MONTREAL PROTOCOL

ON SUBSTANCES THAT DEPLETE

THE OZONE LAYER

UNEP

REPORT OF THE
TECHNOLOGY AND ECONOMIC ASSESSMENT PANEL

MAY 2006

PROGRESS REPORT

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Montreal Protocol
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Report of the UNEP Technology and Economic Assessment Panel

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Foreword

In May 2006, TEAP produced two reports as follows:

1. May 2006 TEAP Progress Report

The Progress Report contains an Executive Summary of all TEAP Progress Report topics. Volume 1 contains the essential use report, progress reports of all TOCs, the MB QPS report, the MB CUN report, an update report on military uses, draft Terms of Reference for case studies, TEAP organisation and working modalities issues, as well as TEAP member biographies and TEAP and TOC membership lists.

2. Special Report:'Validating the Yield Performance of Alternatives to Methyl Bromide for Preplant Fumigation'

The Special Report is a meta-analysis validating the yield performance of alternatives to methyl bromide. The conclusions of the analysis were used by the MBTOC in the evaluation of some Critical Use Nominations for 2008.

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The TEAP thanks the College of Environmental Sciences, Peking University, Beijing, for hosting the TEAP meeting, 24-28 April 2006, where this report was composed and reviewed, and thanks in particular its member Shiqiu Zhang, for making all necessary arrangements in a very forthcoming and outstanding way.

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Review of Essential Use Nominations for Metered Dose Inhalers

The following table summarises the recommendations of the Technology and Economic Assessment Panel (TEAP) and its Medical Technical Options Committee (MTOC) on nominations for essential use production exemptions for chlorofluorocarbons (CFCs) for metered dose inhalers (MDIs).

	European Community	United States
2007	Recommend exemption for CFCs for MDIs for 535 tonnes (no volumes are for single-moiety salbutamol to be sold within the EC).	-
2008	-	Recommend exemption for CFCs for MDIs for 385 tonnes (no volumes are for single-moiety salbutamol).

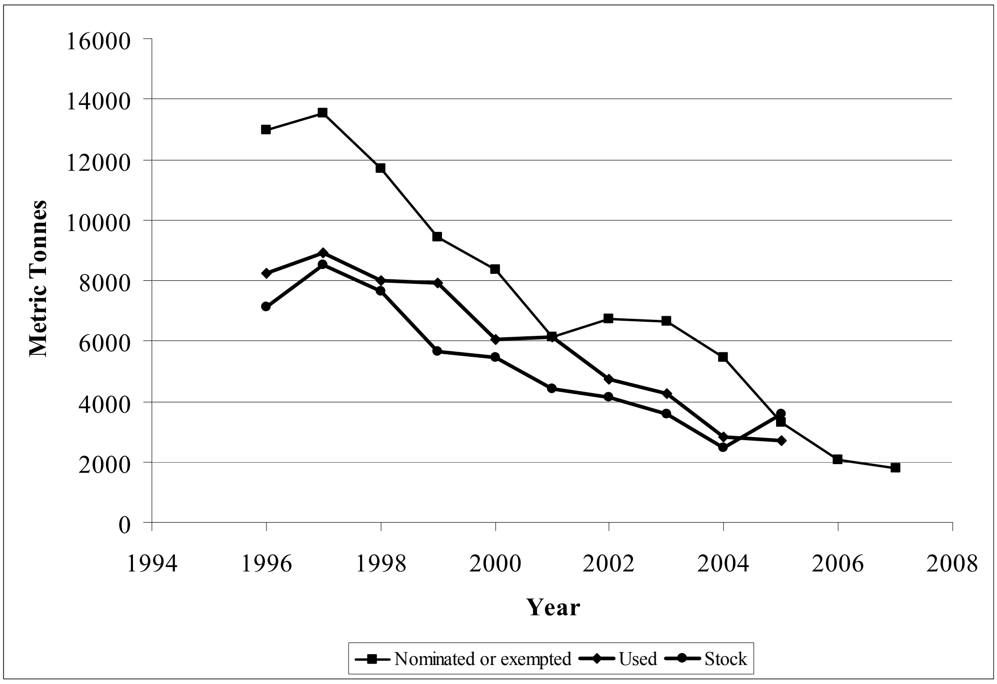
Both of these nominations raise a number of concerns that highlight the considerable difficulties in the tail of the CFC MDI phase-out process. While recommending approval of these nominations, MTOC notes that future nominations must address the concerns outlined in section 1.1.4 for requests to be recommended.

MTOC expects that nominating Parties will manage their processes so that production of CFC MDIs will cease by the end of 2009 for domestic use and for export to Article 5(1) countries. Taking into account stockpiles, MTOC would not anticipate nominations from non-Article 5(1) countries for substantial quantities of CFCs for MDIs for the year 2009.

Medical TOC Technical Progress

The figure below shows the use of CFCs for the production of MDIs for asthma and chronic obstructive pulmonary disease (COPD) in non-Article 5(1) countries. In 2005, 2,699 tonnes of CFCs were used by non-Article 5(1) countries in MDI manufacture under essential use exemptions, as reported through accounting frameworks. This represents a 5 per cent reduction in use compared to 2004.

Quantities of CFCs for MDI manufacture in non-Article 5(1) countries



(Note that in 2005, 'stock' includes 605 tonnes of pre-1996 stock in the United States, which is yet to be allocated by the United States, yet to be sold by Honeywell and available only under agreement with certain United States companies, and 'used' does not include the Ukraine from which an accounting framework was not received in time)

Technically satisfactory alternatives to CFC MDIs are available for short-acting beta-agonists and other therapeutic categories for asthma and COPD. However, it is clear from accumulating experience that the availability of alternate products cannot alone lead to a full uptake in the market without additional regulatory action.

The management of stockpiles at this final stage of the phase-out will be extremely important to avoid unnecessary production of CFCs for essential use. Parties may wish to remind CFC MDI producers that any CFCs obtained under essential use exemptions must be used for the essential uses (including through a transfer), transferred to an Article 5(1) country for basic domestic needs, or destroyed. MTOC is concerned that some users may try to circumvent this rule by claiming that their remaining stockpiles are pre-1996. To ensure transparency, any pre-1996 stocks should be accounted for in the Reporting Accounting Framework for Essential Uses. In addition, Decision IV/25 (Report of the TEAP, May 2005, Progress Report, section 1.1.4.1, page 35) requires companies that hold pre-1996 stocks to use them first before using newly produced CFCs.

Article 5(1) countries must phase out all CFC production by the end of 2009 in line with the Montreal Protocol. Given the widespread availability of technically and economically feasible alternatives, MTOC believes that global phase-out of CFC MDIs will be achievable by 2010. To ensure this occurs, there is an urgent need for all Article 5(1) countries that have not yet done so to develop effective national transition strategies in accordance with Decision XII/2. MTOC strongly recommends that these activities be made a priority to ensure a smooth transition to CFC-free MDIs congruent with the Montreal Protocol phase-out schedule.

The Montreal Protocol phase-out date for CFCs in Article 5(1) countries is less than four years away and considerable challenges will need to be addressed to achieve transition in Article 5(1) countries. On preliminary evaluation, it does not appear that formulation patents will provide an insurmountable barrier to the introduction of CFC-free MDIs into Article 5(1) countries. The challenges can be overcome through the transfer of technology, product launches of CFC-free alternatives and implementation of comprehensive transition strategies.

Nonetheless, if Article 5(1) countries face difficulties in achieving transition by 2010, a final campaign production may need to be considered to ensure CFC supply for MDI manufacturing beyond 2009, if absolutely necessary to protect patient health. Opting for an essential use process may be counter-productive. After 2009, the economics of CFC production will probably make pharmaceutical-grade CFC production for MDIs impractical. Depending upon operational parameters, experience has shown that a bulk CFC production facility will produce a certain percentage of CFCs that do not meet the rigorous specifications required by MDI manufacturers operating in non-Article 5(1) countries. Currently, CFCs that do not meet pharmaceutical specifications can be used for basic domestic consumption. This will not be possible after 2009 when these non-pharmaceutical grade CFCs would need to be destroyed, the costs of which will be significant. If these costs were projected to be prohibitive, it may be more appropriate to arrange for a campaign to produce CFCs before the Montreal Protocol phase-out, for use thereafter if needed.

As overall CFC consumption is being stepped down under the Montreal Protocol, a reduction to 15 per cent of baseline consumption will have to be met in 2007. If some Article 5(1) countries still have CFC requirements for MDI manufacture that are greater than the allowed amount for that year, those countries might be in a potential non-compliance situation.

Foams TOC Technical Progress

The key changes in technology and transitions that have occurred in the last year are:

Transitional Status - Developing Countries

- Virtually all transition projects phasing out CFCs are materially complete in non-insulation areas and reaching completion in insulation applications. However, many projects are still awaiting formal closure.
- HCFCs continue to be the major blowing agent in virtually all insulation applications despite the increasing use of hydrocarbons in domestic appliances.
- The use of hydrocarbon-blown foam in appliances continues to gain ground, particularly in the larger countries of Asia and Latin America, where they are in the majority.
- Some use of HFC-blown foam is emerging in appliances (primarily for export markets) and in OCF (One Component Foam), integral skin foam and shoe soles.
- CFC prices are now consistently above those of HCFCs and are thus driving the remaining transition.

- Significant development of insulation markets in China is driving rapid introduction of XPS (expanded polystyrene) facilities using HCFC technologies

- Consideration is being given to bank management projects in some countries although foam recovery may be difficult logistically, particularly in remote regions.

Transitional Status - Developed Countries

- The use of HCFC-141b in insulation foams is now very limited following introduction of use-bans in key markets.

- Although the supply position has been stabilised in the European Union, the actual uptake of HFCs following HCFC phase-out has been lower than previously predicted.

- Insulation demand continues to grow rapidly in several markets in response to more stringent building and appliance energy efficiency requirements.

- Super-critical CO_2 spray foam technologies have now been commercially introduced in Japan, although the applicability of such technologies to other geographic regions is still unclear.

- Research continues into further blowing agent options, although it is unlikely that the dominant position of hydrocarbons in polyurethane insulation applications will be challenged in the foreseeable future.

- Regulatory, economic and market pressures continue to limit HFC uptake and make further investment in dedicated HFC blowing agents unlikely in the short term.

Other relevant issues

- Work continues on improving emissions forecasting and bank estimation. Latest information suggests that there is greater consistency between atmospheric emission estimates and bottom-up model outputs than first thought.

- Recovery of blowing agents from appliances continues to be practised although recovery levels vary significantly.

- The practicality and economics of ODS recovery from building insulation is still under review although the potential is expected to be limited to certain construction types only.

Halon TOC Technical Progress

The HTOC Lead Authors for the 2006 Assessment Report met on March 6-8, 2006 in Paris, France, to update the status of the transition away from halons for all sectors of use.

The HTOC believes that issues concerning the Article 5(1) countries need particular attention and this is reflected in the composition of the Committee, which includes five new members from

Article 5(1) countries: Brazil, Jordan, Singapore, South Africa, and South Korea, and two new Technical Consultants from Article 5(1) countries: Brazil and Jordan.

As reported at the 17th meeting of the Parties, an HTOC authored article on alternatives and the status of their current use in civil aviation was published in the December 2005 issue of the ICAO Journal. A study on halon usage within civil aviation is nearing completion and the results will be published in the HTOC 2006 Assessment Report, as well being provided to ICAO for their use

In working with the Science Panel, the HTOC discovered a transcription error in the halon-1211 model that overstated Article 5(1) production. With the error corrected, the updated HTOC halon-1211 model prediction of emissions is more in line with the latest atmospheric measurements. However, currently the HTOC model for halon-1301 remains inconsistent with the latest atmospheric data. The model consistently over estimates emissions compared to that data and therefore, with less loss from the bank, the bank of halon-1301 may be significantly larger than the model predicts.

The HTOC just recently learned that newly produced halon-1301 (bromotrifluormethane, CF_3Br) is currently being used as a feedstock for the manufacture of a pesticide. The initial understanding of the HTOC is that this is a long-standing process that first occurred in a non-Article 5(1) country that has now also been transferred to at least one Article 5(1) country. This may be an important issue if use as a feedstock continues and the production could be seen as a future source of halon-1301 for fire protection Essential Use Production Exemptions.

The new HTOC members from Article 5(1) countries confirmed problems with the transition away from halons in some regions, particularly within the airline industry where Middle East airlines have had difficulty convincing manufacturers to supply new aircraft with halon alternatives. They also confirmed contamination of halon stocks with CFCs and other materials. The Halon Bank of South Africa reported that 95% of halon-1301 that it tested does not meet the ISO specification and is commonly contaminated with halon-1211 and/or water.

There is growing concern about the availability of halon-2402 outside of Russia to support existing uses such as aircraft and military vehicles. In particular, India has reported a growing shortage that could be problematic.

The extent of the destruction of halons outside of Australia and the European Union is not very well understood. A new plasma arc destruction facility is being constructed in the United States and is expected to start operations in April 2006.

Refrigeration, AC and Heat Pumps TOC Technical Progress

In general, the phase-out of CFCs in the manufacturing of new refrigeration and air-conditioning systems is now almost complete in Article 5(1) countries. Some of these countries have even started using alternative technologies to HCFCs to meet their export markets. However, there is a continuing substantial use of CFCs in the servicing of existing equipment in Article 5(1) countries.

For ***new alternative refrigerants*** the search continues. Research is being conducted for updating the thermophysical properties of new and existing single component refrigerants as well as blends. The information on thermophysical properties for heat transfer fluids (HTF) is also being updated.

In ***domestic refrigeration***, HFC-134a and HC-600a continue to be the dominant refrigerant options. Conversion of Article 5(1) country domestic refrigerator production from CFC-12 to either HFC-134a, HC-600a or HC-600a/HC-290 blends continues. Refrigerator energy-efficiency is an important product attribute. Data indicate that a new unit typically will use less than one-half the energy of the unit it replaces.

Commercial refrigeration is one of the important components in the food chain. In stand-alone units, replacement of CFCs by non-CFCs is now almost complete in Article 5(1) countries; here the refrigerants of choice are HFC-134a, HC-600a or the blend HC-600a /HC-290. For condensing and centralised systems the preferred refrigerant options are HFC-134a, R-404A and R-507 in non-Article 5(1) countries. The production of condensing units is particularly growing in Article 5(1) countries. In these countries, HCFC-22 is the refrigerant of choice while HFC-134a and R-404A are being introduced in some applications.

In ***large size refrigeration systems,*** CO_2 is emerging as one of the technical options and can be used both as heat transfer fluid and refrigerant. The CO_2 technology has been applied in the US, Japan and Europe. In 2004 and 2005, retrofitting of several systems from HCFC-22 to CO_2 or brine systems proceeded, particularly in the cold storage sector. Trends towards small NH_3 charges continue to increase, even in industrial refrigeration systems. Increasing interest for non-ODP technologies is now reported from some large Article 5(1) countries, where the use of HCFC-22 is stable or slightly increasing.

In ***transport refrigeration,*** HFC-134a and R-404A or R-507A are applied. The use of R-410A will further advance. The leakage rates in transport refrigeration equipment are still higher than the industrial average. All transport refrigeration sub-sectors are characterized by rough conditions, therefore emissions are higher than in other applications

Unitary air- conditioning is gradually converting from ODS to non-ODS technologies. In Japan, the transition to non-ODP technologies (mainly HFC refrigerants) in new equipment is nearly complete. In the United States, residential (7 to 15 kW) ducted systems are now installed with R-410A. In Europe, HCFC replacement technologies have included both hydrocarbon and HFC refrigerants with HFC refrigerants being the predominant technology. Rapid growth in unitary air-conditioner production in China (primarily ductless split air conditioners) continues to increase China's use of HCFC-22. Approximately 21 million ductless split air conditioners were produced for the Chinese domestic market in 2005.

Centrifugal chillers*:* replacement of existing CFC chillers by non-CFC chillers is proceeding further in the non-Article 5(1) countries and is expected to be complete around the year 2010. Only just the savings in energy costs justify the replacement of an aging CFC chiller with a new non-CFC chiller. Today's average chillers use 35% less electricity compared to the average electricity use of chillers produced 20 years ago. Production of new HCFC-22 chillers with positive-displacement compressors is being phased out in most non-Article 5(1) countries. Two trends are important in chiller development at present, i.e., energy efficiency improvements and reduced refrigerant emissions through design changes.

Water-heating heat pump markets are significant in Europe, Japan, and China. HCFC-22 is still used in this sector but manufacturers are changing to offer models using HFC-134a and R-410A. Hydrocarbons are used as refrigerants in some smaller, low-charge heat pumps in Europe.

***In mobile air conditioning**,* HFC-134a has now fully replaced CFC-12 as the globally accepted mobile A/C (MAC) refrigerant. Due to concerns about greenhouse gas emissions from MAC systems, efforts have been made to use low GWP refrigerants, such as HFC-152a, CO_2 and others. Via an industry-government co-operative research program (known as SAE I-MAC) HFC-134a emissions are reduced and A/C system efficiency is improved. In the timeframe 1998-2006, the leading potential replacement refrigerant in Europe has been carbon dioxide. Almost all global vehicle manufacturers and suppliers are currently working on such systems and many have already demonstrated prototype cars. Currently, technical and commercial hurdles still exist that require resolution. Recently three or more chemical companies have each announced a new low GWP refrigerant blend that can replace HFC-134a in MAC. These new chemicals need to be fully assessed for acceptability, which includes toxicity and performance testing.

Refrigerant conservation is becoming more and more important .New stationary and mobile systems with HFCs are now systematically designed for low emission rates. This is achieved by selecting tighter components and tighter complete systems. A number of non-Article 5(1) countries have started the implementation of regulations for the recycling of refrigerant at the end of life for all equipment, not just for domestic appliances and cars that reach end-of-life status.

Chemicals TOC Technical Progress

The CTOC met on February 13-15, 2006 in Paris, France, at the facility provided by EADS (European Aeronautic Defence and Space Company) through the courtesy of Airbus and Avantec companies.

The main purpose of the meeting was to assign responsibilities to prepare the 2006 Assessment Report as well as to respond to specific requests made by Parties through the corresponding decisions.

Process Agents

The 17th Meeting of the Parties, held in Dakar, Senegal in December 2005, decided to approve three decisions, XVII/6, XVII/7 and XVII/8 on process agents. Decision XVII/6(6) requests the TEAP and the ExCom to report to the 27th OEWG in 2007, and every other year thereafter, on the progress (emission reduction, make-up quantities, implementation of emission reduction techniques, alternative processes etc.) of the applications listed in Table A. Further XVII/6(7) requests the TEAP to report and make recommendations to the Parties at the 20th MOP in 2008, and every other year thereafter, on the process agent uses that could be added to or deleted from Table A of Decision X/14. Regarding Table B of Decision X/14, the TEAP is requested to review in 2008, and every other year thereafter, emissions in Table B, taking into account information and date reported by the Parties and to recommend any reductions to the make-up and maximum emission on the basis of that review. Finally the Decision XVII/8 adopted a new list of controlled substances as process agents as an interim Table A-bis for Decision X/14. Parties are requested to submit data of the applications listed in Decisions XVII/7 and XVII/8 before 31 December 2006 to the Secretariat and the TEAP to be reconfirmed and reassessed as process agents at the 19th MOP in 2007.

The CTOC came to consensus for the applications submitted in 2005 by Turkey and Brazil as summarized below.

The CTOC reviewed the process described by Brazil for the manufacture of vinyl chloride monomer (VCM) from ethylene dichloride (EDC), with a thermal conversion whose energy efficiency is enhanced by the presence of carbon tetrachloride (CTC) at a level of ca. 1000 ppm. The CTOC noted that the addition of fresh CTC stopped in the year 2000 and as a consequence the company is currently consuming additional natural gas for this process at additional cost.

The CTOC concludes that this is a Process Agent use, however the CTOC notes that it was phased out by Brazil in 2000.

The CTOC reconsidered the use of bromochloromethane (BCM) in the production of Sultamicillin by the Republic of Turkey. The CTOC concluded that the most part of the bromochloromethane (BCM) is used as process agent and a small part as a feedstock. The fact that a small part is feedstock is proven by the role of BCM in the reaction as a chloromethylating agent. The CTOC noted that emissions from the Process Agent use were in the range of 30 to close to 200 tonnes during 1999-2002 and averaged 110.2 tonnes during 2002-2004

The CTOC recommends that the use of BCM in the process described by Turkey be classified as a Process Agent, even though a small part of BCM is consumed in the reaction as a feedstock.

Alternatives to Process Agents

During the review of the numerous Process Agent Uses included in Table A of Decision XVII/7 and in Table A-bis of Decision XVII/8, TEAP considered that in many instances HCFCs could offer the unique properties required in these chemical processes i.e. non flammable, good chemical and physical properties, excellent solvency, etc.

TEAP is aware of at least one proposed use of an HCFC as a “Process Agent” for the production of fluoropolymers. The use of low-ODP HCFC would be a substitute for the use of an ODS process agent with a much higher ODP. In this case the HCFC would be partly "consumed" through a chain transfer reaction into the product, and the unreacted excess HCFC would be recovered.

There may be other cases where HCFCs can serve as process agents in place of fully halogenated ODS, which have higher ODPs. Parties may wish to consider that it may not be necessary to allow the exempted use of fully halogenated ODSs as process agents in those applications where partially-halogenated ODSs or non-ODS can be used as process agents.

Feedstocks

The HTOC raised a question concerning the use of bromotrifluoromethane, CF_3Br (halon-1301) as a feedstock in the manufacture of a pesticide. The CTOC investigated this matter and found that bromotrifluoromethane is a feedstock for preparation of bioactive compounds such as Fipronil, a broad-spectrum insecticide for control of multiple species of thrips with a reported feedstock production of about 163 tonnes of halon-1301 per year in China (2004 figure) and at least 400 tonnes of halon-1301 per year in the European Community.

