MONTREAL PROTOCOL

ON SUBSTANCES THAT DEPLETE

THE OZONE LAYER

UNEP

Technology and Economic Assessment Panel

ES	Executive Summary
1	Essential Use Nominations
2	Responses to Decisions
3	Sector Updates
4	Organisation of the TEAP and TOCs
	Glossary

April 1998 Report

Montreal Protocol On Substances that Deplete the Ozone Layer

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Co-ordination and organisation: **Sateeaved Seebaluck**

Assistance: Denise Lafitte

Final composition of the report: Gary Taylor

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Index

Section	Section Title	Page #
ES	**Executive Summary**	1
ES 1	Essential Use Nominations	1
ES 2	Adequacy of Halon Supplies for Essential Uses	2
ES 3	Uncontrolled Ozone Depleting Solvents with Potentail for Significant Production	4
ES 4	Military Progress	5
ES 5	Methyl Bromide Issues	5
ES 6	Aerosol Products Issues	5
ES 7	Foams Progress	7
ES 8	Mixtures of ODSs	7
ES 9	Table of Essential Use Recommendations	8
1	**Essential Use Nominations**	11
1.1	Introduction	11
1.2	Review of essential use nominations for MDIs	15
1.3	Review of an essential use nomination submitted by the Russian Federation	25
1.4	Review of an essential use nomination for solvents, coatings and adhesives	26
1.5	Laboratory uses	30
2	**Responses to Decisions**	37
2.1	Response to Decision IX/28:	37
	List of Mixtures Containing Controlled Substances	39
2.2	Response to Decisions VII/12 and IX/19: Final report on issues surrounding a transition to non-CFC-containing treatments for asthma and COPD and national transition strategies	49
2.3	Response to Decisions VIII/17 and IX/21	74
3	**Sector Updates**	115
3.1	Aerosols, Sterilants, Miscellaneous Uses and Carbon Tetrachloride	115
3.2	Economic Options Committee	129
3.3	Rigid and Flexible Foam	130
3.4	Halons	139
3.5	Methyl Bromide	141
3.6	Refrigeration, Air Conditioning and Heat Pumps	148
3.7	Solvents	150
3.8	Military Issues	153
4	**Organisation of the TEAP and TOCs**	169
4.1	TEAP membership background information	169
4.2	TEAP and TOC Members	174
	Glossary	189

ES Executive Summary

ES.1 Essential Use Nominations

The TEAP and its TOCs unanimously report the following findings on Essential Use Nominations. A table, summarising these findings, will be found at the end of this executive summary.

ES.1.1 CFCs for MDIs: Australia, Canada, European Union, Poland, and United States

Recommend the quantities nominated by Australia, the European Union, Poland, and the United States for use in MDIs only for the years 1999 and 2000 (but not for 2001-2004) with the condition that Parties dispense the CFCs as-needed, report all stockpiles suitable for use (whether produced prior to 1996 or as an essential use allocation), and continue to comply with the conditions specified in previous Decisions of the Parties.

Unable to recommend the nomination by Canada for 1999 for CFC intended for the introduction of seven new CFC MDI products because the nomination did not justify the quantities requested and because the nomination did not provide adequate information on the intended markets.

ES.1.2 Halon for fire-fighting

Recommend the quantities nominated by the Russian Federation of halon 2402 for 1999 with renewed instructions that the Russian Federation fully reports quantities and technical progress to the Secretariat.

ES.1.3 ODS Solvents: The European Union, Poland, and the United States

Recommend the quantities nominated by the European Union for use in coating cardiovascular surgical material for 1999 and 2000.

Unable to recommend the use nominated by Poland for maintenance of torpedoes on submarines because the nomination did not provide adequate information.

Recommend the request by the United States to reschedule the remaining authorized quantity of methyl chloroform for use in manufacturing solid rocket motors until such time that the allowance is depleted or until such time that safe alternatives are implemented for remaining essential use. The Solvents TOC will continue to monitor progress.

ES.1.4 Global Laboratory and Analytical Uses

TEAP and its TOC present two options for consideration by Parties:

1) Discontinue the global exemption for laboratory and analytical uses after 1999 but request Parties to submit separate applications for individual use through the annual essential use process.

2) Permit continuing global exemption until 2001, but prohibit up to three additional specific uses with identified alternatives and substitutes:

   i) testing of oil, grease, and total petroleum hydrocarbons in water;
   ii) testing of tar in road paving; and
   iii) forensic fingerprinting.

ES.2 Adequacy of Halon Supplies for Essential Uses

In response to Decisions VIII/17 and IX/21, TEAP and its HTOC studied the future availability of halons for critical applications to determine whether or not there is likely to be a surplus either overall, or available to individual Parties. TEAP and its TOC considered information provided by the Parties and from other published sources and undertook original investigations. The HTOC has significantly improved the Halon Bank model first published in the 1991 Assessment Report. The model has been updated to represent more accurately the distribution and emissions of halon using system/equipment design lifetime as the criterion. It was also adapted to reflect the different use patterns within; North America, Europe and Australia, and Japan. CEIT and Article 5(1) countries will be included in the final version of the model, to be provided in the next Assessment Report. The estimates provided in this report are based on a survey of halon sector experts. A description of the model, including its basic assumptions and detailed results, are included in the halon chapter of this report.

ES.2.1 Response for Halon 1211

Halon 1211 is mainly used in portable extinguishers. There are few critical applications for halon 1211 portable extinguishers; exceptions include aviation, military, and police uses. Analysis of the model, based on available information, indicates a more than adequate supply of halon 1211 from the installed base to meet the demands of these critical uses, resulting in a potential surplus. *By definition*, all non-critical halon 1211 applications can be decommissioned. HTOC estimates that up to 80 % (by weight) of all portable halon 1211 applications can be taken out of service.

Surplus halon 1211 can be taken out of service through voluntary management programmes or mandatory decommissioning incorporating collection, storage, and eventual destruction. Both approaches will require considerable expense and extensive management. Mandatory decommissioning would be particularly expensive and would require extensive control and support measures to ensure collection and to prevent illicit venting. Unless major cost subsidies are provided, HTOC believes that mandatory decommissioning has the potential to result in high early emissions at a time when the ozone layer is most fragile, as owners seek to avoid anticipated expenses. Under either approach provisions will have to be made to ensure enough halon 1211 continues to be available for the remaining critical uses.

Very little experience from destruction programmes is available. As of spring 1998, the only known destruction programme is operating in Australia. It is, however, too early to draw any conclusions regarding the costs associated with establishing and running a halon 1211 destruction facility, or the stability and reliability of the processes involved.

ES.2.2 Response for Halon 1301

Halon 1301 is almost exclusively used in fixed fire protection systems. Analysis of the halon bank model indicates that the global supply and demand for halon 1301 is currently in balance and will remain so over the next thirty years. The model analysis also indicates that halon 1301 has been and continues to be shifting from less critical applications to critical applications through decommissioning and recycling processes. This shift is the result of free market forces within the fire protection industry with varying degrees of government assistance or intervention. There were individual Parties that reported marginal surpluses or deficits but they were experiencing no difficulties redressing this balance through international trade.

The requirements reported by Parties and the assessment of existing data by HTOC are in agreement. HTOC draws the conclusion that the halon 1301 inventory or “Bank” as it has been referred to by HTOC, is being well managed by the fire protection community. The Bank is continuing to provide the necessary quantities of recycled material necessary to meet the needs of critical uses thereby eliminating the need for essential use production exemptions. This has been achieved through the commitments of Government in some Parties - by funding early work for starting banking and recycling activities or by enacting halon management regulations - and by national industries, who engaged voluntarily in the same work.

As supply and demand are fairly well balanced, both in individual Parties and globally, HTOC concludes that there is no need for additional efforts by the Parties to facilitate early decommissioning and subsequent halon 1301 collection for redeployment to critical uses. The success of market forces in balancing supply and demand, adopted by countries such as the UK or the USA, indicates that a regulatory approach is not essential, although regulatory approaches have also been successfully implemented in countries such as Japan, Australia, and Denmark.

ES.2.3 Response for Halon 2402

Halon 2402 was and continues to be used mainly in the Russian Federation and in other CEITs. As evidenced by the Russian Federation's repeated requests for essential use production exemptions, there is a current shortfall in availability of halon 2402 to meet critical needs. As indicated in HTOC evaluation of these requests, no banking scheme for halon 2402 is currently in place. HTOC therefore does not have the information to evaluate whether a potential exists for early decommissioning of halon 2402 systems to support ongoing critical needs.

ES.3 Uncontrolled Ozone-Depleting Solvents with Potential for Significant Production

In the April 1997 Solvents TOC progress report, Parties were informed that two substances with likely ODPs were being globally marketed — chlorobromomethane (CBM) and its derivative Borothene, and n-propyl bromide. The Science Assessment Panel has not reported the ODPs. Subsequent to Decision IX/*24: Control of new substances with ozone-depleting potential*, the Governments of the Netherlands and the United States and the Solvents TOC notified the Secretariat that n-propyl bromide was likely to have substantial production. The U.S. Government also submitted notification on the potential use of chlorobromomethane.

In May 1997 the U.S. Environmental Protection Agency proposed banning chlorobromomethane as a substitute for methyl chloroform and CFC-113 in solvent cleaning. This determination was based on the belief that CBM has a significant ozone depletion potential similar to that of methyl chloroform, plus consideration of potential toxicological effects. N-propyl bromide is also under review by U.S. EPA as an ODS replacement in solvent cleaning.

TEAP has learned the use of n-propyl bromide is also under consideration as an ODS replacement in fire suppression, aerosols, adhesives, coatings and inks applications.

Parties may wish to further consider the potential threat to the ozone layer from these new chemicals subject to the Science Assessment Panel determination of ODP.

ES.4 Military Progress

Military organisations in most developed countries have made impressive progress in eliminating all but essential ODS uses. However, important military uses remain for which no alternatives have yet been identified, especially for halons. Developed countries meet the critical remaining needs by reusing ODSs.

The first control measure for Article 5(1) Parties is 1999. Military organizations of developed countries are sharing their experiences with developing countries in implementing management practices, adopting alternatives and establishing ODS reserves to service ongoing critical uses. A number of international workshops on military ODS alternatives and management strategies have been sponsored by Australia, Canada and the US, and including sponsorship of Article 5(1) participants. In addition, technology co-operation with developing countries has already been highly successful. Examples include Mexico, Thailand, Turkey, and Malaysia.

Some Parties may have enacted domestic legislation restricting use of ODSs, but exempt their domestic military organisations. Unless exemptions apply to foreign military organisations operating within their jurisdictions, some compatibility issues among military organisations affect NATO, United Nations, and other multinational operations. Parties may wish to clarify their domestic legislation and regulations to avoid these problems.

ES.5 Methyl Bromide Issues

In response to Decision IX/7, TEAP calculated that 20 tonnes allocation of methyl bromide for emergency use is sufficient to treat a single very large mill, food processing facility, or cargo ship or is sufficient to treat about 50 hectares of soil.

ES.6 Aerosol Products Issues

For aerosol products, other than MDIs, there are no technical barriers to global transition to alternatives. In CEIT and Article 5(1) countries, the ATOC estimates that 1997 use of CFCs in aerosols, not including MDIs, was less than 15,000 tonnes.

Metered dose inhalers (MDIs) are reliable and effective therapy for respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD). As of March 1998, a number of pharmaceutical companies have introduced or plan to introduce CFC-free products as follows: Glaxo Wellcome has filed registration applications for both salbutamol HFC MDI and fluticasone propionate HFC MDI (125/250 mcg) in over 20 countries worldwide. A number of product approvals have been received and products launched in Denmark, Germany, Switzerland, Norway, France (fluticasone propionate only) and Greece (salbutamol only). Further product launches are anticipated in the coming year. 3M Pharmaceuticals has approvals for and is currently marketing salbutamol HFC MDI in over 40 countries. In the USA, salbutamol HFC MDI has been licensed to Schering Plough. 3M's beclomethasone HFC MDI has been submitted for approval in several countries with the first introduction anticipated during the second half of 1998. Under a further licence agreement, Hoechst Marion Roussell and 3M Pharmaceuticals have entered into a strategic marketing alliance to co-promote some of 3M's HFC MDI products. Rhone-Poulenc Rorer has filed applications for triamcinolone HFC MDI in the USA and Canada. Filings for di-sodium cromoglycate HFC MDI have been made in 21 European countries and in Japan. Boehringer Ingelheim's first submissions for reformulated products are scheduled during 1998. Ivax (Norton Healthcare) launched its first HFC MDI, beclomethasone dipropionate in Ireland in January 1998. The same product range is also approved in France and further international approvals are pending. Norton also expects to receive its first regulatory approvals for salbutamol HFC MDI before the end of 1998.

It is likely that a wide range of reformulated products will be available in many developed nations and transition will be making good progress by the year 2000. Minimal need for CFCs for MDIs is envisaged by the year 2005 in non-Article 5(1) Parties.

The ATOC does not believe that a rigid global transition strategy is appropriate in view of the widely differing circumstances of individual Parties. However, the Parties may wish to consider the benefits of a "Global Transition Framework" which would underpin national strategies and ensure that they are complementary. The ATOC recognises that no single national strategy will be applicable to all countries. The ATOC believes that all Parties, including CEIT and Article 5(1) Parties, should be encouraged to develop their own transition strategies.

In Article 5(1) Parties, the first control measure on the total consumption of CFCs commences in the year beginning July 1, 1999. Experts in India, Pakistan, China, and Brazil have identified similarities and country specific issues. In all countries evidence suggests that airway diseases of asthma and COPD are common and increasing in prevalence. Local manufacture by multinational firms and/or local firms is reported in these countries, with local products sometimes cheaper than those manufactured by multinational firms. In China sixteen million CFC MDIs were produced in 1996 and consumption of CFCs for use in MDIs totalled 400 tonnes. In India, 6 million MDI units are sold annually with an additional 3 million being exported by one Indian company to other Article 5(1) Parties. Since it is anticipated that in most Article 5(1) and CEIT Parties there will be an increasing number of patients newly receiving MDI therapies, it would be preferable for them to start on CFC-free products.

MDIs in Article 5(1) and CEIT Parties will be supplied by import of products or local production. Local production of CFC-free MDIs will require the transfer of new technologies and may require new licensing arrangements and transfer of intellectual property. The costs of such local production of CFC-free inhalers will thus involve capital costs and licensing arrangements. Multinational companies operating in Article 5(1) Parties could be encouraged by Parties to make the technology transfer as soon as possible. One company is already committing resources to install manufacturing capacity in Latin America (Brazil) and Eastern Europe (Poland) to manufacture HFC MDIs. These plants will be operational in the next couple of years and serve local and regional market needs.

ES.7 Foams Progress

CFC use has been eliminated in non-Article 5(1) countries with the exception of use in some CEIT countries. HCFC use is not expanding beyond thermal insulation applications. Next generation HFC alternatives for HCFCs are under development with some level of commercial production expected as early as 2000.

In Article 5(1) Parties, CFCs are widely available and generally much cheaper to use than currently available replacements. No major technical barriers have been identified for the phaseout of CFCs used in Article 5(1) Parties for foam products. However, three issues have been identified which may constrain or otherwise hamper the successful replacement of CFCs: price and availability of substitutes, problems faced by small- and medium-sized enterprises (SMEs), and long term safe use of any relatively more hazardous substitute.

ES.8 Mixtures of ODSs

An updated list of ODS blends and mixtures is supplied in this report in response to Decision IX/28.

ES.9 Table of Essential Use Recommendations

See the following pages.

Nominations made for consideration by the 10th Meeting of the Parties in 1998

Year Nominated	Country	Category	Chemical	For Year	Nominated Tonnes	Use	TEAP Action
1998	Australia	Aerosol	CFC-11	1999	45.0	MDI/COPD	Recommend
1998	Australia	Aerosol	CFC-11	2000	63.0	MDI/COPD	Recommend
1998	Australia	Aerosol	CFC-12	1999	90.0	MDI/COPD	Recommend
1998	Australia	Aerosol	CFC-12	2000	153.7	MDI/COPD	Recommend
1998	Australia	Aerosol	CFC-114	2000	3.3	MDI/COPD	Recommend
1998	Canada	Aerosol	CFC-11	1999	125.0	MDI/COPD	Unable to Recommend
1998	Canada	Aerosol	CFC-12	1999	200.0	MDI/COPD	Unable to Recommend
1998	Canada	Aerosol	CFC-114	1999	65.0	MDI/COPD	Unable to Recommend
1998	European Union	Aerosol	CFC-11	2000	1415.0	MDI/COPD	Recommend
1998	European Union	Aerosol	CFC-12	2000	2057.0	MDI/COPD	Recommend
1998	European Union	Aerosol	CFC-113	2000	6.0	MDI/COPD	Recommend
1998	European Union	Aerosol	CFC-114	2000	292.0	MDI/COPD	Recommend
1998	Poland	Aerosol	CFC-11	1999	120.0	MDI/COPD	Recommend
1998	Poland	Aerosol	CFC-11	2000	125.0	MDI/COPD	Recommend
1998	Poland	Aerosol	CFC-11	2001	130.0	MDI/COPD	Unable to Recommend
1998	Poland	Aerosol	CFC-11	2002	130.0	MDI/COPD	Unable to Recommend
1998	Poland	Aerosol	CFC-11	2003	140.0	MDI/COPD	Unable to Recommend
1998	Poland	Aerosol	CFC-11	2004	145.0	MDI/COPD	Unable to Recommend
1998	Poland	Aerosol	CFC-12	1999	235.0	MDI/COPD	Recommend
1998	Poland	Aerosol	CFC-12	2000	245.0	MDI/COPD	Recommend
1998	Poland	Aerosol	CFC-12	2001	255.0	MDI/COPD	Unable to Recommend
1998	Poland	Aerosol	CFC-12	2002	270.0	MDI/COPD	Unable to Recommend
1998	Poland	Aerosol	CFC-12	2003	275.0	MDI/COPD	Unable to Recommend
1998	Poland	Aerosol	CFC-12	2004	290.0	MDI/COPD	Unable to Recommend
1998	Poland	Aerosol	CFC-114	1999	25.0	MDI/COPD	Recommend
1998	Poland	Aerosol	CFC-114	2000	30.0	MDI/COPD	Recommend
1998	Poland	Aerosol	CFC-114	2001	35.0	MDI/COPD	Unable to Recommend
1998	Poland	Aerosol	CFC-114	2002	40.0	MDI/COPD	Unable to Recommend
1998	Poland	Aerosol	CFC-114	2003	45.0	MDI/COPD	Unable to Recommend
1998	Poland	Aerosol	CFC-114	2004	45.0	MDI/COPD	Unable to Recommend

Nominations made for consideration by the 10th Meeting of the Parties in 1998 (continued)

Year Nominated	Country	Category	Chemical	For Year	Nominated Tonnes	Use	TEAP Action
1998	United States	Aerosol	CFC-11	2000	1013.0	MDI/COPD	Recommend
1998	United States	Aerosol	CFC-12	2000	2391.0	MDI/COPD	Recommend
1998	United States	Aerosol	CFC-114	2000	331.0	MDI/COPD	Recommend
1998	European Union	Solvent	CFC-113	1999	0.1	Surgical Devices	Recommend
1998	European Union	Solvent	CFC-113	2000	0.1	Surgical Devices	Recommend
1998	Poland	Solvent	CFC-113	1999	1.7	Torpedo Maintenance	Unable to Recommend
1998	Poland	Solvent	CFC-113	2000	1.7	Torpedo Maintenance	Unable to Recommend
1998	Poland	Solvent	CFC-113	2001	1.7	Torpedo Maintenance	Unable to Recommend
1998	Poland	Solvent	CFC-113	2002	1.7	Torpedo Maintenance	Unable to Recommend
1998	Poland	Solvent	CFC-113	2003	1.7	Torpedo Maintenance	Unable to Recommend
1998	Russian Federatio	Halon	Halon 2402	1999	160.0	Defense/Aviation	Recommend
1998	United States	Solvent	MC	*	0.0	Rocket/Shuttle	Recommend*
1998	Global	Lab/Analytica	All	2000	-	Lab/Analytical	Recommend**
1998	Global	Lab/Analytica	All	2001	-	Lab/Analytical	Recommend**

* It is not requested that the quantity already allocated be changed. It is requested and unanimously recommended by the TEAP and its TOC that the remaining authorized quantity of methyl choloroform be made available for use in manufacturing solid rocket until such time that the 1999-2001 quantity of 176.4 tonnes (17.6 ODP-weighted tonnes) allowance is depleted, or until such time as safe alternatives are implemented for remaining essential uses.

** Two recommended options are presented to Parties:

(1) Continuing exemption for 2000 and 2001 further disallowing:

(I) testing of oil, grease and total petroleum hydrocarbons in water,
(ii) testing of tar in road paving, and
(iii) forensic fingerprinting.

or

(2) Continued exemption after 2001 by separate nomination by Parties.

1 Essential use nominations

1.1 Introduction

The adjustments adopted at Copenhagen by the Fourth Meeting of the Parties to the Montreal Protocol mandated a phaseout of production and consumption of CFCs, carbon tetrachloride, 1,1,1-trichloroethane and other fully halogenated controlled substances by January 1 1996. Parties have the ability to designate uses as essential. Decision IV/25 of the Fourth Meeting of the Parties set the criteria and the procedure for assessing an essential use and requested each Party to nominate uses considered essential, at least nine months prior to the 6th Meeting of the Parties to the Protocol, to be held in 1994. This decision also requested the TEAP and its TOCs to consider and make recommendations on the nominations. Only nominations requesting specific production/ consumption exemptions for a specific time period were to be assessed by the TEAP and its TOCs.

Essential Use nominations are considered for exemptions on an annual basis. Exemptions granted for more than one year (if any) are still subject to the review provisions described in paragraph 5 of Decision IV/25. Therefore, Parties, which are given multiple year exemptions, should update their nomination annually to facilitate that review.

The criteria for essential use set by Decision IV/25 have two important elements. Each Party should demonstrate that:

1. *The proposed CFC use is necessary for the health, safety or the functioning of society (encompassing cultural and intellectual aspects); and*

   There are no available technically and economically feasible alternatives or substitutes that are acceptable from the standpoint of environment and health; and

2. *Production and consumption if any, of a controlled substance should be permitted only if:*

   All economically feasible steps have been taken to minimise the essential use and any associated emission of the controlled substance; and

   The controlled substance is not available in sufficient quantity and quality from existing stocks of banked or recycled controlled substances, also bearing in mind the Article 5(1) countries need for controlled substances.

Summary tables of TEAP recommendations regarding nominations made for consideration by the 10th Meeting of the Parties in 1998 will be found at the end of the Executive Summary section of this report. The tables on the following pages present the accounting frameworks submitted to date by Parties for essential uses, other than laboratory and analytical applications, for 1996 and 1997.

Reporting accounting framework for Essential Uses other than Laboratory and Analytical Applications 1996

A	B	C	D	E		F (D+E)	G (C-F)	H 1	I (H+F)	J	K	L	M (I-J-L)
Year of essential Use	Ozone Depleting Substance	Amount exempted for year of essential use	Amount acquired by production	Amount acquired for essential uses by imports	Countries of Manufacture	Total acquired for essential use	Authorized but not acquired	On hand start of year				Destroyed	On hand end of year
AUSTRALIA													
1996	CFC-11	72.5	0	68.52	Netherlands	68.52	3.98	2.317	70.837	69.697	12.531	0	1.14
1996	CFC-12	183.7	0	18.29	Spain	180.76	2.94	3.242	184.002	173.282	35.457	0	10.72
				162.47	Netherlands								
1996	CFC-114	3.3	0	3.23	Spain	3.23	0.07	0.572	3.802	1.908	1.157	0	1.894
TOTAL AUSTRALIA		**259.5**	**0**	**252.51**		**252.51**	**6.99**	**6.131**	**258.641**	**244.887**	**49.145**	**0**	**13.754**
CANADA													
1996	CFC-11	152	0	39	USA	39	113	11	50	42	0	0	8
1996	CFC-12	377	0	85	USA	85	292	16	101	84	0	0	17
1996	CFC-114	70	0	5	USA	5	65	2	7	0	0	0	7
TOTAL CANADA		**599**	**0**	**129**		**129**	**470**	**29**	**158**	**126**	**0**	**0**	**32**
CZECH REPUBLIC													
1996	CFC-11	33.4	0	19.5	Netherlands	19.5	13.9	0	19.5	19.5	0	0	0
1996	CFC-12	18.2	0	19.9	Netherlands	19.9	-1.7	0	19.9	19.9	0	0	0
1996	CFC-113	0.15	0	0		0	0.15	0	0	0	0	0	0
1996	CFC-114	16.7	0	2.4	France	2.4	14.3	0	2.4	2.4	0	0	0
1996	HBFC-22B1	1.5	0	0		0	1.5	0	0	0	0	0	0
1996	Halon 1211	0.3	0	0		0	0.3	0	0	0	0	0	0
1996	Halon 1301	5.2	0	0		0	5.2	0	0	0	0	0	0
1996	Halon 2402	2	0	0		0	2	0	0	0	0	0	0
TOTAL CZECH REP.		**69.95**	**0**	**41.8**		**41.8**	**28.15**	**0**	**41.8**	**41.8**	**0**	**0**	**0**
EUROPEAN UNION													
1996	CFC-11	2363	1820	0		1820	543	474	2994	1690	480	85	519
1996	CFC-12	4327	3121	0		3121	1206	1885	5006	2761	896	150	2095
1996	CFC-113	68	0	0		0	68	0	0	0	0	0	0
1996	CFC-114	784	262	0		262	522	962	1224	371	153	12	841
TOTAL EU		**7542**	**5203**	**0**		**5203**	**2339**	**3321**	**9224**	**4822**	**1529**	**247**	**3455**
HUNGARY													
1996	CFC-11	5					5	2.413	2.413	0.198	0.104	0	2.215
1996	CFC-12	2					2	6.737	6.737	5.563	3.84	0.1	1.074
1996	CFC-113	1					1	1.038	1.038	0.083	0.055	0	0.955
1996	CFC-114	2					2	6.68	6.68	5.748	3.84	0.1	0.832
TOTAL HUNGARY		**10**					**10**	**16.868**	**16.868**	**11.592**	**7.839**	**0.2**	**5.076**

Reporting accounting framework for Essential Uses other than Laboratory and Analytical Applications 1996 (continued)

A	B	C	D	E		F (D+E)	G (C-F)	H 1	I (H+F)	J	K	L	M (I-J-L)
Year of essential Use	Ozone Depleting Substance	Amount exempted for year of essential use	Amount acquired by production	Amount acquired for essential uses by imports	Countries of Manufacture	Total acquired for essential use	Authorized but not acquired	On hand start of year				Destroyed	On hand end of year
JAPAN													
1996	CFC-11	75	0	14.2	UK	14.2	60.75	0	14.2	14.2	0	0	0
			0	0.05	France	0.05		0	0.05	0.05	0	0	0
1996	CFC-12	142	0	30.58	UK	30.58	111.37	0	30.58	30.58	0	0	0
1996				0.05	France	0.05		0	0.05	0.05	0	0	0
	CFC-113	1	0	0.054	UK	0.054	0.946	0	0.054	0.054	0	0	0
TOTAL JAPAN		**218**		**44.934**		**44.934**	**173.066**	**0**	**44.934**	**44.934**	**0**	**0**	**0**
POLAND													
1996	CFC-11	330	0	276.4	*	276.4	53.6	75.4	351.8	253.1	51.8	0	98.7
1996	CFC-12	330	0	253.2	**	253.2	76.8	74.2	327.4	252.8	82.4	0	74.6
1996	CFC-114	40	0	21.7	***	21.7	18.3	5.8	27.5	20.7	6.9	0	6.8
TOTAL POLAND		**700**	**0**	**551.3**		**551.3**	**148.7**	**155.4**	**706.7**	**526.6**	**141.1**	**0**	**180.1**
RUSSIAN FEDERATION													
1996	Halon 2402	352	152			152	200	184	336	336			
TOTAL RUS FED.		**352**	**152**			**152**	**200**	**184**	**336**	**336**			
SWITZERLAND													
1996	CFC-11	8	0	0.73	Germany	0	8	0.3	0.3	0.2	0	0	0.1
1996	CFC-12	8	0	0.45	Germany	0.73	7.3	0.23	0.96	0.4	0	0	0.56
1996	CFC-114	8	0			0.45	7.9	0.16	0.31	0.15	0	0	0.16
TOTAL SWITZERLAND		**24**	**0**	**1.18**		**1.18**	**23.2**	**0.69**	**1.57**	**0.75**	**0**	**0**	**0.82**
UNITED STATES													
1996	CFC-11	1077.8	545	231.6	EU	776.6	301.2		776.6	685.1	3.4	0	91.5
1996	CFC-12	2795.2	899.1	435.7	EU	1334.8	1460.4		1334.8	1568.8	10.1	0	-234
1996	CFC-114	362.7	97	0	-	97	265.7		97	114.1	0.9	0	-17.1
TOTAL U.S.		**4235.7**	**1541.1**	**667.3**		**2208.4**	**2027.3**	******3300**	**2208.4**	**2368**	**14.4**	**0**	**-159.6**

* Spain, The Netherlands, United Kingdom
** The Netherlands, United Kingdom, Spain, Russian Federation
*** The Netherlands, United Kingdom
**** These quantities are estimates. The U.S. will provide actual data as soon as possible.

Reporting accounting framework for Essential Uses other than Laboratory and Analytical Applications 1997

A	B	C	D	E		F (D+E)	G (C-F)	H 1	I (H+F)	J	K	L	M (I-J-L)
Year of essential Use	Ozone Depleting Substance	Amount exempted for year of essential use	Amount acquired by production	Amount acquired for essential uses by imports	Countries of Manufacture	Total acquired for essential use	Authorized but not acquired	On hand start of year				Destroyed	On hand end of year
AUSTRALIA													
1997	CFC-11	56	0	51.8	Netherlands	51.8	2.8	73.6	126.8	93	24.15	0.084	33.8
1997	CFC-12	135.7	0	113.2	Netherlands	129.265	6.435	157.11	286.375	196.06	63.394	0.694	88.7
				16.065	Spain								
1997	CFC-114	3.3	0	2.835	Spain	2.835	0.465	1.89	4.725	2.04	1.09	0.01224	2.4
TOTAL	**AUSTRALIA**	**195**	**0**	**183.9**		**183.9**	**9.7**	**232.6**	**417.9**	**291.1**	**88.634**	**0.79024**	**124.9**
CANADA													
1997	CFC-11	164	0	46	USA	46	118	9	55	44	1.5	0.3	11
1997	CFC-12	404	0	90	USA	90	314	17	107	88	3.5	0.3	19
1997	CFC-114	80	0	0	USA	0	80	7	7	0.3	0	0	7
TOTAL	**CANADA**	**648**	**0**	**136**		**136**	**512**	**33**	**169**	**132.3**	**5**	**0.6**	**37**
HUNGARY													
1997	CFC-11	5					5	2.215	2.215	1.163	0.083	0.084	0.968
1997	CFC-12	2		1.96	*Spain	1.96	0.04	1.074	3.034	1.958	1.316	0.023	1.053
1997	CFC-113	1					1	0.955	0.955	0.055			0.9
1997	CFC-114	2		1.96	*Spain	1.96	0.04	0.832	2.792	1.716	1.316	0.023	1.053
TOTAL	**HUNGARY**	**10**					**6.08**	**5.076**	**8.996**	**4.892**	**2.715**	**0.13**	**3.974**
JAPAN													
1997	CFC-11	57	0	14.2	UK	14.2	42.75	0	14.2	14.2	0	0	0
1997			0	0.05	France	0.05		0	0.05	0.05	0	0	0
1997	CFC-12	147	0	30.58	UK	30.58	116.37	0	30.58	30.58	0	0	0
1997				0.05	France	0.05		0	0.05	0.05	0	0	0
1997	CFC-113	0.8	0	0.054	UK	0.054	0.746	0	0.054	0.054	0	0	0
TOTAL	**JAPAN**	**204.8**	**0**	**44.934**		**44.934**	**159.866**	**0**	**44.934**	**44.934**	**0**	**0**	**0**
POLAND													
1997	CFC-11	130		98	Holland	98	32	37.5	135.5	105.1	43.2		30.4
1997	CFC-12	220		193.7	Holland	193.7	26.3	42	235.7	194.5	88.8		41.2
1997	CFC-114	30		13.2	Holland	13.2	16.8	6.8	20	14.6	3.1		5.4
TOTAL	**POLAND**	**380**	**0**	**304.9**		**304.9**	**75.1**	**86.3**	**391.2**	**314.2**	**135.1**	**0**	**77**
SWITZERLAND													
1997	CFC-11	2	0	0.3	Germany	0.3	1.7	0.1	0.4	0.2	0	0	0.2
1997	CFC-12	4	0	0		0	4	0.56	0.56	0.4	0	0	0.16
1997	CFC-114	2	0	0		0	2	0.16	0.6	0.15	0	0	0.01
TOTAL	**SWITZERLAND**	**8**	**0**	**0.3**		**0.3**	**7.7**	**0.82**	**1.56**	**0.75**	**0**	**0**	**0.37**

*These substances were imported from Spain, however the country of manufacture is probably China.

1.2 Review of essential use nominations for MDIs

Decision IV/25 of the Fourth Meeting and subsequent Decisions V/18, VII/28, VIII/9, VIII/10 set the criteria and the process for the assessment of essential use nominations for metered dose inhalers (MDIs

1.2.1 Review of Nominations

The review by the Aerosols, Sterilants, Miscellaneous Uses and CTC Technical Options Committee (ATOC) was conducted as follows. Three members of the ATOC independently reviewed each nomination. Members prepared preliminary reports, which were forwarded to the Co-Chair. The full committee considered the results of these assessments and this report drafted. For nominations where some divergence of view is expressed, additional expertise is sought.

Concurrent with the evaluation being undertaken by the ATOC, copies of all nominations were provided to each member of the Technology and Economic Assessment Panel (TEAP). TEAP members were able to consult with other appropriate individuals or organisations in order to assist in the review and to prepare the TEAP recommendations to the Parties.

1.2.2 Committee Evaluation and Recommendations

Nominations were assessed against the guidelines of the Essential Uses Handbook 1997 as developed by the TEAP. Further information was requested where nominations were found to be incomplete.

The ATOC reviewed all of the submitted nominations for a production exemption. Production in this context includes import of ozone depleting substances for the purposes of manufacture.

The following Parties nominated essential use production exemptions for MDIs (asthma/COPD)

Country	1999	2000	2001	2002	2003	2004
Australia	X*	X				
Canada	X					
European Union		X				
Poland		X	X	X	X	X
USA		X				

* Supplementary nomination to quantities nominated and approved by the Parties at their 9th Meeting.

The ATOC noted that the Russian Federation did not request an Essential use nomination, although there is MDI production in the Russian Federation and a nomination was granted for 1998.

1.2.3 Observations on the Process

Nominations received in 1998 again varied in completeness. Most Parties had to be asked for additional information, some of which was still not available for consideration at the ATOC meeting.

As in the previous year, some applications had significant omissions making it difficult for the ATOC to make recommendations. All Parties are encouraged to ensure that future nominations fully comply with the requirements of the Handbook on Essential Use Nominations 1997. In particular the TEAP and its TOCs requests complete information on actual use of CFCs and levels of CFC stock (whether these stocks are from production prior to 1996 or acquired as an essential use allocation) in the years prior to nomination.

Previously the ATOC noted that it did not anticipate receiving any further applications for new products containing CFCs. Nevertheless, one Party submitted a nomination for a considerable volume of CFC for seven new MDI products; the TEAP and the ATOC were unable to recommend this application.

1.2.4 Future Considerations

Under Decision VIII/9 Parties are requested to submit detailed reporting under the accounting framework for essential uses, other than laboratory and analytical applications. Parties were encouraged to report these data for 1996 and 1997 in their nominations submitted in January 1998. All submissions were incomplete and some Parties did not submit data for 1997. This made it difficult for the ATOC to assess whether future nominations were reasonable, based on past usage. The ATOC strongly requests complete information for 1996, 1997 and 1998 to be submitted with nominations in January 1999. This will enable the ATOC to fulfil its obligations under Decision IV/25.

The ATOC notes that strategic reserves representing at least 12 months use appear to exist. The ATOC suggests that Parties may wish to consider that future nominations should seek to reduce this strategic reserve to a maximum of 12 months; any exceptions to this limit would require appropriate justification. Individual Parties should aim to adjust their allocation according to the appropriate level of their strategic reserve. The appropriate level of reserve should reduce in parallel with the diminishing use. Individual Parties may choose to use the CFC licensing process to accomplish this objective within their country.

The ATOC recognises that strategic reserves may be unequally distributed between companies. A Party may wish to use their CFC allocation flexibly between companies to effectively manage stockpile reduction to an appropriate level. In addition, Parties may wish to consider developing a process that allows movement of CFCs between MDI manufacturers, provided they have an authorised essential use exemption.

One Party requested that nominations be for total CFC rather than specified by individual CFCs. This would allow greater flexibility to switch allowances between CFCs according to manufacturing needs. The ATOC still requests that Parties' nominations contain details of individual CFCs. However, as it would have a negligible effect on ozone depletion, the ATOC recommends that current and future nominations be assessed and recommended for total CFC volumes.

The ATOC noted a lack of information provided in nominations on the recent introduction of new DPI products into many of the nominating country markets. Little consideration was given in nominations to the consequent impact of DPI market penetration on CFC use for the manufacture of MDIs in future years. It might be expected that by 2000, the year for which many nominations were made, there would be some noticeable impact from new market entries during 1997/98. In future years, the ATOC requests Parties' justifications for essential use exemptions for the quantities nominated to include greater consideration of the impact of the introduction of these products.

The ATOC also noted that Parties provided little information on the export destinations of the proposed CFC MDIs to be manufactured using CFC volumes requested in nominations. One Party submitted a nomination for a considerable volume of CFC for seven new MDI products, mainly destined for export, and did not clearly identify the ultimate destination of these new products. There appears to be no additional need for new CFC MDIs in markets where the supply of CFC MDIs is adequate and when alternatives are already being introduced. Without adequate information, the TOC was unable to recommend this application, as neither the case for essentiality nor the volume requested were sufficiently justified.

This Party's nomination was transparent thus allowing a decisive ATOC finding, but similar situations may be inconspicuous in other nominations. The ATOC asks Parties preparing nominations to request companies to provide information on export markets and provide greater justification for the quantities being requested for those export markets. This will enable the ATOC to fulfil its obligations for the Parties under Decision IV/25. Parties may also wish to consider the advantages of avoiding oversupply of CFC MDIs by prohibiting allocations in all such situations.

Circumstances where the TOC may be unable to recommend or may not recommend essential use exemptions under Decision IV/25

1. Where justifications provided in nominations are considered inadequate in response to the essential use criteria of Decision IV/25.
2. Where inadequate information has been supplied on projected market penetrations of new CFC-free products for the year of the nomination and

subsequent years (e.g. no, or vague, estimates of projected market penetrations for HFC MDIs and DPIs).

3. Where the nomination is for production of CFC MDIs for sale in markets where adequate supplies are already available and the transition to CFC-free MDIs is at hand. Justification of the quantities requested and an analysis of the importing markets essential need for CFC MDIs are required to respond to Decision IV/25(1)(a) which states,

   "...that a use of a controlled substance should qualify as "essential" only if:

   (i) it is necessary for the health, safety or is critical for the functioning of society (encompassing cultural and intellectual aspects); and

   (ii) there are no available technically and economically feasible alternatives or substitutes that are acceptable from the standpoint of environment and health;"

4. Where the nomination is for new production facilities to produce CFC MDIs for sale in markets where adequate supplies are already available. Justification of the quantities requested and an analysis of the essential need for CFC MDIs are required to respond to Decision IV/25(1)(a).

5. Where the nomination does not adequately address Decision IV/25(1)(b)(ii) which states that controlled substances for essential use should be permitted only if:

   "the controlled substance is not available in sufficient quantity and quality from existing stocks of banked or recycled controlled substances, also bearing in mind the developing countries' need for controlled substances;"

   The ATOC suggests that Parties may wish to consider that future nominations seek to reduce strategic reserves to a maximum of 12 months; any exceptions to this limit would require appropriate justification. Individual Parties should aim to adjust their allocation according to the appropriate level of their strategic reserve. The appropriate level of reserve should reduce in parallel with the diminishing use. Individual Parties may choose to use the CFC licensing process to accomplish this objective within their country.

1.2.5 Recommendations: Individual Country

Australia

ODS/Year	**1999**	**2000**
CFC-11	45	63
CFC-12	90	154
CFC-114	0	3.3
Total	***135**	**220**

* Revised total for 1999 is 309 tonnes.

Specific Usage: MDIs for asthma and COPD

Recommendation: Recommend exemption

Comments:
This nomination covers two elements, a supplemental request for 1999 and a full year request for 2000. The supplemental request is justified based on the unexpected delays in the introduction of CFC-free MDIs. This was not anticipated when the original nomination was made. The projected increase over 1998 (estimated 279 metric tonnes to 309 metric tonnes) is in line with increased use of MDIs globally (*circa* 10%).

Furthermore, the nominated amount for 2000 is a 29% decrease on 1999, presumably based on successful product introductions in early 1999. This projected reduction is encouraging.

Canada

ODS/Year	**1999**
CFC-11	125
CFC-12	200
CFC-114	65
Total	**390**

Specific Usage: MDIs for asthma/COPD

Recommendation: Unable to recommend

Comments:
This nomination is for use of CFCs by a new manufacturer that has stated an intention to produce a wide range of CFC containing MDIs mainly for export to Mexico, Peru and other unspecified countries in 1999. Most of these products do not appear yet to be in production and the company did not use the CFCs they requested for 1997. The information supplied does not justify the quantities requested for 1999. There appears to be no additional need for the new CFC

MDIs in markets where the supply of CFC MDIs is adequate and when alternatives are already being introduced. Without adequate information on the markets to which this new product will be exported, the case for essentiality is therefore not sufficiently justified.

European Union

ODS/Year	**2000**
CFC-11	1415
CFC-12	2057
CFC-113	6
CFC-114	292
Total	**3770**

Specific Usage: MDIs for asthma and COPD

Recommendation: Recommend exemption

Comments:
The ATOC welcomes the significant reduction for 2000 on the previous years (24% reduction on 1999 approved nomination and 47% reduction on actual usage in 1995).

The ATOC suggests that the European Union consider nominating less than the projected needs in order to commensurately reduce CFC stockpiles as the transition proceeds (refer also to previous comments on strategic reserves).
The ATOC notes a large discrepancy between the 1996 usage figures reported in the 2000 nomination versus the 1996 accounting framework and requests the European Union to clarify this reporting discrepancy.

The European Union has experienced some difficulties in managing the allocation to companies of the various CFCs due to greater than foreseen variation in the demand mix. As the Parties agreed to specific quantities of each CFC separately, the European Union have been unable to switch allowances between CFCs even though such a switch would have no overall effect on ozone depletion. As recommended above for all nominations, the ATOC therefore recommends approval of the total volume of 3770 metric tonnes for the European Union for 2000, to allow flexibility within the allocation of the approved quantities of individual CFCs.

Given the expectation in the European Union nomination, that by the year 2000 there should be no further need for CFC-containing MDIs in the Community, the ATOC would expect any nominations received from the European Union for years beyond 2000 to be significantly smaller in volume.

Poland

ODS/Year	1999	2000	2001	2002	2003	2004
CFC-11	120	125	130	130	140	145
CFC-12	235	245	255	270	275	290
CFC-114	25	30	35	40	45	45
Total	**380**	**400**	**420**	**440**	**460**	**480**

Specific Usage: MDIs for asthma and COPD

Recommendation: Recommend exemption for 1999 and 2000 only.

Comments:
1999 nomination for 380 metric tonnes is not dissimilar to the 395 metric tonnes reported usage for 1993 (in subsequent years usage was smaller reflecting political and economic circumstances within the country). Many of the MDIs produced are exported to other CEIT where there is increasing prevalence of airway disease and increasing understanding of the importance of the inhaled route of administering medication.

The ATOC noted that recent acquisition of local manufacturing facilities by a multinational company would enhance the production of HFC MDIs in Poland and accelerate setting up such a production facility.

The nomination is recommended for 1999 and 2000 only. Poland may nominate production exemptions for years after 2000 when better knowledge is available of the impact of the introduction of CFC-free products into the Polish MDI market and the markets it supplies.

USA

ODS/Year	2000
CFC-11	1013
CFC-12	2391
CFC-114	331
Total	**3735**

Specific Usage: MDIs for asthma and COPD

Recommendation: Recommend exemption.

Comments
The ATOC notes that the nominated volume for the year 2000 was large compared to the historical use data from 1996. Further information on actual use from 1997 might have helped explain this apparent discrepancy (and such data will be expected in future years' nominations). Greater justification of the apparently large volumes, including a detailing of the underlying assumptions, will be required next year. Additionally, the ATOC would like the justification to include consid-

eration of the impact of the introduction of three new multi-dose DPIs to the US market in early 1998.

A precise account of actual CFC stockpiles (both free circulation and materials obtained under essential use) is needed for the years 1996 and 1997. The United States has reported that these data will be available by the end of April 1998, in time for review prior to the July OEWG.

This nomination will be closely reviewed in 1999 when additional information is provided, with a view towards adjusting the nominated volume, if necessary.

1.2.6 Review of Previously Authorised Essential Uses (Decision VII/28 (2a) and (2b))

Under Decision VII/28 (2a) and (2b), Parties decided that:

"(a) The Technology and Economic Assessment Panel will review, annually, the quantity of controlled substances authorised and submit a report to the Meeting of the Parties in that year;

(b) The Technology and Economic Assessment Panel will review, biennially, whether the applications for which exemption was granted still meets the essential-use criteria and submit a report, through the Secretariat, to the Meeting of the Parties in the year in which the review is made;"

The ATOC reviewed the essentiality of MDIs for asthma and COPD, and concluded that they remain essential for patient health until an adequate range of technically and economically feasible alternatives are available.

The ATOC notes the quantities of CFCs previously authorised under essential use Decisions of the Parties and wishes to point out that only one year of information has been provided through accounting frameworks and some additional information has been provided in nominations. These data have been insufficient to accurately compare trends in CFC use with authorised quantities.

Because new CFC free products are rapidly entering markets and because most nominations are received 2 years in advance, Parties may wish to continue to monitor and manage their own CFC acquisition and usage under authorised essential use quantities, and adjust their nominated quantities annually on an "as needed" basis.

Shown previously are the accounting frameworks of the Parties, which have reported for 1996 and/or 1997. The ATOC notes the information provided and finds the frameworks a useful assessment tool under Decision IV/25. The ATOC reported above under its essential use assessments and recommendations some specific issues to be considered by the Parties which relate to accounting frameworks to be reported in future years.

1.2.7 TEAP Clarification on Stockpiles and transition in Article 5(1) Parties

Members of the ATOC asked TEAP to clarify two emerging situations concerning the operation of the Essential Use Process. The questions from the ATOC and the answers from TEAP are presented below for consideration by Parties. TEAP will appreciate confirmation that its ATOC is operating under proper instructions.

1. In the near future numerous CFC-free alternatives will be fully commercialized and national governments may declare that CFC MDIs are not necessary for domestic consumption. The ATOC asks whether a domestic manufacturer can still be allocated CFCs under the Essential Use Decision for products that will be exported to other Parties.

The TEAP responds as follows: The Essential Use Process allocated ODS production or import for uses satisfying the terms of Decision IV/25. CFC MDIs are manufactured in only a few countries but are marketed and used world-wide. Therefore, Parties could qualify for essential use allocations for export to other Parties still dependent on CFC MDIs for their health requirements where the importing Party has not completed its transition. However, if importing countries have completed their transition, the exporting Party could not qualify for essential use allocations to serve that market.

2. Because it is important that patients have access to CFC MDIs until alternatives and substitutes are available, TEAP and its ATOC have recommended ample allocations. Furthermore, it has been recognised that limited stockpiles are necessary as a precaution against unanticipated patient need, interruptions in supply, and other contingencies. Existing stockpiles consist of CFC manufactured prior to the 1996 phaseout plus CFCs allocated under the Essential Use Process but not consumed. TEAP and its TOCs have determined that many manufacturers have been overly optimistic in their estimates of future sales, which results in an additional excess of available CFCs relative to actual use. As a consequence of these actions, it is likely that MDI manufacturers, CFC manufacturers, and/or Parties may possess significant quantities of excess CFC at the time that CFC MDIs are no longer essential. The TEAP and its TOC considered whether MDI manufacturers will be allowed to use up available stockpiles and already manufactured CFC MDIs with the consequence of discouraging investment in alternatives and having the effect of unnecessarily jeopardising recovery of the ozone layer.

The TEAP responds as follows:

In Decision IV/25, 5, Parties stated: "... subsequent reports will also consider which previously qualified essential uses should no longer qualify as essential,"

In Decision VII/11, 2(c) Parties stated: "The Parties granted essential use exemptions will reallocate, as decided by the Parties, to other uses the exemptions granted or destroy any surplus ozone-depleting substances authorised for essential use but subsequently rendered unnecessary as a result of technical progress and market adjustments."

Decision IV/25, 1.(b)(ii) requires that to qualify as an essential use: "the controlled substance is not available in sufficient quantity and quality from existing stocks of banked or recycled controlled substances..."

Together, these Decisions imply that at the time technical progress and market adjustments render CFC MDI use unnecessary, the total quantity of CFCs on hand must be reallocated or destroyed. This condition applies only to CFCs produced under the essential use process. Therefore, MDI manufacturers are expected to first use available stocks of CFCs manufactured before 1996. Parties should allocate essential use nominations only after these initial stocks have been depleted. Stock levels should be reduced as demand decreases to minimise manufacture of new CFCs under the essential use process.[1]

With this understood, MDI manufacturers will have an economic incentive to avoid excessive stockpiles and will end their CFC MDI production with little stock on hand. This approach avoids the possibility that MDI manufacturers will develop large stockpiles of CFCs that they intend to use for the purpose of continuing production even after CFC products are no longer essential as a result of available alternatives and substitutes.

