 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0%
20%
40%
60%
80%
100%
% of Sector Baselines

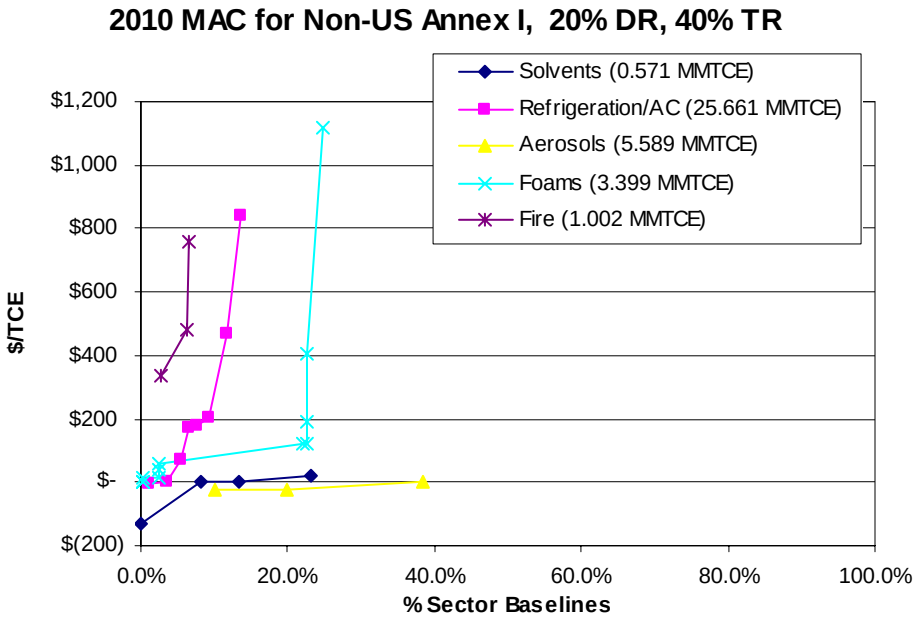

2015 MAC for United States, 4% DR, 0% TR
Solvents (0.525 MMTCE)
Refrigeration/AC (53.953 MMTCE)
Non-MDI Aerosols (3.651 MMTCE)
Foams (3.153 MMTCE)
Fire (0.804 MMTCE)
$300
$200
$100
$-
$(100)
$(200)
$(300)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% of Sector Baselines

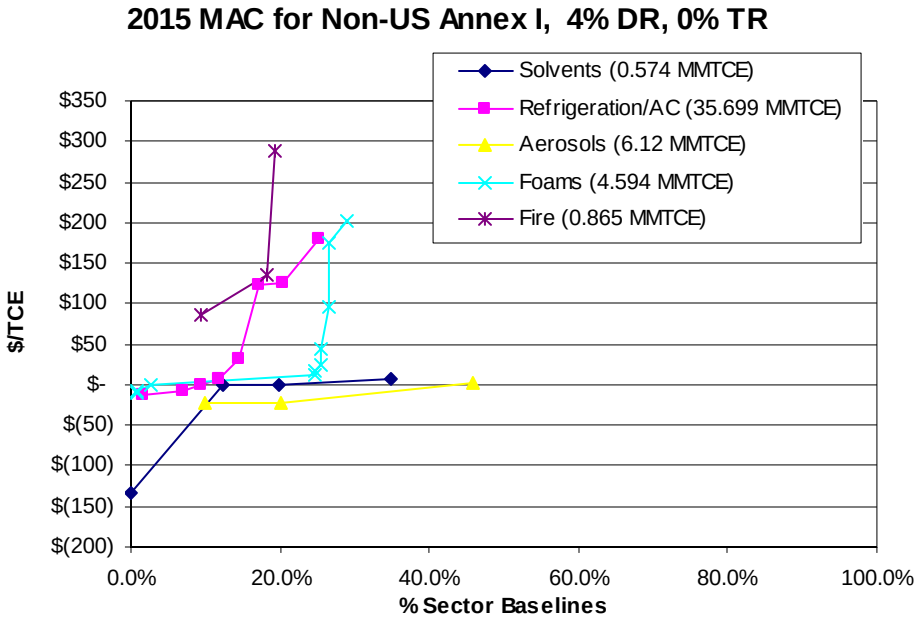

2015 MAC for United States, 20% DR, 40% TR
Solvents (0.525 MMTCE)
Refrigeration/AC (53.953 MMTCE)
Non-MDI Aerosols (3.651 MMTCE)
Foams (3.153 MMTCE)
Fire (0.804 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0%
20%
40%
60%
80%
100%
% of Sector Baselines