Laboratory and Analytical Uses

There has been very little progress in replacing ozone depleting substances (ODS) that are used in laboratory and analytical procedures with substances that are less harmful to the ozone layer. In most cases this is due to the availability of ODS at favourable prices under the EUE and failure of alternative candidates to meet the demanding specifications that have brought about the use of ODS in the first place.

The 17th Meeting of the Parties approved Decision XVII/10 authorizing laboratory and analytical uses of methyl bromide, and requested TEAP to consider possible laboratory and analytical uses for methyl bromide and report to the 26th OEWG in 2006 on its findings.

Methyl bromide is one of the most chemically reactive of the controlled (ozone depleting) substances (ODSs), and it finds use in laboratories where the synthesis of organic chemical substances is studied. Transfer of the methyl group to nitrogen, oxygen, sulfur, phosphorus, carbon or a metal atom is also possible in certain cases. In all such reactions the methyl bromide is referred to as a ‘methylating agent’. Alternatives are available for many of these uses, including substances such as methyl iodide, trimethyl phosphate, dimethyl sulfate or methyl sulfonates. If bromide salts are explicitly required as products these may be from the initial product (iodide, phosphate, sulfate or sulfonate) by anion exchange. This process would avoid the use of a controlled product.

Replacements for methyl bromide in analytical applications can be more difficult to find, and there are specific chemical requirements for calibration or comparison with potential replacements. Representative of such uses, include testing for retention by articles or sensitivity of organisms, calibration of equipment, preparation of specifically treated cultures, and toxicological studies.

Similar comments can be made concerning the broader field of ODS in preparative or analytical chemistry. In particular, CTC is frequently used as a source of CCl_3 or other Cl-C groups in complex molecules (just as CF_3Br can be a source of a CF_3 group), and also finds use in spectroscopy because of its solvent power combined with the absence of C-H bonds that would interfere with the analysis of solutes. While the CTOC was unable to undertake a systematic survey of standard analytical procedures – a very large task – some examples of ODS use in analytical procedures were examined and the reasons for the use of the ODS were explored.

In all of these applications, it is the scale of the operation that largely determines whether it can qualify as a laboratory or analytical use, and the criterion of scale is the size of the package or packages in which the methyl bromide is supplied. Current laboratory and analytical uses of methyl bromide can be accommodated within the criteria developed for such uses for other ODS (Annex II of 6th MOP). The option is available to include any larger quantities in a Critical Use Nomination as long as such uses continue.

Aerosol products, Non-medical

The latest CFC consumption in the aerosol sector reported by Parties in 2003 and 2004 was around 2,000 tonnes in Article 5(1) countries down from the estimated use of 4,300 tonnes in 2001. Today more than 99.5% of non MDI aerosols use non-CFC formulations worldwide.

In 2005 the residual CFC consumption in the sector was only due to the use in Article 5(1) countries. It is expected that the completion of global CFC phase-out in non-MDI aerosols will occur in the very short term as the reduction schedule mandated by the Montreal Protocol comes into force in Article 5(1) countries

There are no technical barriers to global transition to non-ODS alternatives in all non-MDI aerosol applications, which require either low flammability or specific pharmaceutical approval.

Currently available alternatives for CFCs used in non-MDI aerosols as propellants are hydrocarbons (HAPs), dimethyl ether, HFCs, HCFCs and compressed gases (CGs).

There are many alternatives to replace ODS used either as solvents or as active ingredients in non-MDI aerosols. These replacements can be hydrocarbons, high boiling HFCs like HFC-4310mee, and HFC-245fa, high boiling HCFCs like HFC-141b, and other solvents like HFEs or even water. The suitability of the alternative depends heavily on the specifics of the formulation.

Many aerosol products have been replaced by such not-in-kind substitutes as mechanical pumps (finger or trigger pumps), sticks, roll-ons, brushes, etc.

Carbon Tetrachloride (CTC) Emissions and Opportunities for Reduction

Decision XVI/14 entitled “Sources of carbon tetrachloride emissions and opportunities for reductions” requests the Technology and Economic Assessment Panel to assess global emissions of carbon tetrachloride being emitted from a range of different sources.

Carbon tetrachloride can be produced by three main processes (chloromethane, perchlorination and CS_2 processes), all of which involve the reaction of elemental chlorine with substances having 1-3 carbon atoms in their molecules.

Carbon tetrachloride was initially used as a solvent, notably in dry-cleaning and metal cleaning applications (where there is still believed to be small residual use in the Democratic People’s Republic of Korea for instance), but its feedstock applications into fluorocarbons are the most important use. At its peak in 1987, when CFC-11 and CFC-12 production exceeded 800 ktonnes, CTC production was over 1 million tonnes. More recently, CTC has been used as feedstock for the production of a number of HFCs.

There are other applications for CTC, notably in the manufacture of chlorinated rubbers and paraffins (which continue in China and India, for instance), and a number of other feedstock and process agent uses in pharmaceutical and agrochemical applications, and in chlorine plants.

There is a large list of approved process agent uses for CTC that is under review by the Meeting of the Parties to the Montreal Protocol. These applications are described in Table A of Decision XVII/7 and in Table A-bis of Decision XVII/8.

Calculated CTC demand 2002-2009

The Report of the TEAP Basic Domestic Needs Task Force, October 2004 studied CFC production for basic domestic needs of Article 5(1) countries and essential uses for the period 2003-2009. Using the multiplier (1.35 tonnes of CTC required for 1 ton of CFC) contained in the methodology of Sherry, 2003[1], it is possible to make a calculation of the quantities of CTC required for this production.

Forecast amounts of CTC required to produce CFCs that are available to meet the BDN demand of Article 5(1) countries and essential uses (tonnes)

Production	2002	2003	2004	2005	2006	2007	2008	2009
Total CFC Prod	93,511	80,315	71,731	55,484	38,039	19,612	15,882	10,553
Total CTC reqd	126,240	108,425	96,837	74,903	51,353	26,476	21,441	14,247

Process Agent and emissive uses of CTC have been assumed to grow by 6% per year in the larger users (China, India, Democratic Republic of Korea and Pakistan) For other Article 5(1) countries, CTC consumption has been keep to the levels specified in the Montreal Protocol (85% reduction in consumption from 1 January 2005).

Estimated total CTC requirements for emissive uses, such as process agents

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Article 5(1)	31925	29283	26199	28457	30135	31913	33798	35796	37419
Non-A5(1)	4501	4501	4501	4501	4501	4501	4501	4501	4501
TOTAL	36426	33784	30700	32958	34636	36414	38299	40297	41920

CTC is also used as a feedstock for the manufacture of a number of HFCs, in particular HFC-245fa and HFC-365mfc. Ashford et al. carried out a detailed analysis on the future requirements of the foam insulation market for HFCs through to 2015. These data were incorporated into the IPCC/TEAP Report, 2005, and have been used to forecast the use of CTC as a feedstock for these products.

Estimated total CTC requirements as a feedstock for production of HFCs

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total CTC requirement	3295	23649	32412	38231	42342	44399	46422	48376	50285

Calculated CTC Emissions 2002-2010 from known requirements

In order to make an estimate of possible CTC emissions for this report, a number of possible scenarios have been considered. These scenarios contain the following assumptions:

- Emissions from the production of CTC and its use as a feedstock are calculated using 1%, 2% and 5% emissions by weight of the CTC.
- Process agent applications in Article 5(1) countries are assumed to emit completely their consumption during each year. Whilst it is known that some installations in Article 5(1) countries recover and destroy their process agents, for the purposes of this report total loss only is considered to give an upper boundary.
- Process agent applications in non-Article 5(1) countries control their emissions to meet the requirements under Decision X/14 Table B.

The estimates of CTC emissions have been calculated from applying potential emission levels to the estimates of CTC production and CTC use for known applications: emissions from CTC used as a feedstock to produce CFCs and HFCs, and from CTC used for emissive applications such as a process agent. Data used to calculate these emissions are given in Annex I in Section 6 of the CTOC report.

Overall Potential Emissions with Sector agreements

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
1%	35100	32483	29312	14218	13728	13249	13151	13487	12489
2%	38055	35463	32204	16610	15786	14740	14458	14805	13651
5%	46920	44401	40880	23788	21960	19215	18377	18760	17136

Emissions estimated from known requirements of CTC are at present (year 2006) between 13,728 and 21,960 metric tonnes. These are significantly lower than those estimated for scenarios if the CFC production and CTC consumption sector agreements had not been adopted. The major impact of the sector agreements is the reduction of CTC emissions from emissive uses such as process agents.

Atmospheric Concentrations of CTC

According to the calculated CTC emission estimated from the historically observed atmosphere CTC concentrations reported in the international Scientific Assessment of Ozone Depletion: 2002 (Montzka and Fraser), annual CTC emissions peaked at approximately 130,000 tonnes in the mid-1980s, and then declined to about 80,000 tonnes by the late 1990s. Given the range of lifetimes considered for CTC, these figures could involve uncertainties of ±30%. Recent data from the IPCC/TEAP Report, 2005, estimate emissions in 2002 to be 64,000-76,000 tonnes. In summary, the calculated annual emissions are:

Mid-1980s maximum	130±40 ktonnes
Late 1990s	80±25 ktonnes
2002	70±6 ktonnes

A review of the available research clearly indicates that emissions of CTC from industrial operations are underestimated. This likely underestimation of emissions would cause of the discrepancy between reported emissions and figures that can be estimated from the observed atmospheric concentrations of this substance and estimates of its atmospheric lifetime.

Three areas require further investigation to get better data for industrial emissions in Article 5(1) and non-Article 5(1) countries to enable resolution of the discrepancies with atmospheric measurements; the first area is that of CTC production in order to identify the production of CTC as a by-product and its subsequent use, re-cycling or destruction; the second area is to identify any other requirements for CTC and the third is the emission of CTC from sources such as landfills.

Solvents

No new and novel alternatives have been developed. Further it is unlikely that there will be a new solvent alternative break through. Major chemical companies are reluctant to embark on lengthy and expensive research projects, the products of which are subject to extensive scrutiny by federal and state agencies with uncertain results. Thus far only the HFCs, HCFCs and HFEs are leading the field in solvent replacements.

Under Decision XIII/7, TEAP has been requested to report annually on n-PB use and emissions.

Annual Use and Emissions of n-PB (n-propyl bromide) for the year 2005 are estimated to be 5,000 – 10,000 tonnes, with quantities of similar magnitude used in each of China, Japan, USA and the EU. Using a typical ratio suggested by IPCC, it is estimated that 50% of the above quantities will be emitted.

In view of the fact that this is not a controlled substance, no accurate information is available because there is no yearly reporting by the Parties. In addition, due to toxicity concerns (both reproductive and central nervous systems effects) those quantities are expected to be lowered.

A new nomination for Essential Use of CFC-113 was received in April 2006 from the Russian Federation. The CTOC will make a detailed examination of the nomination and report in 2007. Parties may wish to consider a one-year Essential Use Exemption for 2007.

Destruction and Other Issues

Under Decision XVII/17(3), TEAP is requested to review possible synergies with other conventions, such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the Rotterdam Convention on the Prior

Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade and the Stockholm Convention on Persistent Organic Pollutants.

The Conventions included in the International Chemical Agenda as Basel, Stockholm, and Rotterdam, are related to the Montreal Protocol in several issues as environmentally sound management of chemicals and wastes.

One of the main synergies between them exists in the implementation of best practices in order to reduce and eliminate the use of certain chemicals and their waste, also reducing pollution to the environment.

All these conventions protect the environment by reinforcing national capacities through the adoption of standard practices which are listed in the body of this report.

Progress in the ODS Phase-out in the Military Sector

Military organisations have made significant progress in eliminating ODS use. The remaining uses are primarily halons and refrigerants. In non-Article 5(1) countries, these applications continue to be satisfied by recycling existing stocks of ODS. A small number of uses have been met through Essential Use Exemptions. Information about military ODS uses and alternatives is not as readily available as for the commercial sector. But many countries have provided information through a series of global military workshops and multilateral and bilateral military-to-military exchange projects.

The military has begun producing the first modern aircraft that do not use halon in engine nacelles. Five such military aircraft are currently in final development or production in the U.S. and U.K.

Dry bays are the interstitial spaces within aircraft structures adjacent to fuel tanks, which contain electrical cables, hydraulic lines or other equipment and which can be the source of fires or explosions. Inert gas generators are beginning to replace halon in new aircraft.

Two types of aircraft use halon during combat to inert the ullage space in their fuel tanks within wing structures. One of these, the F-16, is used by many countries. There are as yet no alternatives that can be retrofitted into these aircraft.

Halon-1211 is used by some countries in wheeled extinguishers placed adjacent to aircraft parking spaces for "first response." An aircraft can take off following a small pooled-fuel extinguished by halon, but not with other agents.

Because the choice of fire protection for ships and submarines is very platform-specific, a solution for one vessel or application is not necessarily a solution for all. As a result, halon usage across vessels is not consistent. Parties replace halon on warships as specific conditions and costs permit.

Some shipboard CFC refrigerant applications will remain for the foreseeable future due to a lack of economically viable retrofit options and high retrofit costs where alternatives are available. All CFC systems on EU ships and submarines will have been converted to HFC alternatives by the end of 2008 because of a legal mandate.

New technologies have only recently been introduced that can replace halon in ground combat vehicles. Crew protection systems activate very quickly and provide significantly improved crew survival rates. It is unlikely that existing vehicles can be modified, but alternatives should be designed into future vehicles.

Halon has been or is being removed through attrition from virtually all buildings. This removed halon has become the primary source of recycled halon for support of continuing uses in weapons platforms.

Canada, Germany, Norway, Sweden, the UK and the United States reported that they have virtually eliminated the use of ozone-depleting solvents in other military applications. Methyl chloroform available under an Essential Use exemption is used to manufacture solid rocket motors for propelling large payloads into space.

It is easier to design halon alternatives into new equipment than to modify existing equipment. Military systems tend to have very long lifetimes, lasting half a century or longer. They are highly integrated, highly constrained in terms of space and weight, and modification costs are generally very high.

Since its 1989 report, the Halon Technical Options Committee's military experts have described halon uses in weapons systems that would persist beyond a phase-out date, and have predicted that new halon production would not likely be necessary provided that existing halon inventories were managed in a way that preserved them for ongoing military requirements. These estimates and predictions appear to remain valid today. It appears likely that some ODS will continue to be necessary for legacy systems until mid-century, without additional technical breakthroughs.

There appears to be adequate supplies of halon-1301 to meet critical defence needs. Supplies of halon-1211 are less clearly in surplus with some indications of a shortage in some countries. There is growing concern about the availability of halon-2402 outside of Russia. In particular, India has reported a growing shortage that could be problematic. India also reported that halon-2402 systems are being routinely converted to halon-1301 to improve safety and help ensure future supplies.

Supplies of recycled or recyclable ODS are not always located in the areas where they are needed. Transnational shipment for reconditioning and re-use had become an occasional problem for military organisations. As global supplies decline, the need for flexibility in moving ODS to locations where they are needed is becoming increasingly important.

Methyl Bromide TOC Progress Report

This section updates trends in methyl bromide (MB) production and consumption, and gives progress in the registration, development and adoption of alternatives. It also addresses issues related to harmful trade.

Non-Article 5(1) countries reduced their MB production for controlled uses from about 66,000 tonnes in 1991 (official baseline) to less than 24,100 tonnes in 2004, whilst Article 5(1) countries reduced their production for controlled uses from a peak of 2,397 tonnes in 2000 to about 536 tonnes in 2004. Global consumption of MB for controlled uses was estimated to be about 64,420 tonnes in 1991 to about 26,336 tonnes in 2003. Total Article 5(1) consumption was reduced from 75% of the baseline in 2003 to 67% of baseline in 2004 (about 10,520 tonnes). Most Article 5(1) countries achieved their national freeze in 2002; by 2004, 87% of Article 5(1) Parties had achieved the 20% reduction step - earlier than the scheduled date of 2005.

The major alternatives for preplant soil treatment - 1,3-D/Pic, chloropicrin and metham sodium - either alone or in combination with other alternatives are proving as effective as MB in many situations and continue to be widely adopted as key alternatives in many applications. Other alternatives include substrates, steam, grafted plants and resistant varieties. Some Parties previously applying for CUNs, particularly in strawberry fruit, tomatoes and vegetable crops, have adopted these alternatives on a wide scale. They are also showing promise for control of pathogens in the more difficult nursery and replant industries where high levels of disease control are required to meet quality standards. Formulation changes and more adequate application methods continue to improve the effectiveness of several alternatives (Pic EC, 1,3-D/Pic EC) and wider adoption has occurred where these are available. In many instances, this has involved a change in cropping practice, and a greater awareness of soil conditions, which improve the efficiency of alternatives. Modifications to application machinery have sometimes been necessary.

One key transitional strategy to reduce MB usage has been the adoption of MB:Pic formulations with lower concentrations of methyl bromide (e.g. MB:Pic 50:50 or less). Their use in combination with low permeability barrier films (LPBF, e.g. VIF or equivalent) allow increased retention of MB and extended effective exposure periods for pests, thus controlling pathogens and weeds at reduced MB application rates. Typically the reduction in effective methyl bromide dosage can be 25 – 50%. Studies are also proving their use for effective dosage reduction of alternatives, such as 1,3-D. This is important because dosage reduction may increase areas available to be treated with specific fumigants that are limited by township caps.

A statistical analysis or meta-analysis study has been conducted to evaluate methyl bromide alternatives for pre-plant fumigation, with funding provided under Decision XVI/5. A special report of a meta-analysis entitled 'Validating the Yield Performance of Alternatives to Methyl bromide for Preplant Fumigation' will be posted on the secretariat website in May 2006. The Parties are provided with a statistical best estimate of the relative effectiveness of the major chemical alternatives to methyl bromide in different regions and under different pathogen pressures. The study concentrated on two major crops, strawberry fruit and tomatoes, but information generated is relevant to peppers, melons and other cucurbits and eggplants. It concluded that there are one or more alternatives available for both tomato and strawberry production that have similar cost and efficacy to the standard methyl bromide mixtures currently used. The study assisted with referencing studies on alternatives to methyl bromide and identifying studies where LPBF films had proven effective at lower dosages compared to the standard commercial formulations of methyl bromide.

The main alternatives to the disinfestation of flour mills and food processing premises are sulfuryl fluoride and heat (alone or in combination). Phosphine, particularly in fast generating gas forms, has also made good progress and become an important alternative in some applications, primarily commodities. This new form of an older fumigant is responsible for a considerable reduction in use of methyl bromide for commodities.

Sulfuryl fluoride is sufficiently registered in the US to allow virtually all mills and food processing facilities to consider adoption as an alternative to methyl bromide. Registration in EC countries for milling and food processing applications is broad and increasing. In some situations results have been inconsistent or inadequate but where a combination process with heat has been used efficacy has been very high, and fumigant costs have been minimized. There has been considerable research and commercial phase-in trials of heat treatment in mills and other food processing facilities in Canada, the European Union and the United States. Costs of heat treatment, length of time required for treatment, problems in reliability especially in larger mills, and concerns about heat equipment or temperature distribution damaging mill equipment or structure are given as reasons that limit the use of heat as an MB alternative. Given the scarcity of published literature, however, these comments are difficult to evaluate.

Registration of one of the major potential alternatives for soil uses of methyl bromide, methyl iodide, has recently been delayed in the United States due to requests for further studies on risk hazard concerns. Registration of chloropicrin is scheduled to occur in France in 2006. Registration of sulfuryl fluoride for mills, including rice mills in California – the major wheat flour producer in the US - was achieved in May 2005. Conditional registration of sulfuryl fluoride was achieved in Canada early 2006, but at this time it only allows trial efficacy experiments as part of the registration process. Ethyl formate in CO_2 was recently registered in Australia for disinfestation of stored grains, oilseeds, grain storage premises and equipment and horticultural produce. This product is being evaluated in France for fresh chestnuts.

Decision Ex I/4 asked TEAP to identify options which Parties may consider for preventing potential harmful trade of methyl bromide stocks to Article 5(1) Parties as consumption is reduced in non–Article 5(1) Parties. It is possible that stockpiles from some non-Article 5(1) Parties may not have been declared and Parties may wish to make special efforts in obtaining this information and ensuring that such stocks are only exported for critical or QPS uses. Article 5(1) Parties that have phased out MB or reduced their consumption significantly may not have the regulatory capacity to prevent imports of MB in excess of their needs. Parties may wish to insist on prior informed consent of the importing Party before allowing shipment and delivery. Parties may also levy appropriate taxes on the trade of MB and use such levies to promote research and adoption of alternatives. Article 5(1) Parties may also report their needs for MB periodically; it is possible that these needs are lower than the level allowed by the Protocol for production for the purposes of Baseline Domestic Needs.

Methyl Bromide QPS Task Force Report

Following Decision XVI/10(1), TEAP set up a task force, the TEAP Quarantine and Pre-shipment Task Force (QPSTF), to report to the Parties on the current uses of methyl bromide for Quarantine and Pre-shipment (QPS) purposes, the quantities of methyl bromide used, and whether there were alternatives to methyl bromide available for these uses.

Parties have been exhorted to use alternatives to methyl bromide for QPS purposes where technically and economically possible (Decisions VI/11(c) and XI/13(7)). Nevertheless, consumption of methyl bromide for QPS purposes continues to be substantial and may be increasing.

A survey of QPS use by Parties was carried out in 2004 by a consultant commissioned by the European Community, to provide a basis for response to Decision XI/13(4). Decision XVI/10(4) requested Parties that had not already submitted data to provide best available data on QPS uses and associated quantities. Data from these two sources was integrated to give an overview of QPS use by Parties.