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[1] From the point of view of inventory control the following situations could occur:

1. Use could exceed 1996 inventory of CFCs. In this case, any unused CFCs that were granted under the essential use process must be destroyed or reallocated.
2. 1996 stock inventory could be larger than use. In this case there are two possibilities:
    a) If CFCs were granted under the essential use process, the amount granted would have to be reallocated or destroyed.
    b) If CFCs were not requested under the essential use process the remaining stockpile is not controlled under the Montreal Protocol.

Furthermore, it is the obligation of the TEAP and its ATOC under Decision IV/25(b)(ii) to determine whether the controlled substance is available in sufficient quantity and quality from existing stocks of banked or recycled controlled substances. TEAP and its ATOC are currently collecting data on stockpiles produced prior to 1996 or acquired for essential use, and will use this data to adjust recommendations for future essential use allocations.

The TEAP also notes that the criteria for essential use in Decision IV/25 precludes essential use allocations after alternatives and substitutes are commercially available. Because it is anticipated that alternatives and substitutes to CFC MDIs will be available world-wide by the year 2005, it is unlikely that Article 5(1) Parties would qualify for this essential use after their phaseout in 2010. This implies that Article 5(1) Parties may wish to consider the advantage of planning now for the transition, allowing more than the ten year period (1996-2005) estimated to be necessary for the non-Article 5(1) phase-out of CFC MDIs. It may be far less expensive to implement CFC-free MDI technology soon to accommodate the anticipated growth in MDI use in Article 5(1) and some CEIT Parties.

1.3 Review of an essential use nomination submitted by the Russian Federation

An essential use request for 160 metric tonnes of halon 2402 for 1999 was received from the Russian Federation. The TEAP and its HTOC recommend the Essential Use exemption by the Russian Federation for this amount of halons for 1999.

The Halons Technical Options Committee (HTOC) reviewed the Essential Use nomination submitted by the Russian Federation in 1997. The HTOC received information from the Russian Federation and was able to assess progress made over the last two years. It is noted that the actual amounts of halon 2402 produced in 1996 and 1997 were lower than the amounts authorised by Parties. This was due to economic difficulties within the Russian Federation, and successful programs for recycling halon 2402. The HTOC notes the comments made by the Russian member that all efforts are being made to eliminate the need for an additional nomination for the year 2000 and beyond.

The HTOC maintains that a halon replacement strategy, as outlined in the nomination of two years ago and reconfirmed by the latest information provided by the Russian Federation offers the most technically and economically realistic opportunity to reduce and eliminate the need for further production. The Russian Federation is now providing UNEP and the HTOC with an annual progress report. However, the HTOC notes that the Russian Federation has yet to provide production, use, and stockpiles data for 1996, using the Reporting Framework as required by Parties and as shown in the Handbook on Essential Use Nominations.

The HTOC believes that technical assistance and financial support from the GEF to the Russian Federation will be required to fully achieve the goals outlined in the program as submitted to the GEF by the Russian Federation.

The TEAP and its HTOC recommend the Essential Use exemption by the Russian Federation for 160 metric tonnes of halon 2402 for 1999.

1.4 Review of an essential use nomination for solvents, coatings and adhesives

1.4.1 Nominations by the European Union for an essential use exemption for a solvent to be used to manufacture a bio-compatible coating for cardiovascular surgical material.

The European Union on behalf of the Baxter Company (Netherlands) submitted an Essential Use Nomination for an exemption to produce CFC-113 to be used as a solvent for the coating of its cardiovascular surgical devices. Barter needs 100 kg of high purity CFC-113 for the years 1999 and 2000. These devices come into contact with body fluids. It is known that exposure of blood to synthetic surfaces generally leads to detrimental activation of plasma coagulation and blood cell systems commonly referred to as the "whole inflammatory body response". Clinical studies of Baxter Duraflo ® coated devices have shown a reduction in blood loss, decreased body inflammatory response and improved patient recovery.

Specific application steps are:

- For the coating of cannular, a mixture of heparin and TE-35 solvent, which is CFC-113 mixed with 35% SDA alcohol is applied
- For the coating of tubing, a mixture of heparin with TE-5, which is CFC-113 mixed with 5% SDA alcohol is applied.

For both devices the solvent in the mixture is evaporated by airflow and heparin remains on the product. Emissions are minimised by restricted control of all process steps. Air polluted with CFC-113 and alcohol vapours is collected in a carbon-bed filter. Baxter is able to recycle CFC-113 by distillation process. Residues from distillation contain certain quantity of CFC-113, heparin and PVC and are collected in the recycling unit.

During each production run the volume of CFC-113 available diminishes each time it is recycled. Small losses occur during handling of the material as well as during the coating process. As well, a small quantity of CFC- 113 remains in the coating.

The yearly quantity requested in the nomination (100 Kg for 1998, 2000) is to compensate for the losses during production runs.

Baxter is taking all steps to minimise the use of CFC-113. For the tubing a switch to HCFC-141b as solvent and validation is expected in mid-1998.

Because the cannulae contain rigid plastic, exposure to HCFC-141b results in cracking of the substrate. It is intended to coat cannulae with CFC-113/ethyl alcohol blends that are compatible with all cannulae materials until a suitable alternative substance is found. Several other alternative solvents such as hydrocarbons, alcohols, PFC & HCFC based-solvent were found to be incompatible.

Ongoing research work at Baxter has high priority for introducing ODS-free solvents but validation of these requires a long time. Baxter is not able to introduce alternatives in a short time.

The STOC unanimously recommended the authorisation of the quantity of CFC-113 requested for this critical application.

1.4.2 Nomination by Poland for Solvents Used in Maintenance of Torpedoes.

In 1997, Poland exercised its option under the Emergency Exemption (Decision VIII/9, paragraph 10). Import of 1,700 kilograms of CFC-113 for this use was authorised by the Secretariat after consultation with the TEAP and its STOC. In 1998, TEAP and its STOC sought additional information on why CFC-113 is needed so that TEAP and its STOC can help Poland to find a suitable substitute.

Poland submitted an essential use nomination for the years 1999, 2000, 2001, 2002 and 2003 for "disposal of grease from torpedo-weapon systems" requesting authorisation to import 1.7 tonnes per year of CFC-113 during the mentioned period. The purpose of this submittal is to use this solvent to clear torpedo-weapon systems to eliminate grease and provide safety.

Poland claims that CFC-113 is necessary because no alternatives/substitutes are available and the producer of the systems does not recommend any substitutes. They also claim that all trials looking for alternative substitutes have been unsuccessful and that no further steps in this direction are being taken; and no action is being taken to minimise emissions. It is also claimed that the process requires standards that cannot be met by recycled substances. No commitment is made to reduce the use of CFC-113 in the future.

The TEAP and its STOC requested additional information, such as: substrate alloys of components and assemblies; types of coatings applied, if any; types of non metallic components used; type of grease to be removed and its liquefying temperature and approximate thickness of grease layer. Details of grease removing process and working conditions such as ventilation were also requested.

Information was also requested regarding problems that might arise from the use of recycled CFC-113, which alternative processes or substances have been evaluated and the technical reasons for rejection, type of tests carried out, and criteria used for qualification.

The STOC did not receive this information and it is therefore unable to recommend this nomination for continued use.

1.4.3 Rescheduling of a previously authorised essential use exemption for solid rocket motors by the United States

Montreal Protocol Parties in 1995 authorised 176.4 metric tonnes of methyl chloroform (1,1,1-trichloroethane) for the years 1999-2001 for use in the manufacture of solid rocket motors. In 1998, the United States requested that this remaining authorised methyl chloroform be made available for use over a longer period of time.

The STOC unanimously recommend that the remaining authorised quantity of methyl chloroform be made available for use in manufacturing solid rocket motors until such time that the 1999-2001 quantity of 176.4 metric tonne (17.6 ODP-weight metric tonnes) allowance is depleted or until such time that safe alternatives are implemented for remaining essential uses. The STOC will continue to monitor progress toward implementing alternatives and substitutes.

The STOC finds that the manufacturing of solid rocket motors for United States space launch vehicles continues to qualify as essential under the Montreal Protocol criteria and that the quantities already granted are adequate to meet the anticipated needs. Furthermore, the STOC finds that research, development, and implementation of new technology to replace ODSs is proceeding as rapidly as possible and that the United States and its applicants are taking required actions to utilise existing supplies of ODSs and to minimise use and emissions.

The request to use allocated quantities for essential uses until such quantities are depleted is reasonable because: 1) technical setbacks have occurred in efforts to eliminate the use of methyl chloroform in adhesives and rubber activation applications (see elaboration below); 2) difficulties in the supply of the Mir Space Station have required additional shuttle flights; and 3) the replacement for the Space Shuttle may not be available as early as expected and, therefore, the U. S. solid rocket motors may be in service for an extended period of time.

Importance of Space Exploration

Together, the Space Shuttle and Titan expendable launch vehicle provide access to space for payloads, scientists, and other specialists including access to space for payloads requiring heavy lift capabilities. The payloads carried on these vehicles are valuable and important to space exploration, national security, and earth environmental science.

Scientists throughout the world use scientific data from space programs. Titan vehicles were used for the Vela satellites (provided information on solar flares and other radiation); Helios satellites (providing scientific data on solar atmospheres, solar winds and electromagnetic radiation); and for the inter-planetary Viking Spacecraft to Mars and Voyager Spacecraft to Jupiter, Saturn, Uranus and Neptune. The Cassini spacecraft–co-sponsored by European Space Agency, France, Germany, Italy, the United Kingdom, and others—provides close proximity study of Saturn. The Space Shuttle has launched numerous earth-observation satellites, including many used to verify that ODSs deplete the ozone layer and to track recovery of the ozone layer resulting from the controls of the Montreal Protocol. Other important payloads already launched include the Hubble Space Telescope, numerous life sciences and microgravity/space manufacturing platforms, and the International Space Station preparation missions/MIR dockings. Future Space Shuttle missions include additional Spacelab life sciences/microgravity experiments; retrieval of the Long Duration Exposure Space Flier; as well as the continuing construction, operation, and utilisation of the International Space Station.

Solid rocket motors are also used for the successful positioning of communication satellites used for global television and telephone communications and for positioning of critical weather and earth science satellites.

Progress on Eliminating ODSs

There has been significant progress in the elimination of ozone depleting substances from solid rocket manufacture. By 1998, the Titan program reduced 1,1,1-trichloroethane use by well over 99% and the Space Shuttle has eliminated over 90 percent of previous applications including preservation, storage and transportation of metal hardware; most vapour degreasing of refurbished and production hardware; and cleaning of propellant mix and cast tooling. The remaining 10 percent of use for the Space Shuttle are for rubber activation, critical hand-cleaning, and bond preparation of the rocket motor segments as they are manufactured. It was a failure of a field joint that caused the loss of the Space Shuttle Challenger, the death of its human crew, and the loss of its scientific cargo.

Space Shuttle Phaseout Setback

In 1996 the NASA Space Shuttle program experienced a serious setback in its efforts to safely phase out the use of ODSs currently allowed under terms of the Essential Use Exemption. Specifically, during the June 20, 1996 launch of the Space Shuttle Columbia, hot exhaust gases penetrated into the insulation "J" joint of all three field joints on both solid rocket motors. Any gas penetration is a cause for concern for the flight reliability of the shuttle and the safety of the crew; penetrations in six separate locations increase the severity and significance appreciably.

The investigation found that the most likely cause of the gas penetrations was the first time use of a new ODS-free adhesive and a new ODS-free hand-wipe cleaning agent in the assembly of the rocket motor set. Since then, only rocket motors that were assembled using the original, flight-proven adhesive and cleaning agents containing methyl chloroform (1,1,1-trichloroethane) have been flown and these rocket motors using ODS adhesives did not experience gas penetration.

Sources of ODSs for Essential Uses
It is not technically feasible to recycle used solvents to necessary standards of purity for these Essential Uses.

Remaining Essential Uses
Remaining critical uses of 1,1,1-trichloroethane (methyl chloroform) used for manufacture of expendable solid rocket motors which affect the stability and integrity of the critical bond lines in the solid motors include: the application of a tackifier for the insulator to composite bond on the solid motors, tackifier to apply the breather cloth in order to cure the insulator, preparation of the isolator surface to bond the propellant to the insulator and an additive to disperse the curing catalyst for the propellant. Additional essential uses include rubber activation, critical hand-cleaning, and bond preparation of the rocket motor segments as they are manufactured.

Research, Development, and Implementation Continues
Research continues to find substitutes for all remaining critical ODS uses in the manufacture of solid rocket motors. Emerging technology to resolve uses includes palletised CO_2, reformulated adhesives and preparation cleaners, and new aqueous methods to eliminate methyl chloroform in sizing carbon graphite fibres.

1.5 Laboratory Uses

1.5.1 Introduction

Typical laboratory and analytical uses include: equipment calibration; extraction solvents, diluents, or carriers for specific chemical analyses; inducing chemical-specific health effects for biochemical research; as a carrier for laboratory chemicals; and for other critical purposes in research and development where substitutes are not readily available or where standards set by national and international agencies require specific use of the controlled substances.

The Parties to the Montreal Protocol granted at their 1994 6th Meeting (Decision VI/9,3).

"That for 1996 and 1997, for Parties not operating under paragraph 1 of Article 5 of the Protocol, production or consumption necessary to satisfy essential uses of ozone depleting substances for laboratory and analytical uses are authorised as specified in Annex II to the Report of the Sixth Meeting of the Parties;"

The "standard-of-purity" applied to the exemption for laboratory and analytical uses are detailed in Section 1.5.5 of this report. The reason to require manufacture as highly pure chemicals for final marketing by manufacturers, agents, or distributors in small, labelled containers was to discourage non-essential use through the high price and inconvenience of small containers for high volume uses. Because laboratory chemicals often contain stabilisers or are sold at a particular concentration as reference materials, the Decision by Parties allows marketing in blends (including blends containing more than one controlled substance).

The conditions for continuous use under the Global Exemption as specified in Decision VI/9,3,Annex II (See Section 2.5 of the Handbook for the International Treaties for the Protection of the Ozone Layer (1996)), include requirements that:

"Parties shall annually report on each controlled substance produced: the purity; the quantity; the application, specific test standard, or procedure requiring its uses; and the status of efforts to eliminate its use in each application. Parties shall also submit copies of published instructions, standard specifications, and regulations requiring the use of the controlled substance."

"... used or surplus substances should be collected and recycled, if practical. The material should be destroyed if recycling is not practical or destroy the material if recycling is not practical."

In order to elaborate on laboratory uses and to assist the collection of data, the Parties adopted at their 7th Meeting (Decision VII/11), a non-exhaustive list of 'Categories and examples of laboratory uses (Appendix II, Handbook for the International Treaties for the protection of the Ozone Layer (1996)). Furthermore, Decision VII/11,2:

"...urges Parties to organise National Consultative Committees to review and identify alternatives to laboratory and analytical uses and to encourage the sharing of information concerning alternatives and their wider use;

To encourage national standards organisations to identify and review those standards which mandate the use of ozone-depleting substances in order to adopt where possible ODS-free solvents and technologies;

To urge Parties to develop an international labelling scheme and encourage its adoption to stimulate awareness of the issue;"

Decision VII/II,8 continues:

"To urge Parties operating under Article 2 to provide funding within their countries and on a bilateral basis for Parties operating under Article 5 to undertake research and development and activities aimed at ODS alternatives for laboratory

and analytical uses."

The Parties at their 8th Meeting extended the global exemption for laboratory and analytical uses to include 1998 (Decision VIII/9(4)). At the meeting it was noted that Parties had not provided information concerning either the quantities of controlled substances used for laboratory and analytical uses or the efforts made by the Parties to eliminate specific uses.

The 9th Meeting of the Parties extended the exemption to include 1999, reinforced the reporting requirements in Decision IX/17 and clarified that essential use exemptions for laboratory and analytical uses of controlled substances shall continue to exclude the production of products made with or containing such substances.

1.5.2 The Use of Controlled Substances for Laboratory and Analytical Uses

A number of Parties have now reported on the use of controlled substances for analytical and laboratory uses. The European Union, Australia, the Czech Republic and the United States have adopted licensing systems in order to manage supplies into these applications. These systems license supplies to the distributors of controlled substances into the laboratory and analytical sector. Registration of the many of thousands of small users in this sector is generally impracticable. These systems are as follows:

1.5.2.1 United States

Regulations in the United States require companies to follow very specific procedures to ensure compliance with obligations under the Montreal Protocol's global laboratory and analytical essential-use exemption. Laboratories that purchase high purity controlled substances in accordance with Annex II of the Decision VI/9(3) must certify to a distributor that the substance will only be used for laboratory applications and will not be resold or used in manufacturing.

Companies that distribute laboratory supplies are required to meet restrictions in Annex II of Decision VI/9 regarding purity, size and labelling. In order to receive quantities of controlled substances from producers or importers, companies that distribute laboratory supplies must certify that substances purchased under the global laboratory and analytical essential-use exemption are for sale solely to laboratory customers who certify the substances will be used for laboratory applications and will not be resold or used in manufacturing. Companies that distribute controlled substances to laboratories must report quarterly the quantities they receive from producers and importers and report quarterly the quantities they sell to laboratories.

1.5.2.2 European Union

In the European Union, companies that distribute analytical supplies are required on an annual basis to request from the European Commission a quota to enable them to sell, within Europe, controlled substances for use under the laboratory and analytical essential-use exemption. The quota permits the laboratory supplier to obtain from a bonefide producer or importer production or importation of the controlled substance.

The Management Committee under the European Regulation on Substances that Deplete the Ozone Layer carries out allocation of the essential-use quotas. Member States of the European Union are requested to investigate the requests for quotas by those companies that distribute analytical supplies in order to that they meet the requirements to sell the controlled substances.

Companies that distribute analytical supplies and those manufacturing and importing controlled substances against the quotas issued by the European Commission are required to request a licence prior to obtaining production or importation. They are also required to make annual reports to the Commission detailing respectively their sales and production or importation. Companies distributing analytical supplies are required to keep information detailing the actual customers to whom the controlled substances were sold. These records are available for audit by the Commission.

The European Commission has published the quantities of controlled substances that it has licensed in 1995 and 1996 in its Official Journal. These data give an indication of the levels requested by the distributors and do not demonstrate the actual levels used. In a number of cases distributors may be building stocks for future sales or have not actually purchased controlled substances against their licences due to a lack of demand in the sector.

1.5.2.3 Australia

Australia has a licence system for companies that distribute analytical supplies for the import of controlled substances for laboratory and analytical uses. End use declarations are required from all purchasers of the products imported to ensure that they are being used for essential uses.

1.5.2.4 Czech Republic

Manufacturing and/or imports of regulated substances are subject to the licences issued by the Ministry of the Environment according to the Act on the Protection of the Ozone Layer of the Earth passed in 1995.

The products imported and produced in the Czech Republic were for special analytical usage, and to a very limited extent for laboratory research. They were of high purity. For example, CFC-113 was used, above all, for the analytical determination of water quality.

1.5.2.5 Laboratory and Analytical Uses by Countries (Tonnes)

Year	1996			1997		
Party	**CFCs**	**CTC**	**MCF**	**CFCs**	**CTC**	**MCF**
Australia (1)	(6)	(6)	(6)	0.07	0.41	0.09
Czech Republic (2)	6.90	0.10	-	(6)	(6)	(6)
European Union (3)	157.00	1.70	19.50	66.6	96.4	31.1
U.S.A. (4)	(7)4.00	10.00	5.00	(6)	(6)	(6)
Hungary (5)	0.00	0.00	0.00	0.00	0.00	0.00
United Kingdom (5)	0.00	0.00	0.00	0.00	0.00	0.00

MCF 1,1,1 Trichloroethane
(1) Quantities imported
(2) Quantities produced or imported
(3) Licenses required
(4) Wuantities supplied
(5) No production for laboratory/analytical uses
(6) Not yet reported
(7) Specified as CFC-113

1.5.2.6 Other Data

Although data are only available for laboratory and analytical uses in Australia, the Czech Republic, the European Union, Hungary, United Kingdom, and the United States, it can be estimated that the total global use of controlled substances for these applications in non-Article 5(1) Parties will not exceed a maximum of 500 metric tonnes. Use in CEITs is unlikely to be more than a few hundred metric tonnes. An estimate of Indian use of CTC of 150 metric tonnes as a laboratory reagent would indicate that up to 500 metric tonnes could be used for analytical and laboratory uses in Article 5(1) Parties. An estimate for global use of controlled substances for laboratory and analytical uses is 1,500 metric tonnes.

1.5.3 Standards Requiring the Use of ODSs.

The United States has provided a list of institutions that develop laboratory standards, procedures, instructions and regulations requiring the use of ODSs, and those institutions investigating, researching or developing alternative laboratory procedures that do not require ODSs. The latter group comprises 20 committees and the former 13. A list of 80 standard laboratory procedures has been compiled and submitted along with the respective documents detailing the procedures.

1.5.4 TEAP Findings

Parties may wish to decide at their 10th Meeting in 1998 whether to continue the exemption for laboratory or analytical uses. There are two options that could be considered:

1. Discontinue the global exemption for laboratory and analytical uses after 1999. Thereafter, individual Parties may wish to utilize the normal, annual Essential Use Nomination process. The TEAP and its ATOC would undertake the annual assessment with Parties taking final decisions.

   Under this option, Parties would submit Nominations for laboratory and analytical uses for the year 2000 for consideration by the 11th Meeting of the Parties in 1999. This would typically require submission of Nominations to the Secretariat by January 1, 1999.

2. Permit continuing global exemption for essential use for laboratory and analytical use for a specified number of years, but prohibit up to three specific uses with identified alternatives and substitutes:

   a Testing of oil, grease, and total petroleum hydrocarbons in surface and saline waters and industrial and domestic aqueous wastes including the testing of water which is separated from oil and discharged from off-shore drilling and production platforms.

   b Testing of tar in road paving material by dissolving tar and separating it from aggregate.

   c Forensic fingerprinting.

   Readily available cost-effective alternatives for these applications have been implemented in many countries.

   The advantage of continuing the global exemption would be continuity in the use for laboratories and research establishments. The disadvantage of a continued global exemption would be the perception that unregulated use would continue and there would be no driving force to encourage the research, development and adoption of alternatives.

1.5.5 Standard-of-Purity and Required Containers

The Standard-of-Purity recommended by TEAP and Decided by Parties was based on international and/or national standards such as the International Standards Organisation (ISO) or Japanese Industrial Standards (JIS).

ODS	Standard of Purity
CTC (reagent grade)	99.5%
1,1,1-trichloroethane	99.0%
CFC-11	99.5%
CFC-12	99.5%
CFC-12	99.5%
CFC-113	99.5%
CFC-114	99.5%
Other (B.P.> 20°C.	99.5%
Other (B.P.< 20°C.	99.0%

These pure, controlled substances can be subsequently mixed by manufacturers, agents, or distributors with other chemicals controlled or not controlled by the Montreal Protocol as is customary for laboratory and analytical uses.

High purity ozone-depleting substances and mixtures containing controlled substances shall be supplied only in:

- containers equipped with closures, or
- high pressure cylinders smaller than three litres, or in
- 10 millilitre or smaller glass ampoules.

Containers, cylinders and ampoules must be marked clearly as containing substances that deplete the ozone layer.

2 Responses to Decisions

2.1 Response to Decision IX/28: List of Mixtures Containing Controlled Substances

Decision IX/28 requested that TEAP and UNEP/IE compose a list of mixtures, particularly for use as solvents or refrigerants, which contain controlled substances. Many individuals and organisations in both developed and developing nations are having difficulty identifying products consisting of or containing ozone-depleting substances. The purpose of this list is to allow users, agents, ozone officers, customs officers and others to identify products subject to control under the Montreal Protocol.

The list includes trade names, the chemicals contained in the mixtures as well as their weight percentages. Where possible, standard designations and ODPs are also provided.

TEAP, after consulting with UNEP/IE, contacted chemical manufacturers in developed and developing countries and many distributors in developed countries. Manufacturers were helpful in providing information, but it was particularly difficult to determine which mixtures (both those containing CFCs and HCFCs) are being commercialised or imported by developing countries.

Below is a list of tables for mixtures in the refrigeration, foam blowing, solvent and halon sectors, as well as for mixtures containing methyl bromide. Where possible, the manufacturer's names are listed, but this is not necessarily indicative because some products are made by more than one company, under the same name. This list does not contain information about ozone-depleting substances that are not yet regulated, such as chlorobromomethane or n-propyl bromide, nor non-ozone-depleting solvents and other mixtures. The list is not complete, but presents the best information currently available. As requested in Decision IX/28, the list will be updated on a regular basis.

Many products sold under the same name may or may not contain ozone-depleting substances. Known cases are marked on the table with the symbol "***", indicating that additional investigation will be necessary. Furthermore, products not listed may also contain a controlled substance. For example, typing correction fluids are made in versions containing 1,1,1-trichloroethane, hydrocarbon solvents or water. Usually, if correction fluids are labeled as flammable, they probably do not contain ODSs. On the other hand, correction fluids not marked as flammable do not necessarily contain ODSs.

Another problem is that a number of mixtures marketed under the same name, may contain different ingredients. For example, different formulations of Forane may contain pure or blended versions of CFC-113 or pure or blended versions of several different HCFCs or non-ozone-depleting HFCs. This makes it very difficult to identify which products contain ozone ODSs.

For the sake of brevity, individual trade names are generally listed only once under each generic name. For example, at least 19 known solvent blends, plus an additional 10 or so ozone-deleting formulations for other purposes, are marketed under the trade name “Freon”™. If a container is labeled with a name containing “Freon”™, it can be reasonably concluded it contain an ozone-depleting substance, with the single exception of ”Freon F-116"™, which does not contain ODSs.

Any solvent with figures, such as 113, 141, 225, or 1,1,1 etc. on the label probably contain ODSs. This is particularly insightful if the product is labeled in characters which are not commonly used in the country of consumption, such as Cyrillic characters in a country using Latin or Arabic characters.

If the composition of a product is uncertain, the health and safety data sheet will usually indicate whether it does or does not contain ODSs. If a safety data sheet is not available, consult the local manufacturer’s representative or have an analysis made of the contents. A “sniffer” or a Dräger tube can be used to rule out samples that do not contain ODSs, but further tests will be necessary to determine whether samples testing positive actually contain an ODS or whether they contain a non-ODS ingredient that also tests positive.

Products containing ODSs that are not controlled by the Montreal Protocol, as of March 1998, are not included in this document. However, it is possible that such substances may be controlled in the future.

In furnishing the information contained in this list, UNEP and the members of TEAP and its TOCs make no warranty or representation, either express or implied, with respect to its accuracy, completeness or utility. Nor does UNEP, TEAP or its TOCs assume any liability of any kind whatsoever resulting from the use of or reliance upon, any information, material, or procedure contained herein, including but not limited to any claims regarding health, safety, environmental effects or fate, efficacy, or performance, made by the source of the information.

Mention of any company, association, individual, or product in this list is for informational purposes only, and does not constitute a recommendation of any such company, association, individual, or product, either express or implied by UNEP, TEAP or its TOCs.

These tables have been compiled from a number of sources. It is not claimed that these lists are exhaustive and, in fact, there may be many more products in different markets containing ODSs, which are not listed.

2.1.1 Identified Mixtures

Refrigerants/Blowing Agents

Trade Name	Manufacturer	Standard Designation	Components and Weight Percentages							
			Component	%	Component	%	Component	%	Component	%
Arcton 402A	ICI	R-402A	HCFC-22	38.0%	HFC-143a	60.0%	HC-290	2.0%		
Arcton 402B	ICI	R-402B	HCFC-22	60.0%	HFC-143a	38.0%	HC-290	2.0%		
Arcton TP5R	ICI	R-412A	HCFC-22	70.0%	HCFC-142b	25.0%	PFC-218	5.0%		
Arcton TP5R2	ICI	R-509A	HCFC-22	44.0%	PFC-218	56.0%				
Asahiklin 22/142b	Asahi Glass		HCFC-22	40.0%	HCFC-142b	60.0%				
Daiflon 22/142b	Daikin		HCFC-22	40.0%	HCFC-142b	60.0%				
Daikin blend	Daikin		HFC-23	2.0%	HFC-32	28.0%	HCFC-124	70.0%		
Fomacel 124/142b	Dupont		HCFC-124	60.0%	HCFC-142b	40.0%				
Fomacel 22/134a/142b	Dupont		HCFC-22	40.0%	HFC-134a	10.0%	HCFC-142b	50.0%		
Fomacel 22/142b	Dupont		HCFC-22	40.0%	HCFC-142b	60.0%				
Forane FX10	Elf Atochem	R-408A	HCFC-22	47.0%	HFC-125	7.0%	HFC-143a	46.0%		
Forane FX20	Elf Atochem		HCFC-22	55.0%	HFC-125	45.0%				
Forane FX55	Elf Atochem		HCFC-22	60.0%	HCFC-142b	40.0%				
Forane FX56	Elf Atochem	R-409A	HCFC-22	60.0%	HCFC-124	25.0%	HCFC-142b	15.0%		
Forane FX57	Elf Atochem	R-409B	HCFC-22	65.0%	HCFC-124	25.0%	HCFC-142b	10.0%		
Genetron HP80	Allied Signal	R-402A	HCFC-22	38.0%	HFC-143a	60.0%	HC-290	2.0%		
Genetron HP81	Allied Signal	R-402B	HCFC-22	60.0%	HFC-143a	38.0%	HC-290	2.0%		
Genetron MP39	Allied Signal	R-401A	HCFC-22	53.0%	HCFC-124	34.0%	HFC-152a	13.0%		
Genetron MP66	Allied Signal	R-401B	HCFC-22	61.0%	HCFC-124	28.0%	HFC-152a	11.0%		
Genetron 408A	Allied Signal	R-408A	HCFC-22	47.0%	HFC-125	7.0%	HFC-143a	46.0%		
Genetron 409A	Allied Signal	R-409A	HCFC-22	60.0%	HCFC-124	25.0%	HCFC-142b	15.0%		

(1) This is not a complete list of products containing ODSs.
(2) Some products labelled with names on this list may not contain ODSs in some formulations.
(3) This list will be most valuable when used as one part of a comprehensive identification strategy, including reference to "material safety data sheets", consultation with manufacturers and distributors and use of chemical analysis.

Refrigerants/Blowing Agents (continued)

Trade Name	Manufacturer	Standard	Components and Weight Percentages							
		Designation	Component	%	Component	%	Component	%	Component	%
GU G-2015	Greencool	R-405A	HCFC-22	45.0%	HCFC-142b	5.5%	HFC-125a	7.0%	PFC-318	42.0%
GU G-2018a	Greencool	R-411A	HCFC-22	87.5%	HFC-152a	11.0%	HCFC-1270	1.5%		
GU G-2018b	Greencool	R-411B	HCFC-22	94.0%	HFC-152a	3.0%	HCFC-1270	3.0%		
Isceon 69L		R-403B	HCFC-22	56.0%	HC-290	5.0%	PFC-318	39.0%		
Isceon 69S		R-403A	HCFC-22	75.0%	HC-290	5.0%	PFC-318	20.0%		
Meforex Di 24	Ausimont		HCFC-124	39.0%	HFC-134a	59.0%	HC-600	2.0%		
Meforex Di 36	Ausimont		HCFC-22	50.0%	HCFC-124	47.0%	HC-600	3.0%		
Meforex Di 44	Ausimont		HCFC-22	50.0%	HFC-125	42.0%	HFC-143a	6.0%	HC-290	2.0%
MonroeAirTech		R-406A	HCFC-22	55.0%	HCFC-142b	41.0%	HC-600a	4.0%		
Solkane 406A	Solvay	R-406A	HCFC-22	55.0%	HCFC-142b	41.0%	HC-600a	4.0%		
Solkane 409A	Solvay	R-409A	HCFC-22	60.0%	HCFC-124	25.0%	HCFC-142b	15.0%		
Solkane 22/142b	Solvay		HCFC-22	40.0%	HCFC-142b	60.0%				
Suva HP80	Dupont	R-402A	HCFC-22	38.0%	HFC-143a	60.0%	HC-290	2.0%		
Suva HP81	Dupont	R-402B	HCFC-22	60.0%	HFC-143a	38.0%	HC-290	2.0%		
Suva MP39	Dupont	R-401A	HCFC-22	53.0%	HCFC-124	34.0%	HFC-152a	13.0%		
Suva MP66	Dupont	R-401B	HCFC-22	61.0%	HCFC-124	28.0%	HFC-152a	11.0%		
Suva MP52	Dupont	R-401C	HCFC-22	33.0%	HCFC-124	52.0%	HFC-152a	15.0%		
S-10 M1	JSCAstor (RF)		HCFC-21	?	HCFC-22	?	HCFC-142b	?		
S-10 M2	JSCAstor (RF)		HCFC-21	?	HCFC-22	?	HFC-134a	?		

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Mobile AC Service Blends

Trade Name	Manufacturer	Standard Designation	Components and Weight Percentages							
			Component	%	Component	%	Component	%	Component	%
Frigc-FR 12	Intermagnetics		HCFC-124	39.0%	HFC-134a	59.0%	HC-600a	2.0%		
Reezone RB276			HFC-134a	79.0%	HCFC-142b	19.0%	non-fluoro	2.0%		
McCool	People's Welding	R-406A	HCFC-22	55.0%	HCFC-142b	41.0%	HC-600a	4.0%		
Autofrost Chill It	People's Welding		HCFC-22	51.0%	HCFC-124	28.0%	HCFC-142b	16.0%	HC-600a	4.0%
Hot Shot	Icor		HCFC-22	50.0%	HCFC-124	39.0%	HCFC-142b	9.5%	HC-600a	1.5%
GHG-HP	People's Welding		HCFC-22	65.0%	HCFC-142b	31.0%	HC-600a	4.0%		
Freeze 12	Tech Chemical		HFC-134a	80.0%	HCFC-142b	20.0%				
GHG-X5	People's Welding		HCFC-22	41.0%	HCFC-142b	15.0%	HFC-227ea	40.0%	HC-600a	4.0%

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Fire Extinguishants

Trade Name	Manufacturer	Standard Designation	Components and Weight Percentages							
			Component	%	Component	%	Component	%	Component	%
FE-241	Dupont		HCFC-124	?	others	?				
Halotron I	American Pacific		HCFC-123	96.0%	PFC-14	2.0%	Argon	2.0%		
NAF-S III	NA Fire Guardian		HCFC-22	82.0%	HCFC-123	5.0%	HCFC-124	10.0%	HC	3.0%
NAF-P III	NA Fire Guardian		HCFC-?	?						
NAF-P IV	NA Fire Guardian		HCFC-123	90.0%	HFC-125	8.0%	HC	2.0%		

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Others

Trade Name	Manufacturer	Standard Designation	Components and Weight Percentages			
			Component	%	Component	%
Floron 19	SRF India		CFC-11	10.0%	CFC-12	90.0%
Floron 1585	SRF India		CFC-11	15.0%	CFC-12	85.0%
Floron 28	SRF India		CFC-11	20.0%	CFC-12	80.0%
Floron 37	SRF India		CFC-11	30.0%	CFC-12	70.0%
Floron 3565	SRF India		CFC-11	35.0%	CFC-12	65.0%
Floron 46	SRF India		CFC-11	40.0%	CFC-12	60.0%
Floron 55	SRF India		CFC-11	50.0%	CFC-12	50.0%
Floron 64	SRF India		CFC-11	60.0%	CFC-12	40.0%
Floron 73	SRF India		CFC-11	70.0%	CFC-12	30.0%
Floron 82	SRF India		CFC-11	80.0%	CFC-12	20.0%
Floron 8515	SRF India		CFC-11	85.0%	CFC-12	15.0%
Floron 91	SRF India		CFC-11	90.0%	CFC-12	10.0%

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Methyl bromide

Trade Name	Manufacturer	Standard	Components and Weight Percentages					
		Designation	Component	%	Component	%	Component	%
50-50	Bromine Compounds		Methyl Bromide	50.0%	Chloropicrin	50.0%		
57-43	Bromine Compounds		Methyl Bromide	57.0%	Chloropicrin	43.0%		
67-33	Great Lakes		Methyl Bromide	67.0%	Chloropicrin	33.0%		
67-33 Prepl. Soil Fumig.	Bromine Compounds		Methyl Bromide	67.0%	Chloropicrin	33.0%		
70-30 Soil Fumigant	Bromine Compounds		Methyl Bromide	70.0%	Chloropicrin	30.0%		
75-25	Bromine Compounds		Methyl Bromide	75.0%	Chloropicrin	25.0%		
80-20 Prepl. Soil Fumig.	Bromine Compounds		Methyl Bromide	80.0%	Chloropicrin	20.0%		
98-2	Bromine Compounds		Methyl Bromide	98.0%	Chloropicrin	2.0%		
98-2	Great Lakes		Methyl Bromide	98.0%	Chloropicrin	2.0%		
Asahi Methylbromide	Dohkai Chenical		Methyl Bromide	99.5%				
Asahifume	Dohkai Chenical		Methyl Bromide	99.0%	Xylene	0.5%		
Bromofume	Ichikawa Gohsei		Methyl Bromide	98.0%	Chloropicrin	2.0%		
Brom-O-Gas	Great Lakes		Methyl Bromide	98.0%	Chloropicrin	2.0%		
Brom-O-Gas 0.25%	Great Lakes		Methyl Bromide	99.7%	Chloropicrin	0.3%		
Brom-O-Gas 2%	Great Lakes		Methyl Bromide	98.0%	Chloropicrin	2.0%		
Bromogas (3)	Atochem		Methyl Bromide	98.0%	Chloropicrin	2.0%		
Bromomethyl	Nippoh Chemicals		Methyl Bromide	98.0%				
Cylone	Teijin Chemicals		Methyl Bromide	14.0%	Chloropicrin	32.0%	Solvent	54.0%
Ekibon	Ekika Carbon Dioxide		Methyl Bromide	85.0%	Etylene oxide	13.0%		
Fumyl-O-Gas	Atochem		Methyl Bromide	99.7%	Amyl acetate	0.3%		
Kayafume	Nihon Kayaku		Methyl Bromide	98.5%	Xylene	0.5%		
Kunofume	Teijin Chemicals		Methyl Bromide	99.0%	Xylene	0.5%		

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Methyl bromide (continued)

Trade Name	Manufacturer	Standard Designation	Components and Weight Percentages					
			Component	%	Component	%	Component	%
Lankem Metabrom	Bromine Compounds		Methyl Bromide	98.0%	Chloropicrin	2.0%		
Lankem Methyl Bromide	Bromine Compounds		Methyl Bromide	100.0%				
M-B-R 2	Albemarle Chemicals		Methyl Bromide	98.0%	Chloropicrin	2.0%		
M-B-R 33	Albemarle Chemicals		Methyl Bromide	67.0%	Chloropicrin	33.0%		
M-B-R 75	Albemarle Chemicals		Methyl Bromide	75.0%	Chloropicrin	25.0%		
M-B-R 98 Technical	Albemarle Chemicals		Methyl Bromide	98.0%	Chloropicrin	2.0%		
Mebrom Methyl Bromide	Mebrom Chemicals		Methyl Bromide	98.0%	Chloropicrin	2.0%		
Metabrom 98	Bromine Compounds		Methyl Bromide	98.0%	Chloropicrin	2.0%		
Metabrom 99	Bromine Compounds		Methyl Bromide	99.0%	Chloropicrin	1.0%		
Metylbromide	Nihon Kayaku		Methyl Bromide	98.0%				
Methylbron K 1	Teijin Chemicals		Methyl Bromide	98.0%	Chloropicrin	1.0%		
Methylbron K 2	Teijin Chemicals		Methyl Bromide	97.5%	Chloropicrin	2.0%		
Nichifume	Nippoh Chemicals		Methyl Bromide	98.5%	Xylene	0.5%		
Sanfume	Sanko Chemical		Methyl Bromide	98.5%	Xylene	0.5%		
Sanko Methylbromide	Sanko Chemical		Methyl Bromide	99.5%				
Sobrom 98	Atochem		Methyl Bromide	98.0%	Chloropicrin	2.0%		
Terr-O-Gas 57	Great Lakes		Methyl Bromide	57.0%	Chloropicrin	43.0%		
Terr-O-Gas 67	Great Lakes		Methyl Bromide	67.0%	Chloropicrin	33.0%		
Terr-O-Gas 75	Great Lakes		Methyl Bromide	75.0%	Chloropicrin	25.0%		
Terr-O-Gas 80	Great Lakes		Methyl Bromide	80.0%	Chloropicrin	20.0%		
Terr-O-Gas 98	Great Lakes		Methyl Bromide	98.0%	Chloropicrin	2.0%		
Terrogas	Atochem		Methyl Bromide	67.0%	Chloropicrin	33.0%		

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Solvents (only principal ODS components given)

Trade Name	Manufacturer	Principal ODS Component
1,1,1-trichloroethane	Generic	1,1,1-trichloroethane
1,1,1-tri	Vulcan Chemicals	1,1,1-trichloroethane
A C Delco Fabric	Chem-Tek America	1,1,1-trichloroethane
Aerolox	Nat'l Chemsearch	1,1,1-trichloroethane
Aerothene TT and TA	Dow	1,1,1-trichloroethane
Alpha 1220(?)	Apha Metals	1,1,1-trichloroethane
Aquadry	Asahi Chemicals	1,1,1-trichloroethane
Algofrene	Ausimont	CFC-113
Ardrox xxxxxxx	Brent (Asia)	1,1,1-trichloroethane
Arklone	ICI	CFC-113
Arrow Cxxx xx	Arrow Chemicals	1,1,1-trichloroethane
Asahifron		CFC-113
Asahiklin 225	Asahi Glass	HCFC-225ca (45%), HCFC-225cb (55%)
Asahiklin 225 AES	Asahi Glass	HCFC-225
Asahiklin 225 GAES	Asahi Glass	HCFC-225cb
Asahiklin 225 T	Asahi Glass	HCFC-225
Asahiklin AK-141b	Asahi Glass	HCFC-141b
Asahitriethane xxx	Asahi Glass	1,1,1-trichloroethane
B-Lube	Nat'l Chemsearch	1,1,1-trichloroethane
Balcoxx	Bally	1,1,1-trichloroethane
Baltanexx	Elf Atochem	1,1,1-trichloroethane
Benzinoform		Tetrachloromethane
C60	Spraway	1,1,1-trichloroethane
Carbon tetrachloride	Generic	Tetrachloromethane
CG Triethane	Central Glass	1,1,1-trichloroethane
CG Triflon	Central Glass	Tetrachloromethane
Chem-Slick	Nat'l Chemsearch	1,1,1-trichloroethane
Chemlok 252	Lord Corp.	1,1,1-trichloroethane
Cleaning Solvent CB 047	Asahi Glass	HCFC-141b
Cooler Cleaner		1,1,1-trichloroethane
CRC Lectra Clean	CRC Chemicals	1,1,1-trichloroethane
CRC 226	CRC Chemicals	1,1,1-trichloroethane
Daiflon	Daikin	CFC-113
Delifrene	Ausimont	CFC-113
Dional		CFC-113
Dowclene EC	Dow	1,1,1-trichloroethane
Dowclene EC-CS	Dow	1,1,1-trichloroethane
Dowclene LS	Dow	1,1,1-trichloroethane
Electrosolv	Unitor Ship Services	1,1,1-trichloroethane
Ethena	Asahi Chemicals	1,1,1-trichloroethane

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Solvents (only principal ODS components given) (continued)

Trade Name	Manufacturer	Principal ODS Component
F-113	Generic	CFC-113
Film Cleaning Grade	Dow	1,1,1-trichloroethane
Flon	Showa Denko	CFC-113
Flon Showa	Showa Denko	CFC-113
Flug_ne	Elf Atochem	CFC-113
Flug_ne 141b	Elf Atochem	HCFC-141b
Freon (except F-116)	Dupont	CFC-113
Frigen	Hoechst	CFC-113
Friogas 141b	Galco	HCFC-141b
Fronsolve	Asahi Glass	CFC-113
Genesolv	Allied Signal	CFC-113
Genesolv 2004	Allied Signal	HCFC-141b
Genesolv 2xxx	Allied Signal	HCFC-141b
Genetron 141b	Allied Signal	HCFC-141b
Genklene	ICI	1,1,1-trichloroethane
Gex	Nat'l Chemsearch	1,1,1-trichloroethane
HCFC-123	Generic	HCFC-123
HCFC-141b	Generic	HCFC-141b
HCFC-141b MS	Daikin	HCFC-141b
HCFC-225	Generic	HCFC-225 ca/cb
HyperClean	Micro Care	HCFC-141b
Isceon	Rhone Poulenc	CFC-113
JS-536B	Chiland Enterprises	1,1,1-trichloroethane
Kaltron	Kali Chemicals	CFC-113
Kanden Triethane	Kanto Denka Kogyo	1,1,1-trichloroethane
Korfron 141b	Ulsan Chemical	HCFC-141b
Krylon Dulling Spray	Sherwin Williams	1,1,1-trichloroethane
Magicdry	Daikin	CFC-113
Molybkombin UMFT4	Kluber Lubrification	1,1,1-trichloroethane
Mold Release CB 046	Asahi Glass	HCFC-141b
MS-136N	Miller Stephenson	1,1,1-trichloroethane
MV3	Rocol	1,1,1-trichloroethane
NAF xxx	Safety Hi-Tech	HCFC-123
Nanofron	Asahi Glass	CFC-113
NC-123	Nat'l Chemsearch	1,1,1-trichloroethane
Necatorina		Tetrachloromethane
New Dine x	Yokohama Polymer	1,1,1-trichloroethane
Nicrobraz Cement xxx	Wall Colmonoy	1,1,1-trichloroethane
Nilos Solution xxxxx	Nilos Hans Ziller	1,1,1-trichloroethane
Norchem xxx xxx xxx	Goldcrest Intnl	1,1,1-trichloroethane

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Solvents (only principal ODS components given) (continued)

Trade Name	Manufacturer	Principal ODS Component
PC81x	Multicore Solders	1,1,1-trichloroethane
Prelete	Dow	1,1,1-trichloroethane
Proact	Dow	1,1,1-trichloroethane
Propaklone	ICI	1,1,1-trichloroethane
R-113	Generic	CFC-113
Rust Inhibitor B007	Crown Industrial Prods	1,1,1-trichloroethane
S.E.M.I. Grade	Dow	1,1,1-trichloroethane
Safety Solvent 8060	Crown Industrial Prods	1,1,1-trichloroethane
Sankok Grease		CFC-113
Shine Pearl	Toagosei Chemical	1,1,1-trichloroethane
Sienkatanso	Kanto Denka Kogyo	Tetrachloromethane
Solkane 141b	Solvay	HCFC-141b
Solane 507	Solvay	1,1,1-trichloroethane
Solvent Cleaner/Degreas C60	Sprayway	1,1,1-trichloroethane
Solvethane	Solvay	1,1,1-trichloroethane
SonicSolve	Lonco	CFC-113
SonicSolve xxx	Lonco	1,1,1-trichloroethane
SS-25	Nat'l Chemsearch	1,1,1-trichloroethane
Sunlovely	Asahi Glass	1,1,1-trichloroethane
Super Solution	Pang Rubber	1,1,1-trichloroethane
Swish	Nat'l Chemsearch	1,1,1-trichloroethane
Tafclean	Asahi Chemicals	1,1,1-trichloroethane
Tafclean	Asahi Chemicals	CFC-113
Tempilaq	Tempil Division	1,1,1-trichloroethane
Three Bond xxxx	Three Bond Technologies	1,1,1-trichloroethane
Three One	Toagosei Chemical	1,1,1-trichloroethane
Tipp-Ex		1,1,1-trichloroethane
Toyoclean	Tosoh	1,1,1-trichloroethane
Triethane PPG		1,1,1-trichloroethane
Vertrel 423	Dupont Mitsui	HCFC-123

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2.2 Response to Decisions VIII/12 and IX/19: Final report on issues surrounding a transition to non-CFC containing treatments for asthma and COPD and national transition strategies

2.2.1 Predicted global schedule

The schedule for the safe introduction of new propellants and reformulated products suggested in the 1994 report and updated in the 1996 and 1997 reports of the ATOC remains on target.

One reformulated salbutamol product has been on the market for 3 years and is now available in more than 40 countries. A second salbutamol product and two reformulated inhaled steroids have become available in a few countries in early 1998. These and other reformulated products have been submitted for approval by regulatory authorities in some countries. It is likely that a wide range of reformulated products will be available in many developed nations and transition will be making good progress by the year 2000. Minimal need for CFCs for MDIs is envisaged by the year 2005 in non-Article 5(1) Parties. Remaining technical, patent, safety and regulatory issues for some commonly used drugs still make it difficult to predict the schedule for full phaseout with precision.

2.2.2 ATOC consultation process

The ATOC is consulting widely with representatives of the asthma/COPD community and has contact with the following organisations:

- Global Initiative on Asthma (NHLBI/WHO Initiative)
- American Thoracic Society/American Lung Association
- European Respiratory Society
- American Academy of Allergy, Asthma and Immunology
- National Asthma Education and Prevention Programme (USA)
- National Asthma Campaign (UK)
- National Asthma Campaign (Australia)
- Many health and environment regulatory authorities and patient support groups
- IPAC, MDI manufacturers and bulk CFC manufacturers
- Environmental Groups

The ATOC will continue consultation with these and other groups as the process evolves.

2.2.3 How a global framework and national strategies might be complementary

The ATOC was asked to consider, "in the context of a transition phase, how decisions taken within the Montreal Protocol framework and national strategies might complement each other" (Decision VIII/12(5)(a)).