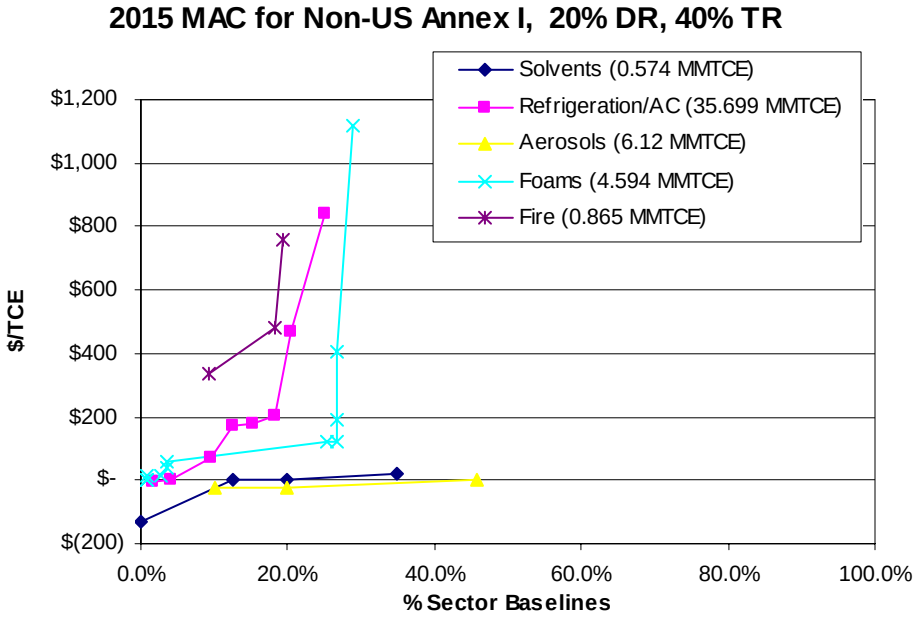

2020 MAC for United States, 4% DR, 0% TR
Solvents (0.567 MMTCE)
Refrigeration/AC (67.838 MMTCE)
Non-MDI Aerosols (4.031 MMTCE)
Foams (7.355 MMTCE)
Fire (0.885 MMTCE)
$300
$200
$100
$-
$(100)
$(200)
$(300)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% of Sector Baselines

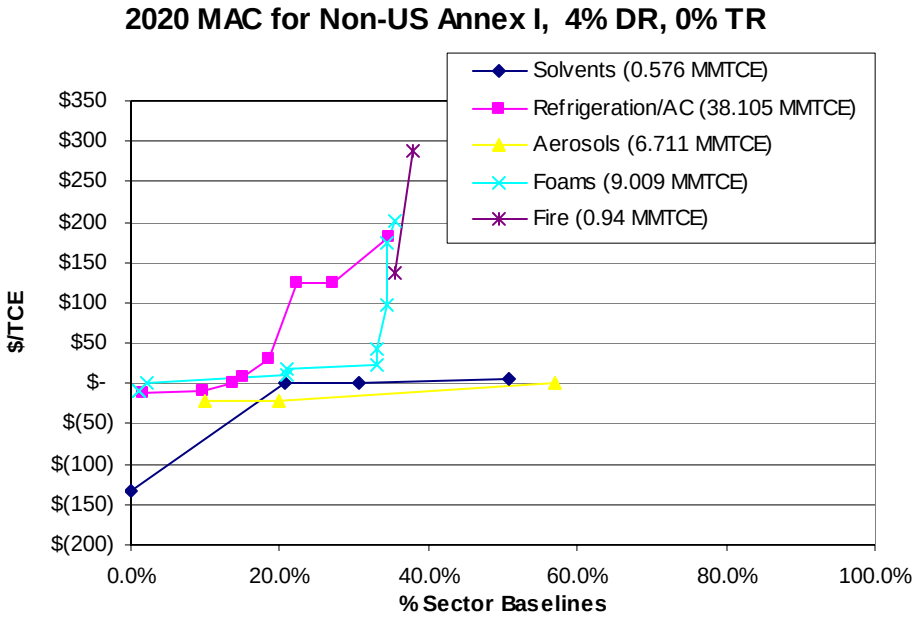

2020 MAC for United States, 20% DR, 40% TR
Solvents (0.567 MMTCE)
Refrigeration/AC (67.838 MMTCE)
Non-MDI Aerosols (4.031 MMTCE)
Foams (7.355 MMTCE)
Fire (0.885 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0%
20%
40%
60%
80%
100%
% of Sector Baselines

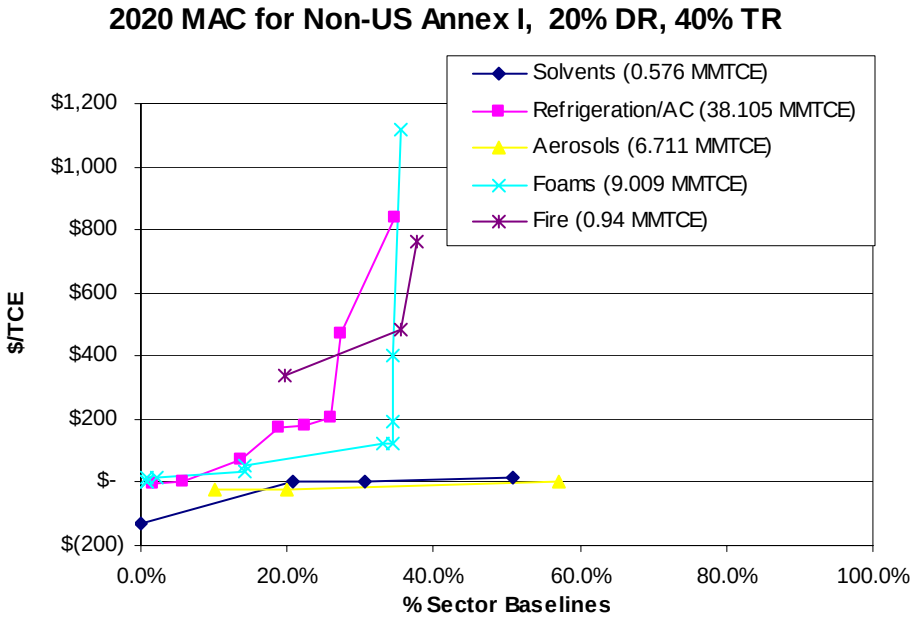

2010 MAC for Non-US Annex I, 4% DR, 0% TR
Solvents (0.571 MMTCE)
Refrigeration/AC (25.661 MMTCE)
Aerosols (5.589 MMTCE)
Foams (3.399 MMTCE)
Fire (1.002 MMTCE)
$350
$300
$250
$200
$150
$100
$50
$-
$(50)
$(100)
$(150)
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