Use of 6,893 tonnes was reported, being about 65% of reported annual QPS consumption (10,601 metric tonnes) in the 2002-2004 period.

Data was not received for 16 of the 70 Parties reporting non-zero consumption of QPS methyl bromide. Five of the 16 Parties with reported annual consumption for QPS purposes exceeding 100 metric tonnes annually did not report use or use details. In several cases, the quantity of methyl bromide reported as used for QPS purposes in a year differed substantially (> +/-30%) from consumption for that year reported to the Ozone Secretariat.

The seven categories with the highest QPS usage cover 96% of the total QPS methyl bromide reported with sufficient detail for analysis. The major use categories were soil (preplant 29%), grains (24%), wood, including sawn timber (16%), fresh fruit and vegetables (14%), wooden packing materials (6.4%), logs (4.0%) and dried foodstuffs (3.0%).

Some major consumers of methyl bromide for QPS are not covered by the data set and particularly the subset analysed for usage category. Some Parties acknowledged the difficulties in data collection, leading to underreporting. These problems potentially bias the conclusions of the survey analysis. Specifically, the use of QPS methyl bromide for treatment of whole logs and timber appears underrepresented. Independent estimates of the volume of methyl bromide required to treat East Asian and Russian trade in logs suggest that QPS methyl bromide use for this use exceed 4,000 tonnes annually.

Parties identified alternatives for the major uses (by volume of MB used) in at least some situations. An updated, comprehensive discussion of alternatives will be included in the 2006 MBTOC Assessment.

Critical Use Nominations for Methyl Bromide: Interim Report

Fourteen Parties submitted 60 critical use nominations for 2007 and 30 nominations for 2008. These totalled 2557.106 and 7098.094 metric tonnes respectively. These Parties had submitted nominations in previous CUN rounds. The total number of nominations and nominating Parties has been reduced. Four Parties that had CUEs in previous years did not submit further nominations in the final round for 2007.

MBTOC assessed the 90 CUNs and recommended 47, with 32 placed in the ‘unable to assess’ category. 11 CUNs were not recommended. A total of 1721.780 tonnes of MB has been recommended, 1115.319 for 2007 and 606.461 for 2008; 742.964 tonnes were not recommended for 2007 use and 148.136 tonnes were not for 2008 use, i.e. a total of 891.100 tonnes of MB were not recommended in this round of CUNs.

MBTOC has sometimes suggested quantities of MB for 2007 or 2008 different from the amounts nominated. The adjustments follow MBTOC’s standard presumptions contained in Annex I of MOP-16 unless indicated otherwise.

Decision XVII/9 (10) of the 17th MOP requests TEAP and its MBTOC to report for 2005 and annually thereafter, for each agreed critical use category, the amount of methyl bromide nominated by a Party, the amount of the agreed critical use and either the amount licensed, permitted or authorised or the amount used. Decision Ex.I/4 requests MBTOC to submit a report on the possible need for methyl bromide critical uses over the next few years, based on a review of the management strategies submitted by Parties pursuant to paragraph 3 of the present decision. Five Parties provided detailed National Management Strategies.

Parties are achieving good progress in phasing out methyl bromide although some challenges remain. While there is an apparent downward trend for almost all CUEs by year, MBTOC is unable to provide a quantitative estimate of the future demand for MB for controlled uses for preplant soil fumigation and post harvest commodity treatments until further information is received from the Parties to complete the current round of CUN nominations. Since 2005, there has been a trend by all Parties to reduce their consumption and CUN nominations, although this has occurred at different rates.

TEAP PROGRESS REPORT

1 Essential Uses

1.1 Essential Use Nominations for Metered Dose Inhalers

1.1.1 Criteria for Review of Essential Use Nominations for MDIs

Decision IV/25 of the 4th Meeting and subsequent Decisions V/18, VII/28, VIII/9, VIII/10, XII/2, XIV/5, XV/5, XVI/12 and XVII/5 have set the criteria and the process for the assessment of essential use nominations for metered dose inhalers (MDIs).

1.1.2 Review of Nominations

The review of essential use nominations by the Medical Technical Options Committee (MTOC) was conducted as follows.

Three members of the MTOC independently reviewed each nomination, each preparing an assessment. Further information was requested where necessary. The MTOC considered the assessments, made recommendation decisions and prepared a consensus report.

Nominations were assessed according to the guidelines for essential use contained within the *Handbook on Essential Use Nominations* (TEAP, 2005) and subsequent Decisions of the Parties.

Concurrent with the evaluation undertaken by the MTOC, copies of all nominations are provided to the Technology and Economic Assessment Panel (TEAP). The TEAP and its TOCs can consult with other individuals or organisations to assist in the review and to prepare TEAP recommendations for the Parties.

1.1.3 Summary of Parties' Essential Use Nominations and Quantities for 2007 and 2008 (in tonnes)

	European Community	**United States**
2007	535	-
2008	-	384.97

1.1.4 Observations on nominations

1.1.4.1 Specific concerns relevant to nominations from the European Community and the United States

Only two essential use nominations were received for consideration by the MTOC in 2006: The European Community (EC) submitted an essential use nomination for 2007 and the United States submitted a nomination for 2008. Both of these nominations raise a number of concerns and issues that highlight the considerable difficulties in the tail of the CFC MDI phase-out process. These specific concerns and issues relevant to each nomination are discussed below. While recommending approval of these nominations, future nominations must address these concerns in detail for requests to be recommended.

MTOC expects that nominating Parties will manage their processes so that production of CFC MDIs will cease by the end of 2009 for domestic use and for export to Article 5(1) countries. Taking into account stockpiles, MTOC would not anticipate nominations from non-Article 5(1) countries for substantial quantities of CFCs for MDIs for the year 2009.

1.1.4.2 Note on the management of pre- and post-1996 surplus CFCs

The nominations raise the general issue of the management of surplus CFCs manufactured both pre- and post-1996. As noted in the *Report of the TEAP, Progress Report* (TEAP, May 2005), TEAP and its TOC understand that there are three options to resolve post-1996 surplus:

1. Transfer to an essential use authorised by Parties;
2. Transfer to an Article 5(1) country for basic domestic needs (with prior informed consent and accounting); and
3. Destruction in processes approved by the Montreal Protocol.

MTOC believes that it is critical during the final stages of the phase-out of CFC MDIs that stockpiles of CFCs meeting quality requirements are utilised in preference to the production of newly produced CFCs. Thus, Parties may wish to consider flexible use of existing stock, including transfer through export for approved uses, and MDI manufacturers may wish to operate to ensure stockpiles are fully depleted at the time of phase-out. National governments will want to anticipate last-minute uncertainties and modify their domestic legislation to allow agile ODS reallocation to avoid jeopardising patient health and wasting money on over-production and destruction.

1.1.5 Committee Evaluation and Recommendations

Quantities are expressed in metric tonnes.

1.1.5.1 European Community

Year	**Quantity**
2007	535 tonnes

Specific Use: MDIs for asthma and COPD

Recommendation: Exemption for CFCs for MDIs – 535 tonnes (no volumes are for single-moiety salbutamol to be sold within the EC).

Comments

MTOC notes that the EC nomination requested CFCs for use only in 2007, with no request included for 2008, in order to "convey to the pharmaceutical industry that the end of the essential use process is fast approaching." The accounting framework and spreadsheets that accompanied the nomination provided some useful information, but were neither comprehensive nor concordant with the nomination text. Subsequent communication with the EC enabled MTOC to better understand the volumes requested.

The amount of CFCs nominated for 2007 is similar to the exempted amount for 2006. However, the 2006 nomination included 180 tonnes that had been identified for use in a salbutamol product for export to the United States that is not continued into the 2007 nomination. Therefore, MTOC would have anticipated a lower nomination for 2007. The similar requested volume means that there will be increased use of CFCs for MDIs within the EC, as well as for export, including to Article 5(1) countries.

The EC reported that all its 25 member states have declared non-essential salbutamol CFC MDIs. Furthermore, 15 out of 25 EC member states have declared non-essential CFC MDIs for the therapeutic category of short-acting beta-agonist bronchodilators. Some EC member states have notified UNEP that they have declared non-essential some corticosteroids, cromolyn and nedocromil CFC MDIs. This overall situation is unchanged from that reported by the EC in last year's nomination (notwithstanding progress in transition within individual member countries or with individual brands that have taken place during 2005).

The concerns referenced in section 1.1.4 as they relate to the EC are as follows:

- As the 2007 nomination reflects a higher volume for use within the EC, MTOC believes this situation warrants a further explanation from the EC in any future nomination, including plans for completing the phase-out of CFC MDIs within the EC.

- One company in the EC is marketing simultaneously a CFC and an HFC MDI product for the same active ingredient within the EC, and may have requested a substantial volume of CFCs for 2007 for this product. Though it is not currently clear that the HFC product is approved for use in all 25 member countries, MTOC will not recommend volumes in future nominations that would supply companies that engage in dual marketing within a given market. Given the final stages of transition, MTOC believes this course of action is entirely consistent with Decision IV/25.

- As Parties make decisions about the phase-out of CFC MDIs in Article 5(1) countries, Parties that export MDIs, such as the EC, will need to respond accordingly. Multinational pharmaceutical companies that are manufacturing CFC-free alternatives for non-Article 5(1) countries should cease exporting the corresponding CFC product and instead export the CFC-free alternative products to Article 5(1) countries at comparable prices consistent with legitimate differences in distribution and marketing expenses.

- This nomination includes volumes for combination products. The MTOC has concerns as to whether combination products that contain moieties that are themselves individually available in CFC-free products remain essential. If any volumes are requested for such products in the future, the EC should provide a specific explanation for why this use remains essential in light of MTOC's concerns.

1.1.5.2 United States

Year	Quantity
2008	384.97 tonnes

Specific Usage: MDIs for asthma and COPD

Recommendation: Exemption for CFCs for MDIs - 385 tonnes (no volumes are for single-moiety salbutamol).

Comments

A total of 384.97 metric tonnes is requested in the United States nomination for the production of MDIs for metaproterenol, a combination of ipratropium and salbutamol, pirbuterol, epinephrine, triamcinolone, cromolyn and nedocromil. No request is made for export or for single moiety salbutamol MDI production. However, the United States reserves the right to nominate in 2007 additional volumes for salbutamol CFC MDIs for 2008 if needed.

The nomination was completed in accordance with the *Handbook on Essential Use Nominations* (TEAP, 2005). It shows a sharp decrease in requested volumes compared to 2007. These remaining CFC MDIs are currently subject to a US FDA rule-making process aimed at phase-out, but may remain allowed under United States law in 2008. The companies that manufacture CFC MDIs other than single moiety salbutamol are entirely separate from those companies that currently manufacture salbutamol CFC MDIs. Those companies producing MDIs other than single-entity salbutamol may not have access to large stockpiles held by those companies producing salbutamol CFC MDIs. Approval of the 2008 volumes assures availability of CFCs for MDIs other than single-moiety salbutamol should the large CFC stockpile prove to be inaccessible due to business considerations or the inability of authorities to reallocate CFC once sold to companies. Authorities unable to reallocate CFC once sold may wish to hold permits for just-in-time allocation.

The concerns referenced in section 1.1.4 as they relate to the United States are as follows:

- MTOC has serious questions concerning stockpiles. The United States reported 398 metric tonnes of pre-1996 stocks separate from the post-1996 stocks. These should have been aggregated into the end-2005 stock. There are also 605 tonnes of pre-1996 currently held by Honeywell, and available for sale in 2006 to manufacturers of CFC MDIs other than single-moiety salbutamol. These quantities are currently not included in the reported accounting framework. Any volumes from these 605 tonnes that are sold to pharmaceutical manufacturers in 2006 should be aggregated into the "on hand at the start of the year" column in the next accounting framework for 2006. Any not sold should be accounted for in the existing stocks. Decision IV/25 (*Report of the TEAP, May 2005, Progress Report*, section 1.1.4.1, page 35) requires companies that hold pre-1996 stocks to use them first before using newly produced CFCs.

Taking the end-2005 stocks (1,958 tonnes), and adding the pre-1996 stocks (1,003 tonnes), together with the 2006 exempted quantity (1,100 tonnes), means that the United States companies together will have access to a maximum of 4,061 tonnes in 2006. The use of CFCs for the United States manufacture of MDIs in 2006 is estimated to be no more than 1,500 tonnes. In this context, the United States exempted quantity for 2007 (1,000 tonnes) appears unnecessary, and the United States could consider withdrawing it or not allocating it. Responsible management of this excessive stockpile through the United States internal allocation process is clearly needed. MTOC anticipates that, at the end of 2007, the United States stockpile will need to be reduced to no more than 1,000 tonnes; otherwise substantial quantities will need to be destroyed at the end of the phase-out in the United States.

- One company (Schering Plough) in the United States has continued to market a CFC salbutamol MDI despite the fact that it has simultaneously marketed an HFC salbutamol MDI for the last 10 years. MTOC estimates that this company has used up to 900 tonnes of CFCs in each of these years. MTOC will not recommend volumes in future nominations that would supply companies that engage in dual marketing within a given market. Given the final stages of transition, MTOC believes this course of action is entirely consistent with Decision IV/25.

- This nomination includes volumes for combination products. The MTOC has concerns whether combination products that contain moieties that are themselves individually available in CFC-free products remain essential. If any volumes are requested for such products in the future, the United States should provide a specific explanation for why this use remains essential in light of MTOC's concerns.

1.1.6 Reports on status in transition

1.1.6.1 Australia

The MTOC notes with pleasure the annual report on transition from Australia, reporting the destruction of all stockpiles and cessation of imports and exports of bulk CFC for manufacture of CFC MDIs. The accounting framework from Australia reported a small amount of CFCs on hand at the beginning of 2005 (26.8 tonnes), which was destroyed in March (11.5 tonnes destroyed, which represents all remaining stocks). The small absolute discrepancy between the calculated stock on hand and those amounts destroyed was reported to relate to the tracking of CFC gas manufacture from the mid-80s through 2002.

1.1.6.2 Russian Federation

The Russian Federation did not submit an essential use nomination for 2008, in accordance with its submitted plan to complete the phase-out of CFC products by the end of 2007. A report was submitted on the status of transition in the Russian Federation under its essential use process for CFC MDIs. This report details a number of considerable difficulties that need to be dealt with to complete phase-out. The 2005 accounting framework shows that there has been no reduction in CFC use over recent years and the stockpile at the end of 2005 was only approximately 3 month's supply.

MTOC notes with appreciation the planned phase-out of CFC MDI products within the Russian Federation by the end of 2007. MTOC is also cognisant of the difficulties in completing this transition while assuring that patients who need these important medications have an uninterrupted supply. While many imported CFC-free alternative inhaled medications are approved for use in the Russian Federation, there is no reported domestic production (either as HFC MDIs or DPIs). The Russian Federation reported that the imported products are more expensive for patients than the domestically produced CFC products currently available. As of 2005, imported inhaled products supplied about one-third of the market in the Russian Federation.

Given these difficulties, Parties may wish to consider ways to support the transition in the Russian Federation within the framework of the Montreal Protocol processes. One option available is to consider the route of an emergency essential use exemption if demand exceeds the amount of CFCs approved by Parties for essential use in any year. Further, MTOC can consider a nomination from the Russian Federation for 2008 in 2007 should the difficulties expressed in the Russian Federation's report prevent the planned completion of phase-out by 2008. This nomination will need to be supported by an explanation of the difficulties leading to any delay and the plans to effectively deal with these difficulties in completing the phase-out by some date thereafter.

1.2 Essential use nomination for Solvent Cleaning with CFC-113

1.2.1 Russian Federation

Year	Quantity
2007	150 tonnes
2008	140 tonnes
2009	130 tonnes
2010	120 tonnes

Specific Usage: Solvent cleaning with CFC-113 for the manufacture of fine mechanical devices for the Russian Federal Space Agency.

Recommendation: TEAP: Unable to recommend because nomination was received by UNEP after the submission deadline. CTOC: Prepared to review nomination for 2007. Parties may wish to consider a one-year essential use exemption while TEAP and its TOCs properly evaluate the nomination and seek sources of stockpiled CFC-113.

Comments:

The Ozone Secretariat received this nomination on 19 April 2006, just before the TEAP met to complete the Progress Report.

The nomination documents in detail diminishing uses of CFC-113 and the adoption of alternatives. Until 2006, CFC-113 was available from stockpiles, which have been depleted. In 2001 use of CFC-113 was 241 tonnes, but since then several alternative solvents and techniques have been implemented. TEAP notes that 65 per cent of the quantities used are released to the atmosphere. With more time CTOC could explore in detail whether other alternatives have been identified by other Space Agencies or whether they face similar problems.

2 Medical Technical Options Committee (MTOC) Progress Report

Figure 2.1 and Table 2.1 show the use of chlorofluorocarbons (CFCs) for the production of metered dose inhalers (MDIs) for asthma and chronic obstructive pulmonary disease (COPD) in non-Article 5(1) countries. Data include exemptions for the Russian Federation and Ukraine after 2002, hence the increase in the exempted amount for that year. In 2005, 2,699 tonnes of CFCs were used by non-Article 5(1) countries in MDI manufacture under essential use exemptions, as reported through accounting frameworks (except for the Ukraine from which an accounting framework was not received in time). This represents a 5 per cent reduction in use compared to 2004.

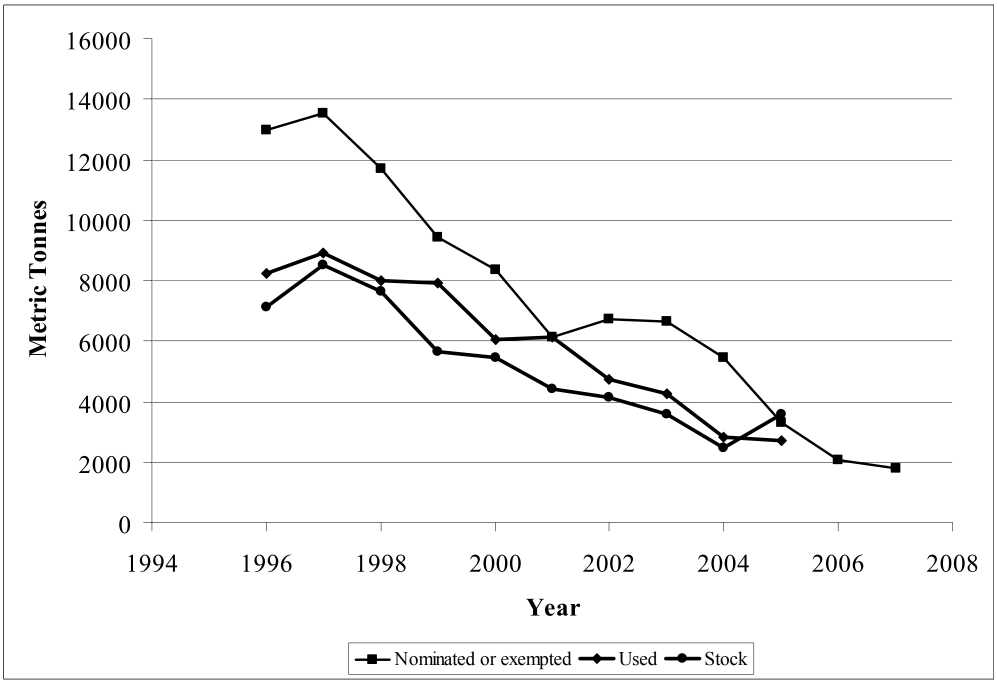


Figure 2.1 Quantities of CFCs for MDI manufacture in non-Article 5(1) countries

(Note that in 2005, 'stock' includes 605 tonnes of pre-1996 stock in the United States, which is yet to be allocated by the United States, yet to be sold by Honeywell and available only under agreement with certain United States companies, and 'used' does not include the Ukraine from which an accounting framework was not received in time)

Table 2.1 Quantities (in tonnes) of CFCs for MDI manufacture in non-Article 5(1) countries

Year of Essential Use	Amount Exempted/ Nominated for year of Essential Use	Used for Essential Use	On Hand End of Year
1996	12,987.20	8,241.13	7,129.59
1997	13,548.00	8,904.99	8,515.24
1998	11,720.18	8,013.60	7,656.63
1999	9,442.13	7,906.35	5,653.95
2000	8,364.95	6,062.75	5,433.32
2001	6,126.53	6,121.62	4,402.59
2002	6,714.75	4,751.92	4,133.71
2003	6,641.55	4,261.91	3,570.27
2004	5,443.12	2,840.82	2,460.10
2005	3,321.10	2,699.46	*3,582.65
2006	2,050.00	-	-
2007	1,778.00	-	-
2008	**384.97	-	-

*Note that in 2005, 'On Hand End of Year' includes 605 tonnes of pre-1996 stocks in the United States, which is yet to be allocated, yet to be sold by Honeywell and available only under agreement with certain United States companies, and 'Used for Essential Use' does not include the Ukraine from which an accounting framework was not received in time.
**Nomination for the United States only: other nominations may be forthcoming in 2007.

It should be noted that no nomination was received from the Ukraine for 2006 or 2007. The Ukraine's last exemption was approved for 2005.

Technically satisfactory alternatives to CFC MDIs are available for short-acting beta-agonists and other therapeutic categories for asthma and COPD. The availability of CFC stocks coupled with these alternatives assures patient safety during the transition.

The management of stockpiles at this final stage of the phase-out will be extremely important to avoid unnecessary production of CFCs for essential use. Parties may wish to remind CFC MDI manufacturers that any CFCs obtained under essential use exemptions must be used for essential uses (including through a transfer), transferred to an Article 5(1) country for basic domestic needs, or destroyed. MTOC is concerned that some users may try to circumvent this rule by claiming that their remaining stockpiles are pre-1996. To ensure transparency, any pre-1996 stocks should be accounted for in the Reporting Accounting Framework for Essential Uses. In addition, Decision IV/25 (Report of the TEAP, May 2005, Progress Report, section 1.1.4.1, page 35) requires companies that hold pre-1996 stocks to use them first before using newly produced CFCs.