The ATOC recognises that no single strategy will be applicable to all countries. There are pronounced differences among the Parties in national health care practices, regulatory requirements and reimbursement policies. The process of transition to non-CFC alternatives is complex involving the need for dialogue between health authorities, environmental agencies and other interested groups. To address these concerns, the ATOC believes that all Parties should develop their own national transition strategies to facilitate smooth transition, irrespective of status or whether they import or export CFC MDIs.

For the reasons outlined above, the ATOC does not believe that a rigid global strategy is appropriate. However the Parties could consider the benefits of a "Global Transition Framework" which would underpin national strategies and ensure that they are complementary. The Essential Use Process under the Montreal Protocol provides the opportunity for the review of progress and seeks to balance the twin aims of rapid CFC phaseout at the same time as protecting patients.

2.2.3.1 Global transition framework

A global transition framework would ensure coherence and support discrete national transition strategies. Any global framework should contain certain principles, but also sufficient flexibility for each Party to develop a national transition strategy that protects patient needs while conforming to that Party's unique legal and regulatory system. These principles include:

- specifying a target date for completing the transition. There must be sufficient time and resources available for education of health professionals and patients. Having a Protocol goal of an ongoing transition which will be completed by 2005 in non-Article 5(1) Parties will help in this regard by giving physicians and other health professionals a sense of the overall timing in which the transition should be completed. In the interim, Parties may wish to consider reducing the need for CFCs for MDIs as rapidly as is reasonably possible.

- addressing transition issues that transcend national boundaries, such as the flow of CFC MDIs from exporting countries to importing countries. Importing countries need to be assured of access to CFC MDIs and CFC-free products as the transition progresses. All countries should consider implementing measures to stop the inward flow of CFC MDIs once transition has been completed in that country.

- continued approval of new CFC-containing MDIs is likely to discourage some manufacturer's reformulation efforts. In keeping with the 1997 recommendations, Parties may like to recommend complete cessation of approvals of new CFC-containing products in non-Article 5(1) Parties now, and to consider setting a time scale for the same objective in Article 5(1) Parties.

- clarifying what constitutes a reasonable strategic CFC reserve. Good manufacturing practice requires maintaining such reserves to guard against the risk of supply disruption. However, care must be taken to ensure that such reserves do not undermine the progress of the transition. Parties could consider limiting strategic reserves (stockpiles) to no more than 12 months of current use.

- making continued availability of essential use allowances conditional on satisfactory progress in transition. In particular, in accordance with Decision VIII/10, the Parties should verify whether a manufacturer is actively pursuing research and development efforts on non-CFC alternatives or actively entering into licensing agreements.

- encourage a rapid introduction of CFC-free inhalers and technologies into Article 5(1) and CEIT Parties.

2.2.3.2 The development of a national strategy

A number of factors need to be evaluated in detail and individual Parties may wish to consider the following issues and principles when developing national strategies for CFC phaseout:

- Phasing out CFCs as rapidly as possible while maintaining patient safety.
- Availability of sufficient technically and economically feasible alternatives to assure an uninterrupted supply of medications in that country.
- One or more separate formulations of each therapeutic substance may need to be available.
- Sufficient post marketing surveillance of the reformulated products.
- Sufficient choice to assure that patient sub groups, especially children, are served by alternatives (ie., full range of doses).
- Adequate availability of supply of alternative non-CFC products.
- Stopping approvals of new CFC MDIs.
- Availability of sufficient time and resources for health professional and patient education.
- The regulatory framework for drug approval.
- The legal and economic framework in that country.
- The level of company commitment regarding reformulation efforts (consistent with Decision VIII/10). Company statements should be verified by Parties.
- How national strategies may impact on the transition occurring in other Par-

ties.

- How to control imports of CFC MDIs once transition has occurred.

The ATOC notes that the USA, EU, UK, Australia, Canada and New Zealand are developing or have developed transition strategies (New Zealand's transition strategy is provided at the end of this section). In line with Decision IX/19, non-Article 5(1) Parties with essential use allowances are required to submit details of national transition strategies to the Ozone Secretariat by 31st January 1999. Other non-Article 5(1) and Article 5(1) Parties are encouraged to develop and submit national transition strategies.

2.2.4 Implications of different policy options for the transition

The ATOC has considered a variety of approaches that an individual Party might take to facilitate the transition from CFC MDIs. The ATOC has tried to reflect some of the considerations that individual Parties might make in developing its own transition strategy in the light of its own circumstances.

It is difficult to defend a strategy under which CFCs are to remain available until every single CFC product has been individually reformulated. This would risk prolonging the phaseout indefinitely, as certain products currently using CFCs may never be reformulated and others may take many years before successful reformulations are launched. This would not be compatible with obligations under the Montreal Protocol. Under the Protocol, essential uses allowances for CFCs will stop once there is available a technically and economically feasible alternative which is acceptable from the standpoint of environment and health. This does not imply that the alternative must be identical either in brand or drug to the CFC product it replaces. For example, some patients currently using one brand of beta agonist might find they could easily switch to an alternative manufactured by another company. Others for example, currently using an inhaled steroid might find they could change to another drug with similar properties whether or not manufactured by the same company. Some patients currently using a CFC MDI might be able to change to a dry powder inhaler.

Some products may not be reformulated for economic reasons, others may ultimately prove impossible to reformulate for technical reasons. Where possible, physicians and patients will have to switch to an alternative treatment within a reasonable time-frame. If such products remain essential, a mechanism for continuing supply will be necessary. However, it must be understood that this could only be a temporary solution, and that there can be no question of long-term dependency on CFCs.

There are substantial differences in the regulatory and pricing approval process for reformulated products in different countries. Some countries regulations allow approval of new products as variations on existing licences, whilst other countries require new product applications. This together with other considerations means that approvals in some countries may be 1-2 years behind others.

2.2.4.1 Options for national transition strategies

The four approaches listed below are not mutually exclusive and it should be stressed that transition is likely to involve a combination of approaches.

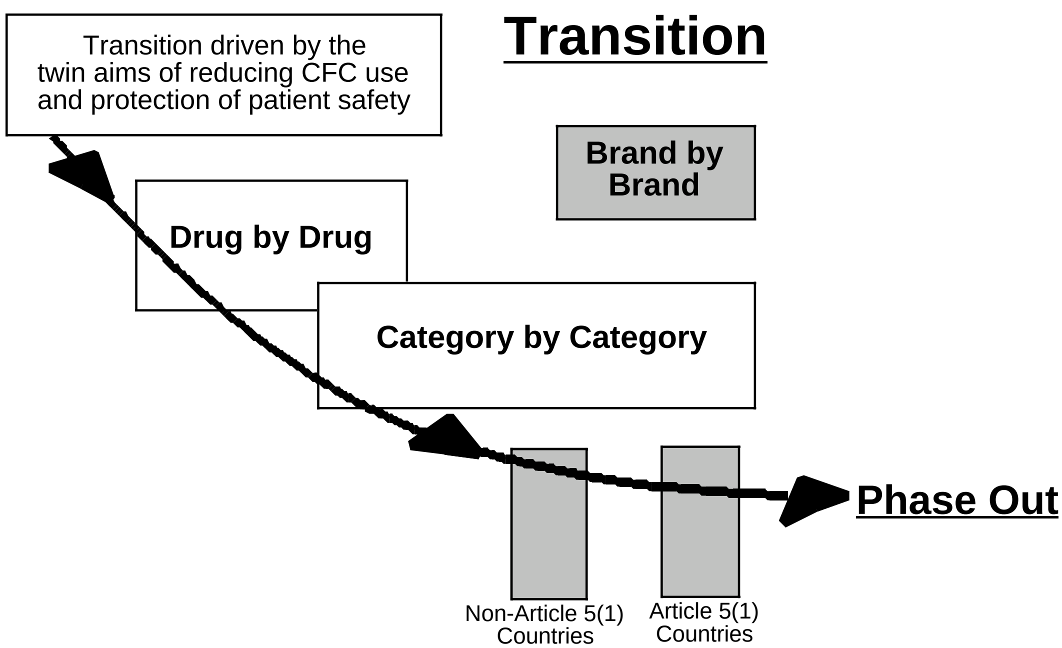
Brand by brand substitution may occur to a variable degree according to individual company decisions, but will not by itself lead to phaseout of CFC MDIs, for example those produced by a company that has no plans for reformulation.

Transition will therefore be driven by balancing the twin aims of a rapid reduction in CFC use versus full protection of patient safety (by assuring an uninterrupted supply of needed inhaled medications). The pace of transition and its fine tuning can be accomplished by a combination of a drug by drug and a category by category approach (see figure and text on following page).

In addition, the mechanism by which CFC products that are deemed no longer essential are phased out will likely differ among Parties. For instance, in the US draft transition policy, once a product is determined to be no longer essential (due to the availability of acceptable alternatives), further sales of that product will not be allowed. This approach of restricting sale of non-essential products allows for precise control (including control of imports). However it could result in residual stockpiles of CFCs if manufacturers do not plan properly.

In contrast, the proposed control over products which are no longer essential in the EU is via the withdrawal of licensing for bulk CFC production for use in that product. Considering CFC stockpiles and product on the shelf, the phaseout of CFC MDIs might therefore take up to 2 years after the licence has been withdrawn. This approach is less precise in its control, but allows for use of any stockpiled CFCs during the phase out.

Proposed Model of Transition



By Individual Product Brand (Brand by Brand)

When a company produces a new reformulated product which replaces its existing product, it would be required to introduce the new product and phase out the old over a time scale consistent with production process, distribution and a reasonable post marketing surveillance period if necessary.
The advantages of this approach might include :

- maintenance of physician/patient choice through brand continuity;
- minimal market disruption.

The disadvantages of this approach might include:

- does not address the issue of products which are not reformulated;
- does not consider non-MDIs as alternatives;
- no incentive for changeover unless linked with some form of volume reduction.

The ATOC does not generally commend this approach by itself for a national strategy since it does not encourage complete phaseout of CFC MDIs. As far as the ATOC is aware, no national strategy proposes this approach.

By Individual Drug (Drug by Drug)

Under a drug by drug approach, after a CFC-free MDI containing a given drug is launched, and a period of post-marketing surveillance undertaken, then a mechanism is triggered to phase out all CFC MDIs containing that drug within a specified period.

The advantages of this approach might include:

- maintenance of physician/patient choice through drug continuity;
- provides fast removal of CFC MDIs provided the withdrawal period is reasonably short;
- rewards the innovating company.
- The disadvantages of this approach might include:
- the patient population may be better served by waiting until at least two CFC-free MDIs are available to cover the unlikely event of product failure;
- physicians and patients have potentially no choice of brands and major brand switching will be necessary with consequent market disruption and the potential creation of monopolies.

The ATOC believes that this approach could provide the cornerstone of a transition policy with three important provisos:

1. Some large volume drug substances (eg. salbutamol) may require more than one replacement product for transition to occur safely.

2. This approach needs to be combined with volume reduction and category by category approach (see below) to ensure effective completion of phaseout.

3. Attention needs to be paid to product characteristics so that all patient needs are satisfied eg. an adequate range of doses and devices.

Category by Category Transition

There are several types of drugs used in the treatment of asthma and COPD. These types of drugs can be grouped into categories as shown below. The number of drugs in each category will vary from country to country depending on domestic availability of products. Drug categories are as follows:

A. Short acting beta agonist bronchodilators
eg. salbutamol (albuterol in USA) terbutaline, fenoterol

B. Inhaled Steroids
eg. beclomethasone, budesonide, flunisolide, fluticasone, triamcinolone

C. Non-steroidal anti-inflammatories
eg. cromoglycate, nedocromil

D. Anticholinergic bronchodilators
eg. ipratropium bromide

E. Long acting beta agonists bronchodilators
eg. salmeterol, formoterol

F. Combinations

It is important to realise that on a global basis categories A and B combined account for approximately 75% of CFC MDIs.

For each of the above categories A-F, when “sufficient” CFC alternatives become available in that drug category, the remaining CFC-containing products in that category can be phased out within a specified time. (“Sufficient” to be defined and determined by each Party).

The advantages and disadvantages of this approach will depend on the numbers of alternatives determined for safe transition for that category in each country.

The advantages of this approach might include:

- tailoring the policy to individual national needs;
- with limited alternatives in a category, fast transition is possible;
- with many alternatives in a category patient safety would be maintained.
- The disadvantages might include:
- CFC-free alternatives may not be available for all drugs in a category before they are phased out;
- with limited alternatives in a category patient safety might be compromised;
- with too many alternatives in a category transition would be slow.

Drugs of the same category can have different therapeutic indications, adverse effects and drug-drug interactions. The ATOC recognises the safety of ensuring an adequate range of treatments with this approach, provided an adequate range of reformulated drugs is available in each category. This approach enables management and completion of phaseout.

Volume reduction
Another strategy might involve setting targets for CFC reduction to zero over a fixed time. If patients are to continue to have access to appropriate medicine they require, including where necessary a choice of suitable therapies, it will be important to ensure that CFCs are not withdrawn prematurely before adequate alterna-

tives are available. A simple volume reduction approach will not meet these criteria. A general cut in CFCs, for example 50% in 1999, would be arbitrary, and could not necessarily protect the patients using CFC products for which no alternative had yet been developed. It may be difficult for Parties adopting this approach to predict when alternatives might be launched. Greater safe guards for health and safety are provided if the phaseout of CFCs is triggered by the de facto availability of acceptable alternatives (ie. category or drug based transition strategy), rather than based on a future prediction of when these alternatives might be launched.

The ATOC believes that a strategy based on volume reduction alone is unacceptable, but it could work well in conjunction with a drug by drug or a category by category approach. A volume reduction goal for full phaseout of CFC manufacture for use in MDIs in non-Article 5(1) Parties by 2005 remains desirable.

2.2.5 Implications of transferable essential use exemptions and trade restrictions on the transition and access to treatment options

The ATOC acknowledges that transfer of essential use exemptions between Parties in line with Decision IX/20 will facilitate the CFC transition and patient access to treatment options. As transition proceeds MDI manufacturers may choose to rationalise production for economic, technical and logistical reasons. Flexibility in the transfer of rights between Parties will facilitate the transition with no net environmental impact.

2.2.6 International markets and fluidity of trade in CFC MDIs and their alternatives

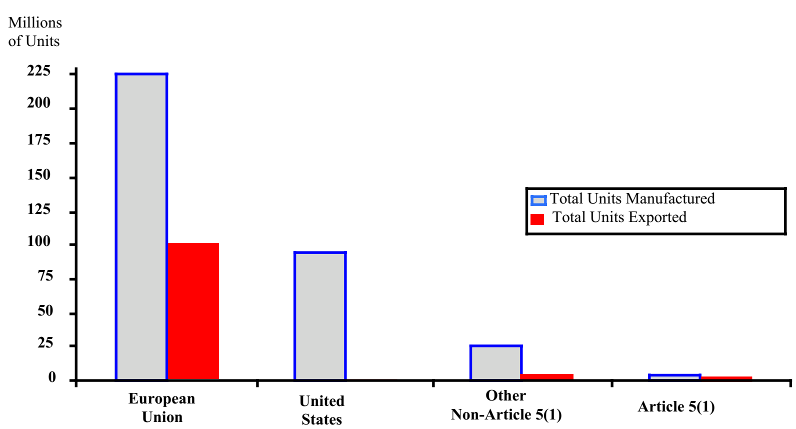
In February 1998, IPAC[†] conducted a confidential survey of its member companies on the manufacture and export of CFC MDIs in 1997. This survey requested that each member of IPAC indicate separately the number of MDI units manufactured in the European Union, the United States, other non-Article 5(1) Parties, and Article 5(1) Parties. The survey also requested that each member indicate the number of MDI units exported from Parties or regions in which it manufactured MDIs. The results of this survey are set out below. While complete global data is not indicated (e.g. CEIT are not represented nor are non-IPAC member pharmaceutical companies, nor is information presented on CFC MDI alternatives), the information presented is useful to help build up a picture of trade in CFC MDIs.

IPAC's members manufactured an estimated 369 million MDI units during 1997 in the following Parties:

Non-Article 5(1) Parties	**Article 5(1) Parties**
Australia	Argentina
France	Brazil
Germany	China
Ireland	India
Italy	Korea
Spain	Mexico
United States	Pakistan
United Kingdom	South Africa
	Taiwan

Members of IPAC exported MDI units for patient care to more than 100 countries worldwide.

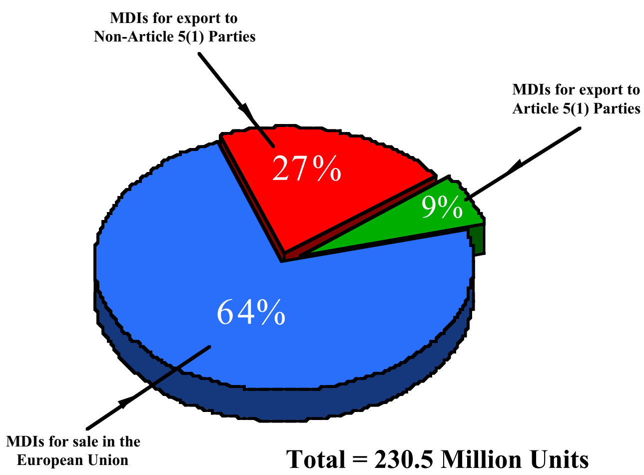
Fig. 1: The manufacture and export of CFC MDIs by IPAC members worldwide



European Union

In the European Union, members of IPAC manufactured an estimated 230.5 million MDI units in 1997. Of these, an estimated 63 million MDI units (or approximately 27%) were exported to non-Article 5(1) Parties outside the European Union. An estimated 21.3 million MDI units (or approximately 9%) were exported to Article 5(1) Parties. An estimated 146.2 million MDI units (or approximately 64%) were manufactured for sale in the European Union.

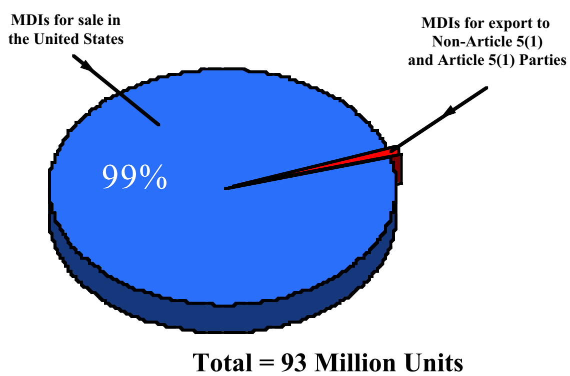
Fig. 2: Export of CFC MDIs by IPAC members from the European Union in 1997



United States

In the United States, members of IPAC manufactured an estimated 93 million MDI units in 1997. Of these, approximately 393,400 MDI units (or approximately 0.4%) were exported to non-Article 5(1) Parties from the United States. An estimated 746,400 MDI units (or approximately 0.8%) were exported to Article 5(1) Parties. Approximately 99% of these units were manufactured for sale in the United States.

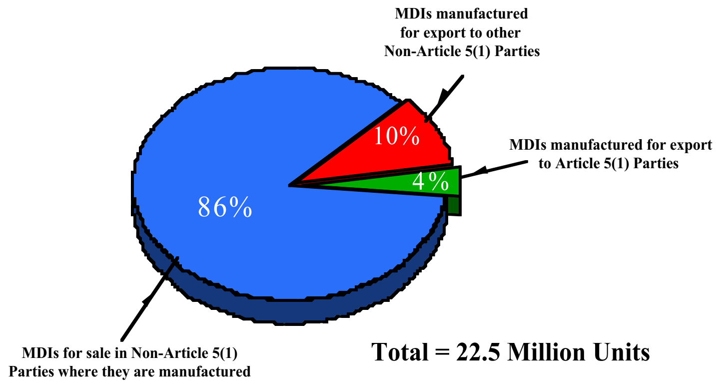
Fig. 3: Export of CFC MDIs by IPAC members from the United States in 1997



Other non-Article 5(1) Parties

In the other non-Article 5(1) Parties, members of IPAC manufactured an estimated 22.5 million MDI units. Of these, an estimated 2.25 MDI units (or approximately 10%) were exported to other non-Article 5(1) Parties. An estimated 900,000 MDI units (or approximately 4%) were exported to Article 5(1) Parties. The remaining 19.35 million (or approximately 86%) of these MDI units were sold in those non-Article 5(1) Parties where they were manufactured.

Fig. 4: ***Export of CFC MDIs by IPAC members from other non-Article 5(1) Parties in 1997***

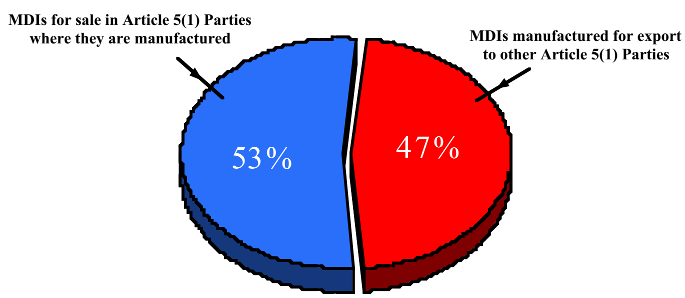


Total = 22.5 Million Units

Article 5(1) Parties

In Article 5(1) Parties, members of IPAC manufactured an estimated 23.4 million MDI units. Of these, 100,000 MDI units (or approximately 0.4%) were exported to non-Article 5(1) Parties. An estimated 10.9 million MDI units (or approximately 47%) were exported from those Article 5(1) Parties where they were manufactured to other Article 5(1) Parties. The remaining 12.4 million (or approximately 53%) of these MDI units were sold in those Article 5(1) Parties where they were manufactured.

Fig. 5: *Export of CFC MDIs by IPAC members from Article 5(1) Parties in 1997*

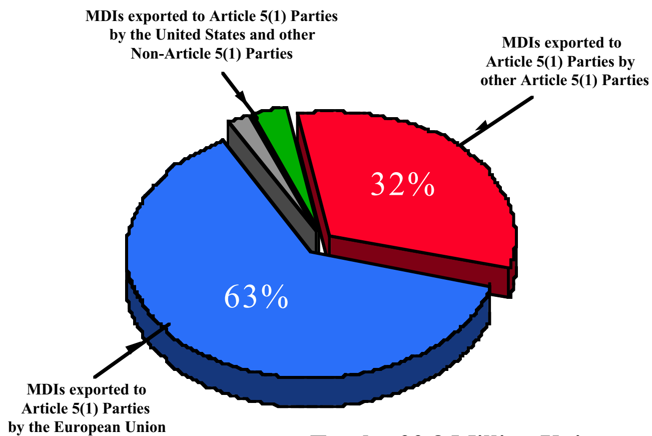


Total = 23.4 Million Units

Export of CFC MDIs to Article 5(1) Parties

An estimated 33.8 million MDI units were exported to Article 5(1) Parties in 1997. Of these, an estimated 21.3 million MDI units (or approximately 63%) were exported from the European Union; an estimated 750,000 MDI units (or approximately 2%) were exported from the United States; an estimated 900,000 MDI units (or approximately 3%) were exported from non-Article 5(1) Parties other than the European Union or the United States; and an estimated 10.9 MDI units (or approximately 32%) were exported from other Article 5(1) Parties.

Fig. 6: ***Export of CFC MDIs by IPAC members to Article 5(1) Parties in 1997***



Total = 33.8 Million Units

In summary, the global total of CFC MDI units manufactured by IPAC members in 1997 was 369.4 million units. Of these, 46.2 million units (13%) were manufactured in or for Article 5(1) Parties. In addition, 22.9 million units (6% of total production by IPAC members) were manufactured in non-Article 5(1) Parties and exported to Article 5(1) Parties.

Once transition has taken place in a Party, there is potential for imports of CFC-containing products from another Party. Under the Montreal Protocol, there is no restriction on movement of finished goods, ie. manufactured MDIs. Any import ban to control imports of CFC MDIs to a Party once a transition is completed would need to comply with international treaties on trade. To do so it would need to be non-discriminatory and compatible with domestic policy. In a number of countries this could be controlled through existing regulations on the import of therapeutic goods and product licence approvals but in other countries there is no precedent for the withdrawal of drugs on any grounds other than safety.

The Parties may also wish to note that a strict interpretation of the Protocol's Decision IV/25 would prohibit the export of CFC MDIs from a Party, once that Party had completed its domestic transition (ie. there was no need for an essential use allowance since it is not necessary for the health and safety of the applying Party). This would disrupt access to treatment options in importing countries. The ATOC respectfully requests that the Parties clarify their interpretation of Decision IV/25 (ie. can Parties which have completed domestic transition continue to export to Parties which have not).

2.2.7 Incentives and impediments to research and development and market penetration of alternatives

2.2.7.1 Research and development

The world market for inhaled products is several billion US dollars and is continuing to grow. This provides a clear incentive to develop replacements. The reformulation of CFC MDIs to replace the propellants began in 1988 and has proved to be much more technically difficult than was originally envisaged. Over 90 laboratories in at least 10 countries are involved in reformulation efforts with a total estimated cost to date of over US $1 billion.

There are differences between the CFC and HFC MDIs which have resulted in the need for extensive clinical investigations and revision of long-standing manufacturing methods. This has necessitated significant capital investment in new manufacturing facilities. In addition the regulatory requirements for approval of HFC products in some countries are significantly greater than for the approval of CFC MDIs.

There are currently in excess of 100 patents or patent applications in the area of CFC-free MDI technologies. However, new technology is being made available for licensing to other companies.

2.2.7.2 Market penetration

Multinational companies have developed CFC-free alternatives which they are marketing themselves or by licensing agreements to exploit their commercial advantage. Once adequate experience has been gained many large volume branded products will change over as manufacturing capacity increases in a "brand by brand" transition.

Factors slowing uptake of non-CFC product include: lack of national strategies to encourage smooth transition; lack of incremental benefit to patients; apathy of physicians to environmental benefits; higher cost than generic products. It is important to note that the lack of motivation to physician prescribing and economic considerations makes it unlikely that marketing and education programmes alone will produce a significant switch away from CFC products in the absence of clearly defined and implemented national transition policies.

Almost 3 years after the introduction of the first salbutamol non-CFC MDI by 3M Pharmaceuticals this product has only reached a very low market share in Europe. In the USA, where the CFC-free product is at a price disadvantage to generic CFC inhalers a similar situation exists.

In a few countries, there are now several non-CFC MDIs available. Awareness of the CFC transition issue may be high (eg. in a survey conducted in the UK during 1997 by the National Asthma Campaign, 92% of primary care physicians were aware that CFCs were likely to be removed from MDIs by the year 2000) but nevertheless the uptake of the HFC MDI products is low. The manufacturers of products that have large market share can effect the transition by voluntary withdrawal of the respective CFC-containing products, once the acceptance of that product has been fully established.

2.2.7.3 Potential impediments

There are several potential impediments to the rapid transition to HFC MDIs. These include:

- lack of national transition strategies;
- continued regulatory approval of CFC-containing MDIs;
- the lack of prioritised regulatory review of HFC MDIs;
- lack of acceptance by local drug formularies;
- no perceived therapeutic advantage to patients;
- potential oversupply of CFCs in stockpiles resulting in continued manufacture of CFC MDIs.

These factors all need to be addressed in the development of national transition approaches.

2.2.7.4 The role of education in transition

There should be co-operation between the professionals involved on a local or regional basis to discuss how the transition is to be implemented. Contacts with patient representatives should be established at an early stage to ensure that patients receive adequate information, both verbally and in writing. This is essential to build the confidence of patients in the new products. Further, the changeover of patients in one area should be done at roughly the same time to reduce the problems of primary and secondary care and the difficulties which would arise from a long period during which both the old and the new products would be available.

Choice of medication is invariably made by the physician and not by the patient. Patients consider this within the competence of the physician and a reason for consultation. However, the patient does expect an explanation for the choice of a specific medicine, especially where a change from a familiar product is involved. Surveys have shown that when the change is recommended by the physician and adequate information is given, most patients are happy to change to the new devices and do so successfully.

Education is a continuous process, a partnership between professionals and patients involving an exchange of information and adequate opportunity for patients to express their fears and concerns. Although physicians are the patients' first source of information on medication, they do consult other professionals in asthma treatment as well as patient associations when they have questions about the treatment of their disease. It is therefore of the utmost importance that all these groups have the same information and give consistent advice to the patients. With adequate preparation and reinforcement of the key messages, most patients are expected to undergo an easy transfer from their existing CFC inhalers to CFC-free devices.

To raise awareness, the following approaches could be considered:

(i) at government level:

National Governments may consider developing a strategy for the transition and health regulatory agencies may wish to consider providing circulars for health professionals, as well as unbiased information leaflets for patients. Appropriate sources of finance should be identified to support the awareness raising campaign. National health systems and/or health insurance schemes may consider preparing a plan to manage the period during which new products are becoming available while cheaper CFC products remain on the market.

(ii) at professional and patient association level:

Doctors, nurses and pharmacists need to be aware that the transition is not optional, and that, over the next few years, all patients currently using CFC products will have to change to non-CFC devices. They should be prepared to help patients understand the reasons for the change and assist them during transition. Patients will require reassurance that:

- the new treatment is as safe and as effective as the previous CFC products;
- the new inhaler devices operate in very similar ways to the CFC inhalers;
- CFCs are damaging to the environment but not damaging to the individual using the inhalers.

Although they will experience differences in appearance, dosage, taste and sensation when using the new products, these differences do not imply any reduction in effectiveness of the medicines.

Educational activities for patients and health professionals might involve:

- *Professional associations* – through medical journals, medical symposia, reports and newsletters. The ATOC welcomes national initiatives such as the professional/pharmaceutical collaboration embodied in the National Asthma Education and Prevention Program in the USA, symposia and newsletters arranged by the British Thoracic Society, workshops arranged by the European Respiratory Society, the American Thoracic Society, the American Academy of Asthma Allergy and Immunology and other initiatives in France, Australia and Brazil amongst many others.

- *Treatment guidelines* issued by the country’s medical authority which document the advantages and drawbacks of different forms of therapy and recommend specific forms of care for specific patient groups. All countries with guidelines continually review and revise their nations guidelines and many now include reference to the CFC/MDI issue. During 1995 the US National Heart Lung and Blood Institute (NHLBI) and WHO introduced a Global Initiative on Asthma (GINA). GINA symposia have been held in many Article 5(1) and non-Article 5(1) Parties and GINA guidelines translated into over 25 languages. The latest draft revision (1998) includes a section on CFC transition.

- *Promotional material and media coverage* – Advertising and promotional material placed in medical journals and circulated to physicians by pharmaceutical companies. Also articles in popular media promote awareness in the public of new products.

- *Pharmaceutical industry* – Education of the medical profession, support of medical symposia, reprint of pertinent articles and reports and information sheets to patients are strategies to help to inform both professionals and the public of developments and alternatives. The International Pharmaceutical Aerosol Consortium (IPAC) developed a brochure for health professionals entitled "Moving Towards CFC-free Metered Dose Inhalers" and a patient brochure entitled "Your Metered-Dose Inhaler Will Be Changing…Here Are The Facts". IPAC has also established a site on the World Wide Web - http://www.ipacmdi.com

- *Medical literature* – Articles appearing in the medical journals inform professionals of developments, and several have been published since 1994, many written by members of the ATOC, with further major editorials due to be published in 1998.

- *Support groups* which provide information, seminars and programmes aimed at both the general community and through schools, sporting groups etc., eg. National Asthma Campaign (Australia), Asthma Society of Canada. The United Kingdom National Asthma Campaign has produced a fact sheet to help prepare patients for changeover of their inhalers and is launching a special CFC telephone helpline with the support of IPAC and the UK Department of Health. In co-operation with Patient Associations, an awareness campaign for patients should be started. To prepare patients for the change to alternatives, various methods are needed. Spoken advice, together with written and audio-visual reinforcement is likely to be necessary.

The amount of educational activity being undertaken varies from country to country and should involve increasing awareness of DPIs as well as the reformulated MDI products. As more alternatives become available it is essential that a more active patient strategy is developed. This will involve concerted effort by the industry, and by health professional associations and national health authorities working together with patient support associations (eg. National Asthma Campaigns and Asthma Foundations). For countries without patient support associations it is possible that the NHLBI/WHO Global Initiative (GINA) may be able to have available suitable literature for copying in the same way as they do with their current patient booklet, or add transition information to the GINA page on the Internet (http://www.ginasthma.com).

Professional bodies and patient associations are most likely to address this issue if governments take a lead in highlighting the importance of the subject. These educational activities are likely to cost money and responsibility and adequate funding need to be identified if a successful transition is to occur. Increasing numbers of medical symposia are scheduled for 1998/9, including the World Asthma Meeting in December 1998. This is supported by the major world respiratory organisations (European Respiratory Society, European Society for Asthma, Allergy and Immunology, American Thoracic Society, Asia-Pacific Society of Respirology, American Academy for Asthma, Allergy and Immunology, International Union Against Tuberculosis and Infectious Disease and GINA). This meeting will highlight issues surrounding the safe transition to non-CFC treatments. UNEP is a co-sponsor of the World Asthma Meeting.

2.2.8 The degree to which DPIs and other alternatives may be considered medically acceptable and affordable alternatives

Dry Powder Inhalers (DPIs) are now available for most inhaled drugs in many countries and the introduction of new DPIs is foreseen in the future. The introduction of 3 new multidose DPIs in early 1998 to the US market is expected to have a significant impact on US CFC requirements in future years. There is good evidence that the previously noted trend of increased DPI usage will accelerate, although the rate of increase in use and penetration differs from country to country.

Main factors that influence the use of DPIs as alternatives to MDIs include:

- the range of DPIs products available in a country;
- the relative cost of DPIs compared to MDIs in some countries;
- DPIs not being suitable or effective for all age and patient groups, eg. young children, the elderly and COPD patients, due to dependence on inspiratory flow rate;
- lack of awareness by physicians and patients of potential benefits of DPIs.

Except for DPIs, no other currently available inhalation systems are considered practical alternatives to MDIs. However, the ATOC notes with interest that a number of portable, hand-held nebulisers, and similar systems are under development. These may be potential future alternatives to MDIs and DPIs.

Four novel oral compounds (leukotriene modifiers) for the treatment of asthma have been approved by regulatory authorities in some countries. These may be of value to a certain number of those with asthma, but it is unlikely that these will be a full substitute for current effective inhaled preventive therapy. Thus, the mainstay of therapy for asthma and COPD is likely to remain therapy administered by the inhaled route.

2.2.9 Implications for importing countries of the transition and reductions in essential use CFC production

As noted under 2.6 above, " The Parties should also note that a strict interpretation of Decision IV/25 of the Protocol would prohibit the export of CFC MDIs from a Party, once that Party had completed its domestic transition. (ie. there was no need for an essential use allowance since it is not necessary for the health and safety of the applying Party). This would disrupt access to treatment options in importing countries."

This would mean that once transition has occurred in countries which manufacture CFC MDIs for export, essential use allowances of CFCs will be required to continue manufacture for export to importing countries. This supply will need to be continued until importing countries have completed transition to non-CFC alternatives, or until alternative sources of supply can be secured. It is particularly important that CFC allowances be available for manufacture of CFC MDIs for export to Article 5(1) Parties, for CEIT and non-Article 5(1) Parties until economically feasible non-CFC MDI alternatives become available. Otherwise the supply of MDIs will be interrupted, posing risks for patient care.

2.2.10 Steps to facilitate access to affordable non-CFC treatment options and technology

As previously noted in this report, the ATOC recognises that the transition to non-CFC treatment options may carry a financial burden for some countries and health authorities. Non-CFC MDIs are likely to be introduced at a price similar to existing CFC branded products, but this may be higher than available CFC generics and unbranded CFC products, thus carefully planned national transitions are needed.

It is desirable that new HFC propellants are utilised in MDI manufacture in developing countries in parallel with their introduction in developed countries. One company is committing resources to install manufacturing capacity in Latin America (Brazil) and Eastern Europe (Poland) to manufacture HFC MDIs. These plants will be operational in the next couple of years and serve local and regional market needs.

The local production of CFC MDIs is likely to continue for some time after cessation of their use in non-Article 5(1) Parties and will overlap with the importation of CFC-free MDIs. Local production of CFC-free MDIs by a local producer, a multi-national company, or by a local producer in collaboration with a multinational company will require the transfer of new technologies and may require new licensing arrangements and transfer of intellectual property. The cost of such local production of CFC-free MDIs will involve capital costs and either multiple year or one-off licensing arrangements. Multinational companies operating in Article 5(1) Parties should be encouraged to make the technology transfer as soon as possible.

However, the issues associated with CFC transition should be differentiated from the ongoing need to provide affordable inhaled therapy for Article 5(1) Parties; this is a huge health care issue irrespective of CFC transition.

2.2.11 Implications for patient sub-groups with compelling medical needs

The ATOC has considered the implications of the transition for patient subgroups which may have compelling medical needs. There are a number of considerations, some major and some minor:

Demographic considerations
Due to the wide variety of products and formulations already introduced and anticipated, there do not appear to be readily identifiable, discrete demographic subgroups which cannot be served by CFC-free products. For example, although multidose DPIs may be considered as alternatives for the purposes of the transition, they may not be suitable for very young children or some elderly or severely impaired patients (due to inadequate inspiratory flow rates). These patient subgroups should have available to them a wide variety of CFC-free MDIs (which for children and others may be administered through holding chambers/spacers) and these should adequately meet their needs. However the specific effects and benefits of holding chambers/spacers when used for delivery of HFC MDIs may differ from that of CFC MDIs and will require further study and experience.

Those experiencing worsening symptoms with alternative products
The efficacy of current alternative products and devices is generally comparable to CFC-containing MDIs. However, some patients may have a personal preference for CFC MDIs. This matter is likely to be overcome by educational endeavours and should not be the basis for an essential use nomination. Whilst unexpected problems with reformulated non-CFC MDIs are not anticipated in specific subgroups, asthma is a condition which varies in severity with time and those with COPD often suffer exacerbations. It is likely that some patients' condition will coincidentally worsen after changing to a new inhaler, and some may die as a result of their disease. Post-marketing surveillance should help detect any true but unexpected problems with tolerability resulting from varied excipients or other aspects of reformulation. Due to spontaneous disease variability, any perceived worsening experienced after a patient is switched to a new CFC product will require empathic handling and extra educational efforts by care givers. For patients who do not feel that they can continue with the new product, alternate CFC-free inhalers (including DPIs) will be

available for most drug categories.

Adverse allergic reactions
Concerns have been expressed regarding the non-reformulation of adrenaline (epinephrine) MDIs for the treatment of allergic reactions. This has occurred for commercial and technical reasons and not as a result of the Protocol. However, most experts believe that the alternative of injectable adrenaline is the preferred route.

Economically disadvantaged
A final subgroup which may have a compelling need for CFC products well into the phaseout is the low income patient (whether in Article 5(1) or non-Article 5(1) Parties) who rely on less expensive generic or locally branded products for control of their diseases. As stated elsewhere in this report, this issue has less to do with HFC MDIs versus CFC MDIs than it does with branded versus generic product price differentials since it does not appear that HFC MDIs will be more expensive to the patient than their branded CFC counterparts. The Parties may wish to consider the impact of restricted access to generic or locally branded products which may occur as a result of the transition. Such considerations may need to be included in the formulation of a Party's national transition strategy.

In consultation with Parties, the ATOC will monitor the continuing medical needs of particular patient subgroups.

2.2.12 Transition to non-CFC metered dose asthma inhalers: the New Zealand strategy

Summary of basic elements

- New Zealand has a long-standing concern to reduce and repair ozone depletion. New Zealand is also a country with a very high incidence of asthma and chronic obstructive pulmonary disease. It is therefore strongly committed to the timely elimination of CFCs from MDIs.
- New Zealand has a proven system of fast track registration of CFC-free MDI products. CFC-free MDIs have been on the market at no cost disadvantage to users for over twelve months.
- New Zealand has a comprehensive legislative environment which includes the capacity to deal with the false or misleading advertising of all products including CFC MDIs.
- Monitoring and consultation is being undertaken along with consideration of possible future action, such as additional targeted education and information programmes and the role of guidelines for the return and disposal of expired, defective or redundant CFC MDIs.
- The transition to CFC-free MDIs will accelerate as additional types and alternatives become available.

- A co-operative and gradualist market based strategy has the best potential in New Zealand for achieving a transition that takes into account patient needs, cost factors and environmental considerations.

Background

1. New Zealand's combination of clean air and unique geographic factors involves particular risks from depletion of the ozone layer. It has therefore been especially committed to the timely elimination of chlorofluorocarbons (CFCs) and all other ozone depleting substances (ODS).

2. Following the elimination of CFC imports on 1 January 1996, as required by the Montreal Protocol, attention has moved to the need to phase out other ODS such as hydrochlorofluorocarbons (HCFCs) and methyl bromide. As far as practicable, the phase out of those few mainly medical uses of CFCs such as asthma and chronic obstructive pulmonary disease (COPD) related metered dose inhalers (MDIs), currently exempted from the 1996 import ban, should also be considered.

3. New Zealand manufactures neither CFCs nor MDIs. MDI requirements are imported from Australia and other suppliers.

4. The Eighth Meeting of Parties to the Protocol in 1996 requested developed country Parties (Decision VIII/12(3)) that have developed a national transition strategy to report this to the Protocol's Technical and Economic Options Panel (TEAP) and its Technical Options Committee (ATOC). Although over the past few years there have been a range of non CFC treatments available for asthma and COPD illnesses in New Zealand, including dry powder inhalers (DPIs), and these have gained a reasonable market share, for various reasons they have not in New Zealand formed a generally acceptable alternative to CFC MDIs.

5. CFC MDIs form a relatively minor source of ozone depleting substances, both in New Zealand and globally. For example, it has been calculated that CFC MDIs have over the past thirty years contributed less than 1 per cent of total global CFC emissions. Nonetheless, there is a need, now that non CFC MDIs are becoming available, to address the question of how these should be introduced to markets and users. The prospect of an increasing scarcity of medical grade CFCs for the continued manufacture of MDIs will hasten this consideration.

The New Zealand approach

6. New Zealand has one of the world's highest incidences of asthma with one in five children suffering from this compared with one in 25 in China. About 450,000 New Zealanders have been diagnosed with the illness which now costs more than $100 million in pharmaceuticals each year, approximately one seventh of the pharmaceutical budget.

7. A non CFC bronchodilator MDI has been approved and made available on the market for users in New Zealand since early 1996. This product attracts the same full subsidy as the CFC MDI. Since 1996 the New Zealand approach to the introduction of non CFC MDIs has been to:

- approach the issue of the financial disincentives for users and merits of CFC and non-CFC MDIs in a neutral manner;
- ensure that there are no unnecessary impediments to the approval or introduction of non CFC products;
- leave the responsibility for marketing and promotion of the relevant products on the suppliers/manufacturers.

8. The request incorporated in Decision VIII/12(3) and associated Decisions provides an opportunity to review the above strategy so as to ensure that a smooth transition that provides for the health and safety of asthma and other COPD sufferers continues to occur.

Factors to be considered

9. The Broad Regulatory Approach

(i) One option would be the forced removal from the market, according to a pre-determined timetable, of CFC product. This, however, would be at some risk to patient safety objectives. It would also involve complicated administrative, regulatory and enforcement procedures. Nor would it in itself create incentives for the speedy reformulation of alternatives for the whole range of CFC MDI products. It is also worth noting that decisions relating to what particular brands of CFC MDIs are licensed or purchased do not necessarily result in additional usage or emissions.

(ii) An alternative is to continue to pursue the environmental objectives involved through persuasion and education of medical practitioners and patients while monitoring the process for avoidable impediments. This approach minimises the risk to patients and recognises that asthma and COPD are highly stressful and dangerous illnesses and some patients may experience considerable difficulty from changes to current medicines. Such an approach recognises that while CFC MDIs may in the future be difficult to obtain it is preferable for the majority of patients to make the change to non CFC treatments voluntarily at their own pace in consultation with their doctor, as alternative products become available.

Packaging and marketing

10. Decision VIII/10(3) asks that non-Article 5(1) Parties request companies applying for MDI essential use exemptions to demonstrate that they, or companies distributing or selling their products, are differentiating the packaging of the companies CFC and non CFC MDI products, and are applying other appropriate marketing strategies , in consultation with the

medical community, to encourage doctor and patient acceptance of the firms non-CFC alternatives subject to health and product safety considerations. Relevant companies in New Zealand are largely just importing and distributing agencies for overseas firms. It is understood that all are, or will be, differentiating their products. Where there is a continuation of established brand names, we understand that distinctive logos will be employed to distinguish alternative CFC and non CFC products.

Advertising

11. Paragraph 4 of Decision VIII/10 requests that developed country Parties encourage companies not to engage in false or misleading advertising targeted at either CFC or non-CFC MDIs. It is considered that current New Zealand legislation is adequate to cover this situation.

Ongoing education

12. Paragraph 2 of Decision VIII/10 asks that developed country Parties request companies applying for MDI essential use exemptions demonstrate that they are undertaking individual or collaborative industry efforts, in consultation with the medical community, to educate health care professionals and patients about other treatment options and the transition to non CFC alternatives. No New Zealand company will be applying for an MDI essential use exemption under the Montreal Protocol. It is known that importing and distributing companies in New Zealand are, however, providing information to health care professionals and patients. The Decision raises the question as to the degree to which additional education and the provision of information could facilitate a smooth transition to non-CFC MDIs in New Zealand. Physicians are provided with relevant information by suppliers who provide patients with appropriate information and advice on the range of non-CFC treatments available. The New Zealand pharmaceutical funding agency has contracted with the supplier of the first non-CFC MDI to provide an information campaign in conjunction with the launch of this product. Ongoing consultation with professional bodies, stakeholders and the community will take place so as to ascertain doctors needs for any additional information, and whether a policy of requesting new patients to be introduced to non-CFC MDIs would be likely to provide benefits.

Product review and approval

13. Paragraph 2 of Decision VIII/11 asks that developed country Parties request national authorities to expedite the review of applications for non-CFC treatments provided that such action does not compromise patient health and safety. In this connection it is noted that New Zealand has had a non-CFC MDI on the market for over 12 months. Many countries have yet to approve any alternatives for introduction. It is considered that New

Zealand has a relatively efficient product approval system.

Procurement and reimbursement

14. Paragraph 3 of Decision VIII/11 asks that national authorities review the terms for public MDI procurement and reimbursement so that purchasing policies do not discriminate against non-CFC alternatives. New Zealand's systems and policies of pharmaceutical procurement do not discriminate against non CFC alternatives and policies designed to ensure that there are no financial disincentives to the use of non-CFC MDIs are applied.

Disposal of expired, defective and returned CFC MDIs

15. Decision VIII/10 asks that Parties, "request companies manufacturing, distributing or selling CFC MDIs to dispose of expired, defective and returned MDIs containing CFCs in a manner that minimises CFC emissions." Initial enquiries reveal that although the major suppliers have appropriate procedures and practices in place a number of smaller suppliers may not. The issue of whether an industry guideline might be helpful is to be taken up with relevant firms.

Conclusion

16. A review of current policies and strategies in regard to the transition to non CFC MDIs indicates that the appropriate processes and incentives are in place. New Zealand has formed the view that while the market penetration of non-CFC products has been limited to date, this process will gain momentum and achieve significant progress as additional CFC free products become available. This will occur without risk to patient safety and without government intervention to restrict products or patient behaviour. The progress of firms in developing and producing non-CFC products has been good and further progress is expected. It is recognised that the environmental impact of MDIs is limited but nonetheless patients and medical practitioners need to be kept informed of the limited future for CFC based products and the inevitability of non-CFC based technology.

2.3 Response to Decisions VIII/17 and IX/21

2.3.1 1ntroduction and Scope

In Decisions VIII/17 and IX/21, Parties requested TEAP to report on questions relating to the feasibility of, and problems with, early decommissioning of halon systems.

Decision VIII/17
Requests the Technology and Economic Assessment Panel and its Halons Technical Options Committee to carry out, on the basis of existing information, further studies on the future availability of halons to meet the demands for use in applications that are deemed critical by Parties not operating under Article 5(1), and to report to the Ninth meeting of the Parties;

Requests Parties not operating under Article 5(1) to estimate the approximate surplus or deficit relative to their assessment of their critical needs, and to submit this information, together with an explanation of how it was determined, to the Industry and Environment Programme Activity Centre of the United Nations Environment Programme by 31 December 1997;

Requests the Technology and Economic Assessment Panel and its Halons Technical Options Committee to evaluate the information received from Parties and make an assessment, if possible, for the Tenth meeting of the Parties of whether there will be adequate halon to meet future needs for critical applications of Parties not operating under Article 5(1), and;

(a.) If there is a shortfall, either overall or in individual Parties, to propose action which may be taken to enable that shortfall to be overcome; or

(b.) If there is a surplus, either overall or in individual Parties, to provide guidance on appropriate policies for disposal or re-deployment, bearing in mind the needs of other Parties not operating under Article 5(1), as well as the needs of Article 5(1) Parties, and to identify potential barriers to such disposal and what steps may be needed to overcome them.

Decision IX/21

1. To request the Technology and Economic Assessment Panel to examine the feasibility of early decommissioning in non-Article 5(1) Parties of all non-essential halon systems, and the subsequent destruction or re-deployment of halon stocks not required for those critical uses that have no identified substitutes or alternatives, bearing in mind the need of Article 5(1) Parties for halon. In undertaking such an examination, TEAP should also examine the efficacy of halon alternatives, experience with potential measures to ensure safety and to minimise any emissions of halons during decommissioning, and experience with the cost and efficiency of storage prior to destruction and with halon destruction activities undertaken to

date;

HTOC has followed the direction indicated in the introduction to Decision IX/21 and combined its answer into this one report.