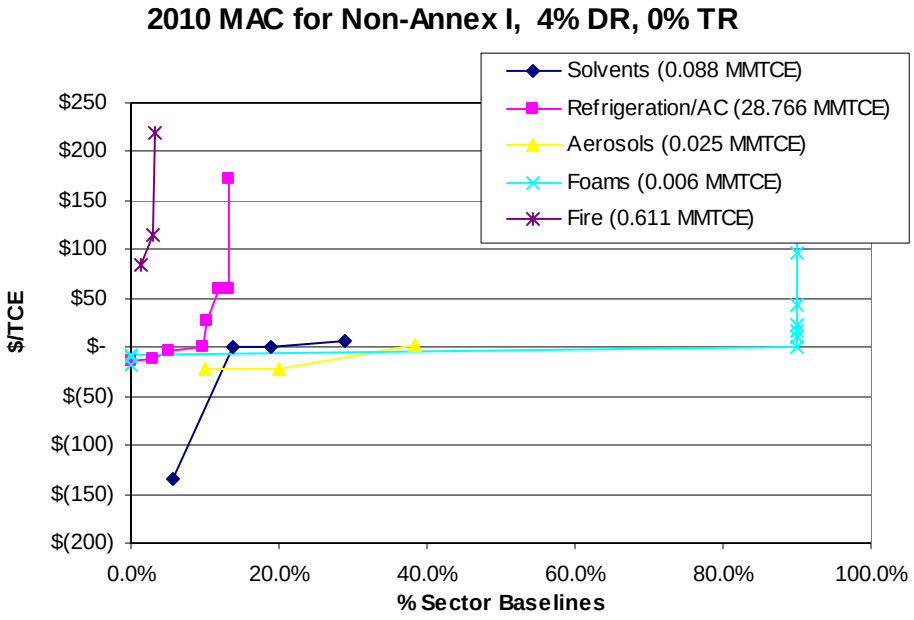

2010 MAC for Non-US Annex I, 20% DR, 40% TR
Solvents (0.571 MMTCE)
Refrigeration/AC (25.661 MMTCE)
Aerosols (5.589 MMTCE)
Foams (3.399 MMTCE)
Fire (1.002 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

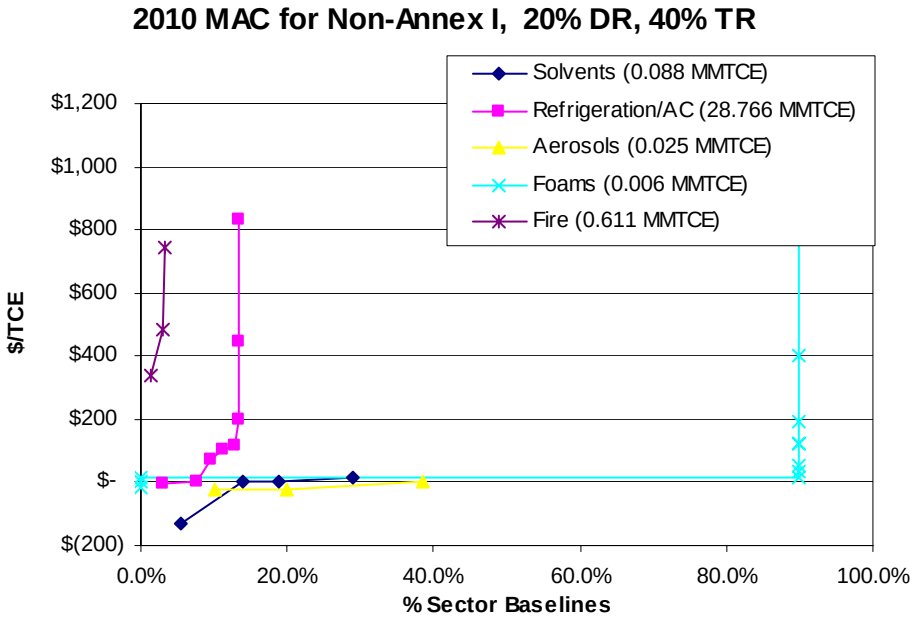

2015 MAC for Non-US Annex I, 4% DR, 0% TR
Solvents (0.574 MMTCE)
Refrigeration/AC (35.699 MMTCE)
Aerosols (6.12 MMTCE)
Foams (4.594 MMTCE)
Fire (0.865 MMTCE)
$350
$300
$250
$200
$150
$100
$50
$-
$(50)
$(100)
$(150)
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