2.1 Transition to alternatives to CFC MDIs

Progress in transition was assessed from data provided by the International Pharmaceutical Aerosol Consortium (IPAC) on products from its constituent members, together with those from 3M and Ivax (Teva). Progress has continued on the development and registration of hydrofluorocarbon (HFC) MDIs and dry powder inhalers (DPIs). A number of companies are well underway in changing their CFC MDI business to HFC MDIs and a range of products are now widely available. The HFC MDI products that have been developed and registered are listed below in Table 2.2.

Table 2.2 Progress in CFC-free MDI introduction by moiety and company: table data refer to numbers of countries

Moiety	Company	Launched by Apr '04	Launched by Dec '05	Approved pending launch Dec '05
Beclomethasone	3M	22	22	15
	Chiesi	11	22	11
	GlaxoSmithKline	6	19	5
	Ivax	27	27	4
Budesonide	AstraZeneca	0	0	*1
	Chiesi	1	15	0
Fenoterol	Boehringer Ingelheim	20	20	1
Fenoterol and Ipratropium	Boehringer Ingelheim	19	19	4
Fluticasone	GlaxoSmithKline	44	111	34
Formoterol	Chiesi	0	11	1
Ipratropium	Boehringer Ingelheim	13	28	0
Nedocromil	Sanofi-Aventis	9	9	0
Salbutamol	3M	30	30	18
	GlaxoSmithKline	86	96	79
	Ivax	34	39	0
Salmeterol	GlaxoSmithKline	0	1	2
Sodium cromoglycate	Sanofi-Aventis	**14	**14	0

*Approved February 2006.
**Includes one launch of sodium cromoglycate in combination with reproterol.

Further analysis (Table 2.3) demonstrates that, in many countries, more than one product is available.

Table 2.3 Device approvals and subsequent launches in all countries: table data refer to numbers of countries

Moiety	Device	Approved	Launched
Beclomethasone	DPI	45	39
	HFC MDI	77	61
Budesonide	DPI	83	76
	HFC MDI	*17	15
Fenoterol	DPI	0	0
	HFC MDI	21	20
Fenoterol and	DPI	0	0
Ipratropium	HFC MDI	23	19
Fluticasone	DPI	94	77
	HFC MDI	145	111
Formoterol	DPI	61	52
	HFC MDI	12	11
Ipratropium	DPI	0	0
	HFC MDI	28	28
Nedocromil	DPI	0	0
	HFC MDI	9	9
Salbutamol	DPI	74	66
	HFC MDI	176	112
Salmeterol	DPI	84	65
	HFC MDI	3	1
Sodium cromoglycate	DPI	2	2
	HFC MDI	**14	**14
Terbutaline	DPI	74	51
	HFC MDI	0	0

*Includes 1 approval from AstraZeneca in February 2006
**Includes one launch of sodium cromoglycate in combination with reproterol.

It is also important, therefore, to consider the data in Table 2.4 that presents the number of countries where at least one product has been approved. It is recognised that this is an underestimate of the true situation, as it takes no account of CFC-free products that have been introduced by producers other than IPAC member companies, 3M and Ivax (Teva).

There is widespread availability of salbutamol (short-acting beta-agonist) HFC MDIs in many countries, with almost 60 countries where there are at least two products approved. The introduction and acceptance of multi-dose powder inhalers has continued along with single-dose DPIs (particularly in some Article 5(1) countries). However it is clear from accumulating experience that the development and registration of alternate products cannot alone lead to a full uptake in the market without additional regulatory action.

Table 2.4 The number of countries where at least one alternative to CFC MDIs is available

Moiety	Approved	Launched
Beclomethasone	85	79
Budesonide	85	79
Fenoterol	21	20
Fenoterol and Ipratropium	23	19
Fluticasone	148	128
Formoterol	61	52
Ipratropium	28	28
Nedocromil	9	9
Salbutamol	176	136
Salmeterol	84	65
Sodium cromoglycate	*14	*14
Terbutaline	74	51

*Includes one launch of sodium cromoglycate in combination with reproterol.

In Japan, the production and importation of CFC MDIs ceased as of the end of 2004, in accordance with Japan's transition strategy. A total of 21 CFC-free alternatives and new inhalers, which cover the range of treatment options, have already been introduced in the Japanese market. Japan is to be congratulated for concluding its transition to CFC-free alternatives during 2005. Of note, a substantial proportion of the former CFC MDI market has changed to DPI alternatives.

Australia destroyed all remaining MDI stocks of CFCs in 2005 and ceased imports and exports of bulk CFC for CFC MDI manufacture. Australia is to be congratulated on this achievement.

It is encouraging that pharmaceutical companies are introducing new drugs directly in CFC-free devices. Following the successful introduction of products such as mometasone furoate in a multi-dose dry powder inhaler and tiotropium bromide as a single-dose dry powder inhaler, there have been recent launches of ciclesonide and levalbuterol, both as HFC MDIs. These products, introduced without a direct antecedent CFC-based counterpart, offer important new treatment options.

On the other hand, this year there were no reported new declarations for current CFC MDI products becoming non-essential in either the United States or in the EC.

2.2 Transition strategies

Transition strategies from six Parties are listed on the UNEP web site. Pursuant to Decision XV/5(4), plans of action regarding the phase-out of the domestic use of CFC-containing MDIs from the EC, the Russian Federation and the United States are listed on the UNEP web site. The Ozone Secretariat received no further transition strategies or plans of action in 2005.

2.2.1 Progress reports on transition strategies

Under Decision XII/2, Parties are required to report to the Secretariat by 31 January each year on progress made in transition to CFC-free MDIs. In 2006, reports were received from Australia, the Hong Kong Special Administrative Region (HKSAR), and the Russian Federation. A summary of the reports from Australia and the Russian Federation are provided in section 1.1.6.

In 2002, the Government of the HKSAR submitted its strategy to facilitate transition to CFC-free MDIs. All MDIs in the HKSAR are imported products. Major registered substitutes available on the market include DPIs and HFC MDIs.

2.3 Global database

Under Decision XIV/5, Parties are requested to submit information on CFC and CFC-free alternatives to the Secretariat by 28 February each year. In 2006, reports were received from Australia, Bulgaria, EC, HKSAR, the United States, and Uruguay.

2.4 Transition in Article 5(1) countries

2.4.1 Decision XVII/14 – Difficulties faced by some Article 5(1) countries with respect to CFCs used in the manufacture of MDIs

As the phase-out schedule for CFCs in Article 5(1) countries approaches 85 per cent reduction from baseline in 2007 and 100 per cent in 2010, Parties have raised concerns about difficulties facing some Article 5(1) countries that consume CFCs for the manufacture of MDIs and which may become non-compliant if this consumption is greater than the percentage of baseline allowed under the Montreal Protocol. Decision XVII/14 notes transfer of technology, information on available alternatives to CFC MDIs, and awareness of transition issues as key areas for further attention and consideration at the 26th meeting of the Open-Ended Working Group in 2006. Parties may wish to consider the following information relevant to these issues.

Even though environmental issues are a major concern in most Article 5(1) countries, there are many socio-economic and health challenges which may be of higher priority for their governments. However all CFC production must be phased out by the end of 2009 in line with the Montreal Protocol. Given the widespread availability of technically and economically feasible alternatives, MTOC believes that global phase-out of CFCs in MDIs will be achievable by 2010. To ensure this occurs, there is an urgent need for all Article 5(1) countries that have not already done so to develop effective national transition strategies in accordance with Decision XII/2. MTOC strongly recommends that these activities be made a priority to ensure a smooth transition to CFC-free MDIs congruent the Montreal Protocol phase-out schedule.

There are diverse conditions prevailing across these countries that make it difficult to recommend a uniform strategy for transition to CFC-free alternatives. In particular, there is a need to differentiate between the following.

- *Countries that rely mainly on imports* – In these countries, the transition to CFC-free products will be driven by marketing strategies of the multinational pharmaceutical companies as well as by the national health and trade authorities. In most of these countries the affordability of alternative CFC-free products may be a factor in transition. Transition strategies will be relatively simple, and be mainly concerned with regulatory approval of CFC-free alternatives and patient and physician education programmes. Countries will need to set an end-date for transition that is congruent with the Montreal Protocol phase-out schedule.

- *Countries that manufacture MDIs* (such as Argentina, Bangladesh, Brazil, China, Cuba, Egypt, Indonesia, India, Iran, Jordan, South Africa and Uruguay) – These countries will need to develop a detailed national transition strategy to phase-out CFC MDIs. Details of such a strategy would include the following:

  – Set a date for cessation of sales of CFC MDIs congruent with the Montreal Protocol phase-out schedule.

  – Involve stakeholders (national departments of health, environment, NGOs, MDI manufacturers, physician and patient groups) in developing the strategy. This group would also lead on the education of physicians, other healthcare workers, and patients. In countries where only a small percentage of patients use MDIs, increasing the use of inhaled medication can be achieved by introducing a single-dose DPI or other low cost alternatives.

  – Ensure adequate supplies of inhaled therapy through phase-out. This will need adequate supplies of bulk pharmaceutical-grade CFCs, which may be affected by the CFC production phase-out schedule from 2007 until the end of 2009 under the Montreal Protocol. The economics of CFC production after the phase-out may make impractical the production of pharmaceutical-grade CFCs for MDIs after 2009 (see section 2.4.5). If Article 5(1) countries do not take effective action now, they will face difficulties in achieving transition by 2010. In these circumstances, a final campaign production may need to be considered to ensure CFC supply for MDI manufacturing beyond 2009.

  – Ensure adequate supplies of CFC-free alternatives. MTOC notes that a range of HFC MDIs and DPIs are now approved for use in many Article 5(1) countries. Companies will need to ramp up production of alternatives as CFC MDI use disappears. Patents do not appear to provide a significant impediment to transition in Article 5(1) countries. National and international procurement programmes (such as www.globaladf.org) to procure inexpensive inhalers for developing countries should only use CFC-free inhalers. Local manufacturing companies should avail themselves of technology transfer, which may require funding.

In planning for the final phase-out in Article 5(1) countries, it would be useful for Parties to have a full understanding of all countries that are manufacturing CFC MDIs domestically. MTOC is aware that information available through the essential use process and its own membership may be incomplete. During 2006, MTOC is seeking the assistance of Article 5(1) countries in identifying their domestic manufacturers of CFC MDIs, the quantity of CFCs used, the volume of production of MDI units, and the moieties involved.

2.4.2 Progress in transition in Article 5(1) countries

It should be noted that significant progress has already been made towards transition in Article 5(1) countries for certain key moieties. Table 2.5 below shows data provided by IPAC on products from its constituent members, together with those from 3M and Ivax (Teva), which are available in these countries.

In many Article 5(1) countries, more than one CFC-free product is available. It is also important, therefore, to consider the data in Table 2.6, wich presents the number of Article 5(1) countries where at least one product has been approved. It is recognised that this is an underestimation of the true situation, as it takes no account of CFC-free products that have been introduced by domestic producers. However, it is clear from accumulating experience that the development and registration of alternate products cannot alone lead to a full uptake in the market without additional regulatory action. Nevertheless, in over fifty Article 5(1) countries, at least two CFC-free salbutamol products have been approved. This further supports the conclusion that transition in Article 5(1) countries is achievable by the phase-out at the end of 2009 under the Montreal Protocol.

Table 2.5 Device approvals and subsequent launches in Article 5(1) countries*

Moiety	Device	Approved	Launched
Beclomethasone	DPI	24	20
	HFC MDI	38	29
Budesonide	DPI	43	39
	HFC MDI	0	0
Fenoterol	DPI	0	0
	HFC MDI	4	4
Fenoterol and Ipratropium	DPI	0	0
	HFC MDI	6	3
Fluticasone	DPI	55	40
	HFC MDI	88	60
Formoterol	DPI	27	21
	HFC MDI	0	0
Ipratropium	DPI	0	0
	HFC MDI	3	3
Nedocromil	DPI	0	0
	HFC MDI	0	0
Salbutamol	DPI	40	37
	HFC MDI	115	82

Moiety	Device	Approved	Launched
Salmeterol	DPI HFC MDI	43 0	37 0
Sodium cromoglycate	DPI HFC MDI	0 0	0 0
Terbutaline	DPI HFC MDI	36 0	23 0

*Note: Table 2.5 does not include products for which there has never been a CFC counterpart e.g. Seretide™, Symbicort™, Alvesco™.

Table 2.6 The number of Article 5(1) countries where at least one alternative to CFC MDIs is available

Moiety	Approved	Launched
Beclomethasone	42	37
Budesonide	43	39
Fenoterol	4	4
Fenoterol and Ipratropium	6	3
Fluticasone	93	75
Formoterol	27	21
Ipratropium	3	3
Nedocromil	0	0
Salbutamol	115	91
Salmeterol	43	37
Sodium cromoglycate	0	0
Terbutaline	36	23

2.4.3 Regional analysis

The situations in a number of Article 5(1) countries are described below. As explained earlier, MTOC does not have information for all Article 5(1) countries.

2.4.3.1 Africa

Limited data exist on asthma prevalence in African countries. Estimated prevalence from a few centres in Africa ranges from 5-20 per cent with higher prevalence generally found in urban compared to rural areas. Since the total population in Africa is approximately 900 million, there are likely 50-100 million patients who may benefit from inhaled therapy. Very few, if any, African countries have national asthma management guidelines. There are limited data on the prevalence of COPD in Africa.

Asthma is mostly treated with oral drugs. Relatively few patients use inhalers, though use is increasing rapidly. The current low rate of inhaler use may be a result of the following:

- Cost of inhalers;
- Low awareness of inhaled therapy among physicians and patients;
- Prescribing habits generally favour use of oral medications; and
- Limited availability of inhalers apart from main cities.

HFC MDIs and DPIs are available but their use comprises a small proportion of the already low inhaler use. This is due to the relatively high price compared to CFC MDIs. Also, inhaler distribution may not extend beyond tertiary and secondary hospital centres.

CFC MDIs are imported from Article 5(1) and non-Article 5(1) countries. CIPLA (India) is a major supplier, though some MDIs are imported from the European Union and some may come from unregulated sources.

Multinational companies supply a range of CFC-free alternatives:

- GlaxoSmithKline is the largest supplier of salbutamol and non-salbutamol HFC MDIs and DPIs to most African countries;
- AstraZeneca supplies a DPI corticosteroid (budesonide) and a DPI bronchodilator (terbutaline) to some countries;
- Ivax has only a small presence and in very few countries;
- Non-salbutamol CFC-free products are increasing in use (salbutamol is still mostly used as oral tablets, manufactured locally); and
- Inexpensive single-dose capsule DPIs, such as those available in India, do not appear to be widely available in Africa.

Issues for successful transition

Most African countries are importers only. These countries will need to develop an appropriate national strategy that will specify a date for cessation of sales of CFC MDIs. This should be preferably on or before 31 December 2009.

MTOC is aware of two African countries (Egypt and South Africa) that manufacture CFC MDIs, which will need a detailed national transition strategy with particular attention to local MDI manufacturers. In order to meet the Montreal Protocol phase-out schedule, national strategies for those countries that manufacture MDIs will need to specify a final phase-out date so that no manufacture of CFCs for MDIs is necessary beyond the end of 2009.

Awareness of CFC phase-out, Montreal Protocol and ozone depletion issues among patients, physicians and government policy makers is low. This is due to a number of factors, including competing social issues, economic challenges and the general lack of awareness and under-diagnosis of asthma and COPD.

There is no local production of bulk CFCs in Africa. Therefore, manufacture of MDIs in Egypt and South Africa depends on the importation of CFCs. Remaining non-medical CFC use is bound by the Montreal Protocol phase-out schedule, with an end to CFC consumption in 2010. Plans to phase-out CFCs in MDIs will need to be part of the overall transition and cannot be overlooked.

Parties may wish to identify countries within each African region that may serve as regional examples for successful transition with the understanding that the timing of transition in most countries is dependent on external supply factors. Therefore regulatory authorities will need to ensure early licensing of CFC-free alternatives to avoid a shortfall of supply of inhalers.

Strategies to increase the use of CFC-free alternatives may include:

- Legislation by government and supra-government organisations such as the African Union;
- Reduction of taxes on imported CFC-free alternatives to enhance affordability, and/or increased taxes on CFC products towards the end of transition; and
- Advocacy by professional societies and NGOs where they exist.

2.4.3.2 Bangladesh

For 2003, Bangladesh reported 68.3 ODP tonnes of CFCs used for local MDI manufacture. Additional information will be sought on the status of transition in Bangladesh and reported in MTOC's 2006 Assessment Report.

2.4.3.3 China

More than 40 million people in China have asthma or COPD. National guidelines recommend inhalation therapy for management of asthma and COPD patients.

In the last three years, the State Food and Drug Administration of China has completed Good Manufacturing Practices (GMP) certification of inhaler manufacturers. This has led to reduction in the number of MDI manufacturers as some producers merged or ceased manufacture. With fewer manufacturers, MDI output from some individual companies has increased. There are three local specialty inhaler companies that produce both MDIs and DPIs.

Approximately 15 million CFC MDIs per year are locally manufactured and consumed about 350 tonnes of CFCs in 2005. There are two types of MDIs: CFC solution and CFC suspension products. The low price, solution-type MDI for asthma and COPD has a large market, which is slowly increasing. About 2.5 million MDIs are sold each year by multinational companies (both imported and locally manufactured). A small quantity of HFC MDIs has been imported since 2004.

Some local companies and researchers have developed and patented new technology for CFC-free MDIs; clinical trials are ongoing. Adequate bulk pharmaceutical-grade HFC is readily available from three multinational producers and likely will be from one local producer.

CFCs are used for Chinese traditional medicines, topical sprays, and nasal sprays (approximately 650 tonnes per year). Technically and economically feasible alternatives are potentially available for all of these products.

China has funding (UNIDO, 200,000 USD) to prepare a national transition strategy, due to be completed in July 2006. No funding has been approved for transition in manufacturing. The local plants were established prior to 1996 and are eligible for funding. Any such funding would be dependent on the development of a national phase-out strategy.

Issues for successful transition

There is an urgent need to develop an effective national transition strategy.

In order to meet the Montreal Protocol phase-out schedule, a national strategy will need to specify a final phase-out date so that no manufacture of CFCs for MDIs is necessary beyond the end of 2009.

The strategy would ideally involve collaboration between the State Food and Drug Administration, environmental agencies, multinational and local manufacturers, physicians, patient groups and the pricing authority. This model has worked successfully in other countries completing their transition, such as Australia and Japan. Physician and patient education programmes will also need to be developed and implemented as part of the national strategies.

Multinational companies will need to change imports to CFC-free alternatives. Likewise multinational companies with local manufacturing will need to switch to CFC-free technology.

For local manufacturers, urgent consideration of means to transfer technology is needed, including for DPI technology. Among these considerations is the need to cover development costs (e.g. clinical trials, CFC-free MDI production lines, etc.) for local manufacturers. These issues are made all the more urgent due to the uncertainties in the continued availability of pharmaceutical-grade CFCs for MDIs until the phase-out date at the end of 2009 (see section 2.4.9). An early final phase-out for CFCs for other medical uses (traditional medicines, topical sprays, nasal sprays) will help ensure adequate CFC supplies for MDIs.

2.4.3.4 India

In India, the prevalence of asthma is approximately 10 per cent, with an estimated 100 million sufferers. This may be increasing. There are no reliable national surveys for COPD.

MDIs for asthma and COPD have been produced in India for several decades. Inhaled medication is not available from government hospitals that provide subsidised medical care to the needy. Due to various reasons, predominantly cost, there is only a minority of patients (less than 5 per cent) with asthma and COPD who use inhaled medications, including MDIs and DPIs. For example, in a recent South Asia survey (AIRSA), it was reported that less than 2 per cent of patients with asthma used inhaled corticosteroids. This number is likely to increase in the future as more patients are expected to be able to afford inhaled medications and there is an improvement in awareness and acceptance of inhaled medications through national education programs.

The estimated consumption of CFCs for local MDI production is approximately 500 tonnes a year, of which about 360 tonnes is used by CIPLA Pharmaceuticals.

Some Indian companies, including CIPLA, have already started producing HFC MDIs. Currently, the sales of these latter products are not strongly promoted and the cost differential (90 versus 75 Rupees) has made them less popular. However, the difference in cost may diminish as the CFC transition proceeds. There are additional alternatives available as single capsule DPIs that are generally less expensive than MDIs and are available for a wide range of medications.

Issues for successful transition

There is an urgent need to develop an effective national transition strategy.
In order to meet the Montreal Protocol phase-out schedule, a national strategy will need to specify a final phase-out date so that no manufacture of CFCs for MDIs is necessary beyond the end of 2009.

The strategy would ideally involve collaboration between the Government health agency, environmental agencies, multinational and local manufacturers, physicians, patient groups and the pricing authority. Physician and patient education programmes will also need to be developed and implemented as part of the national strategies.

Multinational companies will need to change imports and exports to CFC-free alternatives. Likewise multinational companies with local manufacturing will need to switch to CFC-free technology.

For local manufacturers, urgent consideration of means to transfer technology is needed, including for DPI technology. Among these considerations is the need to cover development costs (e.g. clinical trials, CFC-free MDI production lines, etc.) for local manufacturers. These issues are made all the more urgent due to the uncertainties in the continued availability of pharmaceutical-grade CFCs for MDIs until the phase-out date at the end of 2009 (see section 2.4.5). An early final phase-out for CFCs for other medical uses (topical sprays, nasal sprays) will help ensure adequate CFC supplies for MDIs.