2.3.2 Methodology

Throughout this response the term “critical use” will be used for those applications where halons are needed because a replacement is technically and/or economically not feasible. The term “essential use” is confined to those critical uses which require a production exemption (in accordance with Decision IV/25). Due to the different situations for the three different halons, 1301, 1211, and 2402, this response is structured around each halon separately .

While carrying out the requested studies on the future availability of halons, the HTOC has significantly improved the Halon Bank model first published in the 1991 Assessment Report. The model has been updated to represent more accurately the distribution and emissions of halon using system/equipment design lifetime as the criterion. It was also adapted to reflect the different use patterns within the major regions of the world: North America, Europe and Australia, Japan, CEITs, and Article 5(1) Parties. The new estimates are based on a survey of halon sector experts within these major regions. For an extensive description of the model, its basic assumptions and detailed results see the end of this section.

2.3.3 Response for Halon 1211

Halon 1211 is mainly used in portable extinguishers. In Countries with Economies in Transition (CEIT), Japan, European, and some other countries, halon 1211 is sometimes also used in small fixed systems for unoccupied spaces. Although these fixed applications are important they account only for a small proportion of the total installed base of 1211. The reasoning outlined in the response for halon 1301 applies to these fixed systems as well.

2.3.3.1 Decision VIII/17 part 1: Evaluation on the future availability

There are few critical applications for halon 1211 portable extinguishers; exceptions include aviation, military, and police uses. Analysis of the model, based on available information, indicates a more than adequate supply of halon 1211 from the installed base to meet the demands of these critical uses, resulting in a potential surplus.

2.3.3.2 Decision VIII/17 part 3: Evaluation of Parties Response

As of the end of February 1998, the following Parties reported their assessment of the present and future situation of halon supply for critical needs: Australia, Austria, Bulgaria, Croatia, Denmark, Estonia, France, Germany, Hungary, Japan, Kirghiz Republic, Lithuania, Netherlands, Portugal, Romania, Russian

Federation, Switzerland, and USA. Most Parties that responded to the request in Decision VIII/17 indicated a balance between supply and demand for halon 1211. This is not in conflict with the findings of the halon bank model because only a small proportion of the large installed base is being decommissioned to meet the small critical use demand. Australia was the only Party reporting a surplus of halon 1211, this being the result of the Australian collection programme.

2.3.3.3 Decision IX/21: Feasibility of early decommissioning

By definition, all non-critical halon 1211 applications can be decommissioned. HTOC estimates that up to 80 % (by weight) of all portable halon 1211 applications can be taken out of service.

To manage the potential surplus of halon 1211 the following options have been identified. Parties may:

1. **Leave** the remaining halon 1211 portable extinguishers **in place** at their owner's discretion. This is by far the least expensive approach and will provide adequate future supplies for critical uses through market forces. This approach, however, accepts that, over a period of 20 to 25 years, almost all halon 1211 will be emitted. However, it should be borne in mind that these portable fire extinguishers will provide protection to people and property over this period.

2. Embark on a **voluntary** halon 1211 **management programme**, creating a collection, storage, and eventual destruction programme. Such a programme would have to make provisions to ensure that enough halon 1211 continues to be available for the remaining critical uses. If eventual destruction of surplus halon is part of the programme, less halon 1211 will eventually be emitted to the atmosphere than under option 1). Parties who consider choosing this option should be aware that it involves sizeable investments either from the public or the private sector. Parties choosing this approach may also wish to consider a labelling programme for extinguishers to raise the awareness of the general public for careful use and maintenance of these extinguishers.

3. Legislate the **mandatory decommissioning** of all halon 1211 non-critical applications, and collect and store the recovered halon 1211 in centralised locations with the intent of ultimately destroying it. This approach needs extensive control and support measures to ensure collection and to prevent illicit venting. It will require much higher financial investment than option 2). Unless major cost subsidies are provided by governments, HTOC feels that this solution has the potential to result in high early emissions at a time when the ozone layer is most fragile, as owners seek to avoid anticipated expenses. If adequate subsidies are made available, this option should result in a greater reduction of overall emissions of halon 1211 to the atmosphere than under compared 2). Again, provisions will

have to be made to ensure enough halon 1211 continues to be available for the remaining critical uses.

The halon 1211 portable extinguisher inventory of any given user may vary from 1 (in private households) to several hundreds or thousands (as in the case of an airline or the military) and is geographically widely dispersed. Any collection programme, whether voluntary or mandatory, would be difficult to execute successfully without strong public and government support.

Bearing in mind the **needs of Article 5(1) Parties**, HTOC sees the possibility of offering any collected quantities of halon 1211 to Article 5 (1) Parties to offset production or imports of newly produced halons. However, HTOC believes that this re-deployment of surplus halon will be associated with sizeable costs to cover the logistics of transportation. In addition, such an approach may see itself confronted with tariff barriers in certain Parties, and additional costs associated with financial losses from lower halon production in Article 5(1) Parties.

However, Parties may wish to consider that the popularity of halon 1211 fire extinguishers in Article 5(1) Parties is due to ease of manufacture of the fire extinguisher rather than a need to meet a critical requirement. To supply recovered halon 1211 for the purpose of continued manufacture of portable fire extinguishers merely prolongs the need to convert portable fire extinguisher manufacturing facilities to alternatives as soon as possible. Parties may wish to compare the cost benefit of accelerated assistance to convert fire extinguisher manufacturing facilities in Article 5(1) Parties to the cost of domestic recovery and destruction or redeployment programmes.

Regarding the **efficacy of halon alternatives,** HTOC notes that both in-kind and not-in-kind alternatives are available for almost all applications. Important exceptions include certain aviation, military and police applications.

Portable halon 1211 fire extinguishers are not difficult to handle or to prepare for storage or shipment. **Safety issues** and accidental emissions are therefore considered to be a low risk; nevertheless, handling pressurised cylinders inevitably entails potential dangers, and the necessary safety provisions must always be adopted.

Very little experience from **destruction programmes** is available. As of spring 1998, the only known programme is running in Australia. It is, however, too early to draw any conclusions about the costs associated with establishing and running a halon 1211 destruction facility, or about the stability and reliability of the processes involved.

2.3.4 Response for Halon 1301

Halon 1301 is almost exclusively used in fixed fire protection systems. The following discussion therefore refers to fixed systems with halon 1301.

2.3.4.1 Decision VIII/17 part 1: Evaluation on the future availability

Analysis of the halon bank model indicates that the global supply and demand for halon 1301 is currently in balance and will remain so over the next thirty years. The model analysis also indicates that Halon 1301 has been and continues to be shifting from less critical applications to critical applications through decommissioning and recycling processes. This shift is the result of free market forces within the fire protection industry with varying degrees of government assistance or intervention.

2.3.4.2 Decision VIII/17 part 3: Evaluation of Parties Response

An assessment of the individual responses by Parties (see above) confirmed that for non-Article 5(1) Parties the quantity of recovered and recycled halon 1301 that serves to supply halon for critical applications is, on a global basis, in approximate balance with demand.

There were individual Parties that reported marginal surpluses or deficits but they were experiencing no difficulties redressing this balance through international trade.

The reported requirements of the Parties and the assessment of existing data by HTOC are in agreement. HTOC draws the conclusion that the halon 1301 inventory or "Bank" as it has been referred to by HTOC, is being well managed by the fire protection community. The Bank is continuing to provide the necessary quantities of recycled material to meet the needs of critical uses, thereby eliminating the need for essential use production exemptions. This has been achieved through the commitments of Government in some Parties - by funding early work for starting banking and recycling activities or by enacting halon management regulations - and by national industries, who engaged voluntarily in the same work.

2.3.4.3 Decision IX/21: Feasibility of early decommissioning

By definition, all non-critical halon 1301 fixed systems can be decommissioned. However, HTOC believes it is not necessary to do so to meet future demands for critical uses. Halon recovered by normal decommissioning at the end of the useful life of a system (both critical and non-critical) is available for longer term critical uses. This is supported by the HTOC analysis and the reports from the Parties. All available data indicates that over the last 5 years halon 1301 has been migrating from less critical installations to more critical applications and will continue to do so. Both the cessation of production in non-Article 5(1) Parties and the halon bank management efforts by the fire protection community and other organisations have facilitated this transition.

As supply and demand are fairly well balanced, both in individual Parties and globally, HTOC concludes that there is no need for additional efforts by the Parties to facilitate **early decommissioning** and subsequent halon 1301 collection for re-deployment to critical uses. The success to date of the approach of using market forces to balance supply and demand, adopted by countries such as the USA and the UK, indicates that a regulatory approach is not essential, although such approaches have also been successfully implemented in countries such as Japan, Australia, and Denmark.

Currently there is no surplus of halon 1301 that requires destruction, or which could be used to satisfy additional **needs of Article 5(1) Parties** beyond those that are already being taken care of.

Regarding the **efficacy of halon alternatives**, both in-kind and not-in-kind alternatives are available for many new and existing applications. It should be noted, however, that while an alternative may be well suited for a newly designed installation it may be much more difficult, or even impossible to achieve an acceptable level of protection for people or property in an existing situation which was designed with the use of halon in mind. In addition, existing alternatives generally cost more, take up more space, and weigh more than the equivalent halon 1301 systems to achieve the same acceptable level of protection.

Halon 1301 cylinders used in fixed systems are under high pressure and can be easily actuated. Therefore they present a great **safety concern** during decommissioning, transport, and storage. A number of injuries and at least three deaths caused by the decommissioning of halon cylinders have been reported in the last few years. Decommissioning, collection and storage of halon cylinders may also result in greater early emissions (while the ozone layer is most fragile), once equipment has been removed from the original well maintained installation. Care has to be taken to ensure that collected halon will be quickly transferred into appropriate storage tanks to minimise future emissions. These actions will add significantly to the required cost of any decommissioning operation. Experience from physical halon banking programmes in the United States and in Australia indicate costs of US $ 25 to 40 per kilogram for collection and storage of Halons. This price varies according to the distribution pattern of the involved halon systems and does <u>not</u> take into account the replacement costs for the new fire protection needed. Furthermore, experience in these two countries reveals, that between US$ 0.5 to 1.0 per kilogram per year are needed for safe storage of the collected halon prior to destruction or re-allocation for critical uses. These costs were shared between users and Governments in Australia, and carried by the responsible Government agency in the United States.

Only very limited experience of **destruction** of halon 1301 is available. HTOC is not aware of any intermediate or large scale halon 1301 destruction programme having been undertaken.

2.3.5 Response for Halon 2402

Halon 2402 was and continues to be used mainly in the Russian Federation and in other CEITs. As evidenced by the Russian Federation's repeated requests for essential use production exemptions, there is a current shortfall in availability of halon 2402 to meet critical needs. As indicated in HTOC's evaluation of these requests no banking scheme for halon 2402 is currently in place. HTOC therefore does not have the information to evaluate whether a potential exists for early decommissioning of halon 2402 systems to support ongoing critical needs.

2.3.6 Halon bank calculation analysis

2.3.6.1 Introduction

The HTOC has conducted a major review of halon use patterns in the following regions:

- Western Europe,
- Australia,
- North America,
- Japan,
- Article 5(1) countries, and
- CEIT

It was found that use patterns for Western Europe and Australia were similar and as a result these two regions have been grouped for the purpose of the calculations. Individual regional calculations are therefore provided for Western Europe and Australia, North America and Japan for both halon 1301 and halon 1211. As well, summaries and charts are provided for both halon 1211 and halon 1301. The summaries combine data from the regional calculations.

The HTOC is awaiting receipt of historical halon production data for China, India, the Republic of Korea and the Russian Federation. It is expected that the HTOC will be able to provide calculations provided for Article 5(1) countries and CEITs in the 1998 Assessment Report.

The analysis was developed and conducted to provide a basis to determine:

- If sufficient quantities of halons would be available for critical uses where alternatives are not yet available

- If existing quantities of halons exceed the need to satisfy future critical uses
- If excess quantities could be gathered and destroyed or used to supply the needs of Article 5(1) countries and thus reduce the need for further production of halons

2.3.6.2 Overview

2.3.6.2.1 Halon 1301

At present there are no acceptable or approved alternatives to the use of halon 1301 for the following applications:

1) aircraft (civilian or military) for the protection of engine nacelles, cargo bays and dry bays

2) crew compartments of tactical military vehicles, including armoured vehicles used by United Nations Missions

3) inerting of occupied spaces where flammable liquid release could occur

In addition, even though alternatives are now available, in many cases, for new installations, it is virtually impossible to replace halons in the following existing applications due to specific weight, space or personnel safety considerations:

4) machinery and flammable liquid stores spaces on ships

5) remote telecommunications, satellite earth stations and/or aids to navigation sites

These five generic classes of halon 1301 applications are typically cases where the equipment is installed for a long term. Originally the most common application for halon 1301 was for the protection of commercial computer rooms. Normally the fire protection installation for a computer installation becomes redundant when the computer equipment becomes obsolete. In today's fast changing world of data technology, equipment life and the equipment life of ancilliary equipment such as air conditioning equipment and halon 1301 systems equipment is typically less than 15 years (least critical equipment bank). In non-Article 5(1) countries the halon 1301, recovered from computer room fire protection systems, is currently being used to satisfy the most critical applications (1, 2 and 3 above) and for recharge after fires of more critical (4 and 5 above) and most critical applications (1, 2 and 3 above).

At present supply and demand of halon 1301 appears to be balanced and the balance is being maintained by reallocation of halon 1301 from least critical applications to more and most critical applications. The needs of least critical applications are being satisfied by commercially available halon alternatives such as inert gas mixtures and/or halocarbon alternatives. For all non-Article 5(1) countries supply is composed entirely of recycled halon 1301.

2.3.6.2.2 Halon 1211

At present there are no acceptable or approved alternatives to the use of halon 1211 for the following applications:

1) Hand held, halon 1211 fire extinguishers for use onboard aircraft (civilian or military)

2) Military aircraft flightline fire fighting equipment

3) Military and police fire extinguishers for use on persons

These critical uses represent a very small portion of the existing bank of halon 1211 and/or the current production of halon 1211 in Article 5(1) countries.

A low percentage of the bank of halon 1211 is recovered and recycled because:

- Hand held halon 1211 fire extinguishers are of very small capacity in comparison to halon 1301 fire equipment and they are widely distributed. As a result it is very expensive and difficult to develop a recycling program as costs are high and recovery is low.
- There are few critical or essential uses that require recycled halon 1211 as a source of supply, as a result there is very little market demand for recycled halon 1211.
- Newly produced halon 1211 is less costly than recycled halon 1211, eliminating a potential market in Article 5(1) countries.

2.3.6.3 Discussion

2.3.6.3.1 Halon 1301

Calculations based on various usable equipment lifetimes unique to the region of use have been provided. In general, the shorter equipment lifetimes could be equated to least essential applications with the longest equipment lifetimes associated with the most critical applications. A portion of the halon 1301 in equipment that had reached the end of useable life has always been recycled because of the cost of halon 1301, however significant increases in recovery were stimulated by the awareness created by the Montreal Protocol. Recovery rates are provided in the calculations. The halon recovered from least essential applications has migrated to the more and most essential applications and this is shown in the calculations and graphs that follow. It is also noted that test and service emissions decreased significantly after 1987. Details are provided in the calculations.

2.3.6.3.2 Halon 1211

Calculations based on various usable equipment lifetimes unique to the region of use have been provided. No valid argument can be provided to equate equipment lifetime with criticality of use of halon 1211. Very few uses of halon 1211 equipment would be considered to be of critical importance. Recovery rates are provided in the calculations. Halon 1211 recovery rates are lower than those for halon 1301 as the lack of essential or critical uses has not provided an economic incentive to stimulate aggressive recovery efforts. This is shown in the calculations and graphs that follow. Details are provided in the calculations.

2.3.6.4 Conclusions

Production of halon 1211 and halon 1301 peaked in 1988 and has now ended in all non-Article 5(1) countries and India. Currently China and Republic of Korea are the only known producers of halon 1211 and halon 1301. Recycled halons are now the only source of supply of these agents in non-Article 5(1) countries and many Article 5(1) countries.

2.3.6.4.1 Halon 1301

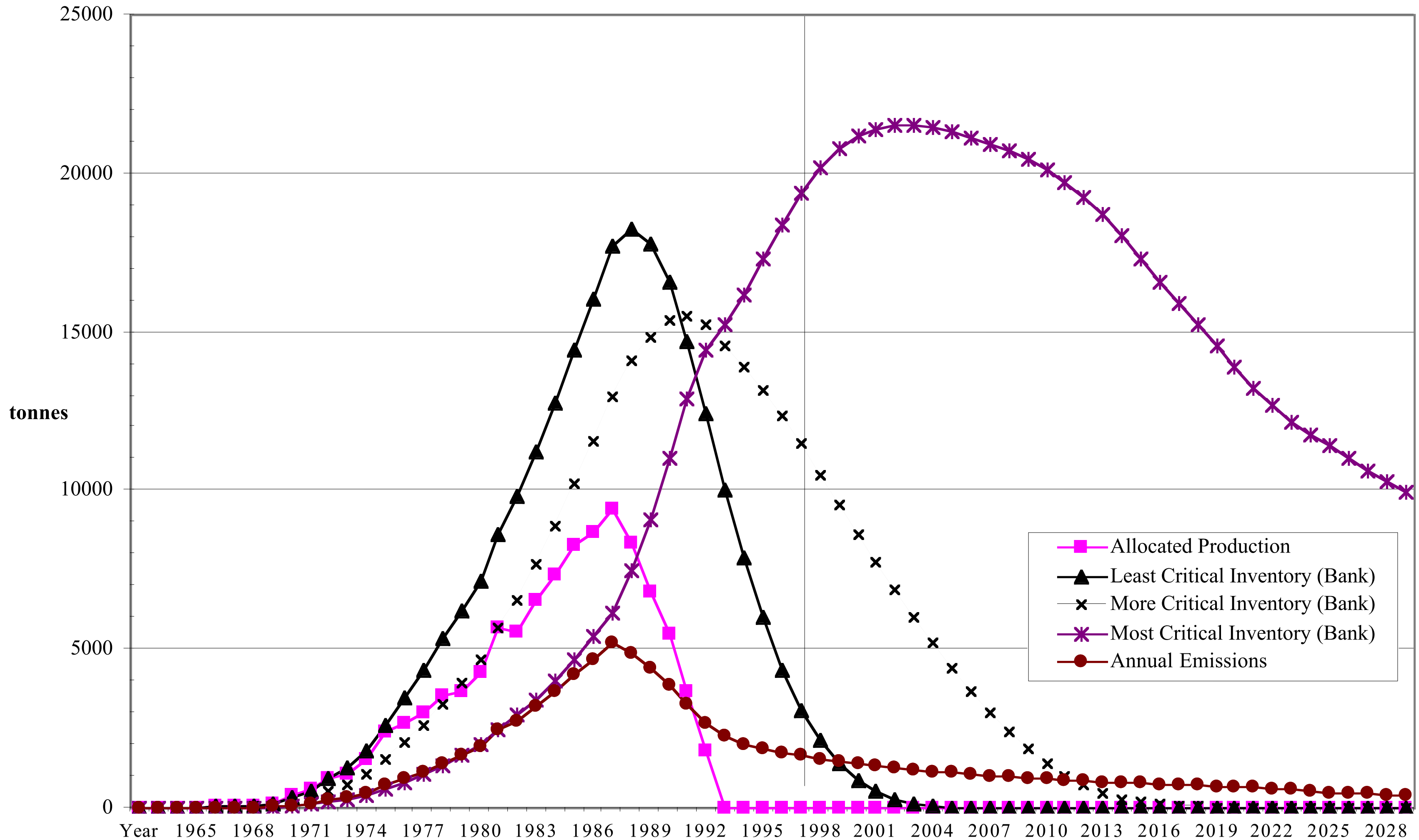
For Western Europe, North America, Japan and Australia it is estimated that the bank of halon 1301 will be adequate to supply maintenance quantities for critical equipment for at least the next 30 years. Also, it appears that limited supplies of recycled halon 1301 will be available to satisfy the needs of the most critical applications after that time. This is consistent with the expected lifetime of aircraft and special military equipment that are coming into service currently and must depend on halon 1301 for fire protection. It is estimated that for all practical purposes the halon 1301 bank expires between 2030 and 2040.

2.3.6.4.2 Halon 1211

For Western Europe, North America, Japan and Australia the bank of halon 1211 should be sufficient to maintain existing equipment using recycled halon. It is anticipated that, in the next few years, some equipment may have to be taken out of service to provide maintenance quantities of halon 1211 and that in the later years small quantities of halon 1211 will become available for new equipment, until the bank expires. There is little economic motivation to recycle or re-deploy halon 1211 as there are few critical or essential uses represented by the existing inventory of halon 1211 portable fire extinguishers, the quantity of halon 1211 contained in each portable fire extinguisher is small and the extinguishers themselves are difficult to gather once they have reached the market. Therefore, effective programmes to recover and destroy halon 1211 may be difficult and expensive to achieve.

2.3.6.5 Data and charts for halon 1211 and halon 1301 banks are provided on the following pages of this section of the report.

Halon 1301 - Western Europe, North America, Japan and Australia



Halon 1301
Western Europe, Australia, North America and Japan

Year	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Allocated Production	8	15	23	30	38	45	75	150	413	629
Least Critical Inventory (Bank)	3	10	19	30	43	58	84	140	307	551
More Critical Inventory (Bank)	2	5	10	16	24	33	48	80	171	307
Most Critical Inventory (Bank)	1	2	4	6	9	13	19	32	66	119
Annual Emissions	1	3	5	8	12	15	23	41	96	162
Cumulative Production Allocation	8	23	45	75	113	158	233	383	795	1424
Cumulative Emissions	1	4	10	18	30	45	68	110	206	368

Year	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Allocated Production	969	1096	1514	2379	2663	3011	3539	3658	4271	5674
Least Critical Inventory (Bank)	916	1290	1800	2628	3469	4341	5315	6185	7182	8642
More Critical Inventory (Bank)	513	736	1041	1529	2050	2619	3274	3913	4651	5668
Most Critical Inventory (Bank)	200	290	415	611	830	1075	1362	1657	2003	2465
Annual Emissions	263	350	492	737	940	1165	1436	1665	1971	2444
Cumulative Production Allocation	2393	3489	5003	7382	10045	13056	16595	20252	24523	30197
Cumulative Emissions	632	982	1474	2211	3150	4315	5752	7416	9388	11832

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Allocated Production	5540	6519	7336	8307	8703	9413	8364	6836	5495	3663
Least Critical Inventory (Bank)	9811	11212	12739	14456	16066	17714	18260	17774	16551	14685
More Critical Inventory (Bank)	6584	7666	8864	10206	11545	12953	14075	14862	15374	15506
Most Critical Inventory (Bank)	2912	3440	4033	4706	5406	6163	7455	9114	11050	12915
Annual Emissions	2735	3189	3663	4189	4659	5183	4852	4389	3866	3265
Cumulative Production Allocation	35736	42255	49591	57898	66601	76014	84378	91214	96709	100372
Cumulative Emissions	14567	17756	21419	25608	30267	35450	40302	44692	48557	51822

Halon 1301
Western Europe, Australia, North America and Japan

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Allocated Production	1832	0	0	0	0	0	0	0	0	0
Least Critical Inventory (Bank)	12415	10049	7899	5996	4367	3089	2113	1385	866	508
More Critical Inventory (Bank)	15263	14576	13888	13180	12375	11483	10518	9567	8638	7734
Most Critical Inventory (Bank)	14445	15234	16197	17302	18401	19382	20190	20769	21165	21398
Annual Emissions	2669	2301	1980	1865	1758	1653	1559	1476	1399	1330
Cumulative Production Allocation	102203	102203	102203	102203	102203	102203	102203	102203	102203	102203
Cumulative Emissions	54491	56792	58772	60638	62396	64048	65607	67083	68482	69812

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Allocated Production	0	0	0	0	0	0	0	0	0	0
Least Critical Inventory (Bank)	281	140	62	25	10	5	1	0	0	0
More Critical Inventory (Bank)	6858	6014	5202	4430	3709	3038	2425	1879	1407	1013
Most Critical Inventory (Bank)	21504	21510	21443	21315	21150	20941	20700	20427	20111	19742
Annual Emissions	1268	1213	1162	1116	1071	1030	991	951	912	874
Cumulative Production Allocation	102203	102203	102203	102203	102203	102203	102203	102203	102203	102203
Cumulative Emissions	71080	72293	73455	74571	75641	76672	77662	78614	79526	80400

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Allocated Production	0	0	0	0	0	0	0	0	0	0
Least Critical Inventory (Bank)	0	0	0	0	0	0	0	0	0	0
More Critical Inventory (Bank)	703	468	298	184	111	68	35	14	3	0
Most Critical Inventory (Bank)	19269	18693	18029	17326	16608	15940	15254	14569	13893	13241
Annual Emissions	845	821	802	781	759	728	706	684	663	641
Cumulative Production Allocation	102203	102203	102203	102203	102203	102203	102203	102203	102203	102203
Cumulative Emissions	81245	82066	82868	83649	84408	85136	85841	86525	87188	87829

Halon 1301
Western Europe, Australia, North America and Japan

Year	2023	2024	2025	2026	2027	2028	2029	2030
Allocated Production	0	0	0	0	0	0	0	0
Least Critical Inventory (Bank)	0	0	0	0	0	0	0	0
More Critical Inventory (Bank)	0	0	0	0	0	0	0	0
Most Critical Inventory (Bank)	12671	12182	11769	11398	11038	10642	10291	9979
Annual Emissions	611	576	537	501	470	449	423	397
Cumulative Production Allocation	102203	102203	102203	102203	102203	102203	102203	102203
Cumulative Emissions	88440	89016	89553	90054	90523	90972	91395	91792

Halon 1301

Western Europe and Australia

Year	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
CEFIC Production	10	20	30	40	50	60	100	200	550	839	1292	1461	2019	3172	3550	4015	4718
% Allocation of CEFIC Production	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%
Allocation of CEFIC Production	2	5	7	9	11	14	23	45	124	189	291	329	454	714	799	903	1062
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	2	5	7	9	11	14	23	45	124	189	291	329	454	714	799	903	1062
Recycle Quantity	0	0	0	0	0	1	1	1	2	4	8	13	18	26	38	52	67
Annual Supply	2	5	7	9	12	14	23	46	126	193	298	341	472	740	837	955	1128
Start Bank - Equip Life 0 to 15 yrs	0	1	4	7	11	16	21	31	52	114	204	339	481	674	985	1307	1647
Start Bank - Equip Life 0 to 25 yrs	0	0	1	2	3	5	7	10	16	35	63	104	149	211	310	414	528
Start Bank - Equip Life 25 to 35 yrs	0	0	1	1	2	3	4	5	9	19	34	57	83	118	174	236	305
Total Start Bank	0	2	5	10	16	24	32	47	78	168	301	501	713	1003	1469	1957	2480
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	0	0	0	0	0	0	0	1	1	3	5	8	11	15	22	29	37
Annual % of Bank Used for Service	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Service Use	0	0	0	0	1	1	2	2	4	8	15	25	36	50	73	98	124
Supply Available for New Installations	2	4	7	9	11	13	21	43	121	182	279	309	426	674	742	828	967
% of Supply Available Used for Testing	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%
Test Use	0	1	1	1	2	2	4	7	20	30	47	52	71	113	124	138	162
% Added to Bank of Equip Life 0 to 15 yrs	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%
Added to Bank of Equip Life 0 to 15 yrs	1	3	4	5	6	7	12	25	70	106	162	180	248	393	432	483	564
% Added to Bank of Equip Life 0 to 25 yrs	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%
Added to Bank of Equip Life 0 to 25 yrs	0	1	1	1	2	2	4	7	20	30	47	52	71	113	124	138	162
% Added to Bank of Equip Life 25 to 35 yrs	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%
Added to Bank of Equip Life 25 to 35 yrs	0	0	1	1	1	1	2	4	10	15	23	26	35	56	62	69	80
Start + Change to Bank of Equip Life 0 to 15 yrs	1	4	7	12	17	23	34	56	123	220	366	519	729	1067	1417	1790	2211
Start + Change to Bank of Equip Life 0 to 25 yrs	0	1	2	3	5	7	10	17	36	65	109	156	221	324	433	553	690
Start + Change to Bank of Equip Life 25 to 35 yrs	0	1	1	2	3	4	5	9	19	34	57	83	118	174	236	305	385
Total Start Bank + Change to Bank	2	5	11	17	25	34	50	83	178	319	533	758	1068	1565	2087	2647	3286
Potential Recycle 0 to 15 Year Bank	0	0	1	1	1	2	3	4	9	16	27	39	55	82	110	143	180
Potential Recycle 0 to 25 Year Bank	0	0	0	0	0	0	0	1	2	3	5	7	10	14	19	25	31
Potential Recycle 25 to 35 Year Bank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Potential Recycle for Year	0	0	1	1	1	2	3	5	10	19	31	46	65	96	129	167	211
Estimated Recovery Rate	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
Estimated Recycle	0	0	0	0	1	1	1	2	4	8	13	18	26	38	52	67	84
Estimated Recycle Loss	0	0	0	1	1	1	2	3	6	11	19	27	39	57	78	100	127
End of Year 0 to 15 Year Equipment Bank	1	4	7	11	16	21	31	52	114	204	339	481	674	985	1307	1647	2031
End of Year 0 to 25 Year Equipment Bank	0	1	2	3	5	7	10	16	35	63	104	149	211	310	414	528	659
End of Year 25 to 35 Year Equipment Bank	0	1	1	2	3	4	5	9	19	34	57	83	118	174	236	305	385
Total End of Year Equipment Bank	2	5	10	16	24	32	47	78	168	301	501	713	1003	1469	1957	2480	3075
Total End of Year Equipment Bank + Recycle	2	5	10	17	24	33	48	80	172	308	514	731	1029	1507	2009	2547	3159
Total Annual Emissions	0	1	2	3	4	5	7	13	31	53	85	111	156	235	297	366	449
Cummulative Emissions	0	1	3	6	10	15	22	35	67	119	204	316	472	707	1004	1370	1819
Cummulative Production Allocation	2	7	14	23	34	47	70	115	239	427	718	1047	1501	2215	3013	3917	4978

Halon 1301

Western Europe and Australia

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
CEFIC Production	4877	5694	7565	7386	8692	9781	11076	11604	12551	11152	9115	7326	4884	2442	0	0	0
% Allocation of CEFIC Production	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%
Allocation of CEFIC Production	1097	1281	1702	1662	1956	2201	2492	2611	2824	2509	2051	1648	1099	549	0	0	0
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	1097	1281	1702	1662	1956	2201	2492	2611	2824	2509	2051	1648	1099	549	0	0	0
Recycle Quantity	84	102	123	151	178	209	244	283	322	363	458	549	630	700	757	798	830
Annual Supply	1182	1383	1825	1813	2133	2410	2736	2894	3146	2872	2509	2198	1729	1250	757	798	830
Start Bank - Equip Life 0 to 15 yrs	2031	2386	2792	3372	3853	4425	5048	5740	6399	7077	7376	7320	7008	6453	5741	4959	4209
Start Bank - Equip Life 0 to 25 yrs	659	785	932	1134	1315	1530	1767	2033	2297	2575	2800	2961	3070	3099	3049	2894	2748
Start Bank - Equip Life 25 to 35 yrs	385	466	562	690	812	957	1120	1304	1495	1701	2078	2568	3138	3675	4094	4262	4495
Total Start Bank	3075	3637	4285	5196	5981	6911	7934	9077	10191	11353	12254	12849	13216	13227	12884	12116	11452
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	46	55	64	78	90	104	119	136	153	170	184	193	198	198	193	182	172
Annual % of Bank Used for Service	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.5%	2.5%	2.5%
Service Use	154	182	214	260	299	346	397	454	510	511	490	450	396	331	322	303	286
Supply Available for New Installations	982	1147	1547	1475	1745	1961	2220	2304	2483	2191	1835	1555	1135	720	241	313	372
% of Supply Available Used for Testing	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	13.9%	11.1%	8.3%	5.5%	2.7%	0.0%	0.0%	0.0%
Test Use	164	192	258	246	291	327	371	385	415	305	204	129	62	19	0	0	0
% Added to Bank of Equip Life 0 to 15 yrs	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	51.7%	44.4%	36.7%	28.3%	19.5%	15.0%	10.0%	5.0%
Added to Bank of Equip Life 0 to 15 yrs	572	669	902	860	1017	1143	1295	1343	1448	1133	815	571	321	140	36	31	19
% Added to Bank of Equip Life 0 to 25 yrs	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	17.2%	17.8%	18.3%	18.9%	19.5%	15.0%	15.0%	15.0%
Added to Bank of Equip Life 0 to 25 yrs	164	192	258	246	291	327	371	385	415	377	327	285	214	140	36	47	56
% Added to Bank of Equip Life 25 to 35 yrs	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	17.2%	26.7%	36.7%	47.3%	58.3%	70.0%	75.0%	80.0%
Added to Bank of Equip Life 25 to 35 yrs	81	95	128	122	145	163	184	191	206	377	490	571	537	420	169	235	298
Start + Change to Bank of Equip Life 0 to 15 yrs	2603	3054	3694	4232	4870	5568	6342	7083	7847	8210	8191	7891	7329	6594	5777	4991	4228
Start + Change to Bank of Equip Life 0 to 25 yrs	823	977	1190	1381	1607	1857	2138	2417	2712	2952	3126	3246	3284	3240	3086	2941	2803
Start + Change to Bank of Equip Life 25 to 35 yrs	466	562	690	812	957	1120	1304	1495	1701	2078	2568	3139	3675	4095	4263	4497	4793
Total Start Bank + Change to Bank	3893	4593	5573	6425	7434	8545	9784	10996	12260	13239	13885	14275	14288	13928	13126	12429	11824
Potential Recycle 0 to 15 Year Bank	218	262	322	379	446	520	602	684	770	833	871	883	876	853	818	782	738
Potential Recycle 0 to 25 Year Bank	38	45	56	65	77	90	105	120	137	152	165	176	185	190	192	193	195
Potential Recycle 25 to 35 Year Bank	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	3
Total Potential Recycle for Year	255	307	377	444	523	610	707	805	907	985	1036	1060	1061	1044	1010	977	936
Estimated Recovery Rate	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	46.5%	53.0%	59.5%	66.0%	72.5%	79.0%	85.0%	85.0%
Estimated Recycle	102	123	151	178	209	244	283	322	363	458	549	630	700	757	798	830	796
Estimated Recycle Loss	153	184	226	266	314	366	424	483	544	527	487	429	361	287	212	147	140
End of Year 0 to 15 Year Equipment Bank	2386	2792	3372	3853	4425	5048	5740	6399	7077	7376	7320	7008	6453	5741	4959	4209	3490
End of Year 0 to 25 Year Equipment Bank	785	932	1134	1315	1530	1767	2033	2297	2575	2800	2961	3070	3099	3049	2894	2748	2609
End of Year 25 to 35 Year Equipment Bank	466	562	690	812	957	1120	1304	1495	1701	2078	2568	3138	3675	4094	4262	4495	4790
Total End of Year Equipment Bank	3637	4285	5196	5981	6911	7934	9077	10191	11353	12254	12849	13216	13227	12884	12116	11452	10888
Total End of Year Equipment Bank + Recycle	3739	4408	5347	6158	7120	8178	9360	10513	11716	12712	13398	13846	13927	13641	12914	12282	11684
Total Annual Emissions	517	612	763	850	994	1143	1311	1457	1621	1513	1365	1201	1018	836	728	631	599
Cummulative Emissions	2336	2949	3712	4562	5556	6699	8009	9467	11088	12601	13966	15167	16184	17020	17747	18379	18977
Cummulative Production Allocation	6076	7357	9059	10721	12677	14877	17369	19980	22804	25313	27364	29013	30112	30661	30661	30661	30661

Halon 1301
Western Europe and Australia

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	796	747	699	643	580	508	434	354	291	246	217	198	192	191	189	186	185
Annual Supply	796	747	699	643	580	508	434	354	291	246	217	198	192	191	189	186	185
Start Bank - Equip Life 0 to 15 yrs	3490	2812	2191	1638	1161	771	470	265	137	62	25	10	5	1	0	0	0
Start Bank - Equip Life 0 to 25 yrs	2609	2450	2273	2081	1892	1708	1529	1355	1188	1027	874	731	598	477	368	275	197
Start Bank - Equip Life 25 to 35 yrs	4790	5108	5415	5708	5956	6153	6286	6351	6340	6270	6156	6015	5856	5689	5521	5348	5170
Total Start Bank	10888	10370	9879	9427	9010	8632	8285	7971	7664	7358	7055	6756	6458	6167	5889	5623	5367
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	163	156	148	141	135	129	124	120	115	110	106	101	97	93	88	84	81
Annual % of Bank Used for Service	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Service Use	272	259	247	236	225	216	207	199	192	184	176	169	161	154	147	141	134
Supply Available for New Installations	360	332	304	266	220	163	102	35	-16	-48	-65	-72	-66	-56	-47	-39	-30
% of Supply Available Used for Testing	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Test Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 15 yrs	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 15 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 25 yrs	10.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 25 yrs	36	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 25 to 35 yrs	90.0%	95.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Added to Bank of Equip Life 25 to 35 yrs	324	316	304	266	220	163	102	35	-16	-48	-65	-72	-66	-56	-47	-39	-30
Start + Change to Bank of Equip Life 0 to 15 yrs	3490	2812	2191	1638	1161	771	470	265	137	62	25	10	5	1	0	0	0
Start + Change to Bank of Equip Life 0 to 25 yrs	2645	2467	2273	2081	1892	1708	1529	1355	1188	1027	874	731	598	477	368	275	197
Start + Change to Bank of Equip Life 25 to 35 yrs	5114	5424	5720	5974	6176	6316	6388	6385	6324	6221	6091	5943	5790	5634	5474	5310	5141
Total Start Bank + Change to Bank	11248	10702	10183	9693	9230	8795	8387	8006	7648	7310	6990	6684	6392	6112	5843	5585	5338
Potential Recycle 0 to 15 Year Bank	678	621	553	477	390	301	204	129	75	37	15	6	3	1	0	0	0
Potential Recycle 0 to 25 Year Bank	195	194	192	189	184	179	174	167	161	153	143	133	121	108	93	78	61
Potential Recycle 25 to 35 Year Bank	6	8	12	17	23	30	38	46	54	66	75	87	100	113	126	140	169
Total Potential Recycle for Year	879	823	756	683	598	510	416	342	290	255	233	226	225	222	219	218	231
Estimated Recovery Rate	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Estimated Recycle	747	699	643	580	508	434	354	291	246	217	198	192	191	189	186	185	196
Estimated Recycle Loss	132	123	113	102	90	77	62	51	43	38	35	34	34	33	33	33	35
End of Year 0 to 15 Year Equipment Bank	2812	2191	1638	1161	771	470	265	137	62	25	10	5	1	0	0	0	0
End of Year 0 to 25 Year Equipment Bank	2450	2273	2081	1892	1708	1529	1355	1188	1027	874	731	598	477	368	275	197	136
End of Year 25 to 35 Year Equipment Bank	5108	5415	5708	5956	6153	6286	6351	6340	6270	6156	6015	5856	5689	5521	5348	5170	4971
Total End of Year Equipment Bank	10370	9879	9427	9010	8632	8285	7971	7664	7358	7055	6756	6458	6167	5889	5623	5367	5107
Total End of Year Equipment Bank + Recycle	11117	10578	10070	9590	9140	8718	8325	7954	7604	7272	6955	6650	6358	6078	5810	5552	5303
Total Annual Emissions	567	538	509	479	450	422	394	370	350	333	317	304	292	280	268	258	249
Cummulative Emissions	19544	20083	20591	21071	21521	21943	22336	22707	23057	23389	23706	24011	24303	24583	24851	25109	25358
Cummulative Production Allocation	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661

Halon 1301

Western Europe and Australia

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	196	218	247	272	290	288	293	301	310	318	311	292	262	231	204	192	171
Annual Supply	196	218	247	272	290	288	293	301	310	318	311	292	262	231	204	192	171
Start Bank - Equip Life 0 to 15 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Start Bank - Equip Life 0 to 25 yrs	136	89	56	34	21	13	7	3	1	0	0	0	0	0	0	0	0
Start Bank - Equip Life 25 to 35 yrs	4971	4753	4519	4285	4056	3853	3648	3445	3245	3052	2881	2734	2608	2495	2386	2268	2168
Total Start Bank	5107	4842	4576	4319	4077	3866	3655	3448	3246	3052	2881	2734	2608	2495	2386	2268	2168
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	77	73	69	65	61	58	55	52	49	46	43	41	39	37	36	34	33
Annual % of Bank Used for Service	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Service Use	128	121	114	108	102	97	91	86	81	76	72	68	65	62	60	57	54
Supply Available for New Installations	-8	24	64	100	127	133	146	163	180	196	196	183	158	131	108	102	84
% of Supply Available Used for Testing	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Test Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 15 yrs	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 15 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 25 yrs	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 25 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 25 to 35 yrs	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Added to Bank of Equip Life 25 to 35 yrs	-8	24	64	100	127	133	146	163	180	196	196	183	158	131	108	102	84
Start + Change to Bank of Equip Life 0 to 15 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Start + Change to Bank of Equip Life 0 to 25 yrs	136	89	56	34	21	13	7	3	1	0	0	0	0	0	0	0	0
Start + Change to Bank of Equip Life 25 to 35 yrs	4963	4777	4584	4385	4184	3986	3794	3608	3425	3248	3078	2917	2766	2625	2494	2369	2253
Total Start Bank + Change to Bank	5099	4867	4640	4419	4205	3999	3801	3610	3426	3248	3078	2917	2766	2625	2494	2369	2253
Potential Recycle 0 to 15 Year Bank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potential Recycle 0 to 25 Year Bank	46	33	22	13	8	6	4	2	1	0	0	0	0	0	0	0	0
Potential Recycle 25 to 35 Year Bank	210	258	299	328	331	338	349	363	374	366	344	309	271	240	226	201	167
Total Potential Recycle for Year	257	291	320	342	338	344	354	365	374	366	344	309	271	240	226	201	167
Estimated Recovery Rate	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Estimated Recycle	218	247	272	290	288	293	301	310	318	311	292	262	231	204	192	171	142
Estimated Recycle Loss	38	44	48	51	51	52	53	55	56	55	52	46	41	36	34	30	25
End of Year 0 to 15 Year Equipment Bank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End of Year 0 to 25 Year Equipment Bank	89	56	34	21	13	7	3	1	0	0	0	0	0	0	0	0	0
End of Year 25 to 35 Year Equipment Bank	4753	4519	4285	4056	3853	3648	3445	3245	3052	2881	2734	2608	2495	2386	2268	2168	2086
Total End of Year Equipment Bank	4842	4576	4319	4077	3866	3655	3448	3246	3052	2881	2734	2608	2495	2386	2268	2168	2086
Total End of Year Equipment Bank + Recycle	5060	4823	4592	4368	4154	3948	3748	3556	3370	3193	3026	2870	2725	2590	2460	2339	2228
Total Annual Emissions	243	237	231	224	214	206	199	193	186	177	167	156	145	136	129	121	112
Cummulative Emissions	25601	25838	26069	26293	26507	26713	26913	27105	27291	27468	27635	27791	27936	28071	28201	28322	28433
Cummulative Production Allocation	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661	30661

Halon 1301 - North America

Year	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
CEFIC Production	10	20	30	40	50	60	100	200	550	839	1292	1461	2019	3172	3550	4015	4718
% Allocation of CEFIC Production	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%
Allocation of CEFIC Production	4	8	11	15	19	23	38	75	206	315	485	548	757	1190	1331	1506	1769
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	4	8	11	15	19	23	38	75	206	315	485	548	757	1190	1331	1506	1769
Recycle Quantity	0	0	0	1	1	2	3	4	6	13	23	38	55	79	116	158	205
Annual Supply	4	8	12	16	20	24	40	79	212	327	507	586	812	1268	1448	1664	1974
Start Bank - Equip Life 0 to 10 yrs	0	2	6	11	17	25	33	48	80	176	316	525	737	1026	1497	1969	2455
Start Bank - Equip Life 0 to 25 yrs	0	1	2	3	6	8	11	17	28	59	107	178	256	363	533	717	919
Start Bank - Equip Life 25 to 35 yrs	0	0	1	2	3	5	6	9	16	33	58	98	142	203	300	408	529
Total Start Bank	0	3	8	16	26	38	51	74	123	268	481	801	1135	1592	2330	3094	3902
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	0	0	0	0	0	1	1	1	2	4	7	12	17	24	35	46	59
Annual % of Bank Used for Service	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Service Use	0	0	0	1	1	2	3	4	6	13	24	40	57	80	117	155	195
Supply Available for New Installations	4	7	11	15	18	22	37	74	204	310	476	534	739	1165	1296	1463	1720
% of Supply Available Used for Testing	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%
Test Use	1	1	2	2	3	4	6	12	34	52	80	89	123	195	216	244	287
% Added to Bank of Equip Life 0 to 10 yrs	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%
Added to Bank of Equip Life 0 to 10 yrs	2	4	6	9	11	13	21	43	119	181	278	311	431	679	756	853	1003
% Added to Bank of Equip Life 0 to 25 yrs	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%
Added to Bank of Equip Life 0 to 25 yrs	1	1	2	2	3	4	6	12	34	52	80	89	123	195	216	244	287
% Added to Bank of Equip Life 25 to 35 yrs	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%
Added to Bank of Equip Life 25 to 35 yrs	0	1	1	1	2	2	3	6	17	26	40	44	61	97	108	121	143
Start + Change to Bank of Equip Life 0 to 10 yrs	2	6	12	19	28	37	54	91	199	357	593	836	1168	1705	2252	2822	3458
Start + Change to Bank of Equip Life 0 to 25 yrs	1	2	4	6	9	12	18	29	62	111	186	267	379	557	750	961	1206
Start + Change to Bank of Equip Life 25 to 35 yrs	0	1	2	3	5	6	9	16	33	58	98	142	203	300	408	529	672
Total Start Bank + Change to Bank	3	9	18	28	41	56	81	136	294	526	877	1246	1750	2563	3410	4312	5336
Potential Recycle 0 to 10 Year Bank	0	1	1	2	3	4	7	11	23	41	68	99	142	209	283	367	465
Potential Recycle 0 to 25 Year Bank	0	0	0	0	0	1	1	1	3	5	8	11	16	24	33	43	54
Potential Recycle 25 to 35 Year Bank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Potential Recycle for Year	0	1	1	2	4	5	7	12	25	46	76	111	158	233	316	410	519
Estimated Recovery Rate	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Estimated Recycle	0	0	1	1	2	3	4	6	13	23	38	55	79	116	158	205	260
Estimated Recycle Loss	0	0	1	1	2	3	4	6	13	23	38	55	79	116	158	205	260
End of Year 0 to 10 Year Equipment Bank	2	6	11	17	25	33	48	80	176	316	525	737	1026	1497	1969	2455	2992
End of Year 0 to 25 Year Equipment Bank	1	2	3	6	8	11	17	28	59	107	178	256	363	533	717	919	1152
End of Year 25 to 35 Year Equipment Bank	0	1	2	3	5	6	9	16	33	58	98	142	203	300	408	529	672
Total End of Year Equipment Bank	3	8	16	26	38	51	74	123	268	481	801	1135	1592	2330	3094	3902	4816
Total End of Year Equipment Bank + Recycle	3	9	17	27	39	53	78	129	281	503	839	1190	1671	2446	3252	4107	5076
Total Annual Emissions	1	2	3	5	7	9	13	23	55	92	149	197	276	414	526	650	801
Cummulative Emissions	1	3	6	10	17	25	39	62	117	209	358	554	830	1245	1771	2421	3221
Cummulative Production Allocation	4	11	23	38	56	79	116	191	398	712	1197	1745	2502	3691	5022	6528	8297