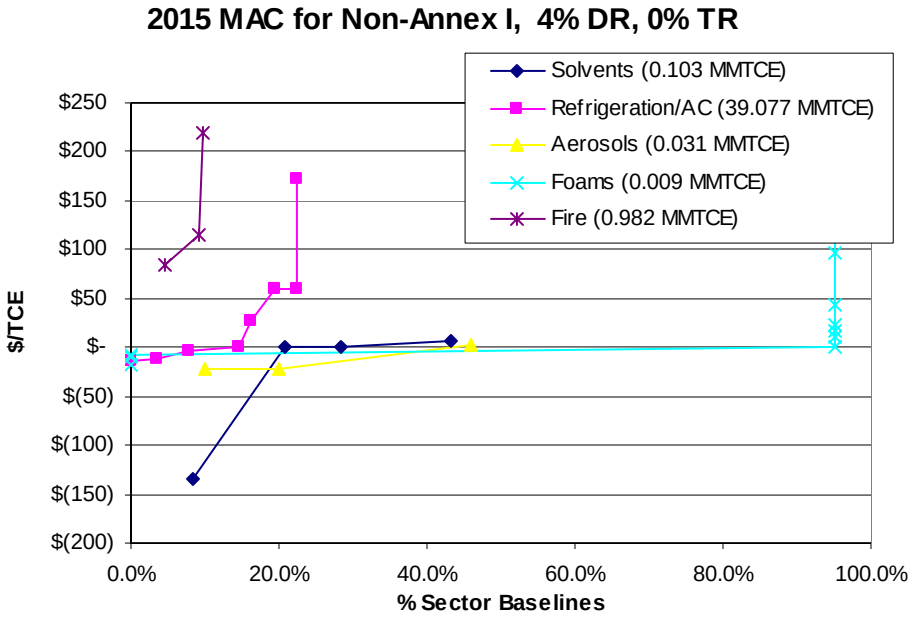

2015 MAC for Non-US Annex I, 20% DR, 40% TR
Solvents (0.574 MMTCE)
Refrigeration/AC (35.699 MMTCE)
Aerosols (6.12 MMTCE)
Foams (4.594 MMTCE)
Fire (0.865 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

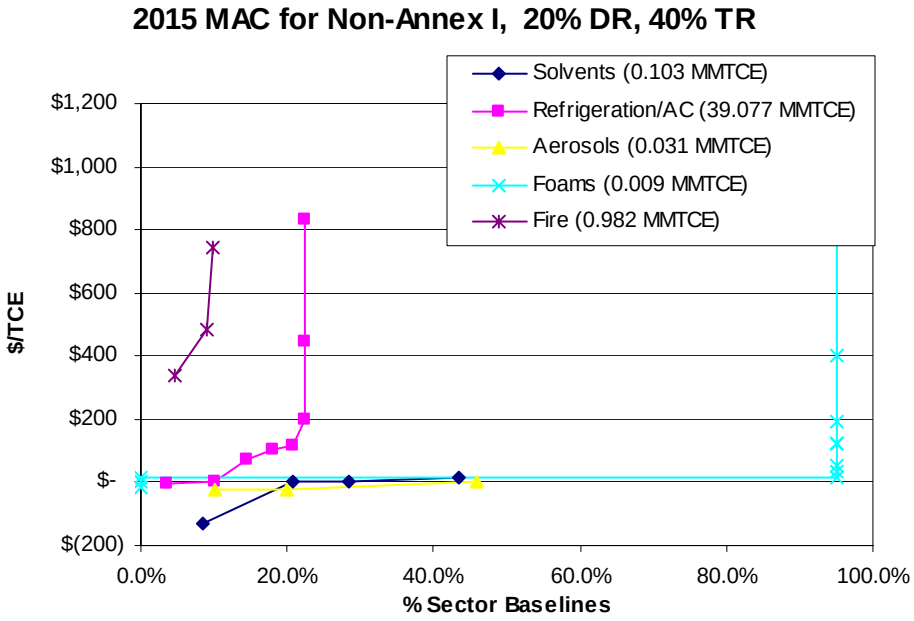

2020 MAC for Non-US Annex I, 4% DR, 0% TR
Solvents (0.576 MMTCE)
Refrigeration/AC (38.105 MMTCE)
Aerosols (6.711 MMTCE)
Foams (9.009 MMTCE)
Fire (0.94 MMTCE)
$350
$300
$250
$200
$150
$100
$50
$-
$(50)
$(100)
$(150)
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

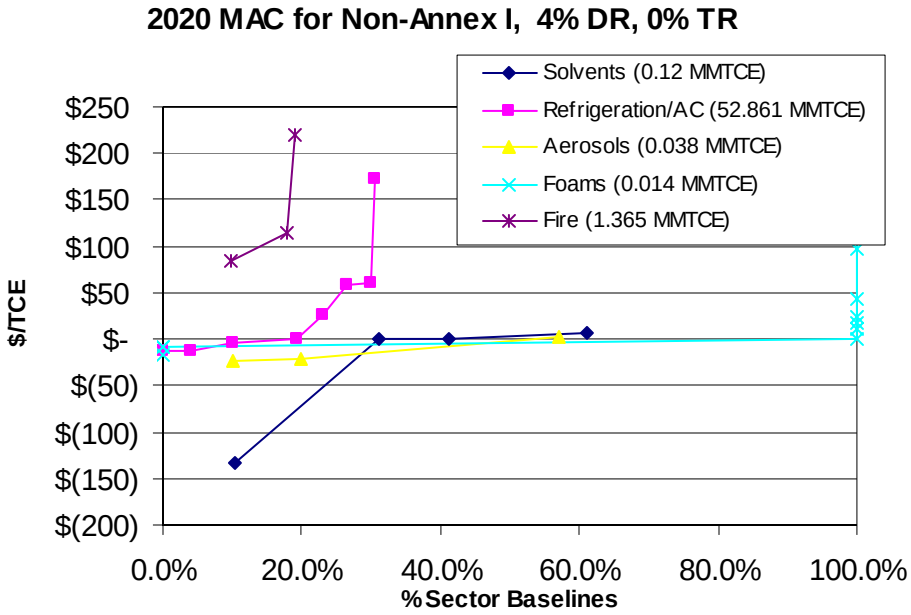

2020 MAC for Non-US Annex I, 20% DR, 40% TR
Solvents (0.576 MMTCE)
Refrigeration/AC (38.105 MMTCE)
Aerosols (6.711 MMTCE)
Foams (9.009 MMTCE)
Fire (0.94 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