DPI medication is currently available and can be viewed as a less expensive and medically satisfactory alternative to MDIs. However, some patients may prefer MDI use (MDIs currently constitute 60 per cent of inhaled therapy). During transition planning, the availability of both DPI and CFC-free MDIs should be assured. In preparation for the phase-out, manufacturing will have to be increased (MTOC understands that substantial capacity currently already exists).

Pharmaceutical-grade HFC propellant is currently imported, as it is not yet manufactured in India. As transition progresses, efforts will be needed to ensure adequate quantities of HFCs for Indian MDI manufacturers.

Currently, one local manufacturer predominates in the capacity to produce CFC-free inhalation products. Other companies may require incentives to facilitate their production of CFC-free products. A competitive marketplace will avoid excessive pricing.

Efforts are needed to educate the medical community, patients, and the general public about the need to replace CFC propellants and how this can be accomplished.

2.4.3.5 Indonesia

For 2004, Indonesia reported 30.1 ODP tonnes of CFCs used for local MDI manufacture. Additional information will be sought on the status of transition in Indonesia and reported in MTOC's 2006 Assessment Report.

2.4.3.6 Iran

For 2003, Iran reported 98 ODP tonnes of CFCs used for local MDI manufacture. CFC MDI products manufactured are for beclomethasone, cromolex, salbutamol, and salmeterol moieties. Additional information will be sought on the status of transition in Iran and reported in MTOC's 2006 Assessment Report.

2.4.3.7 Jordan

For 2004, Jordan reported 5 ODP tonnes of CFCs used for local MDI manufacture. Additional information will be sought on the status of transition in Jordan and reported in MTOC's 2006 Assessment Report.

2.4.3.8 Latin America and Central America

Data on asthma prevalence in Latin America are limited. According to The Asthma Insights and Reality in Latin America (AIRLA) survey (conducted between May and July 2003, covering 11 countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Paraguay, Peru, Uruguay, and Venezuela), the prevalence of diagnosed asthma ranges from 1.1 per cent in Ecuador to 7.1 per cent in Venezuela. The overall prevalence of diagnosed asthma in Latin America is approximately 2.8 per cent. Data on asthma morbidity were stratified by age (children: below 16 years of age; adults: 16 years of age or over). Around 25 per cent of the children (ranging from 20 per cent in Venezuela to 42 per cent in Paraguay) were reported to have moderate to severe asthma symptoms and 58 per cent (47 per cent in Paraguay and 66 per cent in Colombia) reported missing school because of asthma in the past year. Data on bronchodilator medicine use indicated that 54 per cent of asthmatics follow their prescription or buy their medicines over-the-counter (16 per cent). On the other hand, only 6 per cent of patients use inhaled steroids.

Argentina

For 2004, Argentina reported 160.2 ODP tonnes of CFCs used for local MDI manufacture. Additional information is being sought on the status of transition in Argentina and will be reported in MTOC's 2006 Assessment Report.

Brazil

Data from Brazil show that inhaler use is steadily increasing. Considering direct sales to patients, approximately 5.0M units were sold in 1994 and by 2004 this had risen to 8.3M annually. Almost 50 per cent of inhalers used are short-acting bronchodilators, with a further 25 per cent being combination products. HFC MDIs and DPIs covering all the major therapeutic classes are now available in Brazil. However, as a part of its healthcare policy to provide free MDIs to patients, the Government is purchasing CFC MDIs rather than CFC-free alternatives.

Approximately 95 per cent of the inhalers sold in Brazil are imported, with Government control of prices. Approximately 5 per cent of MDIs are locally manufactured. While the Government has agreed to the Montreal Protocol timetable, the precise timing of the transition will be driven in part by the multinational pharmaceutical companies and by decisions of the Government. Regulatory authorities responsible for licensing new pharmaceutical products are not fully aware of their role in facilitating the approval of new CFC-free formulations. The Government is applying for financial support from the Multilateral Fund for assistance in reducing its consumption of CFCs, including helping local MDI manufacturers to prepare for the manufacture of CFC-free MDIs.

Neither physicians nor the general public are being informed about the transition process, even though it is underway.

Cuba

Cuba has a single company producing both salbutamol and beclomethasone CFC MDIs for domestic consumption. The annual use of CFCs for MDIs is estimated to be 109 tonnes. It is imperative that this amount be reduced in order to ensure Cuba's continued compliance under the Montreal Protocol. A project has been approved by the MLF to phase out this CFC use in Cuba. In 2004, a commercial agreement with a technology provider commenced. Due to difficulties in the negotiation of the commercial agreement, in early 2005, the Government of Cuba decided to stop the negotiations with the technology provider and consider other options.

UNDP identified a product developer who was interested in developing the two MDI products required by the company in Cuba: salbutamol and fluticasone. After evaluating the technical and commercial feasibility of developing the products, the change of scope of the project was approved by the Executive Committee. A commercial agreement was signed between the Government of Cuba and the product developer with an anticipated completion date of March 2008.

Uruguay

A single national company produces CFC MDIs and consumes approximately 10 tonnes of CFC per annum. An MLF approved project has commenced to phase out this CFC use. There are currently no patents covering the HFC MDI formulations and costs associated with the local development of new formulations or technology transfer and licence agreements have not been requested.

The project aims to replace a range of CFC MDI products by HFC MDI products. It is anticipated that the local manufacturing company can develop the products and no technology transfer is needed to accelerate the process.

The project covers the installation of suitable manufacturing equipment for HFC MDIs, and the provision of technical support during equipment installation and product development. Formulation development is just starting, along with the purchase of the equipment required for production.

2.4.3.9 Pakistan

The population of Pakistan is approximately 154 million. According to a recent survey conducted in Pakistan, the prevalence of asthma is 5 per cent. Although there are no data on the prevalence of COPD, it is expected to increase in the future because of increasing use of tobacco in recent years. A survey done in 2003 showed that 40 per cent of males and 8 per cent of females smoked.

The majority (80 per cent) of patients with asthma and COPD use only systemic therapy (tablets/syrups/injections). Those patients who are on inhaled medications are mainly using salbutamol. Less than 10 per cent of asthma patients are on inhaled corticosteroids. The reasons for limited use of inhaled medications are many, including cost, social stigma attached to inhaler use, ignorance about the efficacy of inhaled medication, and the fear of becoming addicted. However, as a result of various educational activities, an increasing number of patients are using inhalers compared to five years ago and the market for MDIs continues to grow. In 2005, the sale of inhalers in the country increased by 10 per cent compared to 2004 and this trend is projected to continue for 2006.

All inhalers are imported either by multinational companies (90 per cent) or by local companies (10 per cent). There is no manufacturing plant for inhalers of any sort.

Currently over 90 per cent of inhalers available in the market are CFC-containing MDIs. Last year, two companies introduced CFC-free inhaled corticosteroids, which cost approximately 10 per cent more than their CFC counterparts. The first DPI (a corticosteroid) was also introduced. New CFC-based MDIs are still being launched.

Issues for successful transition

Pakistan is an example of a country with inhaled therapy coming entirely from imports.

A national strategy will need to specify a date for cessation of sales of CFC MDIs. This should be preferably on or before December 31st 2009.

Development of the national strategy should involve stakeholders (national departments of health and environment, NGOs, MDI manufacturers, physician and patient groups) in development and implementation. This group would also lead on education of physicians, other healthcare workers, and patients. This model has worked successfully in other countries completing their transition, such as Australia and Japan.

In Pakistan, compared to other impediments to optimal respiratory care, the issue of CFC MDIs and their impact on the environment is a relatively minor consideration for patients and practitioners. There is also a lack of awareness about the coming transition. The Government, pharmaceutical companies or professional societies have done no significant work in educating the public on the need for transition to CFC-free inhalers. Recent experience showed the need for such awareness when considerable confusion occurred among patients after one company suddenly switched from a CFC MDI to a CFC-free MDI without prior publicity.

Given the impending phase-out, regulatory authorities may wish to consider that no CFC products are introduced into the market between now and the full transition. Prompt regulatory approval of CFC-free alternatives will ensure an adequate range of alternatives for transition.

2.4.4 Patents and transition in Article 5(1) countries

On preliminary evaluation, it does not appear that formulation patents will provide an insurmountable barrier to the introduction of CFC-free MDIs into Article 5(1) countries. While the situation varies between active moieties, and between countries, there are no overarching patents that would prevent a general introduction of CFC-free MDIs. However, it should be emphasised that this observation is based on a survey of formulation patents that have been prosecuted by major multinational pharmaceutical companies in those Article 5(1) countries comprising the top ten users of MDIs by volume. Process patents, such as those in India, have not been considered here. There may also be patents from domestic researchers and producers in individual countries, such as China, which have also not been addressed.

There are some local exceptions to this situation that are worthy of note. From a country perspective, patents covering the use of HFC-227ea and suspension formulations do not expire in South Africa until as late as 2012. From a moiety perspective, formulation patents covering salbutamol, beclomethasone, fluticasone and salmeterol exist in a number of Article 5(1) countries beyond 2010. While it may be possible to introduce different products containing the same moiety that are therefore not covered by the claims of these patents, the technical difficulty to develop them de novo should not be underestimated.

Nonetheless, in many Article 5(1) countries, alternative delivery systems already exist that may actually be better suited to patients (e.g. single capsule DPIs) if they are unable to afford an entire month’s therapy with a single disbursement.

2.4.5 CFC Production for MDIs and the Montreal Protocol phase-out in Article 5(1) countries

Given the widespread availability of technically and economically feasible alternatives, it is expected that global phase-out of CFCs in MDIs should be possible by 2010. The Montreal Protocol phase-out date is less than four years away and considerable challenges will need to be addressed to achieve transition in Article 5(1) countries. These challenges can be overcome through the transfer of technology, product launches of CFC-free alternatives and implementation of comprehensive transition strategies.

If Article 5(1) countries face difficulties in achieving transition by 2010, opting for an essential use process may be counter-productive. Production of CFCs for MDI manufacture and basic domestic needs are linked. Depending upon operational parameters, experience has shown that a bulk CFC production facility will produce a certain percentage of CFCs that do not meet the rigorous specifications required by MDI manufacturers operating in non-Article 5(1) countries. Currently, CFCs that do not meet pharmaceutical specifications can be used for basic domestic consumption. This will not be possible after 2009 when these non-pharmaceutical grade CFCs would need to be destroyed. Although the expectations for purity may vary between Article 5(1) countries, the percentage of production not fit for pharmaceutical use is projected to be no lower than 25 per cent and may be as high as 50 per cent of CFC production. Given these considerations, one company in a non-Article 5(1) country has indicated that the economics of production of CFCs are only likely to remain favourable through to 2009, when use for domestic consumption can utilise that part of production that is non-pharmaceutical grade.

Therefore if an essential use process were to be considered after 2009, the economics of CFC production would make this impractical. The costs of destruction of CFCs that do not meet the required pharmaceutical specifications would be significant. If these costs were projected to be prohibitive, it may be appropriate to arrange for a campaign to produce CFCs before 2010. For campaign production, appropriate volumes would need to be agreed upon and the liability for the destruction of any unused volumes determined. A definitive end-date for pharmaceutical-grade CFC production would provide certainty for CFC manufacturers.

As overall CFC consumption is being stepped down under the Montreal Protocol, a reduction to 15 per cent of baseline consumption will have to be met in 2007. If some Article 5(1) countries still have CFC requirements for MDI manufacture that are greater than the allowed amount for that year, those countries might be in a potential non-compliance situation. Although CFC consumption for MDIs has normally been a very small fraction of total CFC use in a country, the MTOC is aware of at least two cases where such a potential non-compliance situation could arise once the major part of their CFC phase-out is completed.

3 Foams Technical Options Committee (FTOC) Progress Report

3.1 General

This update is the third foam sector review published since the 2002 Report of the Flexible and Rigid Foams Technical Options Committee, issued in May 2003. It highlights changes in technology and transitions that have occurred in the last year. The key conclusions are as follows:

Transitional Status - Developing Countries

- Virtually all transition projects phasing out CFCs are materially complete in non-insulation areas and reaching completion in insulation applications. However, many projects are still awaiting formal closure.

- HCFCs continue to be the major blowing agent in virtually all insulation applications despite the increasing use of hydrocarbons in domestic appliances.

- The use of hydrocarbon-blown foam in appliances continues to gain ground, particularly in the larger countries of Asia and Latin America, where they are in the majority.

- Some use of HFC-blown foam is emerging in appliances (primarily for export markets) and in OCF (One Component Foam), integral skin foam and shoe soles.

- CFC prices are now consistently above those of HCFCs and are thus driving the remaining transition.

- Significant development of insulation markets in China is driving rapid introduction of XPS (expanded polystyrene) facilities using HCFC technologies

- Consideration is being given to bank management projects in some countries although foam recovery may be difficult logistically, particularly in remote regions.

Transitional Status - Developed Countries

- The use of HCFC-141b in insulation foams is now very limited following introduction of use-bans in key markets.

- Although the supply position has been stabilised in the European Union, the actual uptake of HFCs following HCFC phase-out has been lower than previously predicted.

- Insulation demand continues to grow rapidly in several markets in response to more stringent building and appliance energy efficiency requirements.

- Super-critical CO_2 spray foam technologies have now been commercially introduced in Japan, although the applicability of such technologies to other geographic regions is still unclear.

- Research continues into further blowing agent options, although it is unlikely that the dominant position of hydrocarbons in polyurethane insulation applications will be challenged in the foreseeable future.

- Regulatory, economic and market pressures continue to limit HFC uptake and make further investment in dedicated HFC blowing agents unlikely in the short term.

Other relevant issues

- Work continues on improving emissions forecasting and bank estimation. Latest information suggests that there is greater consistency between atmospheric emission estimates and bottom-up model outputs than first thought.

- Recovery of blowing agents from appliances continues to be practised although recovery levels vary significantly.

- The practicality and economics of ODS recovery from building insulation is still under review although the potential is expected to be limited to certain construction types only.

3.2 Technology Status

The following table illustrates the main substitute technologies currently being considered or already used in the polyurethane, extruded polystyrene/polyolefin and phenolic foam sectors.

FOAMS TOC UPDATE REPORT 2006 - TECHNICAL OPTIONS TABLE

SECTOR	DEVELOPED COUNTRIES	DEVELOPING COUNTRIES		COMMENTS
	CURRENT/FUTURE	CURRENT	FUTURE	
POLYURETHANE RIGID				
Domestic refrigerators and freezers	HCs (cyclopentane & cyclo/iso pentane blends), HFCs	Majority HCs, balance HCFC-141b or HCFC-141b/22	HCFC-141b, HFCs & HCs	HFC-134a & HFC-245fa for the North American market
Other appliances	HCs, HFCs	Residual CFC-11, HCFC-141b & HCs	HCFC-141b & HCs	
Transport & reefers	HCs, HFCs	HCFC-141b, HCFC-141b/22	HCFC-141b, HCFC-22 HFCs & HCs	Potentially HFCs but no known use
Boardstock	Mainly HCs, minor use of HFCs	No known production Art 5.1	NA	HFC for stringent product fire standards.
Panels – continuous	Mainly HCs, some HFCs	HCFC-141b & HCs	HCFC-141b & HCs	HFC for stringent product fire standards
Panels discontinuous	Residual HCFC-141b, HFCs, some HC	Residual CFC-11, HCFC-141b	HCFC-141b & HFCs	HFCs, not HCs, for SMEs
Spray	Residual HCFC-141b, HFCs, CO_2, (HC)	Residual CFC-11, HCFC-141b	HCFC-141b & HFCs	Potential use of HCs in North America
Blocks	Residual HCFC-141b, HCs, HFCs,	Residual CFC-11, HCFC-141b	HCFC-141b & HFCs	HC use increasing
Pipe-in-pipe	Mainly HCs, minor HFC	Mainly HCFC-141b	HCFC-141b & HCs	Cyclopentane is main HC
One Component Foam	Mainly HCs, some HFCs	HFCs, HCs	Mainly HCs, some HFCs	HC use driven by cost and legislation
POLYURETHANE FLEXIBLE				
Slabstock & block-foam	LCD (Liquid Carbon Dioxide), EMT(Energy Management Technology), methylene chloride	Methylene chloride, LCD	Methylene chloride, LCD, (EMT)	Regulation limits methylene chloride use in some countries
Moulded	Mainly CO_2 (water), minor LCD	Mainly CO_2 (water), minor LCD	CO_2 (water)	CO_2 (water) is industry standard
Integral Skin	CO_2 (water), HFCs, HCs	Residual CFC-11, CO_2 (water), some HCFCs and HFCs	CO_2 (water), some HCFCs and HFCs	HFC-134a is main HFC
Shoe Soles	CO_2 (water), HFCs	CO_2 (water), HCFCs, HFCs	CO_2 (water), HCFCs, HFCs	HFC-134a is main HFC
PHENOLIC				
Board & block	HFCs, HCs (particularly in Japan)	HCFC-141b	HCs	HFCs are used to retain fire performance in some markets
EXTRUDED POLYSTYRENE				
Sheet	HCs	Mainly HCs		Some safety issues in Art 5.1 countries
Boardstock	HCFC-142b, HFC-134a, HFC-152a, CO_2, CO_2/ethanol, (HCs in Japan), blends of CO_2/hydrocarbons	Mainly HCFC-142b, some HCFC-22 and HCs	HCFC-142b, HFC-134a, CO_2, blends of CO_2/ ethanol or CO_2/hydrocarbons	HCFC-142b use in North America until 2010. Final choice is end-product specific
POLYOLEFIN				
Sheets, planks & tubes	HCs (iso-butane & LPG)	Mainly HCs		Some safety issues in Art 5.1 countries

4 Halons Technical Options Committee (HTOC) Progress Report

The HTOC Lead Authors for the 2006 Assessment Report met on March 6-8, 2006 in Paris, France at facilities provided by UNEP DTIE. This was the first of two planned HTOC meetings for 2006. Attending HTOC members were from the following countries: Bahrain, Denmark, India, Jordan, Poland, Singapore, South Africa, South Korea, UK, and USA.

The purpose of the meeting was to confirm the 2006 Assessment Report content and layout, to discuss information already collected for the report, and to decide on remaining technical issues to be covered by the report, and how accurate, relevant information would be obtained. The HTOC believes that issues concerning the Article 5(1) countries need particular attention and this is reflected in the composition of the Committee, which includes five new members from Article 5(1) countries: Brazil, Jordan, Singapore, South Africa, South Korea, and two new Technical Consultants from Article 5(1) countries: Brazil and Jordan.

The HTOC Lead Authors reviewed current information at the meeting, updating the status of the transition from halons according to the various sectors of use. In addition, several issues have been identified that are key and timely to the continued success of the global transition away from halons.

4.1 Update on Decision XV/11

The HTOC submitted to ICAO an article on alternatives and the status of their current use in civil aviation for the ICAO Journal, which was published in the December 2005 edition. A study on halon usage within civil aviation is nearing completion and the results will be published in the HTOC 2006 Assessment Report, as well as being provided to ICAO for their use. In addition, as noted below, the HTOC will finalize its worldwide halon bank and emission estimates this year, which will enable future halon supply estimates to be provided to ICAO. The HTOC co-chairs plan to meet with ICAO in July 2006, concurrent with the 26th Open Ended Working Group meeting in Montreal. The HTOC also plans to provide another article for publication in the ICAO Journal later this year.

4.2 Review of HTOC halon bank estimates

The HTOC defines the global bank of each of the halons (halon-1211, halon-1301, and halon-2402) as the sum of the halon that is installed in all fire protection equipment plus the halon that is held in storage tanks. The halon bank is the sum of all halon ever produced minus the sum of all halon emissions, i.e., emissions from extinguishing fires, false discharges and leaks, and destruction. Care must be taken to not misuse the term “halon bank” to describe recycling and storage facilities. The HTOC recommends that the term “halon banking” be used to describe the process of collecting, recycling or reclaiming and reusing halons.

In working with the Science Panel, the HTOC discovered a transcription error in the halon-1211 model that overstated Article 5(1) production. With the error corrected, the updated HTOC halon-1211 model prediction of emissions is more in line with the latest atmospheric measurements. None-the-less, there is a need to reconfirm all halon-1211 production, destruction and emission estimates.

Currently, the HTOC model for halon-1301 remains inconsistent with the latest atmospheric data. The model consistently over estimates emissions compared to that data and therefore, with less loss from the bank, the bank of halon-1301 may be significantly larger than the model predicts. The HTOC believes that the data on production are accurate and that the principle error in the model is more likely to be in the assumed emission rates than in the production data. Further, the HTOC has recently become aware of an additional use of halon-1301 (see feedstock use below) that might add to emissions that would widen further the gap between the HTOC predictions and atmospheric measurements. As with halon-1211, there is a need to reconfirm all halon-1301 production, destruction and emission estimates, including emissions that would be expected from use as a feedstock.

Updates to the HTOC models will be cross-checked with the latest data on atmospheric concentrations that are being reported concurrently in the 2006 Science Assessment Panel Report. The HTOC models will be improved to show uncertainty ranges in order to provide a more complete picture of the potential differences between model predictions and observed data.

The HTOC is considering developing an additional model for halon-2402 but needs to confirm the availability of good data on total production, destruction and atmospheric measurements of halon-2402.

The HTOC just recently learned that newly produced halon-1301 (bromotrifluormethane, CF_3Br) is currently being used as a feedstock for the manufacture of a pesticide (see box on pages 55-56). The initial understanding of the HTOC is that this is a long-standing process that first occurred in a non-Article 5(1) country that has now also been transferred to at least one Article 5(1) country. This may be an important issue if use as a feedstock continues and the production could be seen as a future source of halon-1301 for fire protection Essential Use Production Exemptions. The HTOC is working with the Chemicals Technical Options Committee (CTOC) to look into the matter.