Halon 1301 - North America

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
CEFIC Production	4877	5694	7565	7386	8692	9781	11076	11604	12551	11152	9115	7326	4884	2442	0	0	0
% Allocation of CEFIC Production	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%
Allocation of CEFIC Production	1829	2135	2837	2770	3260	3668	4154	4352	4707	4182	3418	2747	1832	916	0	0	0
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	1829	2135	2837	2770	3260	3668	4154	4352	4707	4182	3418	2747	1832	916	0	0	0
Recycle Quantity	260	315	377	458	532	620	716	814	915	1022	1202	1360	1484	1545	1571	1540	1470
Annual Supply	2089	2450	3214	3228	3792	4288	4869	5166	5621	5204	4621	4108	3316	2461	1571	1540	1470
Start Bank - Equip Life 0 to 10 yrs	2992	3463	4003	4807	5436	6193	7020	7957	8827	9714	9953	9578	8765	7580	6163	4715	3433
Start Bank - Equip Life 0 to 25 yrs	1152	1382	1650	2016	2352	2747	3186	3677	4170	4691	5128	5464	5709	5820	5785	5541	5295
Start Bank - Equip Life 25 to 35 yrs	672	819	992	1223	1447	1712	2011	2349	2702	3084	3798	4755	5898	7032	7989	8529	9117
Total Start Bank	4816	5665	6645	8046	9235	10653	12217	13983	15699	17489	18879	19797	20373	20432	19937	18785	17845
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	72	85	100	121	139	160	183	210	235	262	283	297	306	306	299	282	268
Annual % of Bank Used for Service	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	4.5%	4.0%	3.5%	3.0%	2.5%	2.5%	2.5%	2.5%
Service Use	241	283	332	402	462	533	611	699	785	787	755	693	611	511	498	470	446
Supply Available for New Installations	1776	2082	2782	2705	3191	3596	4075	4257	4601	4154	3582	3118	2399	1643	773	789	756
% of Supply Available Used for Testing	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	13.9%	11.1%	8.3%	5.5%	2.7%	0.0%	0.0%	0.0%
Test Use	297	348	465	452	533	601	681	711	768	577	398	259	132	44	0	0	0
% Added to Bank of Equip Life 0 to 10 yrs	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	51.7%	44.4%	36.7%	28.3%	19.5%	15.0%	10.0%	5.0%
Added to Bank of Equip Life 0 to 10 yrs	1035	1214	1622	1577	1861	2096	2376	2482	2682	2148	1590	1144	679	320	116	79	38
% Added to Bank of Equip Life 0 to 25 yrs	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	17.2%	17.8%	18.3%	18.9%	19.5%	15.0%	15.0%	15.0%
Added to Bank of Equip Life 0 to 25 yrs	297	348	465	452	533	601	681	711	768	715	638	571	453	320	116	118	113
% Added to Bank of Equip Life 25 to 35 yrs	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	8.3%	17.2%	26.7%	36.7%	47.3%	58.3%	70.0%	75.0%	80.0%
Added to Bank of Equip Life 25 to 35 yrs	147	173	231	225	265	298	338	353	382	715	956	1144	1135	958	541	591	605
Start + Change to Bank of Equip Life 0 to 10 yrs	4028	4677	5625	6384	7296	8290	9396	10439	11509	11862	11543	10723	9444	7901	6279	4794	3470
Start + Change to Bank of Equip Life 0 to 25 yrs	1448	1730	2115	2468	2885	3347	3866	4388	4939	5405	5766	6034	6163	6140	5901	5659	5408
Start + Change to Bank of Equip Life 25 to 35 yrs	819	992	1223	1447	1712	2011	2349	2702	3084	3799	4755	5899	7033	7990	8531	9121	9722
Total Start Bank + Change to Bank	6295	7399	8963	10299	11893	13648	15611	17529	19532	21066	22064	22656	22639	22031	20710	19574	18601
Potential Recycle 0 to 10 Year Bank	564	674	818	948	1103	1270	1439	1612	1795	1909	1965	1958	1864	1738	1563	1362	1128
Potential Recycle 0 to 25 Year Bank	66	80	98	116	138	162	189	217	248	277	302	325	343	356	360	364	367
Potential Recycle 25 to 35 Year Bank	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	3	6
Total Potential Recycle for Year	630	754	917	1065	1241	1431	1628	1829	2043	2186	2267	2283	2207	2094	1925	1729	1501
Estimated Recovery Rate	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	85.0%
Estimated Recycle	315	377	458	532	620	716	814	915	1022	1202	1360	1484	1545	1571	1540	1470	1276
Estimated Recycle Loss	315	377	458	532	620	716	814	915	1022	984	907	799	662	524	385	259	225
End of Year 0 to 10 Year Equipment Bank	3463	4003	4807	5436	6193	7020	7957	8827	9714	9953	9578	8765	7580	6163	4715	3433	2343
End of Year 0 to 25 Year Equipment Bank	1382	1650	2016	2352	2747	3186	3677	4170	4691	5128	5464	5709	5820	5785	5541	5295	5041
End of Year 25 to 35 Year Equipment Bank	819	992	1223	1447	1712	2011	2349	2702	3084	3798	4755	5898	7032	7989	8529	9117	9716
Total End of Year Equipment Bank	5665	6645	8046	9235	10653	12217	13983	15699	17489	18879	19797	20373	20432	19937	18785	17845	17100
Total End of Year Equipment Bank + Recycle	5980	7022	8504	9767	11273	12932	14797	16614	18510	20082	21157	21857	21977	21508	20325	19315	18376
Total Annual Emissions	925	1093	1355	1507	1754	2009	2289	2534	2810	2611	2343	2048	1711	1385	1182	1011	939
Cummulative Emissions	4146	5239	6594	8101	9854	11863	14152	16686	19497	22107	24450	26498	28209	29594	30776	31787	32726
Cummulative Production Allocation	10126	12261	15098	17868	21128	24795	28949	33300	38007	42189	45607	48354	50186	51102	51102	51102	51102

Halon 1301 - North America

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	1276	1069	842	662	531	436	381	357	349	346	348	348	352	354	354	352	350
Annual Supply	1276	1069	842	662	531	436	381	357	349	346	348	348	352	354	354	352	350
Start Bank - Equip Life 0 to 10 yrs	2343	1463	851	455	217	94	39	15	4	0	0	0	0	0	0	0	0
Start Bank - Equip Life 0 to 25 yrs	5041	4732	4388	4026	3669	3320	2980	2649	2330	2023	1729	1455	1198	963	751	567	411
Start Bank - Equip Life 25 to 35 yrs	9716	10239	10616	10804	10824	10726	10544	10316	10073	9831	9586	9347	9106	8865	8620	8370	8108
Total Start Bank	17100	16435	15855	15284	14711	14140	13562	12980	12407	11853	11315	10801	10304	9827	9372	8937	8520
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	256	247	238	229	221	212	203	195	186	178	170	162	155	147	141	134	128
Annual % of Bank Used for Service	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Service Use	427	411	396	382	368	354	339	325	310	296	283	270	258	246	234	223	213
Supply Available for New Installations	592	411	208	50	-58	-130	-162	-162	-147	-128	-104	-84	-60	-39	-21	-6	9
% of Supply Available Used for Testing	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Test Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 10 yrs	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 10 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 25 yrs	10.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 25 yrs	59	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 25 to 35 yrs	90.0%	95.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Added to Bank of Equip Life 25 to 35 yrs	533	391	208	50	-58	-130	-162	-162	-147	-128	-104	-84	-60	-39	-21	-6	9
Start + Change to Bank of Equip Life 0 to 10 yrs	2343	1463	851	455	217	94	39	15	4	0	0	0	0	0	0	0	0
Start + Change to Bank of Equip Life 0 to 25 yrs	5100	4753	4388	4026	3669	3320	2980	2649	2330	2023	1729	1455	1198	963	751	567	411
Start + Change to Bank of Equip Life 25 to 35 yrs	10249	10630	10824	10854	10766	10596	10382	10154	9927	9702	9482	9263	9045	8825	8599	8364	8117
Total Start Bank + Change to Bank	17692	16846	16063	15335	14653	14010	13401	12818	12260	11725	11211	10718	10243	9788	9351	8931	8529
Potential Recycle 0 to 10 Year Bank	880	611	397	238	123	55	23	12	4	0	0	0	0	0	0	0	0
Potential Recycle 0 to 25 Year Bank	368	365	362	357	349	340	331	319	307	293	275	257	235	211	184	156	125
Potential Recycle 25 to 35 Year Bank	10	14	20	30	40	52	66	80	96	116	135	157	181	205	229	256	313
Total Potential Recycle for Year	1257	991	779	624	513	448	420	411	407	410	410	414	416	416	414	411	438
Estimated Recovery Rate	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Estimated Recycle	1069	842	662	531	436	381	357	349	346	348	348	352	354	354	352	350	372
Estimated Recycle Loss	189	149	117	94	77	67	63	62	61	61	61	62	62	62	62	62	66
End of Year 0 to 10 Year Equipment Bank	1463	851	455	217	94	39	15	4	0	0	0	0	0	0	0	0	0
End of Year 0 to 25 Year Equipment Bank	4732	4388	4026	3669	3320	2980	2649	2330	2023	1729	1455	1198	963	751	567	411	287
End of Year 25 to 35 Year Equipment Bank	10239	10616	10804	10824	10726	10544	10316	10073	9831	9586	9347	9106	8865	8620	8370	8108	7804
Total End of Year Equipment Bank	16435	15855	15284	14711	14140	13562	12980	12407	11853	11315	10801	10304	9827	9372	8937	8520	8091
Total End of Year Equipment Bank + Recycle	17503	16697	15946	15241	14576	13943	13337	12757	12199	11664	11150	10655	10181	9725	9288	8869	8463
Total Annual Emissions	873	806	751	705	665	633	606	581	557	536	514	494	475	456	437	419	406
Cummulative Emissions	33599	34405	35156	35861	36526	37159	37764	38345	38902	39438	39952	40446	40921	41376	41813	42232	42639
Cummulative Production Allocation	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102

Halon 1301 - North America

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	372	416	477	535	582	594	615	634	645	644	600	523	421	314	218	159	96
Annual Supply	372	416	477	535	582	594	615	634	645	644	600	523	421	314	218	159	96
Start Bank - Equip Life 0 to 10 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Start Bank - Equip Life 0 to 25 yrs	287	190	119	71	41	24	12	4	1	0	0	0	0	0	0	0	0
Start Bank - Equip Life 25 to 35 yrs	7804	7459	7079	6687	6297	5943	5588	5241	4909	4601	4355	4165	4026	3918	3818	3697	3595
Total Start Bank	8091	7649	7198	6758	6339	5968	5599	5245	4910	4601	4355	4165	4026	3918	3818	3697	3595
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	121	115	108	101	95	90	84	79	74	69	65	62	60	59	57	55	54
Annual % of Bank Used for Service	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Service Use	202	191	180	169	158	149	140	131	123	115	109	104	101	98	95	92	90
Supply Available for New Installations	48	111	189	264	328	356	391	424	449	460	426	357	260	157	66	11	-48
% of Supply Available Used for Testing	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Test Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 10 yrs	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 10 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 25 yrs	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 25 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 25 to 35 yrs	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Added to Bank of Equip Life 25 to 35 yrs	48	111	189	264	328	356	391	424	449	460	426	357	260	157	66	11	-48
Start + Change to Bank of Equip Life 0 to 10 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Start + Change to Bank of Equip Life 0 to 25 yrs	287	190	119	71	41	24	12	4	1	0	0	0	0	0	0	0	0
Start + Change to Bank of Equip Life 25 to 35 yrs	7853	7570	7268	6952	6625	6299	5979	5665	5358	5061	4781	4522	4287	4074	3883	3707	3547
Total Start Bank + Change to Bank	8139	7760	7388	7023	6667	6323	5991	5669	5359	5061	4781	4522	4287	4074	3883	3707	3547
Potential Recycle 0 to 10 Year Bank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potential Recycle 0 to 25 Year Bank	96	71	48	30	17	12	8	3	1	0	0	0	0	0	0	0	0
Potential Recycle 25 to 35 Year Bank	394	491	581	654	682	711	738	756	757	706	616	495	369	257	187	113	39
Total Potential Recycle for Year	490	562	629	684	699	724	746	759	758	706	616	495	369	257	187	113	39
Estimated Recovery Rate	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Estimated Recycle	416	477	535	582	594	615	634	645	644	600	523	421	314	218	159	96	34
Estimated Recycle Loss	73	84	94	103	105	109	112	114	114	106	92	74	55	39	28	17	6
End of Year 0 to 10 Year Equipment Bank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End of Year 0 to 25 Year Equipment Bank	190	119	71	41	24	12	4	1	0	0	0	0	0	0	0	0	0
End of Year 25 to 35 Year Equipment Bank	7459	7079	6687	6297	5943	5588	5241	4909	4601	4355	4165	4026	3918	3818	3697	3595	3507
Total End of Year Equipment Bank	7649	7198	6758	6339	5968	5599	5245	4910	4601	4355	4165	4026	3918	3818	3697	3595	3507
Total End of Year Equipment Bank + Recycle	8066	7676	7293	6920	6562	6215	5879	5555	5245	4955	4689	4448	4231	4036	3855	3690	3541
Total Annual Emissions	397	390	382	373	358	347	336	324	310	290	267	241	216	195	181	165	150
Cummulative Emissions	43036	43426	43808	44181	44540	44887	45223	45547	45857	46147	46413	46654	46870	47066	47246	47411	47561
Cummulative Production Allocation	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102	51102

Halon 1301 - Japan

Year	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
CEFIC Production	10	20	30	40	50	60	100	200	550	839	1292	1461	2019	3172	3550	4015	4718
% Allocation of CEFIC Production	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
Allocation of CEFIC Production	2	3	5	6	8	9	15	30	83	126	194	219	303	476	533	602	708
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	2	3	5	6	8	9	15	30	83	126	194	219	303	476	533	602	708
Recycle Quantity	0	0	0	0	0	0	1	1	1	3	5	8	12	17	25	33	43
Annual Supply	2	3	5	6	8	9	16	31	84	129	199	227	315	493	557	636	751
Start Bank - Equip Life 0 to 10 yrs	0	0	1	1	2	2	3	5	8	17	31	51	72	100	146	192	239
Start Bank - Equip Life 0 to 25 yrs	0	1	3	6	10	14	20	29	48	101	182	304	437	619	909	1222	1563
Start Bank - Equip Life 25 to 35 yrs	0	0	0	1	1	2	3	4	7	15	27	45	65	93	137	186	241
Total Start Bank	0	1	4	8	13	19	26	38	63	134	239	400	574	813	1193	1600	2043
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	0	0	0	0	0	0	0	1	1	2	4	6	9	12	18	24	31
Annual % of Bank Used for Service	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Service Use	0	0	0	0	0	0	1	1	1	3	5	8	11	16	24	32	41
Supply Available for New Installations	2	3	4	6	7	9	15	29	82	124	190	213	294	464	515	580	680
% of Supply Available Used for Testing	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%
Test Use	0	0	0	0	0	0	1	1	4	6	9	10	14	22	25	28	33
% Added to Bank of Equip Life 0 to 10 yrs	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%
Added to Bank of Equip Life 0 to 10 yrs	0	0	1	1	1	1	2	4	12	18	27	30	42	66	74	83	97
% Added to Bank of Equip Life 0 to 25 yrs	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%
Added to Bank of Equip Life 0 to 25 yrs	1	2	3	4	5	6	10	21	58	88	136	152	210	331	368	414	485
% Added to Bank of Equip Life 25 to 35 yrs	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%
Added to Bank of Equip Life 25 to 35 yrs	0	0	0	1	1	1	1	3	8	12	18	20	28	44	49	55	65
Start + Change to Bank of Equip Life 0 to 10 yrs	0	1	1	2	3	4	5	9	19	35	58	82	114	167	220	275	337
Start + Change to Bank of Equip Life 0 to 25 yrs	1	3	6	10	15	21	30	50	106	190	318	456	647	951	1277	1635	2048
Start + Change to Bank of Equip Life 25 to 35 yrs	0	0	1	1	2	3	4	7	15	27	45	65	93	137	186	241	306
Total Start Bank + Change to Bank	1	4	8	13	20	27	40	66	140	251	421	603	854	1254	1684	2152	2690
Potential Recycle 0 to 10 Year Bank	0	0	0	0	0	0	1	1	2	4	7	10	14	20	28	36	45
Potential Recycle 0 to 25 Year Bank	0	0	0	0	1	1	1	2	4	8	13	20	28	41	56	72	92
Potential Recycle 25 to 35 Year Bank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Potential Recycle for Year	0	0	0	1	1	1	2	3	7	12	20	29	42	62	84	108	137
Estimated Recovery Rate	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
Estimated Recycle	0	0	0	0	0	1	1	1	3	5	8	12	17	25	33	43	55
Estimated Recycle Loss	0	0	0	0	1	1	1	2	4	7	12	18	25	37	50	65	82
End of Year 0 to 10 Year Equipment Bank	0	1	1	2	2	3	5	8	17	31	51	72	100	146	192	239	291
End of Year 0 to 25 Year Equipment Bank	1	3	6	10	14	20	29	48	101	182	304	437	619	909	1222	1563	1956
End of Year 25 to 35 Year Equipment Bank	0	0	1	1	2	3	4	7	15	27	45	65	93	137	186	241	306
Total End of Year Equipment Bank	1	4	8	13	19	26	38	63	134	239	400	574	813	1193	1600	2043	2553
Total End of Year Equipment Bank + Recycle	1	4	8	13	19	26	39	64	136	244	408	586	829	1217	1633	2087	2608
Total Annual Emissions	0	0	1	1	1	2	3	5	10	18	30	42	59	88	117	149	186
Cummulative Emissions	0	0	1	2	3	5	8	13	23	41	70	112	171	259	376	524	711
Cummulative Production Allocation	2	5	9	15	23	32	47	77	159	285	479	698	1001	1476	2009	2611	3319

Halon 1301 - Japan

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
CEFIC Production	4877	5694	7565	7386	8692	9781	11076	11604	12551	11152	9115	7326	4884	2442	0	0	0
% Allocation of CEFIC Production	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
Allocation of CEFIC Production	732	854	1135	1108	1304	1467	1661	1741	1883	1673	1367	1099	733	366	0	0	0
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	732	854	1135	1108	1304	1467	1661	1741	1883	1673	1367	1099	733	366	0	0	0
Recycle Quantity	55	67	80	98	115	135	157	182	207	234	297	361	422	478	527	567	599
Annual Supply	786	921	1215	1206	1419	1602	1819	1922	2090	1907	1665	1460	1155	844	527	567	599
Start Bank - Equip Life 0 to 10 yrs	291	336	387	464	522	594	671	759	840	923	931	876	778	652	511	374	257
Start Bank - Equip Life 0 to 25 yrs	1956	2342	2788	3399	3954	4607	5331	6140	6951	7804	8475	8939	9235	9307	9164	8789	8393
Start Bank - Equip Life 25 to 35 yrs	306	372	449	553	652	770	903	1052	1208	1377	1578	1792	2013	2208	2361	2442	2584
Total Start Bank	2553	3050	3625	4415	5129	5971	6904	7951	8999	10103	10984	11607	12027	12167	12036	11605	11235
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	38	46	54	66	77	90	104	119	135	152	165	174	180	183	181	174	169
Annual % of Bank Used for Service	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.7%	1.4%	1.1%	0.8%	0.5%	0.5%	0.5%	0.5%
Service Use	51	61	72	88	103	119	138	159	180	172	154	128	96	61	60	58	56
Supply Available for New Installations	697	814	1088	1051	1239	1393	1577	1644	1775	1583	1346	1158	878	601	286	335	374
% of Supply Available Used for Testing	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.0%	3.2%	2.4%	1.6%	0.8%	0.0%	0.0%	0.0%
Test Use	33	39	52	50	59	67	76	79	85	63	43	28	14	5	0	0	0
% Added to Bank of Equip Life 0 to 10 yrs	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	11.9%	9.5%	7.1%	4.7%	2.3%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 10 yrs	100	116	156	150	177	199	226	235	254	188	128	82	41	14	0	0	0
% Added to Bank of Equip Life 0 to 25 yrs	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	71.4%	57.1%	42.8%
Added to Bank of Equip Life 0 to 25 yrs	498	581	777	751	885	995	1126	1174	1267	1131	961	827	627	429	204	191	160
% Added to Bank of Equip Life 25 to 35 yrs	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	12.7%	15.9%	19.1%	22.3%	25.5%	28.6%	42.9%	57.2%
Added to Bank of Equip Life 25 to 35 yrs	66	77	103	100	118	132	150	156	169	201	214	221	196	153	82	144	214
Start + Change to Bank of Equip Life 0 to 10 yrs	391	452	543	614	700	793	896	994	1094	1111	1059	958	820	665	511	374	257
Start + Change to Bank of Equip Life 0 to 25 yrs	2454	2923	3565	4150	4839	5602	6457	7314	8218	8934	9436	9766	9862	9736	9368	8980	8553
Start + Change to Bank of Equip Life 25 to 35 yrs	372	449	553	652	770	903	1052	1209	1377	1578	1792	2013	2209	2362	2443	2586	2799
Total Start Bank + Change to Bank	3217	3825	4660	5416	6308	7297	8405	9516	10688	11623	12287	12737	12891	12763	12322	11940	11609
Potential Recycle 0 to 10 Year Bank	55	65	79	91	106	122	138	154	171	180	183	180	168	154	137	117	94
Potential Recycle 0 to 25 Year Bank	112	135	166	196	232	271	316	363	414	459	497	530	555	572	580	587	591
Potential Recycle 25 to 35 Year Bank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3
Total Potential Recycle for Year	167	200	245	288	338	393	454	517	585	639	680	710	724	727	717	705	688
Estimated Recovery Rate	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	46.5%	53.0%	59.5%	66.0%	72.5%	79.0%	85.0%	85.0%
Estimated Recycle	67	80	98	115	135	157	182	207	234	297	361	422	478	527	567	599	584
Estimated Recycle Loss	100	120	147	173	203	236	272	310	351	342	320	288	246	200	151	106	103
End of Year 0 to 10 Year Equipment Bank	336	387	464	522	594	671	759	840	923	931	876	778	652	511	374	257	163
End of Year 0 to 25 Year Equipment Bank	2342	2788	3399	3954	4607	5331	6140	6951	7804	8475	8939	9235	9307	9164	8789	8393	7962
End of Year 25 to 35 Year Equipment Bank	372	449	553	652	770	903	1052	1208	1377	1578	1792	2013	2208	2361	2442	2584	2796
Total End of Year Equipment Bank	3050	3625	4415	5129	5971	6904	7951	8999	10103	10984	11607	12027	12167	12036	11605	11235	10922
Total End of Year Equipment Bank + Recycle	3117	3705	4513	5244	6106	7061	8133	9206	10337	11281	11967	12449	12645	12563	12172	11834	11506
Total Annual Emissions	223	266	326	378	442	512	590	668	751	729	681	617	537	448	391	338	328
Cummulative Emissions	934	1200	1526	1904	2345	2857	3447	4114	4865	5594	6276	6893	7429	7877	8269	8607	8935
Cummulative Production Allocation	4050	4905	6039	7147	8451	9918	11580	13320	15203	16876	18243	19342	20074	20441	20441	20441	20441

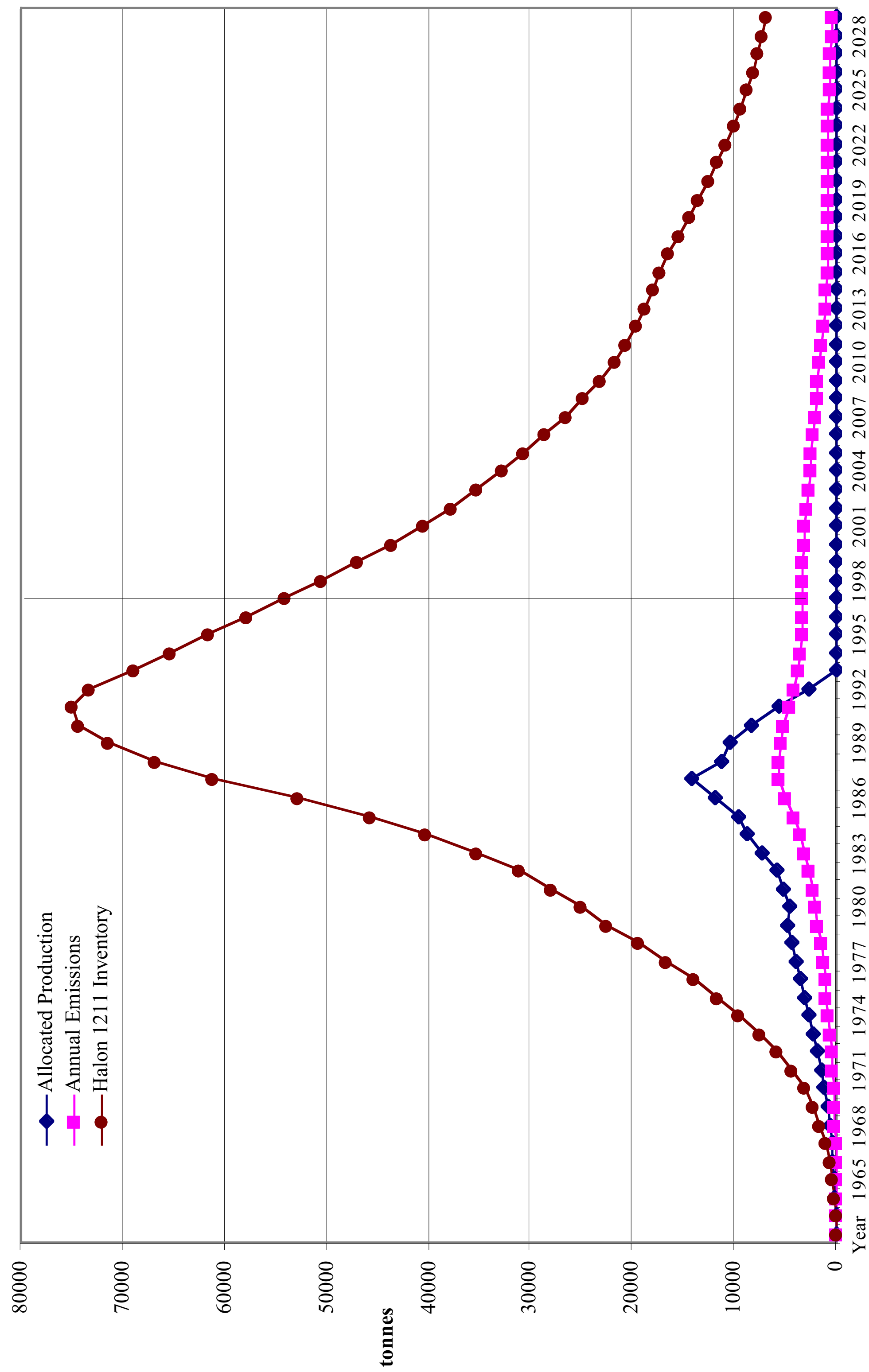
Halon 1301 - Japan

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	584	567	544	525	511	496	485	475	464	453	441	422	404	383	358	329	299
Annual Supply	584	567	544	525	511	496	485	475	464	453	441	422	404	383	358	329	299
Start Bank - Equip Life 0 to 10 yrs	163	92	47	21	7	1	0	0	0	0	0	0	0	0	0	0	0
Start Bank - Equip Life 0 to 25 yrs	7962	7475	6938	6356	5783	5222	4677	4148	3638	3149	2682	2247	1842	1472	1142	857	619
Start Bank - Equip Life 25 to 35 yrs	2796	3053	3351	3678	3989	4285	4568	4838	5097	5343	5574	5789	5979	6146	6285	6393	6464
Total Start Bank	10922	10621	10336	10055	9778	9509	9245	8986	8735	8492	8256	8036	7821	7618	7428	7250	7083
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	164	159	155	151	147	143	139	135	131	127	124	121	117	114	111	109	106
Annual % of Bank Used for Service	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Service Use	55	53	52	50	49	48	46	45	44	42	41	40	39	38	37	36	35
Supply Available for New Installations	366	354	337	324	315	306	300	295	289	283	276	261	248	231	210	184	157
% of Supply Available Used for Testing	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Test Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 10 yrs	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 10 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 25 yrs	28.5%	14.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 25 yrs	104	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 25 to 35 yrs	71.5%	85.8%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Added to Bank of Equip Life 25 to 35 yrs	262	304	337	324	315	306	300	295	289	283	276	261	248	231	210	184	157
Start + Change to Bank of Equip Life 0 to 10 yrs	163	92	47	21	7	1	0	0	0	0	0	0	0	0	0	0	0
Start + Change to Bank of Equip Life 0 to 25 yrs	8067	7526	6938	6356	5783	5222	4677	4148	3638	3149	2682	2247	1842	1472	1142	857	619
Start + Change to Bank of Equip Life 25 to 35 yrs	3058	3357	3688	4002	4304	4592	4868	5133	5386	5626	5850	6050	6227	6377	6495	6577	6621
Total Start Bank + Change to Bank	11288	10975	10673	10379	10093	9815	9545	9281	9025	8775	8532	8297	8069	7849	7637	7434	7240
Potential Recycle 0 to 10 Year Bank	71	45	27	14	6	1	0	0	0	0	0	0	0	0	0	0	0
Potential Recycle 0 to 25 Year Bank	591	588	582	573	560	545	529	510	490	466	435	405	370	330	285	238	187
Potential Recycle 25 to 35 Year Bank	4	6	9	14	18	24	30	36	43	53	61	71	81	92	102	114	127
Total Potential Recycle for Year	667	640	618	601	584	571	559	546	533	519	496	476	451	422	387	352	315
Estimated Recovery Rate	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Estimated Recycle	567	544	525	511	496	485	475	464	453	441	422	404	383	358	329	299	267
Estimated Recycle Loss	100	96	93	90	88	86	84	82	80	78	74	71	68	63	58	53	47
End of Year 0 to 10 Year Equipment Bank	92	47	21	7	1	0	0	0	0	0	0	0	0	0	0	0	0
End of Year 0 to 25 Year Equipment Bank	7475	6938	6356	5783	5222	4677	4148	3638	3149	2682	2247	1842	1472	1142	857	619	432
End of Year 25 to 35 Year Equipment Bank	3053	3351	3678	3989	4285	4568	4838	5097	5343	5574	5789	5979	6146	6285	6393	6464	6494
Total End of Year Equipment Bank	10621	10336	10055	9778	9509	9245	8986	8735	8492	8256	8036	7821	7618	7428	7250	7083	6925
Total End of Year Equipment Bank + Recycle	11188	10879	10580	10289	10006	9730	9461	9199	8945	8697	8458	8226	8001	7786	7579	7381	7193
Total Annual Emissions	318	308	299	291	283	276	269	262	255	248	240	232	224	216	207	198	189
Cummulative Emissions	9253	9561	9861	10152	10435	10711	10980	11241	11496	11744	11983	12215	12439	12655	12861	13059	13248
Cummulative Production Allocation	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441

Halon 1301 - Japan

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEIT Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of CEIT Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of Article 5(1) Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allocation of Article 5(1) Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	267	242	221	201	184	166	160	159	163	171	181	190	198	207	220	238	251
Annual Supply	267	242	221	201	184	166	160	159	163	171	181	190	198	207	220	238	251
Start Bank - Equip Life 0 to 10 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Start Bank - Equip Life 0 to 25 yrs	432	289	186	115	69	41	21	8	2	0	0	0	0	0	0	0	0
Start Bank - Equip Life 25 to 35 yrs	6494	6481	6430	6353	6254	6144	6018	5883	5739	5588	5435	5283	5135	4986	4835	4678	4528
Total Start Bank	6925	6770	6616	6468	6323	6185	6039	5891	5741	5588	5435	5283	5135	4986	4835	4678	4528
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	104	102	99	97	95	93	91	88	86	84	82	79	77	75	73	70	68
Annual % of Bank Used for Service	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Service Use	35	34	33	32	32	31	30	29	29	28	27	26	26	25	24	23	23
Supply Available for New Installations	129	106	89	72	58	43	40	42	48	59	72	84	95	108	123	145	160
% of Supply Available Used for Testing	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Test Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 10 yrs	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 10 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 0 to 25 yrs	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Added to Bank of Equip Life 0 to 25 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Added to Bank of Equip Life 25 to 35 yrs	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Added to Bank of Equip Life 25 to 35 yrs	129	106	89	72	58	43	40	42	48	59	72	84	95	108	123	145	160
Start + Change to Bank of Equip Life 0 to 10 yrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Start + Change to Bank of Equip Life 0 to 25 yrs	432	289	186	115	69	41	21	8	2	0	0	0	0	0	0	0	0
Start + Change to Bank of Equip Life 25 to 35 yrs	6623	6587	6519	6425	6312	6187	6058	5925	5787	5647	5507	5368	5230	5094	4958	4822	4688
Total Start Bank + Change to Bank	7054	6876	6705	6540	6381	6228	6079	5933	5789	5647	5507	5368	5230	5094	4958	4822	4688
Potential Recycle 0 to 10 Year Bank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potential Recycle 0 to 25 Year Bank	142	104	71	46	28	20	13	6	2	0	0	0	0	0	0	0	0
Potential Recycle 25 to 35 Year Bank	142	156	166	171	167	169	175	186	199	213	224	233	244	259	280	295	302
Total Potential Recycle for Year	284	260	236	217	196	189	188	192	201	213	224	233	244	259	280	295	302
Estimated Recovery Rate	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Estimated Recycle	242	221	201	184	166	160	159	163	171	181	190	198	207	220	238	251	256
Estimated Recycle Loss	43	39	35	32	29	28	28	29	30	32	34	35	37	39	42	44	45
End of Year 0 to 10 Year Equipment Bank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End of Year 0 to 25 Year Equipment Bank	289	186	115	69	41	21	8	2	0	0	0	0	0	0	0	0	0
End of Year 25 to 35 Year Equipment Bank	6481	6430	6353	6254	6144	6018	5883	5739	5588	5435	5283	5135	4986	4835	4678	4528	4386
Total End of Year Equipment Bank	6770	6616	6468	6323	6185	6039	5891	5741	5588	5435	5283	5135	4986	4835	4678	4528	4386
Total End of Year Equipment Bank + Recycle	7011	6837	6669	6507	6352	6200	6051	5904	5759	5615	5473	5333	5193	5055	4916	4778	4642
Total Annual Emissions	181	174	168	162	156	152	149	147	145	144	142	141	139	139	139	138	136
Cummulative Emissions	13429	13604	13771	13933	14089	14241	14390	14537	14682	14825	14967	15108	15247	15386	15525	15662	15798
Cummulative Production Allocation	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441	20441

Halon 1211 - Western Europe, North America, Japan and Australia



Halon 1211
Western Europe, Australia, North America and Japan

Year	**1963**	**1964**	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**
Allocated Production	35	70	140	210	350	490	630	882	1190	1540	1925	2310	2660	3049
Annual Emissions	3	9	19	33	57	89	127	182	254	346	459	590	738	955
Halon 1211 Inventory	32	93	214	391	684	1085	1588	2289	3224	4418	5885	7605	9526	11620

Year	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
Allocated Production	3500	3955	4396	4837	4682	5240	5781	7286	8744	9612	11941	14127	11327	10396
Annual Emissions	1099	1318	1557	1822	2058	2353	2681	3130	3654	4197	4915	5736	5620	5460
Halon 1211 Inventory	14021	16658	19496	22511	25136	28022	31122	35278	40368	45783	52808	61198	66750	71483

Year	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Allocated Production	8317	5545	2772	0	0	0	0	0	0	0	0	0	0	0
Annual Emissions	5126	4679	4154	3853	3450	3410	3399	3412	3366	3311	3225	3098	2936	2736
Halon 1211 Inventory	74431	75005	73278	68980	65292	61634	57914	54121	50513	46997	43656	40557	37733	35229

Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Allocated Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Emissions	2561	2403	2251	2106	1954	1795	1641	1463	1266	1131	1005	912	861	847
Halon 1211 Inventory	32864	30623	28531	26576	24803	23221	21799	20628	19721	18824	18030	17258	16438	15537

Year	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Allocated Production	0	0	0	0	0	0	0	0	0	0	0	0
Annual Emissions	871	872	866	851	824	786	739	686	630	574	522	477
Halon 1211 Inventory	14506	13526	12578	11672	10827	10062	9372	8760	8221	7744	7314	6912

Halon 1211
Western Europe and Australia

Year	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
CEFIC Production	50	100	200	300	500	700	900	1260	1700	2200	2750	3300	3800	4356	5000	5650	6280
% Allocation of CEFIC Production	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%
Allocation of CEFIC Production	18	35	70	105	175	245	315	441	595	770	963	1155	1330	1525	1750	1978	2198
Total Production Allocation	18	35	70	105	175	245	315	441	595	770	963	1155	1330	1525	1750	1978	2198
Recycle Quantity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Supply	18	35	70	105	175	245	315	441	595	770	963	1155	1330	1525	1750	1978	2198
Start Bank - Equip Life 10 to 25 yrs	0	16	46	106	194	339	537	786	1132	1594	2183	2906	3754	4700	5729	6909	8204
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	0	0	1	2	3	5	8	12	17	24	33	44	56	70	86	104	123
Annual % of Bank Used for Service	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Service Use	0	1	2	5	10	17	27	39	57	80	109	145	188	235	286	345	410
Annual % of Supply used for Training	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Training Use	2	4	7	11	18	25	32	44	60	77	96	116	133	152	175	198	220
Total Emissive Use	2	5	10	17	30	47	66	95	133	181	238	304	377	458	547	647	753
Supply Available for New Equipment	16	30	60	88	145	198	249	346	462	589	724	851	953	1067	1203	1331	1445
Added to Bank of Equip Life 10 to 25 yrs	16	30	60	88	145	198	249	346	462	589	724	851	953	1067	1203	1331	1445
Total Start Bank + Change to Bank	16	46	106	194	339	537	786	1132	1594	2183	2907	3757	4707	5766	6932	8240	9649
Potential Recycle for year	0	0	0	0	0	0	0	0	0	0	1	3	7	37	23	36	52
Estimated Recovery Rate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Estimated Recycle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Estimated Recycle Loss	0	0	0	0	0	0	0	0	0	0	1	3	7	37	23	36	52
End of Year 10 to 25 Year Equipment Bank	16	46	106	194	339	537	786	1132	1594	2183	2906	3754	4700	5729	6909	8204	9597
Total End of Year Equipment Bank + Recycle	16	46	106	194	339	537	786	1132	1594	2183	2906	3754	4700	5729	6909	8204	9597
Total Annual Emissions	2	5	10	17	30	47	66	95	133	181	239	307	384	495	570	683	805
Cummulative Emissions	2	6	16	34	64	110	177	272	405	586	825	1132	1516	2011	2581	3264	4069
Cummulative Production Allocation	18	53	123	228	403	648	963	1404	1999	2769	3731	4886	6216	7741	9491	11468	13666

Halon 1211
Western Europe and Australia

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
CEFIC Production	6910	6689	7485	8259	10408	12491	13731	17058	20181	16182	14852	11882	7921	3960	0	0	0
% Allocation of CEFIC Production	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%
Allocation of CEFIC Production	2419	2341	2620	2891	3643	4372	4806	5970	7063	5664	5198	4159	2772	1386	0	0	0
Total Production Allocation	2419	2341	2620	2891	3643	4372	4806	5970	7063	5664	5198	4159	2772	1386	0	0	0
Recycle Quantity	0	0	0	0	0	0	0	0	0	0	81	161	239	314	384	448	431
Annual Supply	2419	2341	2620	2891	3643	4372	4806	5970	7063	5664	5279	4320	3011	1700	384	448	431
Start Bank - Equip Life 10 to 25 yrs	9597	11074	12355	13764	15277	17312	19808	22460	25908	30028	32743	35164	36771	37256	36639	34777	33259
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	144	166	185	206	229	260	297	337	389	450	491	527	552	559	550	522	499
Annual % of Bank Used for Service	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	4.6%	4.2%	3.8%	3.4%	3.0%	3.0%	2.5%	2.5%
Service Use	480	554	618	688	764	866	990	1123	1295	1381	1375	1336	1250	1118	1099	869	831
Annual % of Supply used for Training	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	8.3%	6.6%	4.9%	3.2%	1.5%	0.0%	0.0%	0.0%
Training Use	242	234	262	289	364	437	481	597	706	470	348	212	96	25	0	0	0
Total Emissive Use	866	954	1065	1184	1357	1562	1768	2057	2390	2302	2215	2075	1898	1702	1649	1391	1330
Supply Available for New Equipment	1553	1387	1555	1707	2285	2809	3038	3913	4673	3362	3064	2244	1113	-2	-1265	-943	-899
Added to Bank of Equip Life 10 to 25 yrs	1553	1387	1555	1707	2285	2809	3038	3913	4673	3362	3064	2244	1113	-2	-1265	-943	-899
Total Start Bank + Change to Bank	11150	12461	13910	15471	17563	20122	22845	26374	30581	33390	35807	37408	37884	37254	35375	33834	32360
Potential Recycle for year	75	106	146	194	251	314	385	465	553	647	643	637	628	615	598	575	544
Estimated Recovery Rate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	12.5%	25.0%	37.5%	50.0%	62.5%	75.0%	75.0%	75.0%
Estimated Recycle	0	0	0	0	0	0	0	0	0	81	161	239	314	384	448	431	408
Estimated Recycle Loss	75	106	146	194	251	314	385	465	553	566	482	398	314	230	149	144	136
End of Year 10 to 25 Year Equipment Bank	11074	12355	13764	15277	17312	19808	22460	25908	30028	32743	35164	36771	37256	36639	34777	33259	31816
Total End of Year Equipment Bank + Recycle	11074	12355	13764	15277	17312	19808	22460	25908	30028	32824	35325	37010	37570	37023	35225	33690	32224
Total Annual Emissions	941	1060	1211	1378	1608	1877	2153	2522	2943	2868	2697	2474	2212	1932	1798	1535	1466
Cummulative Emissions	5010	6071	7281	8659	10267	12143	14296	16819	19762	22630	25328	27801	30013	31946	33744	35279	36745
Cummulative Production Allocation	16085	18426	21046	23936	27579	31951	36757	42727	49790	55454	60652	64811	67583	68969	68969	68969	68969

Halon 1211

Western Europe and Australia

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	408	379	342	300	252	199	139	72	1572	1447	1333	0	0	0	0	0	0
Annual Supply	408	379	342	300	252	199	139	72	1572	1447	1333	0	0	0	0	0	0
Start Bank - Equip Life 10 to 25 yrs	31816	30446	29151	27927	26774	25690	24676	23731	20759	19571	18458	19052	18290	17559	16856	16182	15535
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	477	457	437	419	402	385	370	356	311	294	277	286	274	263	253	243	233
Annual % of Bank Used for Service	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Service Use	795	761	729	698	669	642	617	593	519	489	461	476	457	439	421	405	388
Annual % of Supply used for Training	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Training Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Emissive Use	1273	1218	1166	1117	1071	1028	987	949	830	783	738	762	732	702	674	647	621
Supply Available for New Equipment	-865	-839	-824	-817	-819	-829	-848	-877	742	664	594	-762	-732	-702	-674	-647	-621
Added to Bank of Equip Life 10 to 25 yrs	-865	-839	-824	-817	-819	-829	-848	-877	742	664	594	-762	-732	-702	-674	-647	-621
Total Start Bank + Change to Bank	30951	29607	28327	27110	25955	24861	23828	22854	21500	20235	19052	18290	17559	16856	16182	15535	14913
Potential Recycle for year	505	457	400	336	265	185	96	2096	1929	1777	0	0	0	0	0	0	0
Estimated Recovery Rate	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%
Estimated Recycle	379	342	300	252	199	139	72	1572	1447	1333	0	0	0	0	0	0	0
Estimated Recycle Loss	126	114	100	84	66	46	24	524	482	444	0	0	0	0	0	0	0
End of Year 10 to 25 Year Equipment Bank	30446	29151	27927	26774	25690	24676	23731	20759	19571	18458	19052	18290	17559	16856	16182	15535	14913
Total End of Year Equipment Bank + Recycle	30825	29493	28227	27026	25889	24815	23804	22331	21018	19791	19052	18290	17559	16856	16182	15535	14913
Total Annual Emissions	1399	1332	1266	1201	1137	1074	1011	1473	1313	1227	738	762	732	702	674	647	621
Cummulative Emissions	38144	39476	40742	41943	43081	44154	45166	46639	47951	49179	49917	50679	51411	52113	52787	53434	54056
Cummulative Production Allocation	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969

Halon 1211
Western Europe and Australia

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	0	0	0	0	0	0	0	0	-379	-369	-358	0	0	0	0	0	0
Annual Supply	0	0	0	0	0	0	0	0	-379	-369	-358	0	0	0	0	0	0
Start Bank - Equip Life 10 to 25 yrs	14913	14317	13744	13194	12667	12160	11674	11207	11264	10926	10597	9815	9423	9046	8684	8337	8003
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	224	215	206	198	190	182	175	168	169	164	159	147	141	136	130	125	120
Annual % of Bank Used for Service	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Service Use	373	358	344	330	317	304	292	280	282	273	265	245	236	226	217	208	200
Annual % of Supply used for Training	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Training Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Emissive Use	597	573	550	528	507	486	467	448	451	437	424	393	377	362	347	333	320
Supply Available for New Equipment	-597	-573	-550	-528	-507	-486	-467	-448	-830	-806	-781	-393	-377	-362	-347	-333	-320
Added to Bank of Equip Life 10 to 25 yrs	-597	-573	-550	-528	-507	-486	-467	-448	-830	-806	-781	-393	-377	-362	-347	-333	-320
Total Start Bank + Change to Bank	14317	13744	13194	12667	12160	11674	11207	10758	10434	10120	9815	9423	9046	8684	8337	8003	7683
Potential Recycle for year	0	0	0	0	0	0	0	-506	-491	-477	0	0	0	0	0	0	0
Estimated Recovery Rate	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%
Estimated Recycle	0	0	0	0	0	0	0	-379	-369	-358	0	0	0	0	0	0	0
Estimated Recycle Loss	0	0	0	0	0	0	0	-126	-123	-119	0	0	0	0	0	0	0
End of Year 10 to 25 Year Equipment Bank	14317	13744	13194	12667	12160	11674	11207	11264	10926	10597	9815	9423	9046	8684	8337	8003	7683
Total End of Year Equipment Bank + Recycle	14317	13744	13194	12667	12160	11674	11207	10885	10557	10239	9815	9423	9046	8684	8337	8003	7683
Total Annual Emissions	597	573	550	528	507	486	467	322	328	318	424	393	377	362	347	333	320
Cummulative Emissions	54652	55225	55775	56303	56809	57296	57763	58084	58412	58730	59154	59546	59923	60285	60633	60966	61286
Cummulative Production Allocation	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969	68969

Halon 1211 - North America

Year	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
CEFIC Production	50	100	200	300	500	700	900	1260	1700	2200	2750	3300	3800	4356	5000	5650	6280
% Allocation of CEFIC Production	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
Allocation of CEFIC Production	15	30	60	90	150	210	270	378	510	660	825	990	1140	1307	1500	1695	1884
Total Production Allocation	15	30	60	90	150	210	270	378	510	660	825	990	1140	1307	1500	1695	1884
Recycle Quantity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Supply	15	30	60	90	150	210	270	378	510	660	825	990	1140	1307	1500	1695	1884
Start Bank - Equip Life 10 to 25 yrs	0	14	40	91	166	290	460	674	970	1366	1871	2491	3218	4028	4911	5922	7032
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	0	0	1	1	2	4	7	10	15	20	28	37	48	60	74	89	105
Annual % of Bank Used for Service	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Service Use	0	1	2	5	8	15	23	34	48	68	94	125	161	201	246	296	352
Annual % of Supply used for Training	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Training Use	2	3	6	9	15	21	27	38	51	66	83	99	114	131	150	170	188
Total Emissive Use	2	4	9	15	26	40	57	82	114	155	204	261	323	393	469	554	645
Supply Available for New Equipment	14	26	51	75	124	170	213	296	396	505	621	729	817	914	1031	1141	1239
Added to Bank of Equip Life 10 to 25 yrs	14	26	51	75	124	170	213	296	396	505	621	729	817	914	1031	1141	1239
Total Start Bank + Change to Bank	14	40	91	166	290	460	674	970	1366	1871	2492	3220	4034	4943	5942	7063	8271
Potential Recycle for year	0	0	0	0	0	0	0	0	0	0	1	3	6	32	19	31	45
Estimated Recovery Rate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Estimated Recycle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Estimated Recycle Loss	0	0	0	0	0	0	0	0	0	0	1	3	6	32	19	31	45
End of Year 10 to 25 Year Equipment Bank	14	40	91	166	290	460	674	970	1366	1871	2491	3218	4028	4911	5922	7032	8226
Total End of Year Equipment Bank + Recycle	14	40	91	166	290	460	674	970	1366	1871	2491	3218	4028	4911	5922	7032	8226
Total Annual Emissions	2	4	9	15	26	40	57	82	114	155	205	264	329	424	489	585	690
Cummulative Emissions	2	5	14	29	55	95	151	233	347	502	707	970	1300	1724	2213	2798	3488
Cummulative Production Allocation	15	45	105	195	345	555	825	1203	1713	2373	3198	4188	5328	6635	8135	9830	11714

Halon 1211 - North America

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
CEFIC Production	6910	6689	7485	8259	10408	12491	13731	17058	20181	16182	14852	11882	7921	3960	0	0	0
% Allocation of CEFIC Production	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
Allocation of CEFIC Production	2073	2007	2246	2478	3122	3747	4119	5117	6054	4855	4456	3565	2376	1188	0	0	0
Total Production Allocation	2073	2007	2246	2478	3122	3747	4119	5117	6054	4855	4456	3565	2376	1188	0	0	0
Recycle Quantity	0	0	0	0	0	0	0	0	0	0	69	138	205	269	329	384	370
Annual Supply	2073	2007	2246	2478	3122	3747	4119	5117	6054	4855	4525	3702	2581	1457	329	384	370
Start Bank - Equip Life 10 to 25 yrs	8226	9492	10590	11798	13095	14839	16978	19252	22207	25738	28065	30140	31518	31934	31405	29809	28508
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	123	142	159	177	196	223	255	289	333	386	421	452	473	479	471	447	428
Annual % of Bank Used for Service	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	4.6%	4.2%	3.8%	3.4%	3.0%	3.0%	2.5%	2.5%
Service Use	411	475	530	590	655	742	849	963	1110	1184	1179	1145	1072	958	942	745	713
Annual % of Supply used for Training	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	8.3%	6.6%	4.9%	3.2%	1.5%	0.0%	0.0%	0.0%
Training Use	207	201	225	248	312	375	412	512	605	403	299	181	83	22	0	0	0
Total Emissive Use	742	818	913	1015	1163	1339	1515	1763	2049	1973	1898	1779	1627	1459	1413	1192	1140
Supply Available for New Equipment	1331	1189	1333	1463	1959	2408	2604	3354	4005	2882	2627	1924	954	-2	-1084	-808	-771
Added to Bank of Equip Life 10 to 25 yrs	1331	1189	1333	1463	1959	2408	2604	3354	4005	2882	2627	1924	954	-2	-1084	-808	-771
Total Start Bank + Change to Bank	9557	10681	11923	13261	15054	17247	19582	22606	26212	28620	30692	32064	32472	31932	30321	29001	27737
Potential Recycle for year	65	91	125	166	215	269	330	399	474	555	551	546	538	527	513	493	466
Estimated Recovery Rate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	12.5%	25.0%	37.5%	50.0%	62.5%	75.0%	75.0%	75.0%
Estimated Recycle	0	0	0	0	0	0	0	0	0	69	138	205	269	329	384	370	350
Estimated Recycle Loss	65	91	125	166	215	269	330	399	474	485	414	341	269	198	128	123	117
End of Year 10 to 25 Year Equipment Bank	9492	10590	11798	13095	14839	16978	19252	22207	25738	28065	30140	31518	31934	31405	29809	28508	27271
Total End of Year Equipment Bank + Recycle	9492	10590	11798	13095	14839	16978	19252	22207	25738	28135	30278	31723	32203	31734	30193	28877	27621
Total Annual Emissions	807	909	1038	1181	1378	1608	1846	2162	2523	2458	2312	2120	1896	1656	1541	1316	1257
Cummulative Emissions	4295	5203	6241	7422	8800	10408	12254	14416	16939	19397	21709	23830	25726	27382	28923	30239	31496
Cummulative Production Allocation	13787	15794	18039	20517	23639	27386	31506	36623	42677	47532	51988	55552	57929	59117	59117	59117	59117