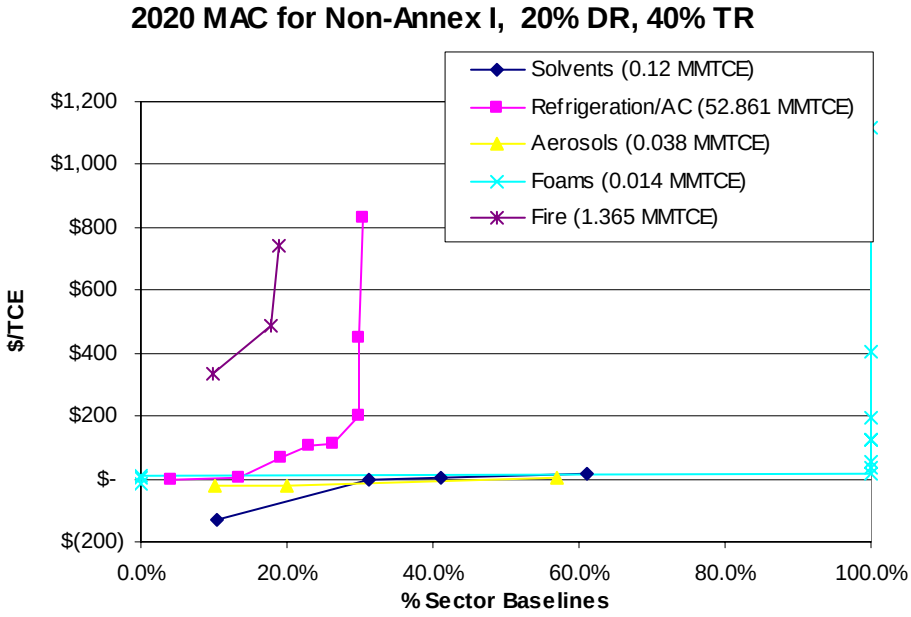

2010 MAC for Non-Annex I, 4% DR, 0% TR
Solvents (0.088 MMTCE)
Refrigeration/AC (28.766 MMTCE)
Aerosols (0.025 MMTCE)
Foams (0.006 MMTCE)
Fire (0.611 MMTCE)
$250
$200
$150
$100
$50
$-
$(50)
$(100)
$(150)
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines


2010 MAC for Non-Annex I, 20% DR, 40% TR
Solvents (0.088 MMTCE)
Refrigeration/AC (28.766 MMTCE)
Aerosols (0.025 MMTCE)
Foams (0.006 MMTCE)
Fire (0.611 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines


2015 MAC for Non-Annex I, 4% DR, 0% TR
Solvents (0.103 MMTCE)
Refrigeration/AC (39.077 MMTCE)
Aerosols (0.031 MMTCE)
Foams (0.009 MMTCE)
Fire (0.982 MMTCE)
$250
$200
$150
$100
$50
$-
$(50)
$(100)
$(150)
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines


2015 MAC for Non-Annex I, 20% DR, 40% TR
Solvents (0.103 MMTCE)
Refrigeration/AC (39.077 MMTCE)
Aerosols (0.031 MMTCE)
Foams (0.009 MMTCE)
Fire (0.982 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines


2020 MAC for Non-Annex I, 4% DR, 0% TR
Solvents (0.12 MMTCE)
Refrigeration/AC (52.861 MMTCE)
Aerosols (0.038 MMTCE)
Foams (0.014 MMTCE)
Fire (1.365 MMTCE)
$250
$200
$150
$100
$50
$-
$(50)
$(100)
$(150)
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines


2020 MAC for Non-Annex I, 20% DR, 40% TR
Solvents (0.12 MMTCE)
Refrigeration/AC (52.861 MMTCE)
Aerosols (0.038 MMTCE)
Foams (0.014 MMTCE)
Fire (1.365 MMTCE)
$1,200
$1,000
$800
$600
$400
$200
$-
$(200)
$/TCE
0.0%
20.0%
40.0%
60.0%
80.0%
100.0%
% Sector Baselines

Appendix G Global Warming Potential Values

G1. Comparison of GWPs and Lifetimes used in the SAR and the TAR

The IPCC recently published its Third Assessment Report (TAR), providing the most current and comprehensive scientific assessment of climate change. Within this report, the GWPs of several gases were revised relative to the IPCC's Second Assessment Report (SAR), and new GWPs have been calculated for an expanded set of gases. Since the SAR, the IPCC has applied an improved calculation of CO_2 radiative forcing and an improved CO_2 response function (presented in WMO 1999). The GWPs are drawn from WMO (1999) and the SAR, with updates for those cases where significantly different new laboratory or radiative transfer results have been published. Additionally, the atmospheric lifetimes of some gases have been recalculated. Because the revised radiative forcing of CO_2 is about 12 percent lower than that in the SAR, the GWPs of the other gases relative to CO_2 tend to be larger, taking into account revisions in lifetimes. In addition, the values for radiative forcing and lifetimes have been calculated for a variety of halocarbons that were not presented in the SAR. The table below presents both SAR and TAR atmospheric lifetime and GWP values.

Emissions for all gases presented in this report are estimated using SAR GWP values when these data are available. For those gases that do not have a SAR value (denoted by *NA* below), TAR values were used.

Based on international conventions used in preparing National Communications (inventories of greenhouse gas emissions) under the UNFCCC, ozone depleting substances are not included in emission totals; therefore, their GWPs are not shown below. The GWPs of hydrocarbons are relatively small and not included in emission totals in this report; therefore, their GWPs (except for methane) are not shown below.