4.3 Implementation challenges in Article 5(1) countries

The new HTOC members from Article 5(1) countries confirmed problems with the transition away from halons in some regions, particularly within the airline industry where Middle East airlines have had difficulty convincing manufacturers to supply new aircraft with halon alternatives. They also confirmed contamination of halon stocks with CFCs and other materials. The Halon Bank of South Africa reported that 95% of halon-1301 that it tested does not meet the ISO specification and is commonly contaminated with halon-1211 and/or water.

Although halon alternatives are available, there is a great dependency on local vendors for decision making. These vendors rely on information from suppliers of alternatives seeking to gain market share and so may not be providing independently verified or balanced information on product suitability. To help decision-makers, the HTOC 2006 Assessment Report will contain an updated chapter on professional fire protection information. The HTOC will work with UNEP DTIE to distribute this type of information independently of the information provided in the HTOC Assessment Report.

4.4 Halon-2402 phase-out

There is growing concern about the availability of halon-2402 outside of Russia to support existing uses such as aircraft and military vehicles. In particular, India has reported a growing shortage that could be problematic. India also reported that halon-2402 systems are being routinely converted to halon-1301 to improve safety and help ensure future supplies.

4.5 Destruction challenges

The extent of the destruction of halons outside of Australia and the European Union is not very well understood. A new plasma arc destruction facility is being constructed in the United States and is expected to start operations in April 2006. However, it is anticipated that halons will not be the main ODS destroyed and that the facility initially will be destroying non-halon ODS from Canada. The HTOC is currently collecting data on destruction facilities capable of destroying contaminated halons.

As part of its work to complete the 2006 Assessment Report, the HTOC will include a new chapter on the issues related to halon destruction.

TEAP's comments on the use of halon-1301 as a feedstock

Under the Montreal Protocol, feedstock uses of ODS are exempt from control measures. Each Party defines its own feedstock uses and exercises a range of stringency in reducing and eliminating unnecessary emissions of ODSs. TEAP and its TOCs have become aware of a feedstock use that could jeopardise protection of the ozone layer.

Halon-1301 is being produced for use as a feedstock for the production of Fipronil, a broad-spectrum pesticide used to control multiple species of thrips. Production of halon-1301 reported to the Ozone Secretariat for this feedstock use has averaged 400 tonnes per annum in France and approximately 160 tonnes in 2004 in China. This feedstock production raises some concerns because production for fire protection uses stopped in non-Article 5(1) Parties in January 1994 and will likely cease in Article 5(1) Parties in 2008.

Since the phase-out in non-Article 5(1) Parties, it has been generally accepted that the only source of halon-1301 in those countries would come from the halon bank, through recovery and recycling, and that production of new halon would be unlikely to restart. Feedstock use was not envisioned. The Halons Technical Options Committee and TEAP have never recommended an essential use production request for halon-1301 because of the availability of material from the bank. Thus eventually a finite halon resource would become difficult to obtain, encouraging users to move to alternatives. The unavailability of future production has been used to great effect to encourage the aviation and military sectors to invest in research and development to solve some of their difficult problems. Nevertheless, the bank of halon-1301 still remains large, and some Parties have implemented use controls in an effort to accelerate the decommissioning of halon systems and encourage the destruction of halon-1301. However, the latter is fairly expensive and energy intensive, and to date relatively little has been reported as destroyed. Therefore, the continued production of halon-1301 for feedstock use raises some serious issues that Parties may wish to consider and evaluate options to resolve.

The bank of halon-1301 is still very large despite measures by some Parties to encourage its destruction. This halon-1301 can be recovered and recycled to the same international specification as newly produced halon-1301, thus making the latter unnecessary for feedstock use and reducing emissions.

TEAP's comments on the use of halon-1301 as a feedstock (cont'd)

Continuing to produce halon-1301 for feedstock use while at the same time destroying halon-1301 by other means is energy intensive and unnecessarily harms the environment by contributing to global warming.

The availability of newly produced halon-1301 may discourage the aviation and other sectors from implementing alternatives if they can be confident in a cost-effective halon supply via an essential use exemption.

Sales for legitimate feedstock use, especially transboundary, might be illegally diverted into fire protection where profits may be higher than in pesticide production.

5 Refrigeration, Air-conditioning and Heat Pumps Technical Options Committee (RTOC) Progress Report

The RTOC met on August 29-30, 2005 in Vicenza, Italy, at the facility provided by the Campus Padova University School of Engineering. This was the first meeting of its full members since the September 2004 meeting in Glasgow, UK. Attending members were from the non-Article 5(1) countries Denmark, France, Germany, Hungary, Japan, Netherlands, Norway, Poland, Russia and from the Article 5(1) countries Brazil, India, Indonesia, Kenya, Thailand, Tunisia, Uganda and Vietnam.

The main purpose of the meeting was to assign responsibilities for the preparation of the 2006 Assessment Report and to agree on time schedules. It was decided that first drafts of chapters would be circulated for comments by February 2006 and should be worked up to a First Order Draft. It was agreed that the next meeting would be held in Trondheim, Norway (back-to-back with a conference on Natural Refrigerants) at the facility provided by SINTEF Energy Research, where a First Order Draft should be discussed. At this meeting two new Chinese members will be adopted. A second RTOC meeting will take place in October-November 2006 to look at peer review comments and to finalise a Second Order Draft (possibly back-to-back with MOP-18 in New Delhi).

For this progress report the following general observations can be given. The phase-out of CFCs in the manufacturing of new refrigeration and air-conditioning systems has now also been almost completed in the Article 5(1) countries. Some of these countries have even started using alternative technologies to HCFCs to meet their export markets. However, there is a continuing substantial use of CFCs in the servicing of existing equipment in Article 5(1) countries. More specific information on the status in each of the sub-sectors is given below.

5.1 Refrigerant Data

The search for new alternative refrigerants continues. Research is being conducted for updating the thermophysical properties of new and existing single component refrigerants as well as blends. The information on thermophysical properties for heat transfer fluids (HTF) is also being updated. The status of the data for the thermophysical properties of refrigerants, which include both thermodynamic properties (such as density, pressure, enthalpy, entropy, and heat capacity) and transport properties (such as viscosity and thermal conductivity), is generally good and is excellent for most common alternative HFCs. Data gaps exist, however, for the thermodynamic and transport properties of blends and less-common fluids as well as the transport properties of many fluids (but particularly for blends). The data situation for the less-common fluids is more variable; there is a need to collect and evaluate the data for such candidates.

A major uncertainty for all of the refrigerants is the influence of lubricants on properties. The working fluid in most systems is actually a mixture of the refrigerant and the lubricant carried over from the compressor(s). Concerted research on the refrigerant-lubricant mixtures is in its early stages. It is complicated by the great variety of lubricants in use and by the often proprietary nature of the chemical structure of the lubricant and/or additives. Most alternatives to CFCs are substantially more polar, so traditional paraphine-based lubricants will not dissolve in them. More polar lubricants such as polyesters have therefore been developed. Efforts are underway to develop recommended refrigerant concentration limits for unplanned exposures and to improve flammability test methods and data.

Heat transfer fluids (HTF) for indirect systems have become more popular in commercial refrigeration applications for the purpose of reducing the primary refrigerant charge and/or mitigating emissions of refrigerants that have notable global warming impact or when regulatory or safety constraints apply. The use of phase-change fluids in indirect systems as a heat transfer fluid is becoming more popular due to favourable thermal and transport properties leading toward energetic benefits. The most common phase change fluids are carbon dioxide and ice-slurries, although other suspensions such as water/ice-filled capsules, hydrophilic material slurries, and frozen emulsions have been considered, but these are largely in developmental stages. With the benefit of much greater heat capacities, and generally improved heat transfer coefficient associated with change of phase, they offer systems potential benefits from lower flow rates and pumping costs, smaller pipe sizes and heat exchangers.

5.2 Domestic Refrigeration

HFC-134a and HC-600a continue as the dominant refrigerant options for application in products. Conversion of Article 5(1) country domestic refrigerator production from CFC-12 to either HFC-134a, HC-600a or HC-600a/HC-290 blends continues. Reliable, current statistical information of the proportion of OEM domestic refrigerator production using each alternative is not available. The perception is that hydrocarbon usage is increasing in every market --except North America-- with a trend towards global parity with the use of HFC-134a. Second generation conversion in Japan from HFC-134a to HC-600a refrigerant also continues. No reports have been received of proliferation of this action to other countries.

Not-in-kind technology developments continue to be pursued for domestic refrigeration. Stirling technology may provide direct conversion from thermal energy and is of interest for restricted or unreliable power distribution situations. The refrigeration cycle with trans-critical carbon dioxide has advance developments directed to more environmentally friendly small equipment including vending machines. The above developments are applicable to domestic refrigeration and merit tracking, but neither is believed to be cost or energy efficiency competitive with the current leading HFC and HC vapour compression refrigeration technology at comparable cost levels.

The service demand for CFC-12 refrigerant continues. Approximately one-half of the estimated 1500 million domestic refrigerators in service originally contained CFC-12 refrigerant. Typical service procedures use the refrigerant originally supplied with the equipment. CFC-free blends have been specifically developed for service of CFC-12 containing units but their use only becomes significant when CFC-12 has a premium cost or limited availability. CFC-12 usage is primarily influenced by regulations: it is banned in some countries; available only as premium-cost, reclaimed material in others; and readily available at economic prices in others.

Refrigerator energy efficiency continues to be a highly competitive product attribute and is directly translatable to global warming considerations. Shipment weighted average energy efficiency data indicate that a new unit typically will use less than one-half the energy of the unit it replaces. Market incentives for demand side management are driving leading edge applications of technologies such as variable speed compressors and dual evaporator systems. Proliferation of these technologies will extend the new versus old unit benefit leverage.

5.3 Commercial refrigeration

Commercial refrigeration is one of the important components in the total chain for chilled as well as frozen food preservation where particularly in Article 5(1) countries more and more consumers depend on this part of the chain. Commercial refrigeration includes three sub-sectors: stand-alone equipment, condensing units and centralised systems for supermarkets.

Stand-alone equipment consists of systems with all components integrated. Such units are more and more used in Article 5(1) countries. The transition from CFCs to non-CFCs in this sector is already almost complete in these countries. The refrigerants of choice are HFC-134a, HC-600a or a blend of HC-600a and HC-290. Some global companies have indicated that they plan to avoid the use of HFC-134a refrigerant, where the preferred alternative refrigerant is CO_2. However, the uptake is so far relatively slow owing to cost issues. For commercial freezers installed by global companies the replacement of HFC-134a by HC-600a in freezers is significant; it can be estimated that about 70% of the current annual market is using HC-600a.

Condensing units are medium size commercial refrigeration systems, which have a refrigerant charge ranging from one to tens of kilograms. In the non-Article 5(1) countries, the preferred refrigerants for medium and low temperature applications are HFC-134a and R-404A, respectively. In the U.S., the use of HCFC-22 has still been significant in the year 2005, but new equipment being manufactured in 2006 should only be using R-404A or R-507A. The production of condensing units is particularly growing in Article 5(1) countries. In these countries, HCFC-22 is the refrigerant of choice while HFC-134a and R-404A are introduced in some applications. The trends in the refrigerant choice for centralized systems are similar to the ones for condensing units. In the U.S., the US EPA and chemical companies forecast a possible shortage of HCFC-22 in the coming years for the servicing of commercial refrigeration equipment (2006 will be the year when R-404A and R-507A will be used for all new equipment). As for the condensing units, the use of HCFC-22 is the dominant choice in Article 5(1) countries for both new equipment and for servicing. In Europe and in Japan, HFCs are the preferred refrigerants; R-404A is specifically used in Europe and R-407C is used for medium temperature applications in Japan.

In low temperature applications in Europe, CO_2 is used as the refrigerant either in cascade systems or in secondary loops. The secondary loop systems in display cases and cooling chambers represent about 10% of the newly installed systems. In some cases, indirect systems are offered at the same price as R-404A based, direct expansion systems.

5.4 Large Size Refrigeration (Industrial, Cold Storage and Food Processing)

The current technical options continue to change, especially in low temperature applications with CO_2 as a heat transfer fluid and as refrigerant. There is a further increase of indirect systems in order to reduce total NH_3 charge. Research activities continue in the US, Japan and Europe on CO_2 as refrigerant and on CO_2 compatible lubricants. In 2004 and 2005, new CO_2 compressor designs have also been introduced.

The CO_2 technology has been applied in new small and large scale systems (up to 5 MW cooling capacities) in the US, Japan and Europe. Many new CO_2 systems continue to be installed in The Netherlands (owing to financial subsidies).

Retrofit of several systems from HCFC-22 to CO_2 systems or brine systems proceeds, particularly in the cold storage sector. Trends towards smaller NH_3 charges continue at a faster rate, even in industrial refrigeration systems. Increasing interest for non-ODP technologies is now reported from some large Article 5(1) countries. In these countries, the use of HCFC-22 is stable or slightly increasing.

5.5 Transport Refrigeration

Transport Refrigeration includes transport of chilled or frozen products by reefer ships, intermodal refrigerated containers, refrigerated railcars and road transport including trailers, diesel trucks and small trucks and vans. It also includes the use of refrigeration and air conditioning on merchant ships above 300 gross tonnes, and air conditioning in rail cars. In 2002, transport refrigeration accounted for 0.8 % of all ODS emissions, while transport refrigeration equipment contained about 0.5 % of the global refrigerant bank. This indicates that leakage rates in transport refrigeration equipment are still higher than the industrial average. All transport refrigeration sub-sectors are characterised by rough conditions, therefore emissions are higher than in other application sectors. To reduce the leakages, better quality is required and these high quality systems are becoming more and more available. Rough conditions cause shorter life cycles so that the typical life span of many transport refrigeration systems is lower than for stationary refrigeration and air conditioning equipment. This is the reason for the fact that the transport refrigeration sector has already more shifted towards HFCs than any other refrigeration sector. HFC-134a and R-404A or R-507 are being applied. The use of R-410A will advance further.

The following outlook can be given for the transport refrigeration sector:

- Zero ODP will be reached within the next few years in transport refrigeration equipment;
- Assessing energy efficiency of refrigeration equipment will become a necessity;
- Competence tests for personnel will become mandatory in many more countries than at present; and best practices in refrigerant handling will have to be applied;
- Annual preventive maintenance should become routine and is and will be enforced in many countries; the archiving of recovery and recycled operations will become mandatory.

5.6 Unitary Air Conditioning

The current state of the technical options for unitary air conditioning has experienced only incremental change since 2005. In Japan, the transition from HCFCs to non-ODP technologies in new equipment is nearly complete. Japanese manufacturers have almost exclusively utilized HFC refrigerants in their non-ODP products. Rapid growth in air conditioner production in China (primarily ductless split air conditioners) continues to increase China’s use of HCFC-22. Approximately 21 million ductless split air conditioners were produced for the Chinese domestic market in 2005. These units represented nearly 50% of the worldwide production of ductless split air conditioners in 2005. In the United States, the shift to non-ODP technologies in unitary products continues at a modest pace. Residential (7 to 15 kW) ducted products now all use R-410A. In 2005, approximately 11% of the HCFC-22 usage had been replaced by HFC refrigerants, with further significant increase expected between 2006 and 2010. In Europe, HCFC replacement technologies have included both hydrocarbon and HFC refrigerants with HFC refrigerants still being the predominant technology. As reported in 2005, research has continued on other non-ODP technologies and refrigerants --particularly CO_2.

5.7 Chiller Air Conditioning

Centrifugal chillers using CFC refrigerants are still being slowly replaced by new chillers using either HCFC-123 or HFC-134a as refrigerants. The most efficient HFC-123 chillers significantly outstand the most energy efficient HFC-134a chillers. The conversion of existing CFC chillers to use non-CFC refrigerants has nearly ended in non-Article 5(1) countries because most good candidates for conversion have already been converted. The savings in energy costs often justify the complete replacement of an aging CFC chiller with a new non-CFC chiller. Today's average chillers use 35% less electricity compared to the energy use of the average chiller produced 20 years ago. While production of CFCs is permitted in Article 5(1) countries until 2010, their use in new chillers is decreasing and has sometimes even halted, which means that that these countries can benefit from the latest designs and technologies available in the world.

The use of HCFC-22 in new chillers with positive-displacement compressors is being phased out of production in most of the non-Article 5(1) countries. New chillers employ scroll compressors in the range from 7 kW to 350 kW (multiple compressors above about 90 kW) and screw compressors in the range from 140 kW to 2275 kW. These chillers generally use HFC-134a as the refrigerant. The trend for scroll compressor chillers is toward the use of R-410A. The refrigerant R-407C still is used as a "transitional" refrigerant by some chiller manufacturers. Air-cooled chillers represent about 75% of the annual unit production in the positive displacement category.

The market for water-cooled screw and centrifugal chillers larger than 250 kW is concentrated in North America, China, Japan, and Europe. The market for absorption chillers above 100 kW is concentrated in Japan, China, and Korea. The use of small chillers with hydronic fan coil units is growing in southern Europe and China while this market is saturated in the U.S. and Japan. In Japan, China, and some European countries part of the commercial air conditioning market is moving away from small chillers toward variable-refrigerant-flow packaged systems employing an outdoor condensing unit and multiple indoor fan coil units.

Two trends continue in chiller development. The first is to increase energy efficiency, reflecting concerns about indirect global warming effects and the performance standards or regulations that a number of countries have put in place. The second trend is the effort to reduce refrigerant emissions through design changes and improved service practices.

5.8 Water-Heating Heat Pumps

Water-heating heat pump markets are significant in Europe, Japan, and China. In Europe, comfort heating is provided by 10-30 kW heat pumps using fan coils with outside air or the ground as the heat source. Hot water temperatures are in the 45^{o} to 55^{o} C range. For hydronic circuits employing radiators the delivery temperatures are 55^{o} to 75^{o} C. The European market for these heat pumps is in the range of 75,000 units / year.

In the mild climate zones of China and Japan, air-source heat pump chillers are widely used for heating and cooling of residential and commercial buildings with fan coil units. Night time electricity rates in Japan are only 25% of daytime rates. As a consequence, domestic hot water (DHW) heat pumps form a rapidly growing market with almost 100,000 units sold annually here. They are operated primarily at night and the hot water is stored for daytime use. Similar heat pumps have been used in Germany and Austria for a number of years.

HCFC-22 still is used in some heat pumps, but manufacturers are changing to offer models using HFC-134a and R-410A. Hydrocarbons are used as refrigerants in some smaller low-charge heat pumps in Europe. In Japan, CO_2 is used extensively in DHW heat pumps in the residential market. For larger water heaters for commercial use, R-410A is employed because larger CO_2 compressors are not available. Water temperatures of 70^o to 80^o C are common.

5.9 Vehicle Air Conditioning

HFC-134a has now fully replaced CFC-12 as the globally accepted mobile A/C (MAC) refrigerant.

Due to global warming concerns related to the emissions from MAC systems, the European Union has enacted legislation to limit the allowable GWP of the refrigerant to 150 or less, which has the effect of phasing out the use of HFC-134a in MAC systems (because the GWP of HFC-134a is about 1300). According to the European legislation, mobile AC must therefore use a new type of refrigerant in new cars as of the year 2011, which will apply to all cars in 2017. The GWP of replacement refrigerants has been limited to this maximum of 150 to set an environmental standard, which allows the use of low GWP refrigerants, such as HFC-152a, CO2, HC or one of the new refrigerants announced recently announced by a number of manufacturers (such as Honeywell, DuPont, Sino Chem and others). Interim emission limits on new HFC-134a systems have also been mandated until conversion away from HFC-134a has been completed. As a result, vehicle makers and their suppliers are focusing attention on reducing refrigerant leakage, improving system energy efficiency, and developing systems for HFC-134a replacement refrigerants. The Society of Automotive Engineers International (SAE) is coordinating an industry-government cooperative research program known as SAE I-MAC (Improved Mobile Air Conditioning) to reduce HFC-134a emissions and improve A/C system efficiency. The I-MAC consortium consists of four parts; emission reduction, energy reduction, vehicle thermal load reduction, and improved service procedures. Targeted improvements include a 50% or greater reduction in refrigerant emissions and a 30% or greater reduction in A/C system energy use. Efforts are ‘on track’ to achieve these reductions.

In the timeframe 1998-2006, the leading potential replacement refrigerant in Europe has been carbon dioxide. Almost all global vehicle manufacturers and suppliers are currently working on such systems and many have already demonstrated prototype cars. Currently, technical and commercial hurdles exist (leakage, leak detection, materials selection, lines and fitting materials, component technology selection, cost, etc.) that require resolution. The use of HFC-152a was proposed in 2001 and has been publicly demonstrated in several prototype vehicles. Although only mildly flammable, vehicle makers have not shown strong interest in pursuing the HFC-152a option so far.

CO_2 and HFC-152a refrigerants have been shown to be comparable to HFC-134a with respect to cooling performance and system fuel use; both exhibit comparable environmental performance, and both qualify for use in the European Union under the current regulation. To date, no announcements have been made regarding commercial implementation of either CO_2 or HFC-152a based MAC systems.

Three or more chemical companies have each announced a new refrigerant blend to replace HFC-134a. One refrigerant blend consists of CF_3I and 1,1,1,2-tetrafluoropropene; the components of the other blends are not yet known. Chemicals with low GWPs tend to be more reactive; this lack of stability can result in unwanted chemical reactions in the lower atmosphere (e.g., smog, flammability), in the A/C system (e.g., material incompatibility), and in the human body (e.g., toxicity). These new chemicals must be fully assessed for acceptability. Such assessment is being proposed by the SAE under a new cooperative research program intended to be comprised of global industry stakeholders. Time is truly of the essence, as decisions must be made by 2007-2008 regarding the acceptable replacement(s) for HFC-134a in order to produce vehicles, which will meet the 2011 requirement in the European legislation.