Halon 1211 - North America

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	350	325	294	257	216	170	119	62	1347	1240	1142	0	0	0	0	0	0
Annual Supply	350	325	294	257	216	170	119	62	1347	1240	1142	0	0	0	0	0	0
Start Bank - Equip Life 10 to 25 yrs	27271	26097	24986	23938	22949	22020	21151	20341	17793	16775	15821	16331	15677	15050	14448	13870	13316
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	409	391	375	359	344	330	317	305	267	252	237	245	235	226	217	208	200
Annual % of Bank Used for Service	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Service Use	682	652	625	598	574	550	529	509	445	419	396	408	392	376	361	347	333
Annual % of Supply used for Training	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Training Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Emissive Use	1091	1044	999	958	918	881	846	814	712	671	633	653	627	602	578	555	533
Supply Available for New Equipment	-741	-719	-706	-700	-702	-710	-727	-752	636	569	510	-653	-627	-602	-578	-555	-533
Added to Bank of Equip Life 10 to 25 yrs	-741	-719	-706	-700	-702	-710	-727	-752	636	569	510	-653	-627	-602	-578	-555	-533
Total Start Bank + Change to Bank	26530	25378	24280	23237	22247	21310	20424	19590	18429	17344	16331	15677	15050	14448	13870	13316	12783
Potential Recycle for year	433	391	343	288	227	159	83	1796	1654	1523	0	0	0	0	0	0	0
Estimated Recovery Rate	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%
Estimated Recycle	325	294	257	216	170	119	62	1347	1240	1142	0	0	0	0	0	0	0
Estimated Recycle Loss	108	98	86	72	57	40	21	449	413	381	0	0	0	0	0	0	0
End of Year 10 to 25 Year Equipment Bank	26097	24986	23938	22949	22020	21151	20341	17793	16775	15821	16331	15677	15050	14448	13870	13316	12783
Total End of Year Equipment Bank + Recycle	26422	25280	24195	23165	22190	21270	20403	19140	18015	16963	16331	15677	15050	14448	13870	13316	12783
Total Annual Emissions	1199	1142	1085	1030	975	920	867	1263	1125	1052	633	653	627	602	578	555	533
Cummulative Emissions	32695	33837	34922	35951	36926	37847	38713	39976	41101	42153	42786	43439	44066	44668	45246	45801	46334
Cummulative Production Allocation	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117

Halon 1211 - North America

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	0	0	0	0	0	0	0	0	-325	-316	-307	0	0	0	0	0	0
Annual Supply	0	0	0	0	0	0	0	0	-325	-316	-307	0	0	0	0	0	0
Start Bank - Equip Life 10 to 25 yrs	12783	12272	11781	11310	10857	10423	10006	9606	9655	9365	9083	8413	8077	7754	7443	7146	6860
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	192	184	177	170	163	156	150	144	145	140	136	126	121	116	112	107	103
Annual % of Bank Used for Service	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Service Use	320	307	295	283	271	261	250	240	241	234	227	210	202	194	186	179	171
Annual % of Supply used for Training	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Training Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Emissive Use	511	491	471	452	434	417	400	384	386	375	363	337	323	310	298	286	274
Supply Available for New Equipment	-511	-491	-471	-452	-434	-417	-400	-384	-711	-690	-670	-337	-323	-310	-298	-286	-274
Added to Bank of Equip Life 10 to 25 yrs	-511	-491	-471	-452	-434	-417	-400	-384	-711	-690	-670	-337	-323	-310	-298	-286	-274
Total Start Bank + Change to Bank	12272	11781	11310	10857	10423	10006	9606	9221	8944	8674	8413	8077	7754	7443	7146	6860	6586
Potential Recycle for year	0	0	0	0	0	0	0	-434	-421	-409	0	0	0	0	0	0	0
Estimated Recovery Rate	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%
Estimated Recycle	0	0	0	0	0	0	0	-325	-316	-307	0	0	0	0	0	0	0
Estimated Recycle Loss	0	0	0	0	0	0	0	-108	-105	-102	0	0	0	0	0	0	0
End of Year 10 to 25 Year Equipment Bank	12272	11781	11310	10857	10423	10006	9606	9655	9365	9083	8413	8077	7754	7443	7146	6860	6586
Total End of Year Equipment Bank + Recycle	12272	11781	11310	10857	10423	10006	9606	9330	9049	8777	8413	8077	7754	7443	7146	6860	6586
Total Annual Emissions	511	491	471	452	434	417	400	276	281	272	363	337	323	310	298	286	274
Cummulative Emissions	46845	47336	47807	48259	48694	49111	49511	49787	50068	50340	50703	51040	51363	51673	51971	52257	52531
Cummulative Production Allocation	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117	59117

Halon 1211 - Japan

Year	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
CEFIC Production	50	100	200	300	500	700	900	1260	1700	2200	2750	3300	3800	4356	5000	5650	6280
% Allocation of CEFIC Production	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Allocation of CEFIC Production	3	5	10	15	25	35	45	63	85	110	138	165	190	218	250	283	314
Total Production Allocation	3	5	10	15	25	35	45	63	85	110	138	165	190	218	250	283	314
Recycle Quantity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Supply	3	5	10	15	25	35	45	63	85	110	138	165	190	218	250	283	314
Start Bank - Equip Life 10 to 25 yrs	0	2	7	17	31	55	88	129	187	265	364	487	633	798	980	1189	1422
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	0	0	0	0	0	1	1	2	3	4	5	7	9	12	15	18	21
Annual % of Bank Used for Service	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Service Use	0	0	0	0	1	1	2	3	4	5	7	10	13	16	20	24	28
Annual % of Supply used for Training	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Training Use	0	0	0	0	0	0	0	1	1	1	1	2	2	2	3	3	3
Total Emissive Use	0	0	0	1	1	2	4	5	7	10	14	19	24	30	37	44	53
Supply Available for New Equipment	2	5	10	14	24	33	41	58	78	100	123	146	166	188	213	238	261
Added to Bank of Equip Life 10 to 25 yrs	2	5	10	14	24	33	41	58	78	100	123	146	166	188	213	238	261
Total Start Bank + Change to Bank	2	7	17	31	55	88	129	187	265	364	488	634	799	986	1193	1427	1683
Potential Recycle for year	0	0	0	0	0	0	0	0	0	0	0	0	1	6	4	6	9
Estimated Recovery Rate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Estimated Recycle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Estimated Recycle Loss	0	0	0	0	0	0	0	0	0	0	0	0	1	6	4	6	9
End of Year 10 to 25 Year Equipment Bank	2	7	17	31	55	88	129	187	265	364	487	633	798	980	1189	1422	1674
Total End of Year Equipment Bank + Recycle	2	7	17	31	55	88	129	187	265	364	487	633	798	980	1189	1422	1674
Total Annual Emissions	0	0	0	1	1	2	4	5	7	10	14	19	25	36	40	50	62
Cummulative Emissions	0	0	1	1	3	5	8	14	21	31	46	65	90	126	166	217	278
Cummulative Production Allocation	3	8	18	33	58	93	138	201	286	396	533	698	888	1106	1356	1638	1952

Halon 1211 - Japan

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
CEFIC Production	6910	6689	7485	8259	10408	12491	13731	17058	20181	16182	14852	11882	7921	3960	0	0	0
% Allocation of CEFIC Production	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Allocation of CEFIC Production	346	334	374	413	520	625	687	853	1009	809	743	594	396	198	0	0	0
Total Production Allocation	346	334	374	413	520	625	687	853	1009	809	743	594	396	198	0	0	0
Recycle Quantity	0	0	0	0	0	0	0	0	0	0	6	11	17	22	27	31	30
Annual Supply	346	334	374	413	520	625	687	853	1009	809	748	605	413	220	27	31	30
Start Bank - Equip Life 10 to 25 yrs	1674	1945	2190	2460	2750	3127	3582	4071	4693	5432	5942	6390	6696	6817	6752	6506	6274
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	25	29	33	37	41	47	54	61	70	81	89	96	100	102	101	98	94
Annual % of Bank Used for Service	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.8%	1.6%	1.4%	1.2%	1.1%	1.0%	1.0%	1.0%
Service Use	33	39	44	49	55	63	72	81	94	98	95	89	80	75	68	65	63
Annual % of Supply used for Training	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.8%	0.6%	0.4%	0.2%	0.1%	0.0%	0.0%	0.0%
Training Use	3	3	4	4	5	6	7	9	10	6	4	2	1	0	0	0	0
Total Emissive Use	62	71	80	90	101	116	132	151	174	186	189	188	182	177	169	163	157
Supply Available for New Equipment	283	263	294	323	419	509	554	702	835	623	560	418	231	42	-142	-131	-127
Added to Bank of Equip Life 10 to 25 yrs	283	263	294	323	419	509	554	702	835	623	560	418	231	42	-142	-131	-127
Total Start Bank + Change to Bank	1957	2208	2484	2783	3169	3636	4137	4773	5527	6055	6502	6807	6927	6860	6610	6374	6147
Potential Recycle for year	12	18	24	33	42	53	66	80	96	113	112	111	110	107	105	101	96
Estimated Recovery Rate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.0%	10.0%	15.0%	20.0%	25.0%	30.0%	30.0%	30.0%
Estimated Recycle	0	0	0	0	0	0	0	0	0	6	11	17	22	27	31	30	29
Estimated Recycle Loss	12	18	24	33	42	53	66	80	96	107	101	95	88	81	73	71	67
End of Year 10 to 25 Year Equipment Bank	1945	2190	2460	2750	3127	3582	4071	4693	5432	5942	6390	6696	6817	6752	6506	6274	6051
Total End of Year Equipment Bank + Recycle	1945	2190	2460	2750	3127	3582	4071	4693	5432	5948	6401	6713	6839	6779	6537	6304	6080
Total Annual Emissions	75	89	105	123	144	169	198	231	270	293	290	282	269	258	242	233	224
Cummulative Emissions	353	442	547	669	813	982	1180	1411	1681	1974	2264	2546	2815	3074	3316	3549	3773
Cummulative Production Allocation	2298	2632	3007	3419	3940	4564	5251	6104	7113	7922	8665	9259	9655	9853	9853	9853	9853

Halon 1211 - Japan

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	29	27	24	21	18	14	10	5	118	110	102	0	0	0	0	0	0
Annual Supply	29	27	24	21	18	14	10	5	118	110	102	0	0	0	0	0	0
Start Bank - Equip Life 10 to 25 yrs	6051	5840	5640	5452	5277	5115	4969	4837	4327	3970	3640	3652	3560	3471	3385	3300	3217
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	91	88	85	82	79	77	75	73	65	60	55	55	53	52	51	49	48
Annual % of Bank Used for Service	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Service Use	61	58	56	55	53	51	50	48	43	40	36	37	36	35	34	33	32
Annual % of Supply used for Training	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Training Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Emissive Use	151	146	141	136	132	128	124	121	108	99	91	91	89	87	85	82	80
Supply Available for New Equipment	-123	-119	-117	-115	-114	-114	-114	-116	10	11	11	-91	-89	-87	-85	-82	-80
Added to Bank of Equip Life 10 to 25 yrs	-123	-119	-117	-115	-114	-114	-114	-116	10	11	11	-91	-89	-87	-85	-82	-80
Total Start Bank + Change to Bank	5929	5720	5523	5337	5163	5002	4854	4721	4337	3981	3652	3560	3471	3385	3300	3217	3137
Potential Recycle for year	89	81	71	60	47	33	17	394	367	341	0	0	0	0	0	0	0
Estimated Recovery Rate	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
Estimated Recycle	27	24	21	18	14	10	5	118	110	102	0	0	0	0	0	0	0
Estimated Recycle Loss	62	57	50	42	33	23	12	276	257	238	0	0	0	0	0	0	0
End of Year 10 to 25 Year Equipment Bank	5840	5640	5452	5277	5115	4969	4837	4327	3970	3640	3652	3560	3471	3385	3300	3217	3137
Total End of Year Equipment Bank + Recycle	5866	5664	5473	5295	5130	4979	4842	4445	4080	3743	3652	3560	3471	3385	3300	3217	3137
Total Annual Emissions	214	203	191	178	165	151	136	397	365	338	91	91	89	87	85	82	80
Cummulative Emissions	3986	4189	4380	4558	4723	4874	5011	5408	5772	6110	6201	6292	6381	6468	6553	6635	6716
Cummulative Production Allocation	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853

Halon 1211 - Japan

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Allocation of CEFIC Production	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Allocation of CEFIC Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Allocation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Quantity	0	0	0	0	0	0	0	0	-25	-24	-23	0	0	0	0	0	0
Annual Supply	0	0	0	0	0	0	0	0	-25	-24	-23	0	0	0	0	0	0
Start Bank - Equip Life 10 to 25 yrs	3137	3059	2982	2908	2835	2764	2695	2628	2645	2635	2623	2534	2470	2409	2349	2290	2233
Annual % of Bank Used for Fires	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Fire Use	47	46	45	44	43	41	40	39	40	40	39	38	37	36	35	34	33
Annual % of Bank Used for Service	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Service Use	31	31	30	29	28	28	27	26	26	26	26	25	25	24	23	23	22
Annual % of Supply used for Training	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Training Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Emissive Use	78	76	75	73	71	69	67	66	66	66	66	63	62	60	59	57	56
Supply Available for New Equipment	-78	-76	-75	-73	-71	-69	-67	-66	-91	-90	-89	-63	-62	-60	-59	-57	-56
Added to Bank of Equip Life 10 to 25 yrs	-78	-76	-75	-73	-71	-69	-67	-66	-91	-90	-89	-63	-62	-60	-59	-57	-56
Total Start Bank + Change to Bank	3059	2982	2908	2835	2764	2695	2628	2562	2554	2545	2534	2470	2409	2349	2290	2233	2177
Potential Recycle for year	0	0	0	0	0	0	0	-83	-81	-78	0	0	0	0	0	0	0
Estimated Recovery Rate	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
Estimated Recycle	0	0	0	0	0	0	0	-25	-24	-23	0	0	0	0	0	0	0
Estimated Recycle Loss	0	0	0	0	0	0	0	-58	-56	-55	0	0	0	0	0	0	0
End of Year 10 to 25 Year Equipment Bank	3059	2982	2908	2835	2764	2695	2628	2645	2635	2623	2534	2470	2409	2349	2290	2233	2177
Total End of Year Equipment Bank + Recycle	3059	2982	2908	2835	2764	2695	2628	2620	2611	2599	2534	2470	2409	2349	2290	2233	2177
Total Annual Emissions	78	76	75	73	71	69	67	7	10	11	66	63	62	60	59	57	56
Cummulative Emissions	6794	6871	6945	7018	7089	7158	7225	7233	7242	7253	7319	7382	7444	7504	7563	7620	7676
Cummulative Production Allocation	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853	9853

3 Sector Updates

3.1 Aerosols, Sterilants, Miscellaneous Uses and Carbon Tetrachloride

In March 1998, there were 35 members of the Aerosols, Sterilants, Miscellaneous Uses and Carbon Tetrachloride Technical Options Committee (ATOC) from 18 countries – Australia, Brazil, China, Germany, India, Indonesia, Japan, Malaysia, Mexico, Pakistan, Poland, Russia, Singapore, Spain, Sweden, United Kingdom, USA, Venezuela – with 8 members from Article 5(1) Parties and the remainder from non-Article 5(1) Parties.

During 1997/98, the ATOC welcomed three new members and will be introducing a new member from China to replace a retiring member during 1998. These new members were selected through nominations made by the Parties.

In addition to responding to the requests of the Parties for reports in 1998 on issues surrounding the transition to non-CFC containing treatments for asthma and COPD, assessments of essential use nominations and a technical update for all sectors, the ATOC will be preparing an Assessment Report during 1998. A first draft is nearing completion to undergo review, with finalisation of the report scheduled for October 1998.

3.1.1 Aerosol products (other than MDIs)

For aerosol products, other than MDIs, there are no technical barriers to global transition to alternatives. The major issue remaining is the use of CFCs in Article 5(1) and CEIT Parties. Some significant reductions have been achieved in recent years, and further reductions can be expected in the near future. Conversions can be characterised as three types: [1] self conversions, [2] conversions assisted by the Multilateral Fund (MLF) of the Montreal Protocol, and [3] conversions assisted by the Global Environment Facility (GEF). Self conversions have occurred when good quality hydrocarbon propellant was available at reasonable cost. Where capital outlay is necessary assistance is generally required from the MLF or GEF. The former assists aerosol fillers in Article 5(1) Parties, while the latter may assist Parties that are not eligible for MLF financing.

The ATOC believes that 1997 CFC consumption in the aerosol sector was less than 15,000 tonnes in Article 5(1) Parties and some CEIT excluding MDI use. The ATOC estimate of regional break down of quantities for 1997 is as follows:

1997 CFC consumption in non-MDI aerosols

Country/Region	Tonnes
Russian Federation	7,800
China	2,400
Indonesia	700
Ukraine	800
Other CEIT and CIS*	200
ASEAN and South Asia**	1,500
Middle East, Africa	700
Latin America	600
Total	14,700

* CIS: Successor States of the former Soviet Union

** South Asia: India, Pakistan, Sri Lanka, Bangladesh, Nepal and Bhutan

Since the 1997 Report, significant reductions have occurred due to the diminishing use of CFCs in China, where only a few pharmaceutical and industrial/technical aerosols remain to be converted. A slight reduction in the use of CFCs in aerosols in the Russian Federation was due to reductions in three of the eight domestic chemicals enterprises. CFC usage in Ukraine has reduced as export of CFC based products is no longer allowed.

Poor economic conditions in South East Asia were responsible for a significant decrease in all aerosol production, including aerosols with CFCs. Additional reductions will occur upon completion of ongoing phaseout projects in several countries such as Jordan, India, Indonesia, Malaysia, Thailand, Tunisia, and Vietnam.

The remaining use of CFCs in most countries - especially Latin America and South East Asia Pacific (SEAP) - is concentrated in the industrial/technical aerosols (principally electronics contact cleaners) and in non-MDI pharmaceutical products. In China, remaining consumption is mostly in non-MDI pharmaceuticals. It is necessary to address the needs of these two sub-sectors to achieve total phase out in aerosols.

Hydrocarbons are the preferred substitutes for CFCs used in aerosols. The phaseout of the remaining CFCs in the aerosol sector is dependent upon the availability of hydrocarbon aerosol propellants (HAPs). Where HAPs supplies were available at reasonable cost, transition out of CFCs has already taken place. Lack of ready availability of HAPs or any good quality hydrocarbon propellant is the main factor impeding the elimination of CFCs in India and SEAP, and an important factor in the Russian Federation.

A HAPs plant may be a simple facility that consists of storage tanks for crude propane and butane, storage tanks for purified propane and butane, and several towers with molecular sieves; or it may be a much more complicated facility that uses the petrochemical process of hydrogenation to saturate undesired olefin molecules. The type of process required depends entirely upon the quality of feedstock available. Transport and safety equipment is also needed.

Construction of suitable HAPs plants under the MLF are contingent on a corresponding volume reduction in CFC production. Usually the HAPs supplier is neither a CFC manufacturer nor an aerosol producer. Furthermore, there is no link between aerosol product manufacturers and CFC producers. Neither the HAPs manufacturer nor the aerosol manufacturer is in a position to guarantee the reductions in CFC production that the MLF is requesting to fund HAPs projects. Consequently although there are no technical barriers to transition, it is difficult to predict when total phase out in the aerosol sector will occur.

The financial cost of retrofitting to handle flammable propellants is another factor constraining transition. This becomes especially important considering the proliferation of small and very small fillers that either continue to use CFCs, or that are using commercial LPG (fuel grade mixtures of butane and propane) in an unsafe manner. Haphazard conversions to hydrocarbons makes it obligatory for governments to develop suitable monitoring procedures to ensure safe practices including proper design, management and use of prescribed filling equipment, hydrocarbon storage and handling facilities. When considering the conversion of CFCs to hydrocarbons, the problems facing small aerosol fillers operating in congested areas in Article 5(1) Parties need to be resolved.

A test project is underway in India to evaluate hand-powered production filling equipment. Should this test prove positive, it will facilitate the conversion of very small aerosol industries, by providing an inexpensive and safe alternative that uses HAPs.

The specific problems of the industrial/technical aerosols and pharmaceutical products require technical assistance in reformulation. Contact cleaners can be reformulated by using different new products such as HFC-43-10mee, volatile silicones or hydrofluoro ethers. In the case of pharmaceutical products, many topical sprays can use HAPs or DME, while HFC-134a is a more costly alternative.

Whereas there is a declining trend in the use of CFCs in aerosols, the pace of reduction is currently slow and would accelerate if the specific problems of [1] HAPs availability, [2] industrial/technical aerosols and non-MDI pharmaceutical products, and [3] conversion of small and very small CFC users are resolved.

3.1.2 Metered dose inhalers

3.1.2.1 CFC-containing metered dose inhalers

CFC-containing metered dose inhalers (MDIs) are reliable and effective therapy for respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD). MDIs generally use CFC-12 as a propellant and most use CFC-11 and CFC-114 either alone or in a mixture to suspend or dissolve medication. HFC-134a and HFC-227ea have been approved as propellants in MDIs.

The prevalence of asthma and chronic obstructive pulmonary disease (COPD) is increasing world-wide. There are at least 300 million people with asthma world-wide and there may be comparable numbers with COPD. Evidence now confirms that asthma prevalence is increasing as urbanisation of developing countries continues. Currently, approximately 500 million MDIs are used annually world-wide, using approximately 10,000 tonnes of CFC.

There is international consensus that primary treatment of these diseases should be by the inhaled route. This permits treatment to be delivered quickly and efficiently to the airways, with minimal risk of adverse reactions. Therapy necessitates regular treatment, often with more than one drug. MDIs remain the dominant inhaled delivery system in most countries and for all categories of drugs.

Overall use of inhaled medication is increasing because of increased disease prevalence. World Health Organisation/US National Heart, Lung and Blood Institute (WHO/NHLBI-GINA) Guidelines in asthma management also encourage the inhaled route as the preferred method of administering medicine. The mainstay of therapy for asthma/COPD is likely to remain therapy administered by the inhaled route.

Alternative technologies, e.g. portable handheld nebulisers, and new oral therapies are also being evaluated.

3.1.2.2 Status of introduction of alternatives

As of March 1998, a number of pharmaceutical companies have introduced or plan to introduce a number of products as follows:

- Glaxo Wellcome has filed registration applications for both salbutamol HFC

MDI and fluticasone propionate HFC MDI (125/250 mcg) in over 20 countries worldwide. A number of product approvals have been received and products launched in Denmark, Germany, Switzerland, Norway, France (fluticasone propionate only) and Greece (salbutamol only). Further product launches are anticipated in the coming year.

- 3M Pharmaceuticals has approvals for and is currently marketing salbutamol HFC MDI in over 40 countries. In the USA, salbutamol HFC MDI has been licensed to Schering Plough. 3M's beclomethasone HFC MDI has been submitted for approval in several countries with the first introduction anticipated during the second half of 1998. Under a further licence agreement, Hoechst Marion Roussell and 3M Pharmaceuticals have entered into a strategic marketing alliance to co-promote some of 3M's HFC MDI products.

- Rhone-Poulenc Rorer has filed applications for triamcinolone HFC MDI in the USA and Canada. Filings for di-sodium cromoglycate HFC MDI have been made in 21 European countries and in Japan. Boehringer Ingelheim's first submissions for reformulated products are scheduled during 1998. Ivax (Norton Healthcare) launched its first HFC MDI, beclomethasone dipropionate in Ireland in January 1998. The same product range is also approved in France and further international approvals are pending. Norton also expects to receive its first regulatory approvals for salbutamol HFC MDI before the end of 1998.

In the ATOC 1997 Update Report, graphical representations were included for projected timetables for the launches of HFC MDI products in both the European Union and the USA. These were based on an industry survey of International Pharmaceutical Aerosol Consortium (IPAC) members. More recent company specific data are available that indicate that a number of companies are well advanced with their reformulation programmes. However, it would appear that the projected IPAC "best case" scenario is now not possible due to regulatory and technical delays.

However, the schedule for the safe introduction of new propellants and reformulated products suggested in the 1994 report and updated in the 1996 and 1997 reports of the ATOC remains on target. It is likely that a wide range of reformulated products will be available in many developed nations and transition will be making good progress by the year 2000. Minimal need for CFCs for MDIs is envisaged by the year 2005 in non-Article 5(1) Parties. Remaining technical, patent, safety and regulatory issues for some commonly used drugs still make it difficult to predict the schedule for full phase-out with precision.

3.1.2.3 CFC consumption and essential use nominations

Essential use nominations for 1999 and 2000 were submitted by several non-Article 5(1) Parties. Nominations varied in completeness and detail, but overall showed a decreasing trend in CFC requirements. The ATOC noted that the Russian Federation did not request an essential use nomination, although there is MDI production in the Russian Federation and a nomination was granted for 1998. The ATOC had noted in its 1997 report that it did not anticipate receiving any further applications for new products containing CFCs. Nevertheless, Canada submitted a nomination for a considerable volume of CFC for seven new MDI products; the ATOC was unable to recommend this application.

Nominations recommended in 1998 for the year 2000, amount to a total of 8,125 tonnes. Use of CFCs by Parties that requested essential use nominations for MDIs is reported to be 7,893 tonnes in 1996 in line with the global use estimate of 10,000 tonnes.

A Party requested that future nominations for essential use allowances not specify individual amounts of each CFC, but rather provide a total allocation. Given that the CFCs involved have similar ODP, Parties may wish to consider the advantages of this approach.

3.1.2.4 Transition strategies

The ATOC does not believe that a rigid global transition strategy is appropriate in view of the widely differing circumstances of individual Parties. However, the Parties could consider the benefits of a "Global Transition Framework" which would underpin national strategies and ensure that they are complementary.

Important principles could include:

- Specifying a target date of 2005 for completing the transition in non-Article 5(1) Parties.

- Encouraging all Parties, including Article 5(1) and CEIT Parties to develop their own national transition strategies.

- Ceasing of approvals of new CFC-containing products in non-Article 5(1) Parties now, and considering setting a timescale for the same objective in Article 5(1) Parties.

- Assuring importing countries of access to CFC MDIs and CFC-free products as the transition progresses.

- Considering how to stop imports of CFC MDIs once transition has been completed in a country.

- Limiting strategic reserves (stockpiles) to no more than 12 months of current use

- Encouraging a rapid introduction of CFC-free inhalers and technologies into Article 5(1) and CEIT Parties.

The ATOC recognises that no single national strategy will be applicable to all countries. There are pronounced differences among the Parties in national health care practices, regulatory requirements and reimbursement policies. The process of transition to non-CFC alternatives is complex, involving the need for dialogue between health authorities, environmental agencies and other interested groups.

In line with Decision IX/19, non-Article 5(1) Parties with essential use allowances are required to submit details of national transition strategies to the Ozone Secretariat by 31st January 1999.

Once transition has taken place in a Party, there is potential for unnecessary imports of CFC-containing products. Under the Montreal Protocol, there is currently no restriction on trade of manufactured MDIs among Parties. In a number of countries this could be controlled through existing regulations on the import of therapeutic goods and product license approvals, but in other countries there is no precedent for the withdrawal of drugs on any grounds other than safety.

The Parties may also wish to consider that once a Party completes its domestic transition, there is no need for an essential use allowance for domestic consumption but production may still be necessary for treatment options in importing countries. The ATOC requests that the TEAP clarify the application of Decision IV/25, i.e. can Parties which have completed domestic transition continue to export to Parties which have not.

In its 1997 report, the ATOC noted that CFC producers in Article 5(1) Parties may be a potential source of essential use CFC supply, if appropriate specifications and registration processes are met. Indeed, manufacturers are investigating whether CFC manufacturers in India, China and Mexico can produce pharmaceutical-grade CFCs for MDI use. Parties may wish to clarify that such sourcing is acceptable under the Protocol. Decision VII/9 may authorise Article 5(1) Parties to supply CFCs to meet the basic domestic needs only of other Parties also operating under Article 5(1).

Strategic CFC stockpiles of reasonable size are prudent to safeguard public health needs. Stockpile size will vary according to country and company specific situations. However, excessive stockpiles could be utilised to prolong CFC MDI manufacture against the spirit of the Montreal Protocol, and act as an impediment to the transition to CFC-free alternatives.

Strategic CFC stockpiles can safeguard manufacturing supplies against unforeseen production contingencies and other uncertainties. Pharmaceutical manufacturers advocate the maintenance of reserves of CFCs to protect against supply disruptions. Maintenance of a strategic stockpile for a period of supply of e.g. up to 12 months is not unreasonable.

3.1.2.5 Patient subgroups and Article 5(1) Parties considerations

The ATOC has considered the implications of the transition for patient subgroups which may have compelling medical needs.

Some patients may have a personal preference for CFC MDIs. This matter is likely to be overcome by educational endeavours and should not be the basis for a continuing essential use nomination. Many patients can convert to Dry Powder Inhalers (DPIs). DPIs are continuing to be introduced by a number of companies into many countries. There is good evidence that the previously noted trend of increased DPI usage continues but since overall inhaled therapy has increased further, they have not reduced the sales of MDIs. Penetration of DPIs into a market depends on health professional and patient acceptance and on cost. There still remains several DPIs which are not available in some countries e.g. Japan. However three new multi-dose powder inhalers have recently been introduced in the USA. It is expected that the availability of DPIs will have a significant impact on US CFC requirements in future years. DPIs are now available for most inhaled drugs in many countries.

A second subgroup which may have a compelling need for CFC products well into the phase out is low income patients (whether in Article 5(1) or non-Article 5(1) Parties) who rely on less expensive generic or locally branded products for control of their diseases. This issue has less to do with HFC MDIs versus CFC MDIs than it does with branded versus generic product price differentials, since it does not appear that HFC MDIs will be more expensive than their branded CFC counterparts.

In Article 5(1) Parties, the first control measure on the total consumption of CFCs commences in the year beginning 1 July 1999. Controls on CFCs make no allowance to permit exemptions for essential uses prior to the phase-out date of 2010. This will mean that MDI manufacturers in Article 5(1) Parties will be competing for CFC supply in their local markets with other users of CFCs.

Communication with experts in a number of countries including India, Pakistan, China, and Brazil has revealed some similarities, but there are some country specific issues. In all of these countries, the limited available information suggests that the airway diseases of asthma and chronic obstructive pulmonary disease (COPD) are common and increasing in prevalence. Local manufacture by multinational firms and/or local firms is reported in these countries, with local products sometimes cheaper than those manufactured by multinational firms. In China sixteen million CFC MDIs were produced in 1996 and consumption of CFCs for use in MDIs totaled 400 tonnes. In India, 6 million MDI units are sold annually with an additional 3 million being exported by one Indian company to other Article 5(1) Parties. In each of these countries, there is reported to be poor awareness of CFC and transition issues in general, as well as a lack of health professional awareness. Also, since it is anticipated that in most Article 5(1) Parties and some CEIT there will be an increasing number of patients newly receiving MDI therapies, it would be preferable for them to start on CFC-free products.

Continued provision of MDIs in Article 5(1) and CEIT Parties will depend either upon import of products, or local production. The local production of CFC MDIs is likely to continue for some time after cessation of their use in non-Article 5(1) Parties and will overlap with the importation and local production of CFC-free MDIs by multinational and national companies. Local production of CFC-free MDIs by a local producer, a multinational company, or by a local producer in collaboration with a multinational company will require the transfer of new technologies and may require new licensing arrangements and transfer of intellectual property. The costs of such local production of CFC-free inhalers will involve capital costs and licensing arrangements. Multinational companies operating in Article 5(1) Parties should be encouraged by to make the technology transfer as soon as possible. One company is already committing resources to install manufacturing capacity in Latin America (Brazil) and Eastern Europe (Poland) to manufacture HFC MDIs. These plants will be operational in the next couple of years and serve local and regional market needs

In relation to Article 5(1) Parties, the ATOC suggests that Parties may wish to consider:

- The importance of maintaining adequate supplies of the necessary range of inhaled medications during transition in non-Article 5(1) Parties.
- Encouraging the introduction of CFC-free technologies into these countries.
- Encouraging these Parties to start work on preparing their national transition strategies.

3.1.2.6 Education and training

To facilitate patient and physician utilisation of the reformulated products, global education and training are required. Options currently employed and planned include:

- *Professional associations* – through medical journals, medical symposia, reports and newsletters. The ATOC welcomes national initiatives such as the professional/pharmaceutical collaboration embodied in the National Asthma Education and Prevention Program in the USA, symposia and newsletters arranged by the British Thoracic Society, workshops arranged by the European Respiratory Society, the American Thoracic Society, the American Academy of Asthma Allergy and Immunology and other initiatives in France, Australia and Brazil amongst many others.

- *Treatment guidelines* issued by the country's medical authority which document the advantages and drawbacks of different forms of therapy and recommend specific forms of care for specific patient groups. All Parties with guidelines continually review and revise their nations guidelines and many now include reference to the CFC MDI issue. During 1995 the US National Heart Lung and Blood Institute (NHLBI) and WHO introduced a Global Initiative on Asthma (GINA). GINA symposia have been held in many Article 5(1)and non-Article 5(1) Parties and GINA guidelines translated into over 25 languages. The latest draft revision (1998) includes a section on CFC transition.

- *Promotional material and media coverage* – Advertising and promotional material placed in medical journals and circulated to physicians by pharmaceutical companies. Also articles in popular media promote awareness in the public of new products.

- *Pharmaceutical industry* – Education of the medical profession, support of medical symposia, reprint of pertinent articles and reports and information sheets to patients are strategies to help to inform both professionals and the public of developments and alternatives. The International Pharmaceutical Aerosol Consortium (IPAC) developed a brochure for health professionals entitled "Moving Towards CFC-free Metered Dose Inhalers" and a patient brochure entitled "Your Metered-Dose Inhaler Will Be Changing…Here Are The Facts". IPAC has also established a site on the World Wide Web - http://www.ipacmdi.com

- *Medical literature* – Articles appearing in the medical journals inform professionals of developments, and several have been published since 1994, many written by members of the ATOC, with further major editorials due to be published in 1998.

- *Support groups* which provide information, seminars and programmes aimed at both the general community and through schools, sporting groups etc., e.g. National Asthma Campaign (Australia), Asthma Society of Canada. The United Kingdom National Asthma Campaign has produced a fact sheet to help prepare patients for changeover of their inhalers and is launching a special CFC telephone helpline with the support of IPAC and the UK Department of Health.

The amount of educational activity being undertaken varies from country to country and should involve increasing awareness of DPIs as well as the reformulated MDI products. As more alternatives become available it is essential that a more active patient strategy is developed. This will involve concerted effort by the industry, and by health professional associations and national health authorities working together with patient support associations (e.g. National Asthma Campaigns and Asthma Foundations). For Parties without patient support associations it is possible that the NHLBI/WHO Global Initiative (GINA) may be able to have available suitable literature for copying in the same way as they do with their current patient booklet, or add transition information to the GINA page on the Internet (http://www.ginasthma.com).

Professional bodies and patient associations are most likely to address this issue if governments take a lead in highlighting the importance of the subject. These educational activities are likely to require funding. Responsibility for and sources of adequate funding need to be identified if a successful transition is to occur.

Increasing numbers of medical symposia are scheduled for 1998/9, including the World Asthma Meeting in December 1998. This is supported by the major world respiratory organisations (European Respiratory Society, European Society for Asthma, Allergy and Immunology, American Thoracic Society, Asia-Pacific Society of Respirology, American Academy for Asthma, Allergy and Immunology, International Union Against Tuberculosis and Infectious Disease and GINA). This meeting will highlight issues surrounding the safe transition to non-CFC treatments. UNEP is a co-sponsor of the World Asthma Meeting.

3.1.3 Sterilants

By the beginning of 1997, CFC-12 use in non-Article 5(1) Parties for 12/88, a sterilant gas based on ethylene oxide (EO), had virtually disappeared, as final inventories were depleted. There remain no technical barriers to the phaseout of CFCs in sterilisation, but in some Article 5(1) Parties there are indications of increased use of CFC-12 as a sterilant gas diluent. Some manufacturers of surgical equipment may even be shipping products from non-Article 5(1) Parties to be sterilised in Article 5(1) Parties.

In non-Article 5(1) Parties low temperature medical device sterilisation is being met by HCFC-diluent replacement sterilant gas, and 10/90 CO_2/EO, both of which are non-flammable. Pure EO can also be used, but since it is a flammable/explosive gas precautionary measures are necessary to use it safely. In some European countries formaldehyde is also used. There are a variety of not-in-kind substitutes, but some of these substitutes may either have materials compatibility problems or may be less robust processes with serious quality implications. Not-in-kind substitutes include radiation (gamma and electron beam), plasma systems and liquid chemical systems. In other instances medical devices compatible with the steam process have been developed.

Global consumption of CFC-12 in this sector is very difficult to estimate since it is basically located in Article 5(1) Parties, it is estimated to be less than 1,000 tonnes. Estimated use of substitute HCFC replacement is thought to be less than 5,000 tonnes (some 150 ODP tonnes). CEIT and Article 5(1) Parties could convert to EO/HCFC-124 sterilant gas rapidly with minimal cost and no changes in operating procedures.

HCFCs remain important as transitional products for sterilisation technology. Quality health care is dependent upon sterility assurance of medical devices. A new non-HCFC/EO sterilant blend has been tried, but has not been successful due to low sterilisation efficacy, high pressure limitations, and high cost. This alternative was developed in reaction to the EU ban on HCFC emissive uses.

3.1.4 Carbon tetrachloride

CTC is an easily manufactured chemical which is widely available. As a controlled substance, CTC production and use has been extensively reviewed.

CTC can be used:

- As a feedstock for the production of other chemicals. The 1997 Report of the Process Agents Task Force (PATF), offered the following definition of feedstock:

  "A controlled substance that undergoes transformation in a process in which it is converted from its original composition except for insignificant trace emissions as allowed by Decision IV/12."

- Used as a process agent. The 1997 Report of the PATF offered the following definition of process agent:

  "A controlled substance that because of its unique chemical and/or physical properties, facilitates an intended chemical reaction and/or inhibits an unintended chemical reaction."

  Note 1: *Refrigeration, solvent cleaning, sterilisation, aerosol propel-*

lants and fire-fighting are not process agents according to this definition.

***Note 2:** Parties need not consider use of ODS for foam blowing, tobacco puffing, caffeine extraction, or fumigation because these uses are already covered in other Decisions and/or by Technical Options Committee Reports."*

- As a solvent. This includes simple solvent extraction such as caffeine extraction and palm oil extraction, and cleaning applications such as metal degreasing and textile spotting. Substitutes are commercially available and economically usable and, thus, these uses should be discontinued to protect the ozone layer as well as to safeguard the health and safety of people now using CTC .

- In miscellaneous applications such as fire extinguishers, as grain insecticide fumigant, and in an antihelminthic agent (especially for the treatment of liver fluke in sheep). These uses also should be discontinued for the same reasons stated above.

- As a laboratory chemical.

Recent atmospheric measurements (Simmonds et al., *Journal of Environmental Research*, 1998) have described levels of CTC at five remote surface locations from 1978 to 1996. They have concluded the following:

- Assuming an atmospheric lifetime of 42 +/-12 years, annual atmospheric emissions of CTC have been estimated at 94 (-11,+22) thousand tonnes for 1979 to 1988 and at 49 (-13,+26) thousand tonnes from 1991 to 1995.

- The reductions in emissions in 1989/1990 coincided with the substantial decrease in global production of CFCs.

Data on both CTC production and consumption have, in the past, been difficult to obtain. The new UNEP data reporting formats will enable the collection of much clearer data and a more detailed analysis of CTC applications. Indeed, total CTC production data including production for feedstock use is well known for 1996 and was reported to UNEP as 230,820 tonnes.

Using similar methodology to that reported by Simmonds, atmospheric emissions of CTC in 1996 were estimated by the ATOC as 41,000 tonnes (-25%, +50%). In this calculation emissions from feedstock use for Article 5(1) and CEIT Parties were estimated to be between 15 and 17 % of the CTC consumed as feedstock.

- CTC remains a widely available and used chemical. The primary source of atmospheric emissions of CTC are those from the use as a feedstock to produce CFCs. This has been estimated to be between 28,500 and 32,000 tonnes in 1996 or 69 to 80% of total CTC atmospheric emissions. The majority of the emissions from feedstock use originate from CFC production in Article 5(1) and CEIT Parties (26,500 to 30,000 tonnes, or 64 to 74% of estimated total global CTC emissions from all sources). The remaining emissions (8,700 to 13,000 tonnes) result from process agent, other uses and inadvertent emissions. See Table 1.1 for breakout of percentage contributions to CTC atmospheric emissions.

Contribution to CTC atmospheric emissions

Emission Source	%	tonnes
Feedstock - Non-Article 5(1)	<5	<2000
Feedstock - Article 5(1)	55 - 65	22,890 - 26,000
Feedstock - CEIT	9 - 10	3,600 - 4,000
Non-Feedstock - Non-Article 5(1)	3 - 5	1,200 - 2,000
Non-Feedstock - CEIT and Article 5(1)	19 - 25	7,500 - 10,400

- CTC consumption for process agents and other uses in non-Article 5(1) Parties is low and has primarily involved the use of existing stocks rather than new production. It is unlikely to exceed 500 tonnes. This figure is estimated to further decline to less than 100 tonnes by the year 2000. The estimate of emissions from laboratory and analytical uses and process agents in previous reports remain valid.

- The global use of CTC as process agents and uses other than feedstock is estimated by the ATOC to be between 8,700 and 13,000 tonnes.

The ATOC notes that whilst CTC atmospheric levels have reduced as a result of the phase-out of CFC consumption in the majority of non-Article 5(1) Parties, they are unlikely to fall significantly until the first reduction in Article 5(1) Parties on 1 January 2005.

There are a number of measures which could lead to reductions in CTC emissions to the environment:

- Closure of CFC manufacturing facilities in Article 5(1) and CEIT Parties with accelerated introduction of alternatives.

- Conversion of facilities using CTC as process agents in Article 5(1) Parties to alternatives.

- Use of improved emission control technology in CTC and CFC manufacturing facilities in Article 5(1) and CEIT Parties.

- Use of improved containment and emission control technology in Article 5(1) and CEIT manufacturing facilities using CTC as process agents.

The ATOC wishes to point out that projects to phase out solvent uses of CTC are eligible for financing under the Multilateral Fund. The ATOC further believes that in some cases eligible solvent uses have been presented to the Multilateral Fund incorrectly as process agent uses and, as a result, have not been funded.

3.2 Economic Options Committee

3.2.1. Membership and Participation

There were 14 members of the Economic Options Committee (EOC) as of March 1998. Article 5(1) participation has been strengthened by new members from China (Co-Chair), India, Tanzania and Colombia. The overall capability of the Committee has been further strengthened by three new members from Non-Article 5(1) Parties. Participation at the Denver meeting of the EOC was 10 out of 14. Relaxation of funding constraints would enhance both participation and productivity.

3.2.2. 1998 EOC Work Programme

The draft documents prepared by the key authors will be discussed and revised during the EOC meeting in June 1998. Following revision of the draft chapters to accord with the conclusions of the EOC discussion, the draft 1998 Report will be circulated to a review group. The deadline for the comments of the reviewers is 15 August 1998.

The third meeting of the EOC is scheduled for Beijing in September. The final text will be completed by early October 1998.

3.2.3. Key Themes for the 1998 EOC Report

Data reporting and data management for ODS consumption and production reported by the Article 5(1) Parties are important for economic analyses that underpin the assessments of the costs and benefits of meeting the Montreal Protocol and therefore will be addressed by the EOC.

The EOC will report on recent publications and on government sponsored research initiatives.

Trade issues are important concerns for the EOC. The EOC will update information on trade in ODS, trade in products containing ODS (e.g., trade in used ODS-containing equipment) and trade in products made with but not containing ODS. The economic implications of "illegal trade" will be covered as well as recent developments in the World Trade Organisation (WTO) on trade issues of concern to the Montreal Protocol.

The EOC will address economic aspects of lessons learned from the Montreal Protocol process that may have relevance for other environmental Conventions.

The EOC will also prepare a review of published literature on economic aspects of the Montreal Protocol process.

3.3 Rigid and Flexible Foam

3.3.1 Executive Summary

3.3.1.1 Key Conclusions

- All CFC use in Non-Article 5(1) Parties (except for some CEIT) has been eliminated

- Zero ODP alternatives are the substitutes of choice in many applications including packaging, cushioning (flexible) and certain rigid thermal applications.

- No single solution has emerged from transition. Choices must be retained to allow optimal solutions for given applications, producer-specific and country-specific circumstances.

- In several markets and for certain applications HCFCs are necessary for rigid thermal insulating foams until other long term zero-ODP solutions are proven.

- Given the availability of zero-ODP substitutes for other foam applications, it is unlikely that there will be expanding use of HCFCs in developing or developed countries beyond thermal insulation applications.

- No technical transition barriers unique to Article 5(1) Parties have been identified

- Article 5(1) transition may be delayed due to price and availability of alternatives and safety issues relating, especially, to SMEs.

3.3.1.2 Status of CFC and HCFC Use

CFC use in non-Article 5(1) Parties was eliminated in 1996 except for some use in CEIT countries. For Article 5(1) Parties CFC phaseout is technically feasible around the year 2001 provided that Multilateral Fund projects are implemented without delay and zero-ODP alternatives are commercially available.

In several markets and for certain applications HCFCs are necessary for rigid thermal insulating foams until other long term zero-ODP solutions are proven. Given the availability of zero-ODP substitutes for other foam applications, it is unlikely that there will be expanding use of HCFCs in developing or developed countries beyond the insulation and integral skin applications.

3.3.1.3 Status of Zero-ODP Substitutes

Zero-ODP alternatives are currently the substitutes of choice in many foam types and applications. The major zero-ODP applications are:

- polystyrene sheet, polyolefin and polyurethane for packaging with CO_2 (water or injected), hydrocarbons or HFC-152a;
- flexible polyurethane slabstock for cushioning with methylene chloride, water, or liquid CO_2; and flexible moulded polyurethane with CO_2 (water).
- polyurethane, polyisocyanurate and polystyrene rigid insulation foams where energy efficiency and fire safety requirements can be met with hydrocarbons, HFC-134a or CO_2 (water or injected); and
- polyurethane integral skin where skin quality requirements can be met with CO_2 (water), HFC-134a or hydrocarbons.

3.3.1.4 HCFC Replacements

The development of potential next generation HFC replacements for HCFC-141b continues for thermal insulating polyurethane, polyisocyanurate and phenolic foams. Although not yet commercialized, technical evaluations of at least on of these substitutes, HFC-245fa, show that they have an equivalent thermal insulation value of currently used HCFCs. Toxicological testing has been completed for the leading next generation HFC candidate (HFC-245fa) and commercialization is expected to begin around 2001. For polystyrene and polyolefin insulating foam, the most likely long term candidates are CO_2 and HFC-134a.

Dimensional stability issues reported in 1997 for polyurethane and polyisocyanurate boardstock foams have been resolved. For polyurethane refrigerator and freezer hydrocarbon blown foams, improvements have been achieved in density and mechanical properties and insulation performance over a wide temperature range of product use. For construction foam applications it is not yet possible to meet fire safety requirements in all markets with hydrocarbon blowing agents, although a number of products are now commercially available in two markets.

3.3.1.5 Article 5(1) Parties

Although no major technical barriers have been identified for the phaseout of CFCs used in Article 5(1) Parties for foam products, three issues have been identified which may constrain or otherwise hamper the successful replacement of CFCs: price and availability of substitutes including delay in transfer of new technologies; problems faced by small and medium enterprises, and long term safe use of any relatively more hazardous substitute. Consistent use of safe practices by manufacturers during storage, production and transportation of products—especially foam sheet—manufactured with flammable blowing agents continues to be of some concern.

CFC-11 continues to be widely available and is generally much cheaper to use than the currently available alternatives. Another factor constraining a more rapid phaseout is that very few alternatives are manufactured in Article 5(1) Parties. Given the advantage of using existing equipment with next generation HFCs, once the uncertainties in price and availability are clarified these substitutes may serve as a cost-effective replacement in Article 5(1) Parties in some applications.

3.3.2 Membership

The Foam TOC has twenty-two members with 44% participation from Article 5(1) Parties. Membership by developed country participants has declined since the 1994 Assessment reflecting successful ODS replacement in non-Article 5(1) Parties. Two meetings were held in 1997 and two meetings will be held in 1998. In March 1998 in New Delhi, the FTOC and UNEP IE participated in a technical workshop on ODS substitutes sponsored by the Polyurethane Association of India. Over sixty participants from across India attended.

3.3.3 1998 Technology Update

3.3.3.1 Rigid Polyurethane Foams

The use of CFCs in the manufacture of polyurethane rigid foams were replaced in almost all non-Article 5(1) Parties by the end of 1995. Only some CEIT Parties failed to meet this deadline. There are currently many phaseout projects in progress in these countries using funds from the Global Environmental Facility (GEF). In Article 5(1) Countries CFC replacement is well underway and many projects supported by the Multilateral Fund have been completed.