	Lifetime (years)		GWP (100 year)			
Gas	SAR	TAR	SAR	TAR		Difference
Carbon dioxide (CO_2)	50-200	5-200[a]	1	1	NC	NC
Methane (CH_4)[b]	12±3	8.4/12[c]	21	23	2	10%
Nitrous oxide (N_2O)	120	120/114 [c]	310	296	(14)	-5%
Hydrofluorocarbons						
HFC-23	264	260	11,700	12,000	300	3%
HFC-32	5.6	5.0	650	550	(100)	-15%
HFC-41	3.7	2.6	150	97	(53)	-35%
HFC-125	32.6	29	2,800	3,400	600	21%
HFC-134	10.6	9.6	1,000	1,100	100	10%
HFC-134a	14.6	13.8	1,300	1,300	NC	NC
HFC-143	3.8	3.4	300	330	30	10%
HFC-143a	48.3	52	3,800	4,300	500	13%
HFC-152	NA	0.5	NA	43	NA	NA
HFC-152a	1.5	1.4	140	120	(20)	-14%
HFC-161	NA	0.3	NA	12	NA	NA
HFC-227ea	36.5	33.0	2,900	3,500	600	21%
HFC-236cb	NA	13.2	NA	1,300	NA	NA
HFC-236ea	NA	10	NA	1,200	NA	NA
HFC-236fa	209	220	6,300	9,400	3,100	49%
HFC-245ca	6.6	5.9	560	640	80	14%
HFC-245fa	NA	7.2	NA	950	NA	NA
HFC-365mfc	NA	9.9	NA	890	NA	NA
HFC-4310mee	17.1	15	1,300	1,500	200	15%
Fully Fluorinated Species						
SF_6	3,200	3,200	23,900	22,200	(1,900)	-7%

CF_4	50,000	50,000	6,500	5,700	(800)	-12%
C_2F_6	10,000	10,000	9,200	11,900	2,700	29%
C_3F_8	2,600	2,600	7,000	8,600	1,600	23%
C_4F_{10}	2,600	2,600	7,000	8,600	1,600	23%
c-C_4F_8	3,200	3,200	8,700	10,000	1,300	15%
C_5F_{12}	4,100	4,100	7,500	8,900	1,400	19%
C_6F_{14}	3,200	3,200	7,400	9,000	1,600	22%
Ethers and Halogenated Ethers						
CH_3OCH_3	NA	0.015	NA	1	NA	NA
$(CF_3)_2CFOCH_3$	NA	3.4	NA	330	NA	NA
$(CF_3)CH_2OH$	NA	0.5	NA	57	NA	NA
$CF_3CF_2CH_2OH$	NA	0.4	NA	40	NA	NA
$(CF_3)_2CHOH$	NA	1.8	NA	190	NA	NA
HFE-125	NA	150	NA	14,900	NA	NA
HFE-134	NA	26.2	NA	6,100	NA	NA
HFE-143a	NA	4.4	NA	750	NA	NA
HCFE-235da2	NA	2.6	NA	340	NA	NA
HFE-245cb2	NA	4.3	NA	580	NA	NA
HFE-245fa2	NA	4.4	NA	570	NA	NA
HFE-254cb2	NA	0.22	NA	30	NA	NA
HFE-347mcc3	NA	4.5	NA	480	NA	NA
HFE-356pcf3	NA	3.2	NA	430	NA	NA
HFE-374pcf2	NA	5.0	NA	540	NA	NA
HFE-7100	NA	5.0	NA	390	NA	NA
HFE-7200	NA	0.77	NA	55	NA	NA
H-Galden 1040x	NA	6.3	NA	1,800	NA	NA
HG-10	NA	12.1	NA	2,700	NA	NA
HG-01	NA	6.2	NA	1,500	NA	NA
Others[d]						
NF_3	NA	740	NA	10,800	NA	NA
SF_5CF_3	NA	>1,000	NA	>17,500	NA	NA
c-C_3F_6	NA	>1,000	NA	>16,800	NA	NA
HFE-227ea	NA	11	NA	1,500	NA	NA
HFE-236ea2	NA	5.8	NA	960	NA	NA
HFE-236fa	NA	3.7	NA	470	NA	NA
HFE-245fa1	NA	2.2	NA	280	NA	NA
HFE-263fb2	NA	0.1	NA	11	NA	NA
HFE-329mcc2	NA	6.8	NA	890	NA	NA
HFE-338mcf2	NA	4.3	NA	540	NA	NA
HFE-347-mcf2	NA	2.8	NA	360	NA	NA
HFE-356mec3	NA	0.94	NA	98	NA	NA
HFE-356pcc3	NA	0.93	NA	110	NA	NA
HFE-356pcf2	NA	2.0	NA	260	NA	NA
HFE-365mcf3	NA	0.11	NA	11	NA	NA
$(CF_3)_2CHOCHF_2$	NA	3.1	NA	370	NA	NA
$(CF_3)_2CHOCH_3$	NA	0.25	NA	26	NA	NA
-$(CF_2)_4CH(OH)$-	NA	0.85	NA	70	NA	NA

[a] No single lifetime can be determined for carbon dioxide. (See IPCC 2001)

[b] The methane GWP includes the direct effects and those indirect effects due to the production of tropospheric ozone and stratospheric water vapor. The indirect effect due to the production of CO_2 is not included.

[c] Methane and nitrous oxide have chemical feedback systems that can alter the length of the atmospheric response; in these cases, global mean atmospheric lifetime (LT) is given first, followed by perturbation time (PT).

[d] Gases whose lifetime has been determined only via indirect means or for whom there is uncertainty over the loss process.