5.10 Conservation

Refrigerant conservation still shows room for improvement. In terms of leak tightness, new stationary systems with HFCs are now systematically designed for low emission rates; this is done by selecting tighter components as well as complete systems; standards are being prepared that describe how to measure components tightness. The automotive AC industry continues to work on better designs of HFC-134a systems with the aim of achieving further leakage reductions. A number of countries have started the implementation of regulations for the recycling of refrigerant at the end of life for all equipment, not only for used domestic appliances and cars.

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6 Chemicals Technical Options Committee (CTOC) Progress Report

6.1 Introduction

Since the reorganization of the former ATOC and STOC to the present CTOC in 2005, the CTOC has made great efforts on recruiting new members mainly from Article 5(1) countries. Three new experts - from Chile, Mauritius and Tanzania – have been added to the CTOC together with one interim co-chair from China.

The CTOC met on February 13-15, 2006 in Paris, France, at the facility provided by EADS through the courtesy of Airbus and Avantec companies. This was the first meeting of its full members since the 2005 meeting in Caracas, Venezuela. Attending members were from the following countries in addition to the three countries mentioned above: Australia, China, France, India, Japan, Kuwait, Netherlands, Russia and USA.

The main purpose of the meeting was to assign responsibilities to prepare the 2006 Assessment Report as well as to respond to specific requests made by Parties through the corresponding decisions.

The CTOC reviewed the tasks requiring actions at this meeting, which were mainly requested by the Parties as reported in the corresponding decisions of the past Meeting of the Parties. These are summarized below. In addition, the CTOC identified the lead authors for each chapter of the 2006 Assessment Report.

6.2 Process Agents

The 17th Meeting of the Parties, held in Dakar, Senegal, in December 2005, decided to approve three decisions, XVII/6, XVII/7 and XVII/8 on process agents. In Decision XVII/7, a list of uses of controlled substances as process agents was adopted as a revised Table A for Decision X/14. The list includes the nominations from the Democratic Peoples' Republic of Korea, Romania, the United Kingdom and the United States of America (No.32-39) which were reviewed by the 2004 Process Agents Task Force and discussed in the 16th MOP. Decision XVII/6(6) requests the TEAP and the ExCom to report to the 27th OEWG in 2007, and every other year thereafter, on the progress (emission reduction, make-up quantities, implementation of emission reduction techniques, alternative processes etc.) in the listed applications. Further XVII/6(7) requests the TEAP to report and make recommendations to the Parties at the 20th MOP in 2008, and every other year thereafter, on the process agent uses that could be added to or deleted from Table A of Decision X/14. Regarding Table B of Decision X/14, the TEAP is requested to review in 2008, and every other year thereafter, emissions in Table B, taking into account information and date reported by the Parties and to recommend any reductions to the make-up and maximum emission on the basis of that review. Finally Decision XVII/8 adopted a new list of controlled substances as process agents as an interim Table A-bis for Decision X/14. The Parties are requested to submit data of the applications listed in Decisions XVII/7 and XVII/8 before 31 December 2006 to the Secretariat and the TEAP to be reconfirmed and reassessed as process agents at the 19th MOP in 2007.

With this background, the CTOC discussed on the remaining applications submitted in 2005 by Turkey and Brazil and came to consensus as summarized below.

6.2.1 *Use of CTC in Manufacture of vinyl chloride monomer (VCM) by Brazil*

The CTOC reviewed the process described by Brazil for the manufacture of vinyl chloride monomer (VCM) from ethylene dichloride (EDC). This thermal conversion has its energy efficiency enhanced by the presence of carbon tetrachloride (CTC) at a level of ca. 1000 ppm. The locally produced EDC feedstock contains by-product CTC at 2000 ppm. This is used, along with supplemental EDC produced elsewhere. The reactor concentration of CTC can be held at ca. 1000 ppm by addition of small amounts of fresh CTC.

The CTOC recognizes that this addition of CTC in the manufacture of vinyl chloride monomer (VCM) from ethylene dichloride (EDC) is a Process Agent use as it serves to enhance the conversion thereby reducing use of natural gas and net operating cost. However, the CTOC noted that in Brazil the addition of fresh CTC stopped in the year 2000 and as a consequence the company is currently consuming additional natural gas for this process at additional cost.

6.2.2 *Use of BCM in Manufacture of Sultamicillin Tosylate Dehydrate by Turkey*

In the light of new information received, the CTOC concluded that the most part of the bromochloromethane (BCM) is used as process agent and a small part as feedstock for the use of BCM.

The fact that a small part is feedstock is proven by the role of BCM in the reaction as a chloromethylating agent. The CTOC noted that emissions from the Process Agent use ranged from 30 to close to 200 tonnes during 1999-2002 and averaged 110.2 tonnes during 2002-2004.

Non-ODS technology is currently being practiced in India and China to produce Sultamicillin and uses chloromethylchlorosulfate in lieu of bromochloromethane.

An international pharmaceutical company currently produces Sultamicillin with a closed loop reactor recycling 99.97% of BCM used in the process. Off-gases from the reaction are directed to an activated carbon system to allow further recovery, and then emissions from this unit are directed to an incinerator that effectively destroys over 99.5% of the BCM emissions. Thus the net effect shows the BCM losses to the atmosphere as less than 0.1% of the net use of BCM.

6.2.3 *Alternatives to Process agents*

During the review of the numerous Process Agent Uses included in Table A of Decision XVII/7 and in Table A-bis of Decision XVII/8, TEAP considered that in many instances HCFCs could offer the unique properties required in these chemical processes i.e. non flammable, good chemical and physical properties, excellent solvency, etc.

TEAP is aware of at least one proposed use of a low-ODP HCFC as a “Process Agent” for the production of fluoropolymers. The HCFC would be a substitute for the use of an ODS process agent with a much higher ODP. In this case the HCFC would be partly "consumed" through a chain transfer reaction into the product, and the unreacted excess HCFC would be recovered.

There may be other cases where HCFCs can serve as process agents in place of fully halogenated ODS, which have higher ODPs. Parties may wish to consider that it may not be necessary to allow the exempted use of fully halogenated ODSs as process agents in those applications where partially-halogenated ODSs or non-ODS can be used as process agents.

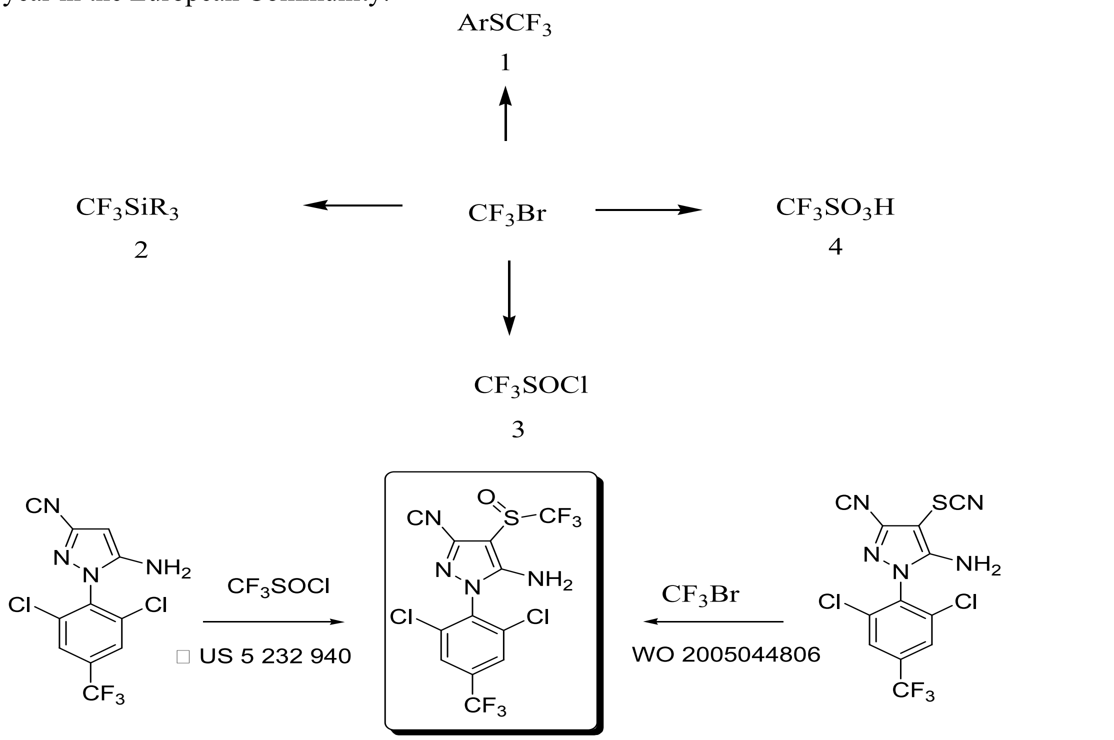
6.3 Feedstocks

Feedstock uses were summarized in the 2005 CTOC Progress Report in detail under Decision X/12. CFC, HCFC, CTC, BCM and methyl bromide were listed as common feedstocks and the emissions of these ODSs were estimated.

The HTOC raised a question concerning the use of bromotrifluoromethane, CF_3Br (halon-1301) as a feedstock. The CTOC investigated this matter and found that bromotrifluoromethane is a feedstock for preparation of bioactive compounds as described below.

6.3.1 Application of Halon-1301 as a feedstock

Trifluoromethyl thiophenol (1), trifluoromethyl trialkylsilanes (2), trifluoromethyl sulfenyl chloride (3) and trifluoromethyl sulfonic acid (4) can be used as intermediates for preparation of agricultural chemicals and pharmaceuticals, and those compounds are prepared from trifluoromethyl bromide (halon-1301). In a particular case, Fipronil, a broad-spectrum insecticide used to control multiple species of thrips on a wide range of crops, is produced by treatment of 5-amino- 3-cyano-1-(2,6-dichloro-4-trifluoro-methylphenyl) pyrazole with trifluoro- methyl sulfenyl chloride or by 5-Amino-3-cyano-1- (2,6-dichloro-4-trifluoro-methylphenyl)-4-thiocyanato-1-H-pyrazolecyano- 1-pyrazole with trifluoromethyl bromide. In China both processes are in operation in agrochemical companies. The estimated feedstock production of halon-1301 is about 163 tonnes of per year in China (2004 figure) and at least 400 tonnes of per year in the European Community.



Fipronil

TEAP's comments on the use of halon-1301 as a feedstock

Under the Montreal Protocol, feedstock uses of ODS are exempt from control measures. Each Party defines its own feedstock uses and exercises a range of stringency in reducing and eliminating unnecessary emissions of ODSs. TEAP and its TOCs have become aware of a feedstock use that could jeopardise protection of the ozone layer.

Halon-1301 is being produced for use as a feedstock for the production of Fipronil, a broad-spectrum pesticide used to control multiple species of thrips. Production of halon-1301 reported to the Ozone Secretariat for this feedstock use has averaged 400 tonnes per annum in France and approximately 160 tonnes in 2004 in China. This feedstock production raises some concerns because production for fire protection uses stopped in non-Article 5(1) Parties in January 1994 and will likely cease in Article 5(1) Parties in 2008.

Since the phase-out in non-Article 5(1) Parties, it has been generally accepted that the only source of halon-1301 in those countries would come from the halon bank, through recovery and recycling, and that production of new halon would be unlikely to restart. Feedstock use was not envisioned. The Halons Technical Options Committee and TEAP have never recommended an essential use production request for halon-1301 because of the availability of material from the bank. Thus eventually a finite halon resource would become difficult to obtain, encouraging users to move to alternatives. The unavailability of future production has been used to great effect to encourage the aviation and military sectors to invest in research and development to solve some of their difficult problems. Nevertheless, the bank of halon-1301 still remains large, and some Parties have implemented use controls in an effort to accelerate the decommissioning of halon systems and encourage the destruction of halon-1301. However, the latter is fairly expensive and energy intensive, and to date relatively little has been reported as destroyed. Therefore, the continued production of halon-1301 for feedstock use raises some serious issues that Parties may wish to consider and evaluate options to resolve.

The bank of halon-1301 is still very large despite measures by some Parties to encourage its destruction. This halon-1301 can be recovered and recycled to the same international specification as newly produced halon-1301, thus making the latter unnecessary for feedstock use and reducing emissions.

Continuing to produce halon-1301 for feedstock use while at the same time destroying halon-1301 by other means is energy intensive and unnecessarily harms the environment by contributing to global warming.

The availability of newly produced halon-1301 may discourage the aviation and other sectors from implementing alternatives if they can be confident in a cost-effective halon supply via an essential use exemption.

Sales for legitimate feedstock use, especially transboundary, might be illegally diverted into fire protection where profits may be higher than in pesticide production.

6.4 Laboratory and Analytical Uses

6.4.1 Laboratory and analytical uses of methyl bromide

Under Decision IX/17 an Essential Use Exemption for laboratory and analytical uses of ODS was introduced. Decision X/19 extended this exemption until 31 December 2005. Decision XV/8 asked TEAP to report annually on the development and availability of laboratory and analytical procedures that can be performed without using the controlled substances in Annexes A, B, and C (groups II and III). The CTOC prepared the update as described below in 4.2.

Further, the 17th Meeting of the Parties decided to approve Decision XVII/10 on laboratory and analytical uses of methyl bromide, in which the TEAP is requested to consider possible laboratory and analytical uses for methyl bromide and report to the 26th OEWG in 2006 on its findings.

6.4.1.1 Introduction

By decision XVII/10, the Parties agreed to consider certain uses of methyl bromide as laboratory and analytical critical uses for the year 2006. In that same decision, Parties requested the TEAP to review those and other potential laboratory and analytical uses of methyl bromide, and, at the same time, to consider the criteria that had been previously adopted for laboratory and analytical uses of Annex A, B and C substances, in order to assess their relevance of those criteria to the laboratory and analytical uses of methyl bromide.

The Technology and Economic Assessment Panel and its Chemicals Technical Options Committee and Methyl Bromide Technical Options Committee carried out the review.

Any consideration of laboratory and analytical uses of methyl bromide needs to be informed by previous decisions of the Parties concerning all Ozone Depleting Substances (ODS) and concerning methyl bromide (MB) in particular. Decision VII/11 included several clauses of direct relevance to the present discussion. These were: (i) adoption of the illustrative list of laboratory uses shown in Annex IV of the report of the Seventh Meeting of the Parties, (ii) exclusion of several uses of ODS from the global exemption (of relevance here are use for preservation of publications and archives, and sterilization of materials in a laboratory), (iii) replacement of ODS wherever possible in standard procedures, and (iv) agreement that controlled substances used for laboratory and analytical purposes should meet the standards for purity as specified in Decision VI/9.

The purity standards and other requirements placed on laboratory and analytical uses are given in Annex II of the report of the Sixth Meeting of the Parties including the following: (i) purity requirement for ‘other controlled substances with boiling point below 20^{o}C and of at least 99.0%’ (the boiling point of methyl bromide is 3.6^{o}C); (ii) criteria that controlled substances for laboratory and analytical uses shall be supplied only in re-closable containers or high pressure cylinders smaller than three litres or in 10 millilitres or smaller glass ampoules; and (iii) advice concerning preparation of mixtures containing the controlled substances, labelling, recovery and reuse, and annual reporting of activities.

The intention behind Annex II of the report of the Sixth Meeting of the Parties seems to be to restrict the use of relevant ODSs to analytical and laboratory synthesis applications, and effectively to exclude its use in many other situations. For example, the high cost and inconvenience of using small containers of CFC-12 would discourage the use of the substance to recharge automobile air conditioners designed to use CFC-12 but not yet retrofitted to use ozone-safe refrigerants. Thus, the high purity standard, carrying with it increased cost, and the restriction on the size of container in which the substance can be supplied, militate against the use of such material in large scale operations. One of the uses of methyl bromide which was reviewed by TEAP and its CTOC and MBTOC was in a field trial to evaluate its effectiveness for soil disinfestations and to benchmark alternatives. The weight of opinion is not in favour of classifying such a trial as a laboratory or analytical use. For the field trial to be of any extent, a large number of 3 litres or 10 millilitres containers would need to be opened and this goes against the spirit of the exemption but these sizes would be adequate for QPS test purposes. For such operations, any methyl bromide required could be included by the Party in the Critical Use Nomination, and one Party is known to do this.

6.4.1.2 Laboratory uses

Methyl bromide is one of the most chemically reactive of the controlled (ozone depleting) substances (ODSs), and it finds use in laboratories where the synthesis of organic chemical substances is studied. The link between the bromine and the methyl group is easily broken, and the usual outcome of such a chemical reaction is the transfer of the methyl group to the molecule of some other chemical reactant at the point where its molecule contains a nitrogen, oxygen, sulfur or phosphorus atom. Transfer of the methyl group to carbon or a metal is also possible in certain cases. In all such reactions the methyl bromide is referred to as a 'methylating agent'. Such reactions are carried out in research laboratories of universities, institutes and industry. In a typical case, methyl bromide (MeBr) may react with an amine, R_3N: to give a quaternary ammonium salt with structure $R_3MeN^+ Br^-$. This same kind of reaction is conducted on an industrial scale for the preparation of substances with particular desired properties. In such cases methyl bromide is classified as feedstock and would not meet the requirements for exemption as a laboratory or analytical use. Methyl bromide is also used in research laboratories for transfer of the methyl group via an organometallic intermediate such a Grignard reagent as CH_3MgBr.

Alternatives are available for many of these uses, and they often come into use when supplies of methyl bromide held in research laboratories are exhausted and difficulty is encountered in the purchase of quantities of 10-20 kg, as had been past practice. In formation of Grignard reagents, methyl iodide is often a suitable replacement, and this substance along with other methylating agents such as trimethyl phosphate, dimethyl sulfate or methyl sulfonates can also be used in other procedures. If bromide salts are explicitly required as products, then anion exchange of the initial product (iodide, phosphate, sulfate or sulfonate) would be required and no controlled substance would be required for this step.

This is not to suggest that methylbromide should be excluded from use as methylating agent and for formation of Grignard reagent under 'laboratory and analytical' uses, since these are non emissive.

6.4.1.3 *Analytical uses*

Replacements for methyl bromide in analytical applications can be more difficult to find, especially while methyl bromide uses continue to be permitted (CUN, QPS) and there are requirements for calibration or comparison with potential replacements. The following cases were contributed by committee members as representative of such uses.

- Experiments reported by one Party involved the treatment of goods such as mattresses, toys, and medical devices to see how much methyl bromide is retained after fumigation. The amounts needed were minute. Similarly, small quantities of methyl bromide have been used in testing for gas distribution in commodities and for plant damage during fumigation.

- Methyl bromide may be needed as a calibrant for analytical purposes, including calibration of instruments involved in fumigation trials in which an alternative is to be benchmarked against MB, for determining residue levels, for measurement of levels at fumigation sites, and for studies of emissions from fumigation chambers or films - virtually impermeable and low permeable films (VIF and LPF, respectively).

- Methyl bromide may be used as a test gas to measure sensitivity of organisms, in particular where levels of effectiveness are to be determined for quarantine purposes, and where newly identified organisms are studied or where damage to plant material or retention in commodities is being studied.

- Methyl bromide may be used in a small gas chamber to disinfect plants which may be used as host for biological control by known organisms (a range of - possibly unidentified - organisms having been eliminated by the methyl bromide treatment).

- Methyl bromide may be used as a test gas for toxicological studies such as those for inhalation toxicology associated with permitted uses, including tests of its retention in an activated carbon canister.

- Methyl bromide must necessarily be used as a calibrant when testing for recycle and destruction of MB.

In all of these applications, many of which are emissive uses, the scale of the operation may vary greatly. The criterion of scale as specified in Annex II of 're-closable container or high-pressure cylinders smaller than three litres' could be maintained for methyl bromide laboratory and analytical uses. The option is available, as observed above, to include any larger quantities in a Critical Use Nomination.

6.4.2 Laboratory and analytical procedures with ODS

6.4.2.1 Laboratory uses

The Technology and Assessment Panel to report annually on the development and availability of laboratory and analytical procedures that can be performed without using controlled substances in Annexes A, B, and C, groups II and III, of the Protocol (April 2006 and every year thereafter).

There has been very little progress in replacing ozone depleting substances (ODS) that are used in laboratory and analytical procedures with substances that are less harmful to the ozone layer. In most cases this is due to the availability of ODS at favourable prices under the EUE and failure of alternative candidates to meet the demanding specifications that have brought about the use of ODS in the first place.

Some information about laboratory uses has been obtained from research laboratories in universities, research institutions and industry laboratories. The ODS may play the role of reaction solvent, such that if the situation were an industrial one, and use commenced before June 1999, there would be a case for classification of the ODS use as Process Agent. It is likely that alternative solvents could be found to allow the disuse of ODS in these situations.

In other laboratory uses, the ODS would be regarded as feedstock, since it is wholly or partly destroyed in the reaction as a result of the incorporation of all or some portions of the ODS molecule into the product of the chemical reaction. This would be the case, for example, where carbon tetrachloride (CTC, CCl_4) was used in a free-radical-initiated reaction which results in the incorporation of a CCl_3- fragment into a new molecule. In such cases the ODS play unique roles which depend on the fine details of their chemical structures and on the reactivity of the groups of atoms they contain, and so it is difficult to see how they could be replaced in these reactions by alternative, non-ODS substances. In general, compared with industrial uses and their concomitant emissions, the emissions of ODS from these laboratory uses are very small and therefore not of major concern under the Montreal Protocol.

Opportunities to reduce the use (and therefore emissions) of ODSs in Preparative and analytical laboratories will arise as adoption of Green Chemistry practices - good laboratory practices and environmentally sound management of chemical reactions - spreads from the initial development in the USA and could eventually be enshrined in regulation.