In terms of technology the main choices have been either HCFC-141b or hydrocarbons (cyclopentane or pentane isomers). There are several issues and considerations which are common across the applications and geographic regions:

HCFCs

HCFC-141b has been used in more than 80% of the cases where an HCFC route has been chosen. These cases cover virtually every application, the main ones being domestic refrigerators and freezers in North America, Japan and several Article 5(1) Parties and building/construction in all regions. HCFC-141b is chosen because it offers a thermal conductivity/insulation performance almost equivalent to that given by CFC-11 and does not require significant changes to existing processing equipment. In several markets and for certain applications HCFCs are necessary for rigid thermal insulating foams until other long term zero-ODP solutions are proven. Dimensional stability issues reported in 1997 have been resolved through extensive laboratory analysis using predictive testing and formulation changes. Density and dimensional stability issues have been addressed, in some instances, by co-blowing with HCFC-22. Other than HCFC-141b there has been relatively minor use of the HCFC-142b/HCFC-22 blend and HCFC-22 (particularly in sandwich panels).

Hydrocarbons

The main uses are cyclopentane in household refrigerators and freezers in Europe and in both GEF and MLF projects. There is extensive use of iso and n-pentane in building/construction applications in Europe and emerging use in other regions. Considerable progress has been made in optimising refrigerator and freezer formulations to reduce density and increase insulation performance over a wide temperature range of product use. Dimensional stability problems in boardstock formulations have been resolved in a similar manner as for HCFC formulations.

Non-HC Zero ODP Options

Despite relatively poor insulating properties, there has been some renewed interest in HFC-134a for sandwich panels, refrigerators and freezers because it is non-flammable, overcomes some of the quality issues seen with current blowing agents including dimensional stability improvement and aesthetic improvement (smoothness) on the outer surface of refrigerators, and is currently available. The properties of 100% CO_2 formulations have not made any significant advances.

There is a very high level of interest and expectation for next generation HFCs which are now under development. These are expected to have comparable energy efficiency properties to HCFC-141b. They are also potential near "drop-in" replacements for existing equipment which uses HCFC-141b when it is phased out in non-Article 5(1) Parties beginning in 2003. For long term these next generation HFCs are viewed as the only potential viable alternatives to hydrocarbons. In the last three years greater quantities of HFC-245fa have been available for foam evaluations. The balance of energy savings and direct climate impacts of use of HFCs in insulating foam are also being evaluated.

The leading candidate is HFC-245fa which has been proven to be a technically feasible replacement for HCFC-141b in all major rigid polyurethane and polyisocyanurate insulating foam applications. It may also be useful in certain integral skin applications where HFC-134a or CO_2 does not provide the necessary skin quality. Toxicology testing has been completed and regulatory reviews are anticipated to be completed over the next several months. Some level of commercial production is expected as early as 2000 with full commercialization following in a time frame to meet market demands. Another candidate is HFC-365mfc. Commitment to commercialize HFC-365mfc is unconfirmed.

3.3.3.2 Polyurethane Integral Skin Foam

For automotive applications there has been further progress in proving the technical suitability of all water/CO_2 formulations. For example, European and Japanese OEM specifications can be met in many cases. However, these formulations are used in conjunction with IMC (in mould coatings) which are required in some instances to give the required surface appearance and properties.

In other non-Article 5(1) Parties water/CO_2 is used but there is comparatively greater use of other zero-ODP options including HFC-134a and n-pentane; HFC-245fa is also under investigation for those applications where skin quality requirements cannot be met with water/CO_2 or HFC-134a or where hydrocarbons cannot be used due to flammability, VOC restrictions, or other safety concerns. Most Article 5(1) manufacturers are in the process of converting foam CFC-11 to HCFC-141b or water/CO_2 formulations.

For footwear applications, the general trend towards water/CO_2 for both polyether and polyester formulations continues. In other cases there is use of HCFC-141b and HFC-134a. The transition from CFC-11 is not complete in CEIT and Article 5(1) Parties.

3.3.3.3 Flexible Polyurethane Foam

ODS alternatives have been identified for all flexible foam applications and phaseout in non-Article 5(1) Parties is complete except for some CEIT Parties. A number of Article 5(1) facilities have completed replacement projects and numerous others are underway.

ODS phaseout technologies for flexible foams are frequently specific to the three sub-categories: slabstock, box and moulded.

In slabstock foam, the use of methylene chloride (MC) and liquid carbon dioxide

(LCD) prevails, with minor use of additives, acetone, forced cooling and variable pressure technology. LCD is replacing not only CFC-11 but also methylene chloride in instances where this substance is under regulatory pressure.

In box foam the use of methylene chloride prevails with additives applied where methylene chloride use is restricted. Some minor application of forced cooling remains. LCD technology, whilst it is theoretically capable to be applied in boxfoam operations is not yet offered for this production process.

For hot cure moulded foams, established replacement technologies include methylene chloride systems, water blown systems (with the use of an additive) or conversion to water blown cold cure foams.

For cold cure moulded foams, established technologies include all water blown systems and auxiliary carbon dioxide. The technology based on the injection of carbon dioxide (liquefied or gaseous) during or prior to the mixing of the chemicals is the most interesting replacement option that recently emerged. The advantages are significant operating economy, environmental benefits (no ODP, GWP or health hazards) and lower foam densities, while maintaining quality. The disadvantages are relatively high initial investment and more complicated process/process control.

The application of LCD in flexible moulded foams has not seen a similar rapid development as in slabstock. This may be related to the fact that the current major CFC replacement technology—the use of water based formulations—does not face any regulatory restrictions and requires significantly lower investment. However, the largest use of moulded foams is in automotive seats, an application that requires intensive product scrutiny before product changes are allowed.

3.3.3.4 Extruded Polystyrene (XPS) Sheet

There has been no change in the alternatives available for this application. There is no technical nor economic justification for the use of CFCs or HCFCs in non-Article 5(1) and Article 5(1) Parties for XPS sheet foam. CFCs and HCFCs are banned in all non-Article 5(1) Parties in this highly emissive non-insulating application. Hydrocarbons and CO_2 are the most widely used alternatives. In Article 5(1) Parties, alternative blowing agent technologies using either CO_2 or hydrocarbons are available and transferable.

3.3.3.5 Extruded Polystyrene (XPS) Board

HCFCs remain as the primary transitional blowing agents for XPS insulation boards in most parts of the world because of their contribution to the overall insulation performance of the product. Nonetheless, transition to zero-ODP alternatives has begun in some countries. One new development product (HFC-

134, an isomer of 134a) has been announced since the 1997 update. It is not known whether the compound will become commercially available at some future date.

Technically proven, commercially available zero-ODP options are:

a) CO_2 either alone or with non-halogenated organic co-blowing agent; and

b) HFC-134a and -152a — where HFC 134a is the preferred option because it offers improved thermal resistance and is non-flammable.

Geographically, transition to zero-ODP alternatives is not uniform. In Europe, the CO_2 - blown foam is, in spite of the current disadvantages of higher density and lower insulation performance, gradually increasing its market acceptance in the classical XPS applications where the performance properties such as moisture resistance and compressive strength are as significant as thermal insulation value.

There are XPS applications which have dimensional constraints which require the maintenance of high performance insulation. In such areas, unless there is a further breakthrough in CO_2 technology, HFC-134a remains the most likely zero-ODP alternative.

3.3.3.6 Polyolefin Foam

HCFCs have been completely phased out from use in polyolefin foams in non-Article 5(1) Parties with the exception of annular shape (tubing) for thermal insulation piping Most Article 5(1) Parties are expected to be switching directly from CFCs to zero ODP alternatives.

No new zero-ODP substitute technologies or products have been identified. The alternatives remain:

- Hydrocarbons (primarily isobutane, n-butane mixtures); and
- HFC-152a or HFC-134a usually a mixtures with hydrocarbons or CO_2.

3.3.3.7 Phenolic Foam

With only a few exceptions, the use of HCFC-141b has dominated the phenolic foam sector following the phase-out of CFC use in non-Article 5(1) Parties. In Europe, the use of continuously laminated phenolic foam products is growing strongly and is supported by steadily increasing sales of discontinuous block foam. In contrast, the use of phenolic foams in North America continues to decline, primarily because of technology difficulties and a market which does not fully differentiate the superior fire properties. Pentane is being used in one South

Asia Article 5(1) Party.

3.3.4 Article 5(1) Party Update

Although replacement of CFCs in Article 5(1) Parties is proceeding and no major technical barriers have been identified for the phaseout of CFCs used in Article 5(1) Parties for foam products, the issues outlined below may delay or otherwise hamper the successful replacement of CFCs.

3.3.4.1 Price and Availability of Substitutes including Transfer of New Technologies

CFC-11 and -12 continues to be widely available and is generally much cheaper to use than the currently available alternatives. In addition, not all substitutes are manufactured in Article 5(1) Parties which consequently leads to both higher prices and reduced availability. Given the advantage of using existing equipment with next generation HFCs, once the uncertainties in price and availability are clarified these substitutes may serve as a cost-effective replacement in Article 5(1) Parties.

Although there is considerable long term economic benefit, significant initial capital outlays necessary for conversion for some substitutes may be a barrier for immediate ODS replacement. Logistical barriers to the introduction of substitutes also continue to be an issue in a number of countries.

New foam technologies tend to be transferred to Article 5(1) at a rate of 1-3 years behind transfer across developed countries. Transfer delays can result from: need to protect proprietary knowledge within individual countries; priority given to technology sharing within a company; achieving economies of scale; adaptations necessary for different climates especially for hot and humid regions; and time needed to build up sufficient local technical expertise.

With an abundant array of commercially developed ODS free technologies available there is no technical barrier for the manufacturer of flexible polyurethane foam to make the transition to a zero ODP product. Some non-technical barriers may slow the transition including (i) existing or emerging regulatory restrictions, mainly related to the emission of organic compounds and (ii) the capital costs to make the transition.

The main issue for integral skin foam specific to Article 5(1) Parties is that the newly developed water/CO_2 formulations for automotive applications are not yet available in all regions.

For extruded polystyrene sheet there is considerable long term economic benefit transitioning to zero ODP alternatives. However, the significant initial capital outlay necessary for conversion may be a barrier for immediate ODS replacement.

Generally, butane is the technically preferred alternative in extruded polystyrene sheet foam but availability in some Article 5(1) Parties is limited. One hundred percent CO_2 is technically available for extruded polystyrene sheet foam but investment for this proprietary technology may be prohibitive for Article 5(1) Parties.

Although indigenous hydrocarbon and HCFC-based technologies have been identified for at least the last 2 years, most of those phenolic foam manufacturers historically-using CFCs have not yet made the change. It is difficult to judge whether the main reason arises from short-comings in the locally developed technologies, HCFC availability or lack of funding. However, it is clear that further attention is required to facilitate phase-out of CFCs in Article 5(1) Parties.

3.3.4.2 Small and Medium Enterprises

SME foam manufacturers generally have few resources for testing and implementing ODS replacements and, thus, want to implement replacements with minimal problems. Although the Protocol provides many facilities like Technical Options reports, technology sources reports, experts to prepare projects many SMEs are hesitant to use technically feasible replacements. Some umbrella projects in some countries are being considered or implemented to help SMEs. More progress may be made if:

- Technically feasible substitutes are made more visible by canvassing or demonstration facilities;
- Safety practices are enhanced through training and awareness workshops; and
- Indigenous production of substitutes (when market is available) is supported or substitutes are made more readily available.

3.3.4.3 Safety Concerns

Many Article 5(1) Parties are transitioning from CFCs to materials that are relatively more hazardous for various foam applications. Consistent use of safe practices for flammable or toxic materials during storage, production and transportation continues to be of some concern. Recent fires in the extruded polystyrene and polyolefin sectors have especially heightened fire safety concerns for Article 5(1) Parties. Strict safety practices have to be applied.

Generally, the manufacturers of the blowing agents or foam equipment can provide the necessary information to safely handle flammable or toxic materials and will provide some level of technical assistance in assuring that these materials are properly and safely handled.

3.4 Halons

3.4.1 Membership and Participation

Two members of the 34 members and consulting experts of the Halons Technical Options Committee (HTOC) were replaced last year. Regional balance was maintained and Article 5(1) members have been active participants.

3.4.2 Work completed

In the past year the HTOC has held two meetings and has concentrated on the following issues:

- Conducting necessary research and preparing the response to Decisions VIII/17 and IX/21
- Reviewing the essential use nomination from the Russian Federation
- Developing the 1998 Assessment report

The Response to Decisions VIII/17 and IX/21 is submitted with this TEAP report. The work was based both on the information received from some Parties (according to Decision VIII/17) and on a completely updated mathematical model of the Halon Bank. The basis of the model and results from the model analysis are also included in this report.

The essential use nomination for Halon 2402 for 1999 from the Russian Federation is supported by the HTOC. The committee recommends, however, that Parties require the Russian Federation to accompany any future essential use nomination with a full accounting report on quantities produced and utilised under the past production exemptions.

In addition, the HTOC is on schedule in preparing the 1998 Assessment Report. It will include an assessment of the progress made to date, outline outstanding issues and provide technical options that could be considered by parties to assist in achieving further progress.

3.4.3 Progress in 1997/98

Significant measures have been put in place to reduce actual and potential emissions of halons to the atmosphere in Article 5(1) Parties. As a result of diminished demand, halon 1211 production in India ceased in the first half of 1998. The strong commitment of H.S. Kaprwan, the HTOC-member from India, contributed significantly to this achievement. Other members of the HTOC from

Article 5(1) countries also report progress in reducing halon use in their countries.

The Russian Federation reported progress in the development and implementation of their halon banking programmes. This resulted in lower production of halon 2402 than was authorised for 1997. It is expected that additional progress by the Russian Federation will completely eliminate the need for further production exemptions in the very near future.

GEF assistance will improve the situation for education and training programmes in Countries with Economies in Transition, helping to raise awareness and facilitate the transition to alternative fire protection measures.

Continuing applications research and toxicology research is underway to expand the applicability of commercialised halon alternatives. Basic research continues to fully commercialise water mist technologies, especially for marine applications. The search for extinguishing agents that could serve as alternatives for halons in the following applications continues:

1. Halon 1301 use for aircraft (civilian or military) for the protection of engine nacelles, cargo bays and dry bays

2. Halon 1301 use for crew compartments of tactical military vehicles, including armoured vehicles used by United Nations Peace Keeping Missions

3. Halon 1301 use for inerting of occupied spaces where flammable liquid release could occur

4. Hand held, halon 1211 fire extinguishers for aircraft (civilian or military)

5. Halon 1211 for use on military flightline operations

6. Military and police use of halon 1211 fire extinguishers on persons

Prudent management of the installed halon inventory by halon 1301 banking programmes, has made further progress in non-Article 5(1) Parties, further reducing the likelihood of essential use applications for halon 1301 in the foreseeable future. These banking programmes have made it possible to satisfy all needs of halon 1301 for critical installations. HTOC members from non-Article 5(1) Parties report that no new installations of halon fire equipment for non-critical applications are being undertaken. In addition the HTOC notes that fire equipment manufacturers in non-Article 5(1) Parties have discontinued manufacture of halon based fire equipment, except for the very specialised equipment used for aircraft and military applications.

3.4.4 Outstanding Issues

The success in phasing out production in India and the approval of the China halon sector programme not withstanding, the members of the HTOC remain concerned regarding the significant production of halons in China and Republic of Korea. Support is also needed for other Article 5(1) and CEIT Parties to assist with the elimination of the need for further imports (consumption). Support for halon 1301 banking programmes and conversion of manufacturing facilities for halon 1211 portable fire extinguishers will support this goal.

The HTOC plans to hold a meeting in Korea this fall and is striving to hold a technology transfer workshop with Korean fire protection authorities.

All assessment reports and the technical information provided by the HTOC (as is the case for other TOCs) is available only in English. This makes it rather difficult for many areas of the world, especially many CEIT and Article 5(1) Parties to draw on this information for technology transfer, educational and training programmes or for developing national phase-out and transition strategies. Translation of technical reports should be considered to achieve potential value of TOC reports.

Safe management of the installed halon 1301 inventory, the Halon 1301 Bank, is of utmost importance. Responsible care for existing installations is important to minimise emissions of halons into the atmosphere. Such an approach also maintains the supply of recycled halon 1301 necessary to meet the needs of those critical applications where alternative fire protection measures have yet to be found. The HTOC notes that the value of recycled halon 1301 has provided effective motivation for successful halon 1301 management programmes in both the public and private sector. However there are few critical applications for halon 1211 and as a result there is little economic stimulus to encourage halon 1211 management programmes. Although it may be technically feasible to gather and destroy a large portion of the existing inventory, collection of the small, widely disbursed quantities of halon 1211 contained in portable fire extinguishers poses a difficult and expensive challenge. Collection and destruction is always less cost effective than early phaseout of production.

3.5 Methyl bromide

3.5.1. Committee organisation and meetings

In compliance with the 1996 directions of the Parties, expressed in the TOR for TOCs and TEAP, MBTOC has been reorganised to reduce its size and increase proportion of Article 5(1) members. The Committee has been reduced from a size of about 65 members to 37 with 11 (30%) Article 5(1) members . The number of Article 5(1) Party members will continue to be increased as, and when, qualified candidates are identified and funds are made available for their participation.

Dr. Tom Batchelor succeeded Dr. Jonathan Banks as MBTOC Co-Chair in January 1998.

The reorganised MBTOC met in Canberra, Australia from 13-16 January 1998 to plan and commence writing the 1998 Assessment MBTOC Report. Two further meetings (Agadir, Morocco 18-22 May; Mexico or U.K., September 1998) are planned to finalise the report.

3.5.2 Progress in alternatives

The 1994 Assessment Report of the MBTOC, as updated in the TEAP report of 1997, describes a wide range of potential and existing alternatives for the uses of methyl bromide. A full review of the alternatives and their implementation is to be given in the 1998 Assessment.

Several projects are now in progress under bilateral or Multilateral Fund financing in Article 5(1) Parties which aim to demonstrate alternatives to MB in the context of Article 5(1) situations. A substantial number of other demonstration and investment projects are currently being negotiated.

Countries where methy bromide demonstration projects are currently underway include:

Country	Project Description	Implementing Agency
Argentina	Open and closed circuit non-soil cultivation as the main alternatives to the use of MB in tomato, cut flowers and strawberry production.	UNIDO
Brazil	Non-soil cultivation, solarization and low dose chemicals in tobacco sector.	UNIDO
China	Alternative technologies to MB applied to cucumber, tomatoes, tobacco and medicinal plants.	UNIDO
Canada	Diatomaceous earth and IPM approach as alternative to MB in grain storage	Canada
Guatemala	Steam pasteurization, non-soil cultivation, solarization and low dose chemicals in combination with IPM for broccoli and tomatoes.	UNIDO
Kenya	Use of CO2 and phosphine as applied to commodities, grain storage in transit, in outdoor storage and sealed bagstack systems	Australia
Morocco	Steam pasteurization, non-soil cultivation, solarization; and low-dose chemicals in combination with IPM in horticulture.	UNIDO
Zambia	Non-soil cultivation and low dose chemicals in the production of resistant tobacco seedlings.	UNIDO

A bilateral project between Chile and Canada to demonstrate the Bromosorb recycling/recapture for MB has been recently completed.

3.5.3 MB production and consumption

Global trend data in MB production and consumption is being gathered for inclusion in the 1998 Assessment. Production in Article 5(1) and CEIT countries appears to be about 5,000 tonnes per annum and this has been stable for several years. Speculation continues that production of MB will move from developed countries to Article 5(1) Parties. It is confirmed that at least one joint venture has been organised in an Article 5(1) Party to fill small cans with MB.

Consumption trends in Article 5(1) Parties has been highly variable with some Parties phasing out or greatly reducing their consumption (e.g. Colombia, Ghana, Indonesia) while others (e.g. Morocco, Mexico, China) substantially increasing usage. This additional usage is largely attributable to increased use as a soil fumigant. There are some reports that there may be stockpiling of purchases in some countries in excess of immediate requirements to increase the baseline for calculation of controls under the Protocol (average of 1995-98 consumption).

It is anticipated that the 1998 Assessment will include an updated information on the use pattern of MB consumption in Article 5(1) Parties. With the assistance of the Ozone Secretariat, a questionnaire soliciting this information has been circulated to the National Ozone Units in Article 5(1) Parties.

Several developed countries have reduced consumption at rates ahead of the Montreal Protocol controls through implementation of a wide range of alternatives. However, others are continuing to consume MB at close to the quantities allowed under the Protocol.

3.5.4 Quarantine and Pre-shipment (QPS) Exemptions - definitions

The definitions of the terms 'pre-shipment' and 'quarantine' with regard to methyl bromide uses exempted from control under Annex E of the Protocol are contained in Decision VII/5, which reads, in part:

> *"(a) 'Quarantine applications', with respect to methyl bromide, are treatments to prevent the introduction, establishment and/or spread of quarantine pests (including diseases), or to ensure their official control, where:*
>
> > *(i) Official control is that performed by, or authorized by, a national plant, animal or environmental protection or health authority;*
> >
> > *(ii) Quarantine pests are pests of potential importance to the areas endangered thereby and not yet present there, or present but not widely distributed and being officially controlled;*
>
> *(b) 'Pre-shipment applications' are those treatments applied directly preceding and in relation to export, to meet the phytosanitary or sanitary requirements of the importing country or existing phytosanitary or sanitary requirements of the exporting country;"*

There appears to be a wide variation between Parties and also methyl bromide users as to the interpretation of the terms 'quarantine' and 'pre-shipment application'. In order to assist Parties in a consistent application of these terms, TEAP provides the following interim explanatory notes:

1. The term ‘quarantine’ may have different connotations to different quarantine officials in some countries. For example, in some cases treatments regarded as ‘quarantine’ are applied to kill species of insects (e.g. cosmopolitan grain pests) already present in the country. Detection by inspection authorities of live insects in an incoming shipment may be sufficient to require authorisation of a treatment they regard as ‘quarantine’. However, the definition adopted by the Montreal Protocol of ‘quarantine’ treatments is narrower than this. It conforms to current concepts of quarantine by FAO and IPPC, where the pest for which treatment is authorised must be a declared object of quarantine, as specified in (a)(ii) above.

   (In IPPC/FAO language, “quarantine” applications are limited to regulated quarantine pests, and exclude applications for “regulated non-quarantine pests”.)

2. In the definition of ‘pre-shipment application’ TEAP understands that this is restricted by the terms ‘phytosanitary or sanitary’ to officially authorised but non-quarantine treatments, fulfilling official requirements of the importing or exporting country at time of export. It was not intended to cover informal or purely contractual or commercial arrangements not required under official regulations.

   (Applying new IPPC?FAO terms, pre-shipment applications are limited to “regulated pests”.)

3. The definition in Decision VII/5 is silent on quarantine application in intracountry trade. However at the time of crafting the definition of QPS it was not intended to exclude official intracountry quarantine treatments from exemption although the text of Decision VII/5 could be interpreted to restrict exempt quarantine treatments to those conducted or authorised by national, not state authorities.

4. The intention of the definition of ‘pre-shipment applications’ was to limit exemptions to those treatments carried out at time of export under official requirements either of the importing country or regulations in force in exporting countries at the time of the Decision (December 1995). This excludes arrangements which are contractual only.

5. In (b) above, it is clear that a pre-shipment application is applied to export trade between countries and that the application must be made shortly before export to qualify for exemption. With a methyl bromide treatment, including airing, taking from a few hours to three or four days depending on circumstances the term ‘directly preceding’ in (b) suggests a treatment applied, at most, within a few days prior to export.

There has been considerable discussion over the scope of the QPS exemption. TEAP suggests to Parties that application of the considerations above should give a well-defined exemption, that would promote implementation of alternatives in non-exempt areas in accordance with the objectives of the Protocol. TEAP suggests MBTOC further consider the scope of QPS exemptions and give examples of where these exemptions may or may not apply.

3.5.5 Emergency Use Provisions for Methyl Bromide - Decision IX/7

Decision IX/7 provides for the use of up to 20 tonnes of MB for emergency use by a Party, post phaseout, with application for retrospective approval by the Parties. This report discusses the adequacy of the 20 tonnes allowance in the event of a single emergency. Decision IX/7 reads:

> *"To allow a Party, upon notification to the Secretariat, to use, in response to an emergency event, consumption of quantities not exceeding 20 metric tonnes of methyl bromide. The Secretariat and the Technology and Economic Assessment Panel will evaluate the use according to the "critical methyl bromide use" criteria and present this information to the next meeting of the Parties for review and appropriate guidance on future such emergencies, including whether or not the figure of 20 metric tonnes is appropriate."*

3.5.5.1. Considerations

Control measures for substances under Annex E (methyl bromide), agreed at the Fourth and subsequent Meetings, provide for an exemption from control for QPS uses. QPS uses are defined under Decision VII/5.

MBTOC, at its meeting of 13-16 January 1998, discussed the adequacy of the provision of a 20 tonnes allocation with regard to methyl bromide and potential emergency situations. MBTOC found difficulty in identifying any emergency situation which would not be covered by QPS exemptions. MBTOC notes that the frequency of potential use under emergency use provisions is dependent on the decisions by the Parties.

Likely examples of potential emergency use for methyl bromide that would not fall under QPS exemption include:

(1) Flour mill or other food processing plant in which the IPM Programme had failed to prevent development of an unacceptable level of infestation deep in the fabric of the building and food safety legislation or other regulations prevented further food production until infestation was eradicated.

A 'complete site treatment' would be necessary and speed would be critical. Even a one day shut down can be very costly. If the situation or type of building meant the risk was inappropriate to employ rapidly acting alternatives, such as phosphine or heat technologies, then the methyl bromide emergency use may apply.

Other possible emergency situations could include:-

(2) Ships prior to loading containing infestation of non-quarantine pests. An empty cargo vessel that is infested must be treated with a highly effective treatment otherwise it cannot trade. Methyl bromide is currently the only approved option in some situations in some countries.

(3) Potential emergency treatments of soil for preplanting not involving quarantine pest outbreaks, might include elimination of herbicide-resistant strains of some weeds or breakdown of IPM control of nematodes or other soilborne pests nematodes, where alternatives are, for some reason, regarded as inappropriate.

MBTOC further notes that 20 tonnes methyl bromide is sufficient to treat even very large storages, mills or other premises. For example, treatment of a very large mill or food processing premises (200,000 m^3 @ 48 g m^{-3} MB) would take less than 10 tonnes MB. In the case of ship fumigation this again is likely to require less than 10 tonnes in a single event (200,000 m^3 @ 48 g m^{-3} MB).

In the case of soil treatment, 20 tonnes of methyl bromide will treat around 50 hectares of soil.

The following table summarises the use situation of MB under different treatment capacities at specific rates of applications.

Use of methyl bromide under different treatment regimes

Use situation	Typical high dosage	Treatment capacity of 20 tonnes at this rate
Soil fumigation	40 g m-2	50 ha
Commodity treatment	48 g m-3	250,000 t
Structural treatment	48 g m-3	400,000 m3

3.5.5.2 Limited stockpiling to for emergency uses

Approval by the Parties for critical or essential use is currently a one-year process, commencing January 31 of one year and concluding at the Meeting of the Parties by December 31 of the same year, and possibly much earlier, as determined by the scheduling of the Meeting of the Parties. MBTOC notes this is out of synchrony with the agricultural seasons in some regions. Furthermore, that some uses of methyl bromide that may be deemed ‘critical’ are unpredictable: treatments being applied on an ‘as needed’ not routine basis. This is consistent with the trend in agricultural practice that particular pest control procedures, including methyl bromide treatment, are applied when pests are known to be present or likely to be present, rather than as a routine risk management practice.

National stockpiles of MB may be desirable because it takes time to access stocks or production from other countries.

Methyl bromide can be stored, with appropriate health and safety precautions, for long periods under dry condition in steel cylinders. Stockpiling is thus technically feasible.

3.6 Refrigeration, Air Conditioning and Heat Pumps

3.6.1 Membership and Participation

The RTOC consisted of more than 40 full members in the last quarter of 1997 of which there were 12 members from Article 5(1) and CEIT countries. Several nominations for new members were received in 1997 and 1998 from both developed and developing countries. Three new members were appointed as a replacement for members that either retired or changed position. Total membership has increased with the appointment of other new members. Analysis of the performance and participation of all members during 1998 may result in a small reorganisation in order to maintain a committee of 40-45 members. Whereas the number of experts from Article 5(1) and CEIT countries is expected to increase to 14 or 15 in the short term, the long term target is to appoint additional new members from these countries which will further increase their percentage share of the total RTOC membership.

More than 30 members participated in each of the RTOC meetings held during 1996 - 1998. The RTOC met in Delhi, India, 16/17 March 1998 to discuss the first draft of the 1998 Assessment Report; two further meetings are planned in 1998 to finalise the report. It has not always been possible for all members to attend meetings due to business commitments and lack of funding, particularly in the case of the developed country experts.

3.6.2 Technology

The 1998 Assessment Report will extensively report on the technology developments in each sub-sector.

Domestic refrigeration.
The use of ozone-depleting chemicals has been phased out in the developed countries in favour of HFC-134a and isobutane. In particular, the use of *isobutane* continues to increase on a global basis. Energy efficiency is the main issue in this sub-sector. Considerable attention is being given to the use of hydrocarbons and the servicing of equipment in developing countries. The TOC is co-operating with UNEP IE on a report that sets out existing knowledge and field experience in servicing with hydrocarbon mixtures.

Commercial refrigeration.
When converting to HFCs leak tightness is important. Smaller, non-centralised units and secondary loop systems using non-fluorocarbons or fluorocarbons, with low inventory, are experiencing increasing acceptance. The main issue in this sector is energy efficiency compared to the investment (life cycle cost) decision.

Industrial refrigeration and cold storage.
Has been using ammonia in many units. The share of HCFC chemicals will e reduced since many non-ODP candidates have become available.

Air-cooled air conditioning units.
The global use of HCFC-22 in this sector is substantial and is expected to remain so during the next decade. However, in the near future, new equipment is expected to use HFC blends (R-410A). Also., the use of non-fluorocarbons is being evaluated in this sector.

Chiller equipment.
This sector with a large refrigerant inventory has not yet identified a suitable replacement for HCFC-123, which is an excellent refrigerant from the viewpoint of energy efficiency. The rate at which retrofits from CFCs to other refrigerants are taking place is much slower than expected.

Mobile air conditioning.
This sector remains committed to HFC-134a. Many developments in the use of carbon dioxide are taking place, particularly in Europe. One of the main issues during the next 3 - 5 years will be the development of an adequate comparison of performance and investments in this sector. There remain large numbers of cars using CFC-12, particularly in the developing countries. The implications of the CFC-12 required to service these vehicles needs further attention.

3.6.3 Summary

Generally, developments have proceeded faster than expected during 1993-97. In domestic refrigeration, HFC-134a and isobutane will play major roles in future. Energy efficiency is the main issue in this sector. Unitary air conditioning and chillers will become increasingly dependent on HCFC-22 in future. In many applications, the use of HFC blends such as R-404A, R-507 and increasingly R-410A will increase and their applications will mature.

Hydrocarbons and carbon dioxide are promising candidates for many sectors; an assessment of the performance of carbon dioxide in mobile air conditioning is urgently required. Aspects that deserve urgent attention are both the short term phase out of CFCs in the developing countries and the use of chemicals suitable for retrofit (in both the developed and developing countries).

3.7 Solvents

3.7.1. Introduction

The work programme of the Solvents, Coating and Adhesives Technical Options Committee (STOC) established in 1996 has largely been carried out. Four members from Article 5(1) and CEIT countries have been enlisted. Based on the information gathered on new chemicals with ozone depleting potential, STOC provided the ground work for Decision IX/24 of the Ninth Meeting of the Parties. The work on 1998 Assessment Report is progressing satisfactorily.

Two meetings were held during 1997 when all significant tasks were handled. In addition, international workshops titled "Viable Alternatives to OD Solvents" were held at two locations in India in October 1997.

Open panel discussion at the end of the workshop technical programme was focused on assisting SMEs in the region. The problems and concerns expressed by representatives of SMEs and government agencies are being further followed up by STOC.

3.7.2. Highlights of STOC Activities

3.7.2.1 Status of Membership

Efforts were continued to enlist suitably qualified experts from Article 5(1) and CEIT countries. Four new members have joined the Committee and three members from developed countries have withdrawn due to lack of sponsorship from their employers. Losing highly experienced members from developed countries is a continuing drain on the expertise level and may have serious impact on the functioning of the Committee. STOC has at present 32 members.

3.7.2.2 Status of 1998 STOC Assessment Report

Drafting was initiated in April 1997. It was decided to retain in general the format and chapter titles of the 1994 Assessment Report. Lead authors for each chapter have been designated to prepare the draft documents. Each chapter will address developing country perspectives with a special emphasis given to SMEs.

3.7.3 Essential Use Nominations

Three "essential use nominations" received by the Technology and Assessment Panel from the UNEP Ozone Secretariat were considered by the STOC and reported on in this Report in the section on Essential Uses.

3.7.4 Uncontrolled Ozone-depleting Solvents with Potential for Significant Production

In April 1997 Solvents TOC progress report, Parties were informed that two new substances with likely ODPs were being globally marketed, chlorobromomethane (CBM) and its derivative Borothene, and n-propyl bromide. The Science Assessment Panel has not reported the ODPs. subsequent to Decision IX/24: control of new substances with ozone-depleting potential, the Governments of the Netherlands and the United States and the Solvents TOC notified the Secretariat that n-propyl bromide was likely to have substantial production. The U.S. Government also submitted notification on the potential use of chlorobromomethane.

In May 1997, the U.S. Environmental Protection Agency proposed banning chlorobromomethane as a substitute for methyl chloroform and CFC-113 in solvent cleaning. This determination was based on the belief that CBM has a significant ozone depletion potential (ODP) similar to that of methyl chloroform, plus consideration of potential toxicological effects. N-propyl bromide is also under review by U.S. EPA as an ODS replacement in solvent cleaning.

TEAP has learned that the use of n-propyl bromide is also under consideration as an ODS replacement in fire suppression, aerosols, adhesives, coatings and inks applications.

Parties may wish to further consider the potential threat to the ozone layer from these new chemicals subject to the Science Assessment Panel determination of ODP.

3.7.5 Developments in ODS Alternatives and STOC Ready Reference Guide

In early 1997, STOC reported that n-propyl bromide and chlorobromomethane were being aggressively marketed as drop-in replacement for CFC-113 and methyl chloroform in vapor degreasing. Their uses in electronic and precision cleaning are considered to be of primary interest.

Information gathered by STOC suggests that there is some inconsistency or uncertainty in properties of these materials and effects such as flash point characteristics, toxicity and ODP values as currently reported by the manufacturers and independent testing houses.

The STOC does not consider these solvents to be technically proven for use particularly in developing countries where strict emission controls and personnel health monitoring are not well established. Adequate data on their properties and effects are not yet available for an objective assessment.

Since 1997 a second major aircraft manufacturer has introduced a zero ODP chlorinated compound as a substitute for CFC-113 containing rain repellent. The aircraft industry is now in the process of implementing ODS-free rain repellents. It is expected that no new models of aircraft will require the use of ODS-containing rain repellent. The retrofitting of currently operational aircraft is in progress and elimination of CFC-113 containing rain repellent will accelerate in the near future as confidence is gained other replacements.

The STOC has compiled a list of commercially available solvents containing restricted substances. The list is comprised of 107 products. This list is available from UNEP IE. Solvent blends from this list are integrated in the lists requested in Decision IX/28.

3.7.6 Workshops held in India

Two workshops titled “Viable Alternatives to OD Solvents” were organised by the Indian Institute of Chemical Technology on behalf of STOC and in cooperation with UNEP-IE. The Ozone Cell, Ministry of Environmental and Forests, Government of India also provided active assistance. Presenters came from STOC, with invited guests from abroad and selected local speakers representing both large and small scale enterprises from the region. Various industrial sectors including aircraft and aerospace, electronics, precision and general metal working were represented. Government agencies also participated.

At the end of workshop a panel discussion was held to identify problems and issues confronted by different industrial sectors with emphasis on SMEs. It was noted that:

a) ODS phase-out in “Solvents” sector is slow due to a multitude of applications in a number of diverse industries. It is further complicated by a large number of SMEs randomly located in different parts of the country.

b) Large international companies with “Joint Venture” type associations are involved in the phase-out process and no serious barriers are anticipated.

c) Large indigenous companies and SMEs are facing problems in adopting/introducing ODS-free technology.

d) Few organisations (both government and industry) have adopted a clear phase out strategy. Lack of awareness of proven substitutes for specific applications is an additional barrier.

e) Few small scale units are aware of the financial support available through the MLF or believe they are too small to propose projects.

f) There is lack of information on the technical, economic and environmental benefits that may be derived from adopting alternative technologies.

g) The decision making process is further hampered by the absence of practical demonstrations of alternative processes and more detailed information on pros and cons of adopting ODS replacements for specific applications. The lack of choice of alternative processes to meet the needs of a small scale unit and their practical demonstration delays the decision making.

h) There is a lack of focused training in handling production jobs without ODS and there needs to be an improved transfer of information on this to SMEs.

3.7.7 STOC Meeting in Delhi

A TOC meeting was held in Delhi on October 22 1997. The purpose of the meeting was to appraise the effectiveness of the workshops, to identify the barriers confronted by the industry particularly the SMEs in their phase-out efforts and to exchange information on opportunities to cooperate with the ODS replacement process.

The following could assist SMEs to replace ODS solvents:

1. concise information on the range of substitutes available to meet their specific requirements.

2. demonstration training centre where prospective users can see ODS replacements alternative applied by experienced persons.

3. training programs targeting appropriate persons from government and industrial organisations either at demonstration centres or at selected companies or institutions.

3.8 Military progress

3.8.1 Introduction

3.8.1.1 Background

Military organisations in most developed countries have made impressive progress in eliminating all but essential ODS uses. The majority of military ODS uses are identical to those found in the commercial sector, and the progress in the military sector is consistent with that in the commercial sector. However, there remain uses which are unique to specific weapons platforms.

A number of developed and few developing countries have provided information to TEAP regarding military ODS uses and efforts to find alternatives, however many nations have not reported progress. Parties operating under Article 5(1) may wish to consult their military organisations to begin planning for the phase-out.

3.8.1.2 Conflicting National Legislation

Some Parties may have enacted domestic legislation restricting use of ODSs, but exempt their domestic military organisations. Unless exemptions apply to foreign military organisations operating within their jurisdictions, some interoperability issues affect NATO, United Nations, and other multinational operations. Parties may wish to clarify their domestic legislation and regulations to avoid these problems.

3.8.1.3 International Military Co-operation

A number of workshops have been organised since 1991 on military ODS uses and alternatives, and a significant number of Article 5(1) Parties have participated. These include NATO sponsored workshops in 1990, 1991 and 1994. Other regional workshops featured sessions on ODS uses and alternatives, were sponsored by a trilateral consortium of Australia, Canada and the United States: in September 1996 in Hawaii for nations of the Asia-Pacific-Indian Ocean regions, and in June 1997 in Miami, Florida for nations of the Western Hemisphere. Also in 1997, the Australia, Canada and United States trilateral and the TEAP jointly sponsored the Third International Workshop on the Role of the Military in Implementing the Montreal Protocol and the First International Workshop on the Role of the Military in Climate Protection in Washington, D.C. A list of specific workshops and the participating nations is provided in Chapter 3.8.5.

There are some instances in which Article 5(1) Parties have co-operated with developed country military organisations. For example, the United States provided training on use of halon recycling equipment, halon banking strategies and halon alternatives in over 50 developing continues, including India and China.

However, important military uses remain for which no alternatives have yet been identified, especially for halons. The early phase-out was possible because developed countries meet the small important remaining needs by reusing ODSs. Military organizations ensure that recycled stocks are used only for critical applications, thus greatly extending the length of time the global supply of existing ODS will last.

3.8.1.4 Situation Regarding Article 5(1) Parties

The first control measure for Article 5(1) Parties is 1999. Article 5(1) Parties will implement management practices, adopt alternatives and establish ODS reserves to service ongoing important uses. Military organizations of developed countries are sharing their experiences in successfully implementing ODS phase-out strategies with developing countries.

Technology cooperation with developing countries has already been highly successful or has prepared countries to take prompt action once incentives and financing are in place. Examples include Mexico, Thailand, Turkey, and Malaysia.

3.8.2 Halons

3.8.2.1 Restrictions on Alternatives

The possible alternatives to halons are restricted in some countries. For example, HCFCs, HFCs, and PFCs have been banned for use as fire suppressants (halon alternatives) by national legislation. HCFCs are restricted because of their ozone depletion potential; and HFCs and PFCs because of their global warming potential and extremely long atmospheric lifetimes.

Toxicity is also a significant concern in approving alternatives. CF_3I has been evaluated for possible use in engine nacelles and APUs. However, CF_3I is quite toxic and there would be potential danger to maintenance personnel. It is also an expensive chemical. The U.S. Navy rejected CF_3I from for the F-18E/F, and the Air Force rejected it for the F-22. It appears unlikely that CF_3I will be accepted as a viable alternative.

3.8.2.2 Aviation

The existing supplies of halons are limited. A number of important end users have expressed concerns regarding the long term adequacy of remaining supplies. As a result, military and civil aviation authorities jointly formed an international working group to find and certify alternatives for aviation. The goal of the group is to identify alternatives and develop certification protocols which will enable aircraft to obtain certificates of airworthiness without the use of halons. Currently, civil aircraft cannot obtain such certification without halon systems on board. Strictly speaking, the military is not required to obtain civil certificates of airworthiness for its aircraft. In practice, however, the military does comply with civil airworthiness requirements. The working group is a joint effort among international aviation regulatory authorities, military agencies, and industry. The actual testing work is being done by the U.S. Federal Aviation Administration and the U.S. Department of Defense. The scope of the effort is to find and certify alternatives to all on-board uses of halons.

There are 6 primary aviation uses of halon:

1. Portable extinguishers
2. Engine Nacelles and Auxiliary Power Units (APU)
3. Dry Bays
4. Fuel Tank Inerting
5. Cargo, including a new requirement to protect class D cargo holds in commercial aircraft
6. Ground Support

3.8.2.3 Portable Extinguishers:

Halon 1211 is used on some, but not all military aircraft. Military organisations use halon 1301 portables more widely than 1211 for this application. In 1996, the U.S. Navy completed a study on alternatives, and identified CO_2 portables as suitable replacements for halon 1301 portables aboard both fixed-wing and rotary-wing aircraft. Clean gaseous alternatives, such as HFC-227ea are under active evaluation by the international working group for civil aviation.

The U.S. Army uses halon 1301 portable extinguishers in helicopter crew compartments, but is in the process of replacing them with carbon dioxide. This should provide useful data to the effort to find alternatives to the halon 1211 portable extinguishers in fixed wing aircraft.

Engine Nacelles and Auxiliary Power Units

The military has begun implementing alternatives on their aircraft using their own certification procedures. These include HFC-125 for the V-22 engine nacelle, the upgraded H-1 helicopter, and the F-18E/F Navy fighter; and inert gas generators also on the F-18E/F.

The U.S. Army has redesigning the fuel system of the Comanche helicopter to reduce the risk of fire to the point that HFC-227ea could be used. The U.S. Air Force's new F-22 fighter will use HFC-125 for both engine nacelles and auxiliary power units. These experiences should provide confidence to the commercial sector and regulatory authorities that alternatives are practical and effective.

Dry Bays

Dry bays are the interstitial spaces within aircraft structures adjacent to electrical cables, hydraulic lines or other equipment which can cause fires or explosions due to a ballistic threat. This is largely a military unique requirement. The U.S. Navy is implementing inert gas aboard the F-18E/F, and has already implemented it in wing dry bays aboard the V-22.

Fuel Tank Inerting

A number of aircraft use halon systems to pressurize fuel cells within wing structures to prevent the wing from exploding in the event it is hit with a ballistic round. The U.S. Air Force now deactivates these systems during peacetime, and use them only during conflict which has significantly reduced reduced halon consumption. Future servicing of these existing systems depends on availability of recycled halon 1301. The most widely used aircraft with this feature is the F-16, which is operated by a large number of countries.

There are two promising alternatives. One is the On-Board Inert Gas Generating System (OBIGGS), which produces inert gases by filtering air. The other is the inert gas generator, which uses automobile air bag technology. Despite the similar names, the technologies are very different. The inert gas generator was developed for the U.S. V-22 wing fire suppression system and the F-18E/F dry bay fire extinguishing system. It would be very difficult, if not impossible, to retrofit either of these systems into existing aircraft - they are only candidates for new aircraft. To date, research has failed to identify an alternative which can function with existing airframe and fuel system designs and is compatible with the fuel in cells.

Cargo

There are a number of different types of cargo compartments. The U.S. Federal Aviation Administration recently adopted a new regulation requiring fire protection in Class D cargo holds of commercial aircraft. This was an outcome of a recent crash of a U.S. jet (ValueJet) which resulted from an explosion in the cargo compartment. These systems will initially use halon, however research continues on acceptable alternatives. A review of U.S. Air Force cargo compartments revealed that for identical types of cargo aircraft, some holds are protected by halons, and others are not. This leads to the question of whether or not an automatic fire suppression system is required in military cargo compartments. Requirements to use halon in cargo compartments should be based on a comprehensive assessment of the fire threat.

Lavatories

There is an approved HFC-227ea system for this application which was developed under the international halon working group. It is easily retrofitted into existing aircraft, however these systems typically hold only 125 grams of halon 1301 in each lavatory system so the quantities involved are minuscule.

Ground Support

The most widely used fire protection system for "first response" to an aircraft fire while on the ground is halon 1211 in 150 pound wheeled extinguishers. Alternatives are under investigation, but none have yet received wide acceptance.

Fire trucks or "Crash-Rescue Vehicles" use a combination of agents. Some military services use halon 1211, while others have removed the halon and converted the vehicles to dry powder and AFFF (aqueous film forming foam). This switch was made because halon 1211 is used as “first response”, and if the fire is large enough that 150 pounds of halon 1211 is inadequate to extinguish, secondary damage caused by the use of a powder agent is not an issue compared to the damage caused by the fire. An exception is aircraft carrier decks, which typically use halon 1211. However, the Navy is re-examining its clean agent requirement for flight decks. The commercial aviation sector has not used halon as extensively as the military, and the most widely used agents for vehicles are foams and powders.

The U.S. Army is replacing their halon 1211 flightline extinguishers with dry powder and CAF (compressed air foam). Foam is favored over dry powder because it provides better throw and presents less of a problem with residue. For ground support of helicopter operations, they will use dry powder and foams to replace halon 1211. Although a clean agent was a requirement, the Army is rethinking the application of dry powder.

3.8.3.4 Ships and submarines.

The choice of fire protection for ships and submarines is very platform specific, and a solution for one vessel or application is not necessarily a solution for all. This is because any alternative must be taken in the context of an overall fire protection strategy. For example, the UK Royal Navy uses halon but the U.S. does not. Nevertheless, lessons learned by one nation or military service can provide important data to others considering alternatives. For example, the Canadian Navy has conducted a fire risk assessment of all spaces on their ships and have determined that all halon systems can either be removed or replaced with a non-ODS agent.

The use of halons in ships and submarines has been divided into the following broad categories:

- Electrical Spaces
- Machinery Spaces (occupied and unoccupied)
- Machinery (Engine) Enclosures
- Flammable Liquid Storage Spaces

Electrical Spaces

Halons are not widely used in electrical spaces. Carbon dioxide and fresh water hoses are typical. Power to affected equipment is normally disabled by occupants, and not by automatic switches connected to fire detection systems.

Machinery Spaces

There are two types of machinery spaces to consider: occupied and unoccupied. The presence of staff influences the fire protection strategy, and therefore the choice of fire protection system.

The U.S. Navy is currently using halon 1301 with manual AFFF bilge sprinkler backup. Manual fire fighting in these spaces is provided by AFFF hose reels, CO_2 portables, and dry powder portables. New construction vessels will be halon-free, using water mist and HFC-227ea.

The Canadian Navy protects machinery spaces in most ships, such as the Halifax class, with single shot halons systems, but are currently studying replacing these halon systems with Fine Water Spray systems similar to those planned for machinery enclosures. Space limitations are the most significant concern since any retrofit will be limited to the space currently occupied by the halon systems.

Denmark is using Intergen or Argonite (inert gases) in total flooding systems. It occupies eight times the volume of halon, and therefore is not practical on submarines but Denmark finds the space and weight penalty acceptable on surface ships.

It is important to note that halon does not cool down hot surfaces. This can only be accomplished using a water based agent.

Machinery (Engine) Enclosures
Machinery enclosures are surrounds which enclose the engines. Gas turbine engines and in some cases diesel engines, are located in enclosures for acoustic attenuation. They are supplied by the equipment manufacturers, and come with an integral, pre-packaged fire protection system. Halon has been the industry standard, however this is changing. Future new construction vessels will use either water mist or HFC-227ea.

Flammable Liquid Storage Spaces
Halon 1301 or CO_2 is currently used. There are concerns over expanded use of CO_2 for reasons of worker safety. HFC-227ea is being adopted in some circumstances, however the U.S. Navy has an on-going research program to develop a water mist system for this application.

3.8.3.5 Ground Vehicles

The use of halons in ground vehicles has been divided into the following broad categories:

- Crew Compartments
- Engine Compartments
- Portable Extinguishers (Inside and Outside the Crew Compartment)

Crew Compartments of Tactical Vehicles
A number of countries, including Canada, Germany, India, Israel, Russia, the U.K. and the U.S among others, use halon 1301 total flooding systems for explosion suppression in crew compartments of tactical vehicles.