Source: IPCC (2001)

NC (No Change)

NA (Not Applicable)

Appendix H List of Abbreviations

$/TCE	Dollars per Metric Ton of Carbon Equivalent
ABS	Acrylonitrile-Butadiene-Styrene
CAAA	Clean Air Act Amendments of 1990
CBM	Chlorobromomethane
CFC	Chlorofluorocarbon
COP	Coefficient of Performance
DPI	Dry Powder Inhaler
DX	Direct Expansion
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
GHG	Greenhouse Gas
GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
HBFC	Hydrobromofluorocarbon
HC	Hydrocarbon
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
HFE	Hydrofluoroether
HIPS	High-Impact Polystyrene
HTOC	Halon Technical Options Committee
HVAC	Heating, Ventilation, and Air-Conditioning
IMC	In-Mold Coating
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
kg	Kilogram
kWh	Kilowatt Hour
LCCP	Life Cycle Climate Performance
LCD	Liquid Carbon Dioxide
MAC	Marginal Abatement Cost, Marginal Abatement Cost Curve
MDI	Metered Dose Inhaler
MMTCE	Million Metric Tons of Carbon Equivalent
MVAC	Motor Vehicle Air Conditioning, Motor Vehicle Air Conditioner
NAECA	National Appliance Energy Conservation Act
NESHAP	National Emissions Standard for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NIK	Not-in-Kind
NPV	Net Present Value
O&M	Operation and Maintenance
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substance
PFC	Perfluorocarbon
PFPE	Perfluoropolyether
PU	Polyurethane
R&D	Research and Development
ROW	Rest of Wolrd
SNAP	Significant New Alternatives Policy
SOLAS	Safety of Life at Sea (a term of the International Maritime Organization)

TCE	Metric Ton of Carbon Equivalent
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	United Nations Environment Programme
VOC	Volatile Organic Compound
WMO	World Meteorological Organization
XPS	Extruded Polystyrene

Appendix I Glossary

Baseline Emissions. The emissions that occur or will occur without further regulations (i.e., "in the baseline") for a given source category, expressed in terms of GWP-weighted emissions of greenhouse gases, for example, in million metric tons of carbon equivalent (MMTCE).

Baseline Market Penetration. The market penetration of the option in the baseline. In most cases, this figure is assumed to equal zero in order to evaluate the incremental potential of an abatement option. Baseline market penetration for all options is assumed to be zero, except for the refrigerant recovery/recycling option, for which baseline market penetration is assumed to be 80 percent for Annex I countries, and 30 percent for non-Annex I countries.

Chlorofluorocarbons (CFCs). Compounds made up of atoms of carbon, chlorine, and fluorine. An example is CFC-12 (CCl_2F_2), used for example as a refrigerant in refrigerators and air conditioners and as a foam blowing agent. Because CFCs deplete the stratospheric ozone layer, they are being phased out by national regulations and international accords.

Global Warming Potential (GWP). An index used to translate the level of emissions of various gases into a common measure in order to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations. GWPs are calculated as the ratio of the radiative forcing that would result over a period of time (usually 100 years) from the emission of one kilogram of a greenhouse gas to that from the emission of one kilogram of carbon dioxide.

Greenhouse Gas (GHG). Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), ozone (O_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Based on international conventions used in preparing National Communications (inventories of GHG emissions) under the UNFCCC, ozone depleting substances such as CFCs and HCFCs are not included in GHG emission totals.

Halons. Compounds, also known as bromofluorocarbons, that contain bromine, fluorine, and carbon. They are generally used as fire extinguishing agents and cause ozone depletion. Bromine is many times more effective at destroying stratospheric ozone than chlorine.

Hydrocarbons (HCs). Substances containing only hydrogen and carbon. Some hydrocarbon compounds are major air pollutants and react readily to form ground-level ozone (smog). Hydrocarbons have short atmospheric lifetimes and very small GWPs.

Hydrochlorofluorocarbons (HCFCs). Compounds containing hydrogen, fluorine, chlorine, and carbon atoms. Although ozone depleting substances, they are less potent at destroying stratospheric ozone than chlorofluorocarbons (CFCs) and will be phased out at later dates. Many have been introduced as temporary replacements for CFCs.

Hydrofluorocarbons (HFCs). Compounds containing only hydrogen, fluorine, and carbon atoms. They were introduced as alternatives to ozone depleting substances in serving many industrial, commercial, and personal needs. HFCs are emitted as by-products of some industrial processes and are also used in manufacturing certain items. They do not deplete the stratospheric ozone layer, but they are powerful greenhouse gases with global warming potentials ranging from 140 (HFC-152a) to 11,700 (HFC-23).

Lifetime (atmospheric). The amount of time it would take for the anthropogenic increment to an atmospheric pollutant concentration to return to its natural level (assuming emissions cease) as a result of either being converted to another chemical compound or being taken out of the atmosphere via a sink.

This time depends on the pollutant's sources and sinks as well as its reactivity. The lifetime of a pollutant is often considered in conjunction with the mixing of pollutants in the atmosphere; a long lifetime will allow the pollutant to mix throughout the atmosphere. Average lifetimes can vary from about a week (e.g., sulfate aerosols) to more than a century (e.g., CFCs, PFCs and carbon dioxide).

Lifetime (k). The average technical lifetime of a technology or practice evaluated as an emission abatement option in this report.