These systems activate in less than 250 milliseconds to protect the crew from explosions resulting from enemy fire. Tests and battlefield experiences show significantly improved survival rates for crews in vehicles equipped with these systems. Despite significant research investments, no feasible alternatives have yet been identified. Russia currently uses halon 2402 in crew compartments. There are some indications that the Russian Federation may be converting these systems to halon 1301.

The U.S. Army began testing alternatives which had been previously identified as potentially promising, in November 1997. The following agents/systems are currently being evaluated in a crew compartment test bed:

- hybrid gas generator with water,
- hybrid gas generator with HFC-227ea,
- wet-distribution water system,
- standard system using HFC-227ea with optimized distribution, and
- standard system using PFC-218 with optimized distribution.

Their two year testing program will lead to a decision point by the end of September 1999. Preliminary testing indicates that the decomposition of HFCs may generate hazardous levels of hydrogen fluoride. Provided a suitable alternative system evolves from this test program, a final decision will be made in 2003 with vehicle retrofits to begin in 2005. It is important to emphasize that research programs are uncertain and alternatives may not be acceptable.

Engine Compartments

The U.S. Army has concluded that sodium bicarbonate dry powder agents are suitable for extinguishing fires in engines that must remain running, such as tanks which need to exit the battlefield. Retrofit costs can be higher than for other approaches due to the sophisticated distribution system required, but this is often offset by the much lower operational costs which are due to the low cost of the powder (typically less than USD 0.50 per pound). Engines that are shut down prior to agent discharge offer a more benign fire environment, and area appropriate for HFC-227ea or FE-36. Retrofit costs are small, but agent costs are much higher than for powder systems. In November 1997, the Army approved dry powders for use in the engine compartments of the M1 Abrams main battle tanks., and HFC-227ea in M2/3 Bradley Fighting Vehicles. Other ground vehicle systems will follow one of these approaches depending on their operating scenarios. Retrofits will be conducted in 1999 through 2005.

Germany has adopted nitrogen systems, which occupy approximately twice the space as existing halon systems. Germany is able to retrofit with nitrogen, because halon systems were originally designed for a double shot of halon. A single shot of nitrogen can be accommodated within the same space. Some military organizations consider a single shot inadequate protection for the crew and reject the nitrogen solution. HFC-227ea and FE-36 require approximately the same space as halon, and therefore allow for a double shot. Denmark is using HFC-227ea for engine compartments, but not for crew compartments.

Portable Extinguishers

Portable Halon fire extinguishers have been replaced by CO_2 extinguishers in combat vehicles where the operating scenario permits the crew to dismount. However, this solution is inappropriate where the crew is required to remain locked-down. After a discharge event, the CO_2 tends to pool in the driver's area causing asphyxiation. A test program was initiated to find a suitable Halon-alternative agent for occupied space applications.

Full scale testing was conducted in the U.S. on the three most promising alternatives for this scenario,. However, in each case the agents proved to be extremely hazardous to the crew. As a result, the Army will continue using Halon portables until a suitable non-toxic, non-asphyxiating agent can be found. The Army is also re-looking the requirement for a clean agent portable. The applicability of sodium bicarbonate dry powders in crew compartments is being investigated.

3.8.3.6 Facilities

Halon in facilities have largely been eliminated in developed countries. Sprinkler systems have replaced most of the halon systems, including in rooms containing computers and other electronic equipment. The halon in facilities, especially the halon 1301 total flooding system, have become the source of halon for weapons platforms. As facilities are modified, the halon systems are removed and the bottles are sent to the military halon reserve. In the event a system discharges due to fire, the halon system is not recharged, but rather is replaced or retrofitted with an alternative. The U.S. Army requires that halon be removed from all non-mission critical facilities by 2003. However, most military organizations which provided data indicated that they remove halon systems and send the gas for recycling as buildings are renovated or otherwise modified.

In cases where facilities cannot be adequately protected with water sprinkler systems alone, halon systems are replaced or retrofitted with an alternative agent, such as inert gases (Argonite or Intergen), or HFC-227ea. An engineering decision is required to determine whether discharged halon systems shall be replaced with water sprinklers, or require retrofit with an alternative agent. All halon removed from facilities should be recovered and returned to a recycling facility for reuse in mission critical applications.

3.8.6.7 Post-Production Phaseout Management Strategies

The military participants at the various workshops expressed concern over these proposals to collect and destroy military halon stocks, particularly halon 1301. Estimates of the amount of halon needed into the future are based on assumptions about the number and duration of military operations and small changes in these assumptions can result in large changes in the amount of halon needed. Consensus of the military experts that efforts to destroy existing military stocks of halon are premature. There is no military objection to collection and destruction of halon 1211 from civilian sources.

3.8.3 Refrigerants

3.8.3.1 Past Military Accomplishments/Progress:

Through a tremendous amount of effort and cooperation between the military and commercial sector, alternatives to virtually every military refrigeration application have been identified. As an example of successful military phaseout efforts the U.S. Navy provided a paper to all session participants detailing the Navy's successful program for shipboard ODS elimination. A copy of the paper is available for download from "http://www.navyseic.com/documents/asne.pdf".

In many cases military equipment retrofit and replacements are underway.

Examples include:

- U.S. Navy has completed over 40% of their retrofits to CFC-12 systems in the Fleet
- U.S. Army has several retrofit programs ongoing or completed including retrofits to U.S. Army watercraft refrigeration systems, tactical shelter environmental control units, and other tactical vehicle cooling systems.

While much progress has been made, considerable effort remains to complete the ozone-depleting refrigerant phaseout in military equipment. For example, the U.S. Navy will not complete retrofit of surface ship R-114 centrifugal compressor AC plants until 2008 or beyond.

Remaining Uses of Ozone-Depleting Refrigerants / Promising Alternatives: Numerous CFC refrigerant applications will remain in most militaries for some time to come due to lack of economically viable retrofit options in the face of shrinking national military budgets.

The majority of refrigerant alternatives identified and being implemented are hydrofluorocarbons (HFC), such as HFC-134a, and HFC blends such as R-404A, R-407C, and R-410A. However, especially in the case of building chillers, hydrochlorofluorocarbons (HCFCs) such as HCFC-123 and HCFC-22 are playing an important role as interim alternatives. Although non-fluorocarbon refrigerants such as hydrocarbons and ammonia are also playing an important role in the commercial sector phaseout, use in military applications is unlikely due to flammability and safety concerns in a battlefield environment.

While not playing a significant role in the ODS phaseout at this time, Not-In-Kind (NIK) technologies such as thermoelectric, thermoacoustic, and others should continue to be researched as longer-term replacements. The primary draw-backs of NIK technologies to date have been higher implementation costs and higher Total Equivalent Warming Impacts (TEWI) as a result of low efficiency.

3.8.3.2 Post-Production-Phase-out Management Strategies:

Since ozone-depleting refrigerant applications will remain in militaries around the world for many years until retrofit programs are completed or existing weapon platforms are retired, militaries are exercising responsible use policies such as:

- Conservation (Recycling, leak monitoring and repair, installation of high-efficiency purge units, etc.)

- Retrofit and replacement where possible

- Cascading of refrigerant from retrofit and replacement of equipment down to remaining operational equipment.

- Refrigerant banking

Where appropriate, interim substitutes such as HCFCs and HCFC refrigerant service blends are being used to ease the transition to total ODS-phaseout.

3.8.3..3 Challenges:

Since the phase-out is not complete, militaries need to maintain focus on the problem. Awareness programs need to continue and information exchange is vital, especially between developed countries and Article 5 (1) Parties.

Militaries need to be able to continue to use transitional substitutes (HCFCs) until existing equipment can be retired at the end of its useful life. TEAP knows of no military organization with plans or funding to conduct early retrofit or replacement of HCFC equipment.

Militaries should cooperate with national government authorities to implement ODSs controls that accommodate the use of banks and existing stocks of CFC refrigerants that are integral to military phase-out strategies. In addition, controls should be designed to allow likely joint military operations.

3.8.4 Solvents

The most important military issue for solvents is related to the U.S. essential use request for ODS used to produce solid rocket motors for propelling large payloads into space. These rockets carry military and civil communications and other scientific and commercial equipment into space on behalf of many countries and companies of the world. Large research and development investments have been made to identify and validate alternatives.

Canada, Germany, Norway, Sweden and the United States reported that they have virtually eliminated the use of ozone-depleting solvents in military applications.

3.8.4.1 Cleaning of Oxygen Systems

In January 1994 NATO identified the cleaning of oxygen systems as one of the most difficult challenge facing military and aerospace applications. In Fall 1994, the International Cooperative for Ozone Layer Protection (ICOLP), Aerospace Industry Association (AIA), U.S. EPA, National Aeronautical and Space Administration (NASA) and the U.S. Air Force convened a special workshop on cleaning of oxygen systems without ozone-depleting solvents.

Since that time, two alternatives have been successfully adopted. Aqueous cleaning options have been successfully developed and implemented for many oxygen system cleaning situations. For example, Lockheed uses aqueous processes in the manufacturing and maintenance of aircraft and missile oxygen systems, the Air Force uses aqueous cleaning for some aircraft oxygen system maintenance, NASA/Kennedy Space Center uses aqueous solutions for cleaning oxygen bulk storage and transfer systems for rocket motors, and the U.S. Navy uses aqueous cleaning processes for cleaning the tubing in oxygen systems on ships and submarines.

Isopropyl alcohol (IPA) is being used by Lufthansa German Airlines to clean the oxygen systems in their commercial aircraft fleet. Sweden has reported using a solvent blend for oxygen system cleaning consisting of 95% ethanol.

Some parts of oxygen systems can be changed to simplify or avoid the necessity of cleaning or they can be adapted to allow aqueous cleaning.

3.8.4.2 Electronics Cleaning

The need for post-solder flux-residue cleaning varies widely and depends on the final electronics application. For example, most printed circuit boards that are used in toys and home appliances are cleaned perfunctorily, if at all. In contrast, boards that are manufactured for automotive, military, space, medical and other critical applications require high levels of cleanliness.

During the past several years, aqueous cleaning and no-clean technology have largely taken over the tasks of cleaning electronics circuit boards and components.

Although aqueous cleaning is used in a number of electronics applications, it is not approved for all applications. The military has widely adopted the use of non-rosin fluxes and no-clean technology.

3.8.4.3 Gyroscopes and Precision Guidance Instruments

Momentum control gyroscopes and precision guidance instruments are used to control and detect movement in satellites, space probes and platforms, and missiles. Contamination-free surfaces are required during fabrication in order for these devices to operate reliably for extended periods of time in harsh military and space environments. The cleaning processes used must be compatible with a variety of materials, including: metals, thermoset polymers, thermoplastics, elastomers, lubricants, organic and inorganic coatings, and optical components. In addition, cleaning processes must be effective in removing contaminants such as hydrocarbon, ester, and fluorocarbon lubricants, handling debris, damping fluids, and process residuals.

For particle removal in critical cleaning operations, CO_2 "Snow", perfluorocarbon sprays, and water-based sprays were selected as alternatives to ozone-depleting solvents. Equipment has also been specially designed to use perfluorocarbon solvents for the removal of fluorocarbon oils and greases, while limiting solvent emissions to the atmosphere. Carbon dioxide is also being used in another cleaning process — supercritical fluid cleaning — for the removal of a wide variety of oils. Flammable and combustible solvents have also been employed for processes that are not compatible with other alternative cleaning solutions.

Although the floated gyroscope technology is being superseded by solid state, optical systems, commercial and military gyroscope equipment will remain in service for many years. Because these gyroscopes need to be serviced and maintained, there is a long-term requirement for compatible solvents for manufacturing spare sensors and gyroscopes and for cleaning existing units.

Possible cleaning alternatives for gyroscopes include nonozone-depleting chlorinated solvents, organic solvents, hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs), aqueous processes, supercritical fluids, and perfluorocarbons (PFCs).

3.8.4.4 Hydraulic Control Systems

Hydraulic military vehicle control systems have control valves with extremely small diameter bores as well as parts such as O-ring seals and gaskets made of elastomers. These systems are flushed to remove the working fluid and to remove all particulate contamination during assembly, after functional testing, and during field maintenance. CFC-113 has traditionally been the solvent of choice because of its chemical stability and noncorrosive properties. Smaller tactical weapon systems often use a gas control system in which a source of high pressure gas, either chemically generated (e.g., extruded double-based propellent) or a “cold” compressed gas such as nitrogen at 3.56×10^7 N/M^2, controls the actuator systems’ valves. Gas controls require extreme cleanliness as they are sensitive to particulate contamination. Gas control systems are pressure tested, and water often is used as the test fluid. Many hot gas control units have long blind holes from which it is difficult to remove water by oven evaporation. Water-displacing mixtures based on CFC-113 effectively dry these systems.

Possible alternatives for hydraulic control system cleaning include alcohols, supercritical fluids, and gas plasma.

3.8.5 Military workshops

Parties participating in the Western Hemisphere Defence Environmental Workshop: 3-4 June 1997, Miami, U.S.A.

Antigua and Barbuda	Dominican Republic	Paraguay
Argentina	Ecuador	Peru
Bahamas	El Salvador	Dt. Kitts
Barbados	Grenada	St. Lucia
Belize	Guatemala	St. Vincent and the Grenadines
Bolivia	Guyana	
Brazil	Haiti	Suriname
Canada	Honduras	Trinidad and Tobago
Chile	Jamaica	United States
Columbia	Mexico	Uruguay
Costa Rica	Nicaragua	Venezuela
Dominica	Panama	

Parties participating in the Asia-Pacific Indian Ocean Defence Environmental Workshop: September 1996, Honolulu, U.S.A.

Australia	Kazakstan	Solomon Islands
Bangladesh	Nepal	Sri Lanka
Canada	New Zealand	Sweden
Chile	Pakistan	Tonga
Federal States of Micronesia	Papau New Guinea	United Kingdom
	Philippines	United States
Fiji	Republic of Korea	Uzbekistan
Indonesia	Russian Federation	Vanuatu
Japan	Singapore	Western Samoa

Parties participating in the Third International Workshop on the Military Role in Implementing the Montreal Protocol and the First International Workshop on the Military Role in Climate Protection

Albania	France	Paraguay
Australia	Kenya	Poland
Canada	Mauritius	Sweden
Denmark	Panama	United States

4. Organisation of the TEAP and TOCs

4.1 TEAP membership background information

TEAP has interpreted the Terms-of-Reference (TOR) regarding Code-of-Conduct to require disclosure statements by TEAP members. These are presented in full in annual TEAP Reports. Disclosure for members of TOC and others subsidiary bodies and compliance with the Code-of-Conduct are reviewed each year by TEAP and reported to Parties. The TOC Co-Chairs are currently requesting disclosure statements for 1998-99.

In 1997-98, it was reported to TEAP Co-Chairs that several TOC members may have acted on instructions of their employers or industry associations. When contacted, these members disputed the report and assured TEAP that they would abide by the Code-of-Conduct, TEAP Co-Chairs deemed that no action was necessary at this time but continued to monitor the situation.

Since 1988 many Parties have made substantial in-kind and financial contributions to the operation of TEAP and its TOCs, Working Groups and Task Forces. The principal financial contributors include Australia, Canada, Germany, Japan, Netherlands, Sweden, Switzerland, United Kingdom, and the United States. In a typical year TEAP requires US$100,000-150,000 in administrative and management wages, communication, word processing, printing, and mailing costs. TOCs typically spend US$35,000-100,000 depending on whether the time of chairs is an in-kind contribution or a sponsored contribution.

10 of 24 current TEAP members are from Article 5(1) of Parties or CEIT.

Radhey S. Agarwal, Co-chair of the Refrigeration, Air-conditioning and Heat Pumps Technical Options Committee, is Professor of Mechanical Engineering at the Indian Institute of Technology (IIT Delhi), Delhi, India. IIT Delhi makes in-kind contribution for wages. Costs of travel, communication and other expenses are paid by the Ozone Secretariat.

Stephen O. Andersen, Co-Chair of the Technology and Economic Assessment Panel, is Director of Strategic Climate Projects in the Atmosphere Pollution Prevention Division of the U.S. Environmental Protection Agency, Washington, D.C., USA The U.S. EPA makes in-kind contributions of wages, travel, communication, and other expenses. With approval of its government ethics officer, EPA allows specified expenses to be paid by other government organisations and non-government-organisations (NGOs) such as the United Nations Environment Programme (UNEP).

Jonathan Banks, Co-Chair (in transition) of the Methyl Bromide Technical Options Committee, is a Chief Research Scientist of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Stored Grain Research Laboratory and program leader within CSIRO Division of Entomology, Canberra, Australia. CSIRO is an Australian government, non-profit research organisation. Funding for CSIRO is provided by industry, the government of Australia and by grants from other national and international government agencies.

Tom Batchelor, Co-chair of the Methyl Bromide Technical Options Committee, is a consultant. His participation is supported through CSIRO, an Australian government, non-profit research organisation.

Walter Brunner, Co-Chair of the Halon Technical Options Committee, is a partner in the consulting firm envico, Zurich, Switzerland. He operates the halon registry and the halon clearinghouse under contract from the Swiss Government. The Government of Switzerland funds his participation in the Halons Technical Options Committee (HTOC) and TEAP.

Suely Carvalho, Co-Chair of the Technology and Economic Assessment Panel, is Senior Technical Adviser and Deputy Chief of the Montreal Protocol Unit at UNDP - New York. UNDP makes in-kind contributions of wages, travel and other expenses.

Jorge Corona, Co-chair of the Solvents, Coatings and Adhesives Technical Options Committee, is in charge of foreign relations of the Environmental Commission of Camara Nacional de la Industria de Tranformacion (CANACINTRA), National Chamber of Industries, Mexico City. Communications, wages and miscellaneous expenses are covered personally. Travel expenses are paid by the Ozone Secretariat. From 1997, communications and other expenses are being covered by the Ozone Secretariat. During recent years, Jorge Corona has worked for UNEP and UNDP on a consultancy basis.

László Dobó, Senior Expert Member, is an honorary (non-paid) consultant on ODS phaseout to the Hungarian Ministry for Environment and Regional Policy (MERP) in Budapest, Hungary, since 1992. Until the end of 1996 his travel, and other costs were covered by the European Commission in the framework of the Task Force assessing the difficulties of CEITs in complying with the Montreal Protocol. Travel costs are now covered by UNEP, and communication costs are an in-kind contribution by MERP.

Yuichi Fujimoto, Senior Expert Member, is an Adviser to Japan Industrial Conference for Ozone Layer Protection (JICOP), Tokyo, Japan. The Japanese Government makes in-kind contributions for travel expenses and JICOP carries the costs for communication and other expenses. Wages are paid by Hitachi, the Japanese electrical manufacturer.

Barbara Kucnerowicz-Polak, Co-chair of the Halons Technical Options Committee, is an adviser to the Head of the Polish Fire Service in Warsaw, Poland. Funding for the Halon Technical Options Committee related activities is provided partly by the Ozone Secretariat and partly by the Government of Poland.

Lambert Kuijpers, Co-chair of the Technology and Economic Assessment Panel and Co-chair of the Refrigeration, Air-conditioning and Heat Pumps Technical Options Committee, is based in Eindhoven, The Netherlands. He has been financially supported by the Netherlands and, up to date, sponsorship has been agreed by the European Commission and Germany for his activities related to the TEAP and the TOC Refrigeration, which includes in-kind contributions for wages and travel expenses. They also fund administrative costs on an annual budget basis. In addition to activities at the Department "Technology for Sustainable Development" at the Technical University Eindhoven, other activities include consultancy to governmental and non-governmental organisations, such as the World Bank and UNEP IE. Dr. Kuijpers is also an advisor to the Re/genT company, Netherlands (R&D of components and equipment for refrigeration, air-conditioning and heating).

Mohinder P. Malik, Co-chair Solvents, Coatings and Adhesives Technical Options Committee, is Manager, Materials and Process Technology, Lufthansa, the German Airline in Hamburg, Germany. Lufthansa pays wages, travel, communication and other expenses.

Thomas Morehouse, Senior Expert Member for Military Issues, is a Researcher Adjunct at the Institute for Defence Analyses (IDA), Washington D.C., USA. IDA makes in-kind contributions of communications and miscellaneous expenses. Funding for wages and travel, is provided by grants from the Department of Defense and the Environmental Protection Agency. IDA is a not-for-profit corporation that undertakes work exclusively for the US Department of Defense. He also occasionally consults to associations and corporate clients.

David M. Okioga, Co-chair, Methyl Bromide Technical Options Committee, is the co-ordinator of the Kenyan Government Ozone Unit which is financed by the Multilateral Fund. Based in Nairobi, Dr. Okioga is responsible for co-ordinating, processing and monitoring, on behalf of the Government of Kenya, the country programme implemented by United Nations specialised agencies or through bilateral assistance to Kenya under the provisions of the Montreal Protocol. Funding for travel and communication costs related to MBTOC and TEAP are provided by the UNEP Ozone Secretariat.

Jose Pons Pons, Co-Chair Aerosol Products Technical Options Committee, is President, Spray Quimica, La Victoria, Venezuela. Spray Quimica makes in-kind contributions of wage and miscellaneous and communication expenses. Costs of Mr. Pons' travel are paid by the Ozone Secretariat. From 1997, most costs of communication and other expenses are being paid by the UNEP Ozone Secretariat.

Sally Rand, Co-Chair Rigid and Flexible Foam Technical Options Committee, is an expert in the Significant New Alternatives Program of the Stratospheric Protection Division of the U.S. Environmental Protection Agency, Washington, D.C., USA. The U.S. EPA makes in-kind contributions of wage, travel, communication, and other expenses. With approval of its government ethics officer, EPA allows expenses to be paid by other government organisations and non-government organisations (NGOs).

Rodrigo Rodriguez-Kábana, Co-Chair of the Methyl Bromide Technical Options Committee, is an emeritus professor of nematology at Auburn University, Alabama, USA. The University receives finance from US federal and state government grants, campus operation and grants from public and private foundation and corporate and individual sponsors. Some research is financed by corporations. Rodrigo Rodriguez-Kabana is a consultant to numerous national and international organisations.

Sateeaved Seebaluck, Senior Expert Member, is Principal Assistant Secretary at the Ministry of Local Government and Environment, Port Louis, Mauritius. The Government of Mauritius makes in-kind contribution of salary and cost of communications. Travel expenses are paid by the UNEP Ozone Secretariat. From 1997 most communications costs related to TEAP activities are being paid by the UNEP Ozone Secretariat.

Lalitha Singh, Co-Chair Rigid and Flexible Foam Technical Options Committee, former Adviser in the Department of Chemicals and Petrochemicals (Government of India) is an independent consultant to the petrochemical industry (public and private sector corporations) and Montreal Protocol related areas. She is an expert member of the committee to review the India Country Programme and also of other Government committees. She is chairperson of the panel ‘Chemical Industry 2020’ study under the Technology Assessment and Forecasting Council of India. Travel, communication and other expenses are paid by the UNEP Ozone Secretariat.

Gary Taylor, Co-Chair of the Halon Technical Options Committee is a principal in the consulting firm Taylor/Wagner, Toronto Canada. Funding for the Halon Technical Options Committee is provided by the Halon Alternatives Research Corporation (HARC). HARC is a not-for-profit corporation established under the United States Co-operative Research and Development Act. Additional funding was provided by HARC to Taylor/Wagner Inc. to develop, maintain and operate the TEAP Web Site. During recent years, Gary Taylor has also undertaken a limited amount of work for UNEP IE and BP (Alaska) as a technical consultant.

Helen Tope, Co-Chair Aerosol Products Technical Options Committee, is a Policy Officer of the Policy Directorate, Environment Protection Authority, Victoria, Australia. EPA Victoria makes in-kind contributions of wage and miscellaneous expenses. Additional funds have been provided until late 1996 from a grant from the U.S. EPA to EPA Victoria. A grant for travel, communication, and other expenses of the Aerosols Technical Options Committee is provided by the International Pharmaceutical Aerosol Consortium (IPAC) via the Protocol Secretariat. IPAC is a not-for-profit corporation.

Robert Van Slooten, Co-Chair of the Economic Options Committee, is an independent economic consultant, following 25 years service in the UK Government Economic Service (London), whose participation in TEAP is funded under contract with the UK Department of the Environment. The contract covers expenses incurred in carrying out TEAP responsibilities and professional fees. Professional fees and expenses for non-TEAP assignments are paid under separate contracts from the commissioning organisations such as UNEP IE and the World Bank.

Ashley Woodcock, Co-Chair Aerosol Products Technical Options Committee, is a Consultant Respiratory Physician at the North West Lung Centre, Wythenshawe Hospital, Manchester, UK. Dr. Woodcock is a full-time practising physician and Senior Lecturer to the University of Manchester. The North West Lung Centre carries out drug trials of CFC-free MDIs and DPIs for pharmaceutical companies. Wythenshawe Hospital makes in-kind contributions of wages and communication and the UK Department of Health sponsors travel expenses.

Zhang Shiqui, Co-Chair of the Economic Options Committee is an Associate Professor of the Center for Environmental Sciences of Peking University and a Research Fellow of the Beijing Environment and Development Institute. Travel, communication and other expenses are paid by the UNEP Ozone Secretariat.

4.2 Technology and Economic Assessment Panel Co-Chairs, Senior Expert Members and Members

Dr. Radhey S. Agarwal (Refrigeration TOC Co-Chair)
Mechanical Engineering Department
Indian Institute of Technology, Delhi
New Delhi - 110016
India
Telephone: 91 11 685 7753, 685 5279 (R)
Fax: 91 11 652 6645, 91-11-685 7753
E-Mail: rsarwal@mech.iitd.ernet.in

Dr. Stephen O. Andersen (Panel Co-Chair, Solvents TOC member)
Director of Strategic Climate Projects
Atmospheric Pollution Prevention Division
United States Environmental Protection Agency
Mail Code 6202J
401 M Street, SW
Washington, DC 20460
U.S.A.
Telephone: 1 202 564 9069
Telefax: 1 202 565 2135
E-Mail: andersen.stephen@epa.gov

Dr. Jonathan Banks (Methyl Bromide TOC Co-Chair in transition)
CSIRO Division of Entomology
GPO Box 1700
Canberra ACT 2601
Australia
Telephone: 61 26 246 4207
Telefax: 61 26 246 4202
E-Mail: jb@ento.csiro.au

Dr. Thomas Batchelor (Methyl Bromide TOC Co-Chair)
P.O. Box 308
Prospect
Tasmania, 7250
Australia
Telephone: 61 3 6334 8682
Fax: 61 3 6334 8683
Email: tombatchelor@compuserve.com

Dr. Walter Brunner (Halons TOC Co-Chair)
envico AG
Gasometerstrasse 9
CH 8031 Zurich
Switzerland
Telephone: 411 272 7475
Telefax: 411 272 8872
E-Mail: wbrunner@access.ch

Dr. Suely Maria Machado Carvalho (Panel Co-Chair and Economics OC member)
Senior Technical Adviser and Deputy Chief
Montreal Protocol Unit
UNDP/EAP/SEED
304 East 45th Street
Room FF9124
New York, NY 10017
USA
Telephone: 1 212 906 6687
Telefax: 1 212 906 6947
E-Mail: suely.carvalho@undp.org

Mr. Jorge Corona (Solvents TOC Co-Chair)
Environmental Commission (CANACINTRA)(Camara Nacional de la Industria de Transformacion)
Cto. Misioneros G-8, Apt. 501, Cd. Satélite
53100, Edo de Mexico
Mexico
Telephone: 52 5 393 3649
Telefax: 52 5 572 9346
E-Mail: jcoronav@supernet.com.mx

Mr. László Dobó (Senior Expert Member)
Hungarian Ministry for Environment and Regional Policy
Fo utca. 44-50
1011 Budapest
Hungary
Telephone: 36 1 457 3565
Telefax: 36 1 201 3056
E-Mail:

Mr. Yuichi Fujimoto (Senior Expert Member)
Japan Industrial Conference for Ozone Layer Protection (JICOP)
Hongo-Wakai Bldg.
2-40-17, Hongo
Bunkyo-ku
Tokyo 113-0033
Japan
Telephone: 81 3 5689 7981 or 7982
Telefax: 81 3 5689 7983
E-Mail: jicop@nisiq.net

Dr. Barbara Kucnerowicz-Polak (Halons TOC Co-Chair)
State Fire Service Headquarters
P.O. Box 20 Ul. Domaniewska 36/38
00-950 Warsaw
Poland
Telephone. 48 22 601 1567
Telefax: 48 22 621 4079
E-Mail: B.J.Polak@oskarpro.com.pl

Dr. Lambert Kuijpers (Panel Co-Chair, Refrigeration TOC Co-Chair)
Technical University
P.O. Box 513
NL5600 MB Eindhoven
The Netherlands
Telephone: 31 40 250 3797 or 31 40 247 3078
Telefax: 31 40 246 6627
E-Mail: lambermp@pi.net

Dr. Mohinder P. Malik (Solvents TOC Co-Chair)
Manager, Materials and Process Technology
Lufthansa German Airlines
Postfach 630300
D22313 Hamburg
Germany
Telephone: 49 40 50 70 2139
Telefax: 49 40 50 70 1397
E-Mail: smtp.mohinder malik@lht.dlh.de

Mr. E. Thomas Morehouse (Senior Expert Member)
Institute for Defense Analyses
1801 North Beauregard St.
Alexandria, VA 22311-1772
U.S.A.
Telephone: 1 703 750 6840
Telefax: 1 703 750 6835
E-Mail: etm1@erols.com / emorehou@ida.org

Dr. David Okioga (Methyl Bromide TOC Co-Chair)
Co-ordinator, National Ozone Unit
Ministry of Environmental Conservation
P.O. Box 67839
Nairobi
Kenya
Telephone: 254 2 242 890 or 242 887
Telefax: 254 2 242 887 or 604 202
E-Mail: silfvenp@unep.org

Mr. Jose Pons Pons (Aerosol Products TOC Co-Chair)
Spray Quimica C.A.
URB.IND.SOCO
Calle Sur #14
Edo Aragua, La Victoria
Venezuela
Telephone: 58 44 223297; 214079; 223891
Telefax: 58 44 220192
E-Mail: joseipons@eldish.net

Ms. Sally Rand (Foams TOC Co-Chair)
Atmospheric Pollution Prevention Division
United States Environmental Protection Agency
Mail Code 6202J
401 M Street, S.W.
Washington, DC 20460
U.S.A.
Telephone: 1 202 564 9739
Telefax: 1 202 565 2135
E-Mail: rand.sally@epa.gov

Dr. Rodrigo Rodriguez-Kábana (Methyl Bromide TOC Co-chair)
Department of Plant Pathology
Auburn University
Auburn, Alabama 36848-5409
U.S.A.
Telephone: 1 334 844 4714
Telefax: 1 334 844 1948
E-Mail: cweaver@acesag.auburn.edu

Mr. Sateeaved Seebaluck (Senior Expert Member)
Principal Assistant Secretary
Ministry of Local Government and Environment
10th Floor
Ken Lee Tower
c/r. St. Georges and Barracks Streets
Port Louis
Mauritius
Telephone: 230 212 7181
Telefax: 230 212 8324
E-Mail: equal@bow.intnet.mu

Ms. Lalitha Singh (Foams TOC Co-Chair)
80 Vigyan lok
Delhi-92
India 110092
Telephone: 91 11 214 9573
Telefax: 91 11 332 7223 or 91 11 331 3318
E-Mail:

Mr. Gary M. Taylor (Halons TOC Co-Chair)
Taylor/Wagner Inc.
19 Pleasant Avenue
Willowdale, Ontario M2M 1L8
Canada
Telephone: 1 416 222 9715
Telefax: 1 416 250 0967
E-Mail: GTaylor@taylorwagner.com

Dr. Helen Tope (Aerosol Products TOC Co-Chair)
Policy Directorate
Environment Protection Authority
477 Collins Street
GPO Box 4395QQ
Melbourne, Victoria 3001
Australia
Telephone: 61 3 9628 5522
Telefax: 61 3 9628 5699
E-Mail: helen.tope@epa.vic.gov.au

Dr. Robert van Slooten (Economics Options Committee Co- Chair)
Economic Consultant
St. Mary's Cottage, Church Street
Worlingworth, Suffolk IP13 7NT
United Kingdom
Telephone: 44 1728 628 677
Telefax: 44 1728 628 079
E-Mail: RVS@anglianet.co.uk

Dr. Ashley Woodcock (Aerosol Products TOC Co-Chair)
North West Lung Centre
Wythenshawe Hospital
Manchester M23 9LT
United Kingdom
Telephone: 44 161 291 2398
Fax: 44 161 291 5020
E-Mail: ashley@nwlung.u-net.com

Ms. Shiqui Zhang (Economics Options Committee Co-Chair)
Associate Professor
Center for Environmental Sciences
Peking University
Beijing 100871
The People's Republic of China
Telephone: +(86) 10-627-51921
Fax: +(86) 10-627-51927
Email: zhangshq@mail.ied.ac.cn

Technology and Economic Assessment Panel (TEAP)

Co-Chairs	Affiliation	Country
Stephen O. Andersen	Environmental Protection Agency	USA
Suely Carvalho	Montreal Protocol Unit - UNDP-NY	Brazil
Lambert Kuijpers	Technical University Eindhoven	Netherlands

Senior Expert Members	Affiliation	Country
László Dobó	Ministry for Environment and Regional Policy	Hungary
Yuichi Fujimoto	Japan Industrial Conference for Ozone Layer Protection	Japan
Thomas Morehouse	Institute for Defense Analyses	USA
Sateeaved Seebaluck	Ministry of Local Government and Environment	Mauritius

Panel Members (TOC Chairs)	Affiliation	Country
Radhey S. Agarwal	Indian Institute of Technology Delhi	India
Jonathan Banks	Commonwealth Scientific and Industrial Research Organisation (CSIRO)	Australia
Thomas Batchelor	Consultant	Australia
Walter Brunner	envico	Switzerland
Jorge Corona	CANACINTRA(National Chamber of Industry)	Mexico
Barbara Kucnerowicz-Polak	State Fire Service	Poland
Mohinder Malik	Lufthansa German Airlines	Germany
David Okioga	Ministry of Environmental Conservation	Kenya
Jose Pons Pons	Spray Quimica	Venezuela
Sally Rand	Environmental Protection Agency	USA
Rodrigo Rodriguez-Kábana	Auburn University	USA
Lalitha Singh	Consultant	India
Gary Taylor	Taylor/Wagner	Canada
Helen Tope	Environment Protection Authority, Victoria	Australia
Robert van Slooten	Consultant	UK
Ashley Woodcock	University Hospital of South Manchester	UK
Shiqiu Zhang	Peking University	China

TEAP Aerosols, Sterilants, Miscellaneous Uses andCarbon Tetrachloride Technical Options Committee

Co-Chairs	Affiliation	Country
Jose Pons Pons	Spray Quimica	Venezuela
Helen Tope	Environment Protection Authority, Victoria	Australia
Ashley Woodcock	University Hospital of South Manchester	UK

Members	Affiliation	Country
D.D. Arora	Tata Energy Research Institute	India
Paul Atkins	Glaxo Wellcome PLC	UK
Olga Blinova	Russian Scientific Centre "Applied Chemistry"	Russia
Nick Campbell	ICI Klea	UK
Hisbello Campos	Ministry of Health	Brazil
Christer Carling	Astra Draco	Sweden
Francis M. Cuss	Schering Plough Research Institute	USA
Chandra Effendy	p.t. Candi Swadaya Sentosa	Indonesia
Carmen Flasch	Boehringer Ingelheim Pharma KG	Germany
Charles Hancock	Charles O. Hancock Associates	USA
Eamonn Hoxey	Medical Devices Agency	UK
Zhangxi Hua	China National Council of Light Industry	China
Javaid Khan	The Aga Khan University	Pakistan
P. Kumarasamy	Aerosol Manufacturing Sdn Bhd	Malaysia
Robert Layet	Ensign Laboratories	Australia
Robert Meyer	Food and Drug Administration	USA
Robert F. Morrissey	Johnson & Johnson	USA
Geno Nardini	Instituto Internacional del Aerosol	Mexico
Dick Nusbaum	Penna Engineering	USA
Tunde Otulana	Aradigm Corporation	USA
Martyn Partridge	Whipps Cross Hospital	UK
Fernando Peregrin	AMSCO/FINN-AQUA	Spain
Jacek Rozmiarek	Polfa Poznan S.A.	Poland
Abe Rubinfeld	Royal Melbourne Hospital	Australia
Daisaku Sato	Ministry of Health and Welfare	Japan
Albert L. Sheffer	Brigham and Women's Hospital	USA
Greg Simpson	CSIRO, Molecular Science	Australia
Robert Suber	RJR-Nabisco	USA
Ian Tansey	3M Health Care	UK
David Townley	Boehringer Ingelheim International	Germany
Adam Wanner	University of Miami	USA
Chip Woltz	Allied Signal	USA

TEAP Economic Options Committee

Co-Chairs	Affiliation	Country
Robert Van Slooten	Consultant	UK
Zhang Shiqiu	Peking University	China
Members	**Affiliation**	**Country**
Penelope Canan	University of Denver	USA
Suely Carvalho	MPU/SEED,UNDP-NY	Brazil
Stephen DeCanio	University of California	USA
Shreekant Gupta	University of Delhi	India
H.B.L. Lunogelo	Agrisysterms Ltd	Tanzania
Anil Markandya	University of Bath	UK
Melanie Miller	Consultant	Australia
David O'Connor'	Senior Consultant, OECD	USA
Sergio Oxman	KIEN Consultants	Chile
James Schaub	Dept of Agriculture	USA
John VanSickle	University of Florida	USA
Diego Velasco	Department of Environment	Colombia

TEAP Flexible and Rigid Foams Technical Options Committee

Co-Chairs	Affiliation	Country
Sally Rand	Environmental Protection Agency	USA
Lalitha Singh	Consultant	India

Members	Affiliation	Country
Godfrey Abbott	Dow Europe/Exiba	Switzerland
Kuninari Araki	Hitachi	Japan
Paul Ashford	Caleb Management Services	UK
Ted Biermann	BASF Corporation	USA
Mike Cartmell	ICI Polyurethanes	USA
John Clinton	Intech Consulting	USA
Mike Jeffs	ICI Polyurethanes	Belgium
Robert Johnson	Whirlpool Product Evaluation Services	USA
Akihide Katata	Japanese Electronics Manufacturers Association	Japan
Ko Swee Hee	Jumaya Industries SDN.BHD.	Malaysia
Kee-Bong Lee	LG Electronics	Korea
Candido Lomba	Instituto Nacional do Plastico	Brazil
Yehia Lotfi	Technocom	Egypt
Heinz Meloth	Cannon	Italy
Risto Ojala	MPU/SEED/UNDP-NY	Finland
Robert Russell	Dow Plastics	USA
M. Sarangapani	Polyurethane Association of India	India
Shigeru Tomita	Kurabo Industries Ltd.	Japan
Bert Veenendaal	RAPPA	USA
Dave Williams	Allied Signal	USA

TEAP Halons Technical Options Committee

Co-Chairs	Affiliation	Country
Walter Brunner	envico AG	Switzerland
Barbara Kucnerowicz-Polak	State Fire Service Headquarters	Poland
Gary Taylor	Taylor/Wagner Inc.	Canada

Members	Affiliation	Country
Yusof Bin Sidek	Fire and Rescue Department	Malaysia
Richard Bromberg	Gespi Ind. Com. de Equip. Aeronauticos Ltda	Brazil
David V. Catchpole	BP Exploration (Alaska) Inc.	USA
Michelle M. Collins	National Aeronautics and Space Administration	USA
Robert L. Darwin	Naval Sea Systems Command	USA
Phil J. DiNenno	Hughes Associates Inc.	USA
Annie Illett	Environment Australia	Australia
Matsuo Ishiama	Halon Recycling & Banking Support Committee	Japan
H. S. Kaprwan	Defence Institute of Fire Research	India
Nicolai P. Kopylov	All-Russian Res. Institute for Fire Protection.	Russia
David Liddy	Ministry of Defence	UK
Arthur Lim	ABL Lim (FPC) Pte. Ltd.	Singapore
Guillermo Lozano	GL & Associados	Venezuela
John J. O'Sullivan, M.B.E	British Airways	UK
Erik Pedersen	World Bank	Denmark
Reva Rubenstein	Environmental Protection Agency	USA
Roy Young	Consultant	UK
Hailin Zhu	Tianjin Fire Research Institute	China

Consulting Experts	Affiliation	Country
David Ball	Kidde Graviner Limited	UK
Thomas A Cortina	Halon Alternatives Research Corporate	USA
David England	Wormald Ansul (UK) Limited	UK
Steve McCormick	Army SARD-ZCS-E	USA
Joseph A. Senecal	Kidde-Fenwal Inc.	USA
Ronald Sheinson	Navy Research Laboratory	USA
Ronald W. Sibley	DoD Ozone Depleting Substances Reserve	USA
Malcolm Stamp	Great Lakes Chemical (Europe) Limited	UK
Robert E. Tapscott	University of New Mexico	USA
Daniel Verdonik	Hughes Associates Inc.	USA
Brian Ward	Kidde Fire Protection	UK
Robert T. Wickham	Wickham Ass.	USA
Michael Wilson	Michael Wilson & Associates	Australia

TEAP Methyl Bromide Technical Options Committee

Co-Chairs	Affiliation	Country
Thomas Batchelor	Consultant	Australia
David Okioga	Ministry of Environmental Conservation	Kenya
Rodrigo Rodriguez-Kábana	Auburn University	USA

Members	Affiliation	Country
Jonathan Banks	Commonwealth Scientific & Industrial Research Organization	Australia
Antonio Bello	Centro de Ciencias Medioambientales	Spain
Chris Bell	Central Science Laboratory	UK
Mohamed Besri	Department of Plant Pathology, Institut Agronomique et Vétérinaire Hassan	Morocco
Chamlong Chettanachitara	Department of Agriculture	Thailand
Miguel Costilla	Agro-Industrial Obispo Colombr	Argentina
Sheila Daar	Bio-Integral Resource Center	USA
Ricardo Talavera Deang	Fertilizer & Pesticide Authority	Philippines
Patrick Ducom	Ministère de l'Agriculture et de la Pêche	France
Linda Dunn	Industry Canada	Canada
Seizo Horiuchi	National Res. Inst. of Vegetables	Japan
Mohd. Ridzuan Ismail	Department of Agriculture	Malaysia
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Fusao Kawakami	Yokohama Plant Protection, MAFF	Japan
Maria Lodovica-Gullino	University of Turin	Italy
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Melanie Miller	Consultant	Australia
S.K.Mukerjee	Ministry of Environment and Forests	India
Juarez Müller	Empresa de Pesquisa Agropecuária e Extensão	Brazil
Maria Nolan	Department of the Environment	UK
Grace J.A. Ohayo-Mitoko	HEWA/PANEA	Kenya
Ian Porter	Institute of Horticultural Development	Australia
Michael Host Rasmussen	Ministry of Environment	Denmark
John Sansone	SCC Products	USA
Don Smith	Industrial Research	New Zealand
Stappies Staphorst	Plant Protection Research Institute	South Africa
Robert Tayl		
K Bill Thom	s Environmental Protection Agen / r Natural Resources Institu	y U
A Joop van Haaster	n Ministry of Housing, Spatial Planni and the Environme	g Netherlan
t Kenneth Vi	k United States Department of Agricultu	e U
A Yuejin Wa	g Institute of Plant Quaranti	e Chi
a Chris Wats	n IGR	
K James Wel	s California Environmental Protection Agen	y U
Frank V. Westerlu	d California Strawberry Advisory Boa	d U

TEAP Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee

Co-Chair	Affiliation	Country
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Lau Vors	L&E Teknik og Management	Denmark
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TEAP Solvents, Coatings and Adhesives Technical Options Committee

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Jorge Corona	CANACINTRA (National Chamber of Industry)	Mexico
Mohinder Malik	Lufthansa German Airlines	Germany

Members	Affiliation	Country
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John Stemniski	Charles Stark Draper Labs	USA
Katsuyuki Takei	Japan Assoc. for Hygiene of Chlorinated Solvents	Japan
John Wilkinson	Vulcan Materials	USA
Masaaki Yamabe	Asahi Glass	Japan
X'Avier HK Yoong	National Semiconductor	Malaysia

1998 Meeting Schedule for the TEAP and TOCs
(For the budget decided at the 9th MOP)

Body	Dates	Location
TEAP	24 - 28 March	Mauritius
	October	Washington, USA
ATOC	19 - 23 March	Mauritius
EOC	18 - 22 February	Denver, USA
	1 - 5 June	Bath, UK
	1 - 5 September	Beijing, China
FTOC	14 - 16 March	Delhi, India
	15 March (Workshop)	Delhi, India
	22 - 23 July	Brussels, Belgium
HTOC	23 - 26 February	Paris, France
	14 - 16 September	Korea
	17 September (Workshop)	Korea
MBTOC	13 - 16 January	Canberra, Australia
	18 - 22 May	Agadir, Morroco
	6 - 14 September	Mexico or U.K.
RTOC	16 - 18 March	Delhi, India
	5 - 7 June	Oslo, Norway
	6 - 7 October	Nuremberg, Germany
STOC	23 - 25 February	Brussels, Belgium
	8 - 10 June	Moscow, Russia

Glossary of Terms

AFEAS	Alternative Fluorocarbon Environmental Acceptability Studies
ARI	Air Conditioning and Refrigeration Institute
ASEAN	Association of South-East Asian Nations
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASTM	American Society of Testing and Materials
ATOC	Aerosols, Sterilants, Miscellaneous Uses and Carbon Tetrachloride TOC
CANACINTRA	Camara National de la Industria de la Transformacion (Mexico)
CCMS	Committee on the Challenges of a Modern Society (NATO)
CECOM	Communications Electronics Command
CEIT	Countries with Economies in Transition
CFC	Chlorofluorocarbon
COPD	Chronic Obstructive Pulmonary Disease
CTC	Carbon Tetrachloride
DIFR	Defense Institute for Fire Research (India)
DLA	Defense Logistics Agency (USA)
DME	Dimethyl Ether
DoD	Department of Defense (USA)
DPI	Dry Powder Inhaler
DSCS	Defense Supply Center Columbus
EO	Ethylene Oxide
EOC	Economic Options Committee
EPA	Environmental Protection Agency (USA)
EU	European Union
FAA	Federal Aviation Administration (USA)
FDA	Food and Drug Administration
FOE	Friends of the Earth
FTOC	Foams Technical Options Committee
GEF	Global Environmental Facility
GINA	Global Initiative on Asthma
GSA	General Services Administration (USA)
GWP	Global Warming Potential
HAG	Halon Alternatives Group (UK)
HAP	Hydrocarbon Aerosol Propellant
HARC	Halon Alternatives Research Corporation (USA)
HBFC	Hydrobromofluorocarbon
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
HRAI	Heating, Refrigeration and Air Conditioning Institute (Canada)
HTOC	Halons Technical Options Committee
HUNC	Halon Users National Consortium (UK)
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization

ICEL	International Cooperative for Environmental Leadership
ICOLP	International Cooperative for Ozone Layer Protection
IMACA	International Mobile Air Conditioning Association
IPAC	International Pharmaceutical Aerosol Consortium
IPM	Integrated Pest Management
ISO	International Standards Organization
ITRI	Industrial Technology Research Institute (Japan)
JAHCS	Japan Association for Hygiene of Chlorinated Solvents
JEMA	Japan Electrical Manufacturers Association
JICC	Japan Industrial Conference on Cleaning
JICOLP	Japan Industrial Conference on Ozone Layer Protection
LCD	Liquid Carbon Dioxide
LPG	Liquified Petroleum Gas
MACS	Mobile Air Conditioning Society (USA)
MB	Methyl Bromide
MBTOC	Methyl Bromide Technical Options Committee
MCF	Methyl Chloroform (also 1,1,1 Trichloroethane)
MDI	Metered Dose Inhaler
METAG	Military Electronics Technology Advisory Group
MITI	Ministry of International Trade and Industry (Japan)
MLF	Multilateral Fund
NAFED	National Association of Fire Equipment Distributors (USA)
NASA	National Aeronautics and Space Adminstration (USA)
NATO	North Atlantic Treaty Organization
NAVAIR	Naval Air Systems Command (USA)
NAVSEA	Naval Sea Systems Command (USA)
NFPA	National Fire Protection Association
NGO	Non-governmental Organization
NHLBI	National Heart, Lung and Blood Institute
NMERI	New Mexico Engineering Research Institute (USA)
NOAA	National Oceanographic and Atmospheric Administration (USA)
NRDC	Natural Resources Defense Counsel
NRL	Naval Research Laboratory (USA)
ODS	Ozone Depleting Substance
PAFT	Program for Alternative Fluorocarbon Testing
PATF	Process Agent Task Force
PIMA	Polyisocyanurate Insulation Manufacturers Association
PUF	Polyurethane Foam
QPS	Quarantine and Preshipment
RSES	Refrigeration Service Engineers Society
RTOC	Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee
SAE	Society of Automobile Engineers
SEAP	South East Asia Pacific
SEDUE	Secretaria de Desarollo Urbano y Ecologia

SISIR	Singapore Institute of Standards and Industrial Research
SME	Small and Medium Sized Enterprises
STOC	Solvents, Coatings and Adhesives Technical Options Committee
TCA	1,1,1, Trichloroethane (also Methyl Chloroform)
TEAP	Technology and Economics Assessment Panel
TOC	Technical Options Committee
Tonne	1000 kilograms
UBC	Uniform Building Code (USA)
UFC	Uniform Fire Code (USA)
UL	Underwriters Laboratory
UMC	Uniform Mechanical Code (USA)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP IE	UNEP Industry and Environment
UNIDO	United Nations Industrial Development Organization
VOC	Volatile Organic Compound
WHO	World Health Organization
WMO	World Meteorological Organization
WRI	World Resources Institute
XPS	Extruded Polystyrene