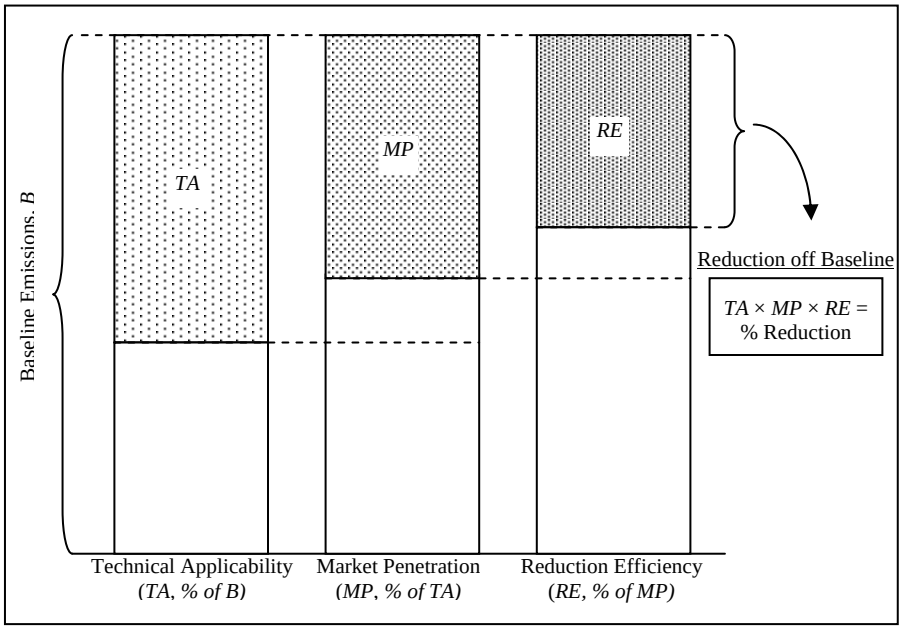
Market Penetration. See *Baseline Market Penetration* or *Maximum Potential Market Penetration.*

Maximum Potential Market Penetration. A sub-portion of the emissions to which a given option is applicable (see *Technical Applicability*), estimated based on economic/infrastructure factors. In most cases, maximum market penetration is estimated as the incremental penetration and the baseline market penetration is assumed to be zero to evaluate the emission abatement potential of an incremental use of a particular option that is already implemented in the baseline.

Ozone Depleting Substances (ODSs). A family of anthropogenic compounds that includes, but is not limited to, chlorofluorocarbons (CFCs), bromofluorocarbons (halons), methyl chloroform, carbon tetrachloride, methyl bromide, and hydrochlorofluorocarbons (HCFCs). Gaseous ODSs can deplete the ozone layer when they slowly rise into the stratosphere, are broken down by ultraviolet radiation, release chlorine or bromine atoms, and then react with ozone molecules. Based on international conventions used in preparing National Communications (inventories of GHG emissions) under the UNFCCC, ozone depleting substances are not included in GHG emission totals.

Percent Reduction from Baseline. The percent of baseline emissions that can be reduced at the national or regional level by a given option. This is the product of *Technical Applicability*, *Maximum Potential Market Penetration*, and *Reduction Efficiency* of the option. In the diagram below, this is represented by $TA \times MP \times RE$ (a percentage of B).

Perfluorocarbons (PFCs). A group of anthropogenic chemicals composed of carbon and fluorine only. These chemicals (predominantly CF_4 and C_2F_6), along with hydrofluorocarbons, were introduced as alternatives to the ozone depleting substances, but are used much less frequently than the HFCs. In addition, PFCs are emitted as by-products of some industrial processes and are also used in manufacturing certain items. PFCs do not harm the stratospheric ozone layer, but they are very powerful greenhouse gases: CF_4 has a global warming potential (GWP) of 6,500 and C_2F_6 has a GWP of 9,200.



Reduction Efficiency (RE). This term describes how efficient a particular option is at reducing the emissions to which it is finally applied. After an option is applied to a given emission

stream (considering both *Technical Applicability* and *Market Penetration*), the reduction efficiency shows the percentage of said stream effectively abated. RE is shown in the diagram above.

Technical Applicability (TA). Percent of total emissions from a particular emissions sector (e.g., refrigeration/air-conditioning, foams, solvents, etc.) to which a given option can be potentially applied (e.g., an option for motor vehicle air-conditioners can only be applied to the portion of refrigeration/ air-conditioning emissions represented by MVAC). TA is shown in the diagram above. For each country/region, technical applicability varies based on the percent of sector emissions from applicable end uses. Additionally, for the leak repair and refrigerant recovery/recycling options, only one-half of the emissions from applicable end uses are assumed to be abatable; for all other options, 100 percent of emissions from applicable end uses are assumed to be abatable.

Tons of Carbon Equivalent (TCE). A metric measure used to compare the emissions of the different greenhouse gases based upon their global warming potential (GWP). Greenhouse gas emissions are commonly expressed as "million metric tons of carbon equivalent" (MMTCE) or "tons of carbon equivalent" (TCE). Global warming potentials are used to convert kilograms of greenhouse gas emissions to carbon dioxide equivalent, which is then multiplied by 12/44 to express emissions in units of overall carbon content such as TCE.

Example Calculation of Percent Reduction from Baseline

The equation used to derive total emission reductions off the baseline for each option is as follows:

Emission Reduction = Technical Applicability × Incremental Maximum Potential Market Penetration × Reduction Efficiency

The following table provides a sample calculation using the option of leak repair for large equipment in the United States in 2020 as an example:

Sample Calculation of Emission Reductions: Leak Repair for Large Equipment--United States (2020)

Applicable End Uses	Technical Applicability[a]		Incremental Maximum Potential Market Penetration		Reduction Efficiency		Percent Reduction from 2020 Baseline
Chillers	1.6% * 50%		5%		95%		0.04%
Retail Food	41.6% * 50%		5%		95%		0.99%
Cold Storage	1.5% * 50%		5%		95%		0.04%
Industrial Process	7.0% * 50%		5%		95%		0.17%
Total	51.7% * 50%	×	5%	×	95%	=	1.23%[b]

[a] For each country/region, technical applicability varies based on the percent of sector emissions from applicable end uses. Additionally, for the leak repair and refrigerant recovery/recycling options, only one-half of the emissions from applicable end uses (i.e., large end-uses for leak repair; small end-uses for recovery/recycling) are assumed to be abatable; for all other options, 100 percent of emissions from new (post-2004) equipment in applicable end uses are assumed to be abatable.

[b] Totals may not sum due to independent rounding.