6.4.2.2 Analytical uses

A similar situation is found with analytical uses, although few of these have quite the specificity of the preparative uses of ODS. Some changes have been reported where the ODS was formerly used as a solvent just because it possessed convenient properties such as solvent power and liquid range (difference between freezing and boiling point). There is one ASTM method, for the analysis of volatiles in coal, in which CTC has been replaced by hexane. Compilations of standard methods such as those maintained by the American Society for Testing Materials (ASTM), the United States Environmental Protection Agency (US EPA), and the United States National

Institute of Occupational Health and Safety (US NIOSH) and probably others would need to be searched for cases where ODS are employed in testing and analyses, and investigations made of possible replacements. This would be a major task, and there are reasons of cost as well as the desire of the relevant professional community to maintain consistency of the reporting of analytical results that such a search has not been undertaken.

CTC is used in analyses for total hydrocarbons extracted from water, wastewater and sediments, using method ASTM D-3921, with quantitation by means of infrared (IR) spectroscopy. Similarly, it is used in hydrocarbon extraction from water and soils, by method APHA AWWA-WPCF 5520C (IR method). CTC is also used in iodine value (Wijs method) determination of fats and oils, by method AOCS Cd 1b-87, and in simeticone extraction and cleaning of NaCl cells for FTIR analysis and in viscosity coefficient determination. CTC also finds use as a solvent in nuclear magnetic resonance (NMR) and infrared (IR) spectroscopy, for example in method USP XXIII in pharmacy. It is used as a gas chromatography (GC) standard in method EPA 1311, for waste analysis by TCLP (Toxicity characteristics, Leaching Procedure), and for determination of specific weight of cement, according to the one national method although this use can be replaced by kerosene or gasoline.

1,1,1-Trichloroehane (TCA) is used in bromine index determination of hydrocarbons by potentiometric titration (ASTM D 2710-99 and ASTM D 2710).

CFC-113 is used in oil, grease and hydrocarbon determinations from wastewater with quantitation by partition infrared method No 5520C (Standard Methods for Water and Wastewater), and for hydrocarbon extraction from water (ASTM D 3921).

In some cases known to the TEAP, there are special features of the analytical procedure that would make it hard to replace the ODS with an alternative non-ODS substance. Such is the case in tests in which petroleum hydrocarbons are collected and dissolved in CFC-113 (CCl_2F-CF_2Cl) before estimation of the amount of hydrocarbon by means of infrared spectroscopic analysis. The key requirement for the test is that the solvent, CFC-113, have no infrared absorption in the region where C-H vibrational frequencies are found, so that a clear assay can be made of the intensity of the hydrocarbon C-H peaks. Alternatives solvents with no C-H bonds are either ODS (such as CTC) or substances such as carbon disulfide which is unlikely to be adopted because of its high volatility and on the grounds of its occupational health and safety features including flammability, toxicity and unpleasant odour.

Preliminary data from a survey in one Article 5(1) country showed that analytical uses of CTC, TCA and CFC-113 amounted to 10-20 litres per year, with typical analyses employing 100-200 millilitres.

6.5 Aerosol Products, Non-medical

Worldwide aerosol fillings have grown over the last years and were close to 11 billion cans in 2005, the largest number ever. Today more than 99.5% of non MDI aerosols use non-CFC formulations worldwide.

ODS that can be used in the manufacture of aerosol products are CFCs, HCFCs, methyl chloroform, (1,1,1 trichloroethane), and CTC. They may act either as propellants, solvents or active ingredients depending on the formulation.

6.5.1 CFC phase-out

In 2005 the residual CFC consumption in the sector was only due to the use in Article 5(1) countries. It is expected that the completion of global CFC phase-out in non-MDI aerosols will occur in the very short term as the reduction schedule mandated by the Montreal Protocol comes into force in Article 5(1) countries.

The main groups of non-MDI aerosol products still using ODS (CFC/HCFC) are:

- Local anaesthetics, vaginal foams, wound sprays, throat and nasal sprays, traditional Chinese medicines;
- Industrial/technical aerosols (dusters, electronics cleaners, freeze sprays, spinnerette sprays, anti-spatter sprays, tire inflators, fluorinated greases deposition etc.);
- Insecticides and disinfectants for aircrafts etc.

There are no technical barriers to global transition to non-ODS alternatives in all these applications, which require either low flammability or specific pharmaceutical approval.

The latest CFC consumption in the aerosol sector reported by Parties in 2003 and 2004 was around 2000 tonnes in Article 5(1) countries (Table 6.1), down from the estimated use of 4300 tonnes in 2001. This progress in CFC consumption phase-out from 2001 is due to:

- Finalisation of the conversion process by Russia and Ukraine. Some self-conversions occurred, but most reductions were due to implementation of GEF-supported products;
- Large drop in CFC consumption in China where the largest remaining consumers are fillers of pharmaceutical aerosols and traditional Chinese medicines. Conversion of this users requires approval by national health authorities after pharmacological and clinical trials; and
- Progress in the phase-out of CFC use in India through a MLF- supported terminal umbrella project in the non-MDI sector.

Implementation of MLF-supported projects in Cote D´Ivoire, Indonesia, Mexico, Romania and Vietnam, between others, will further reduce CFC consumption.

Consumption of other ODS in the aerosol sector is much smaller and mainly reflects the use of HCFC-22, and HCFC-141b.

The residual ODS phase-out in the non-MDI aerosol sector will require:

- Efforts by national environmental facilities and governmental bodies, including national legislation and enforcement;
- Technical/financial assistance for reformulation;
- Educational assistance in alternatives choice and handling;
- Sufficient time for the conversion of medical aerosols that must be clinically tested and approved by national health and drug authorities.

Table 6.1 Latest CFC consumption reported by Article 5(1) countries in the non-MDI aerosol sector

Country	Latest reported consumption	ODP tonnes
Algeria	2004	82.0
Bangladesh	2003	36.3
Chile	2004	7.0
China*	2004	842.0
Colombia	2004	8.1
Congo, DR	2004	22.0
Cote D´Ivoire	2004	42.6
Cuba	2004	19
Indonesia	2004	656.2
Iran	2003	53.0
Jordan	2004	10.0
Lebanon	2004	8.2
Mali	2003	0.5
Mexico	2004	87.4
Nigeria	2004	58.0
Philippines	2003	2.2
Romania	2003	36.0
Sudan	2004	30.0
Syria	2003	76.0
Total		**2066.50**

* Estimates

6.5.2 Alternatives to CFC propellants in non-MDI aerosols

Currently available alternatives for CFCs used in non-MDI aerosols as propellants are as follows (in order of use):

Hydrocarbon Aerosol Propellants (HAPs): HAPs are blends of hydrocarbons (propane, n-butane, iso-butane) and are the most common and suitable substitutes for CFCs in aerosols.

HAPs have uniform pressure, low odour and low content of non-saturated organics (olefins, aromatics, etc.). HAPs are chemically stable and compatible with most formulations.

HAPs have some important disadvantages, which are well-known:

- Their flammability and risk of explosion are high. Therefore, strict safety measures are required during HAPs storage, transfer and filling. As HAPs are refined to have virtually no odour there is a danger that explosive concentration is reached without being noticed. In this case any ignition source would cause an accident;
- HAPs are not admissible for products where flammability should not be allowed;
- HAPs are classified as Volatile Organic Components (VOCs) in some states of USA, and there their use in aerosols is regulated; and
- HAPs are not miscible with water and are poorer solvents than ODS.

HAPs proved to be so economically attractive, that savings resulting from their use justified many self-conversions. However, their use requires significant investments and their economic convenience will change with local circumstances:

- The conversion capital costs can be high if the factory has to be re-equipped and provided with safety and alarm systems, starting with the propellant storehouse and finishing with the product warehouses and the rejects destruction plants. Sometimes even the site of the manufacture facility has to be changed, e.g. moved out of a city;
- HAPs transportation is regulated in many countries and transport costs are high;
- Thorough education and training of personnel, and close control of the manufacturing process are needed; and
- HAPs may not be available everywhere at low prices.

Dimethyl Ether (DME): DME is also a flammable hydrocarbon, but it is an excellent solvent which is miscible with water. It successfully substitutes alcohols in many aerosol formulations and its consumption in aerosols goes up whenever the alcohol prices grow.

The main technical disadvantages of DME are as follows:

- DME is flammable and explosive. Therefore all safety precautions required for HAPs are to be taken into account with DME.
- DME causes swelling, or dissolving of some materials (gaskets, coatings, etc.) of aerosol cans and valves.

DME is the alternative propellant number two in the world (about 10%).

Hydrofluorocarbons (HFCs): Hydrofluorocarbons (HFC-152a, HFC-134a, and HFC-227ea) are non-ODS substitutes and greenhouse gases currently produced by USA, EU, Japan, Russia and China. They are available at prices higher or comparable with those of CFCs, but much higher than those of HAPs, DME or compressed gases (CGs).

HFCs provide the same pressure ranges as HAPs and DME, and require minimum plant investment. However, they should be used only where they provide important safety, functional or health benefits for the users, because they contribute to global warming.

In 2003 they were mainly used in USA, EU and Japan (respectively 40%, 30% and 10% of the total use). They are not considered VOCs and are replacements of ODS in those aerosol uses that still remain. Cost considerations are likely to limit their use worldwide.

HFC-134a and HFC-227ea are non-flammable and non-explosive, while HFC-152a is slightly flammable, (though far less than HAPs or DME). HFC-152a has the lower price and its GWP value is the least among HFCs.

HFCs are chemically stable and compatible with most product formulations, and with usual cans and valves, however in some cases time consuming compatibility trials are needed for product reformulation.

The main disadvantages of HFCs are as follows:

- They are expensive;
- Because of their GWP the usage of HFC is recommended only where other non-ODS cannot be used;
- HFCs have very low solvency.

Hydrochlorofluorocarbons (HCFCs): HCFCs have non-zero ODPs and their use is regulated by the Montreal Protocol. HCFCs are banned in aerosol applications in most industrial and in some Article 5(1) countries.

Therefore, HCFCs, mostly HCFC-22 and HCFC-142b, are used only where their use in aerosol products is not forbidden. They have some limited applications in aerosol products requiring low flammability. HCFCs are cheaper than HFCs.

Compressed gases (CGs): Include compressed air, CO_2, N_2, N_2O. These are different from the traditional liquefied propellants that are the backbone of the aerosol industry.

CGs have found some niche markets because these substances are relatively cheap and easily available worldwide. They are environmentally friendly, their ODPs are zero, and GWPs are negligible. CGs are non-flammable and non-toxic, properties that make them applicable in some medical (N_2) and food products (N_2O).

The main disadvantages of CGs are as follows:

- The aerosol cans and valves used with CGs are more expensive as they must stand higher working pressures than liquefied propellants such as HAPs or DME.
- They produce coarse sprays with large droplet size
- As the product is spent the can pressure falls and the drop size increases. There are devices used to partially offset this effect (mechanical breakers, smaller orifices, etc.).
- Common aerosol cans with CGs should not be inverted when applied, or the propellant will be spent much earlier than the liquid product. All solutions to offset this effect increase the product cost.

The economical attractiveness of CGs, due to low capital costs for conversion and their low prices, seldom compensates the poor quality of the end product except in some niche markets.

6.5.3 Alternatives to ODS solvents in non-MDI aerosols

There are many alternatives to replace ODS used either as solvents or as active ingredients in non-MDI aerosols. These replacements can be hydrocarbons, high boiling HFCs like HFC-43-10mee, and HFC-245fa, high boiling HCFCs like HFC-141b, and other solvents like HFEs or even water. The suitability of the alternative depends heavily on the specifics of the formulation.

The selection of a solvent for an aerosol formulation has to take into account several parameters such as: solvency power, flammability, evaporation rate, density, viscosity and surface tension (wetting power), environmental acceptability, cost, and local availability.

ODS were used in aerosol products because they are all non-flammable, evaporate rapidly, have high density, low viscosity and surface tension. They are widely available at relatively low cost. Their solvency power varies from very high in the case of CTC and methyl chloroform, to very low in the case of CFC-113.

6.5.4 Not-in-kind substitutes for non-MDI aerosols

Many aerosol products have been replaced by such not-in-kind substitutes as mechanical pumps (finger or trigger pumps), sticks, roll-ons, brushes, etc.

6.6 Carbon Tetrachloride (CTC) Emissions and Opportunities for Reduction (Decision XVI/14)

CTC is controlled under the Montreal Protocol. It is a clear liquid with a sweet, ether-like odour and a boiling point of 76.5°C. It is not flammable and barely miscible with water. It has strong solvency properties.

Scope of this work

Decision XVI/14 entitled "Sources of carbon tetrachloride emissions and opportunities for reductions" requests the Technology and Economic Assessment Panel "*to assess global emissions of carbon tetrachloride being emitted:*

(a) From feedstock and process agent sources situated in Parties not operating under paragraph 1 of Article 5;

(b) From sources situated in Parties operating under paragraph 1 of Article 5 already addressed by existing agreements with the Executive Committee of the Multilateral Fund;

(c) From feedstock and process agent uses of carbon tetrachloride applied in Parties operating under paragraph 1 of Article 5 not yet addressed by agreements with the Executive Committee of the Multilateral Fund;

(d) From sources situated both in Parties operating under paragraph 1 of Article 5 and in those not so operating that co-produce carbon tetrachloride;

(e) From waste and incidental quantities of carbon tetrachloride that are not destroyed in a timely and appropriate manner;"

and " to assess potential solutions for the reduction of emissions for the categories above; and to prepare a report for the consideration of the Parties at the Eighteenth Meeting of the Parties in 2006."

Sources of CTC Production

Carbon tetrachloride (CTC) is one of the four members of the *chloromethanes* family of products. The chloromethanes may be visualised as a molecule of methane (CH_4) with increasing degrees of substitution of chlorine to displace a molecule of hydrogen: thus

Methane	CH_4
Methyl chloride (monochloromethane)	CH_3Cl
Methylene chloride (dichloromethane)	CH_2Cl_2
Chloroform (trichloromethane)	$CHCl_3$
Carbon tetrachloride (tetrachloromethane)	CCl_4

There are various manufacturing techniques to produce chloromethanes, but it should be noted that the production of methylene chloride and chloroform (which are always co-produced, albeit in different ratios, from the reaction of chlorine with either methyl chloride or methane) always entails the co-production of CTC.

CTC can also be produced as a stand-alone product, although this was largely discontinued as a manufacturing practice by the early 1990s, and can be co-produced together with another chlorinated solvent/intermediate material – perchloroethylene.

All routes have been historically extensively used. At its peak in 1987, when production of CFC-11 and CFC-12 from CTC exceeded 800kt, CTC production was over 1 million tonnes.

In summary, carbon tetrachloride can be produced by the following three main processes:

- By the chlorination of methane or methyl chloride, using thermal- or photo chlorination. . In this process, CTC is a co-product. This is called the chloromethanes route. On a chloromethanes' unit, CTC production is linked to the maximum production of chloroform for which, it can be estimated (Sherry, 2003), there is a maximum capacity of 1.1 million tonnes.

- By the thermal chlorination of mainly C2 and C3 hydro- and chloro-carbons in the perchlorination process, which co-generates perchloroethylene and CTC. In this process, CTC is a co-product. This is called the perchlorination route.

- By the reaction of chlorine with carbon disulfide. In this process, CTC is the desired and sole product. This is called the CS_2 route.

It is very difficult to estimate the global capacity of CTC as it is totally dependant upon the operation of complex chlorinated solvent manufacturing facilities. For example, while there is approximately 440 ktonnes of capacity to produce CTC/perchloroethylene on perchlorination plants, it is possible to not produce CTC at all on perchlorination reactors. Similarly, CTC output can be minimised to approximately 5% of the total output of chloromethane reactors (Sherry, 2003[1]). Sherry has also noted that this minimisation would require investment and, "if such investment had been made, the total global minimum output of CTC could be some 80 ktonnes."

Applications for CTC

Carbon tetrachloride was initially used as a solvent, notably in dry-cleaning and metal cleaning applications (where there is still believed to be small residual use in the Democratic People's Republic of Korea for instance) but its toxicological profile, being listed in the National Toxicology Program's Ninth Annual Report on Carcinogens as a "substance which may reasonably be anticipated to be a carcinogen", caused its elimination from most open-use solvent applications. Its most important applications are as feedstock for fluorocarbons. There are, or have been, some process applications for CTC notably in the manufacture of chlorinated rubbers and paraffins (which continue in China and India, for instance), and there are a number of designated essential uses into pharmaceutical and agrochemical applications, and in chlorine plants. Small quantities are used in laboratories and for analyses.

The most important uses, including newer chemical intermediate applications, are shown below.

CFC-11 (trichlorofluoromethane, CCl_3F)

CFC-11 is produced by the reaction of anhydrous hydrofluoric acid on CTC. CFC-11 is generally co-produced with CFC-12 in ratios varying from 30:70 to 70:30. The theoretical ratio of CTC to CFC-11 is 1.12 units per unit of CFC-11, but in practice, with side reactions and yield losses, a range of 1.20-1.24 units of CTC is more appropriate and will be applied in this study.

In the peak year of 1987, this corresponded therefore, to some 470 ktonnes of CTC demand to CFC-11.

CFC-12 (dichlorodifluoromethane, CCl_2F_2)

CFC-12 is produced by the reaction of anhydrous hydrofluoric acid on CTC. CFC12 is generally co-produced with CFC-11 in ratios varying from 30:70 to 70:30. The theoretical ratio of CTC to CFC-12 is 1.27 units per unit of CFC-11, but in practice, with side reactions and yield losses, a range of 1.35-1.45 units of CTC is more appropriate and will be applied in this study.

In the peak year of 1987, this corresponds therefore to some 595 ktonnes of CTC demand to CFC-12.

CTC demand for the production of CFC-11 and CFC-12 therefore exceeded 1 million tonnes in 1987.

CFC-13 (Chlorotrifluoromethane, $CClF_3$)

This product is a side reaction from the manufacture of CFC-11 and CFC-12 and has had insignificant commercial use in refrigeration applications. It is not separately accounted for.

New feedstock applications

HFC-245fa (Pentafluoropropane, $C_3H_3F_5$)

This product has been commercialised by Honeywell in the USA, and (with some patent discussions) by Central Glass in Japan, as a replacement product for HCFC-141b in foam blowing applications. HCFC-141b replaced CFC-11 in foam blowing uses through the 1990s but in its own right has a fairly high ODP of 0.11 and has been subjected to phase-out in the USA in 2003, progressively in the EU through 2003, and in Japan by 2004.

It is believed HFC-245fa uses pentachloropropane as feedstock, and this is produced by the reaction of vinyl chloride (monochloroethylene, C2H3Cl) with CTC. It is possible to estimate the CTC demand to the application, which is calculated, including yield losses, at a unit ratio of 1.36 units of CTC per unit of HFC-245fa. At estimated capacity operation, this would mean 27 ktonnes per annum CTC. There may be additional volume in Japan.

HFC-236fa (Hexafluoropropane, $C_3H_2F_6$)

This product is a fire-fighting material developed and globally patented by DuPont to replace halon-1211. It is also manufactured in China. Capacity in the USA is estimated to be 10 ktonnes per annum.

The product requires hexachloropropane ($C_3H_2Cl_6$) which is prepared by the reaction of vinylidene chloride (1,1-dichloroethane, VDC, $C_2H_2Cl_2$) with CTC.

An estimation of the CTC demand to the application can be calculated, including yield losses, at a unit ratio of 1.2 units of CTC per unit of HFC-236fa. At estimated capacity operation in the USA, this would mean 12 ktonnes per annum CTC.

HFC-365mfc (Pentafluorobutane, $C_4H_5F_5$)

This product has been commercialised in Europe as a replacement product for HCFC-141b in foam blowing applications. HCFC-141b replaced CFC-11 in foam blowing uses through the 1990s but in its own right has a significant ODP of 0.11 and has been subjected to phase-out in the USA in 2003, progressively in the EU through 2003, and in Japan by 2004. A single plant is operating of 15 ktonnes per annum capacity.

HFC-365mfc uses pentachlorobutane as feedstock which is believed to be produced by the reaction of monochloropropene (C_3H_5Cl) with CTC. An estimation of the CTC demand can be calculated, including yield losses, at a unit ratio of 1.25 units of CTC per unit of HFC-365mfc. At estimated capacity operation this would mean ~20 ktonnes per annum CTC.

Summary of new fluorocarbon applications for CTC

By 2010, new HFCs can be estimated, using data in IPCC/TEAP 2005, to exert a demand of some 54 ktonnes per annum of chemical intermediate CTC into HFC-245fa, HFC-236fa, and HFC-365mfc.

In non-chemical intermediate applications

There is a large list of approved process agent uses for CTC that is under constant review by the Meeting of the Parties to the Montreal Protocol as alternative process agents gain acceptance. These applications are described in Table A of Decision XVII/7 and Table A-bis of Decision XVII/8.

6.6.1 Calculated CTC demand 2002-2009 for known requirements

6.6.1.1 Estimated CTC demand 2002-2009 for known requirements, taking into consideration current Production and Consumption agreements

(a) For CFC Production

The Report of the TEAP Basic Domestic Needs Task Force, October 2004 studied CFC production for basic domestic needs for the period 2003-2009. Table 6.2 from that report is re-produced below:

Table 6.2 Forecast amounts of CFCs produced that are available to meet the BDN demand of Article 5(1) countries (ODP tonnes)

Production	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Total CFC Prod.	93,511	80,315	71,731	55,484	38,039	19,612	15,882	10,553
For essential uses	4,166	3,946	3,359	1,961	1,673	1,200	800	800
Balance	**89,345**	**76,369**	**68,372**	**53,523**	**36,366**	**18,412**	**15,082**	**9,753**

Using the multiplier (1.35 tonnes of CTC required for 1 tonne of CFC) contained in the methodology of Sherry, 2003[1], it is possible to make a calculation of the quantities of CTC required for this forecasted production.

The TEAP BDN study forecast future production of CFCs on a country by country basis. A number of countries have agreed accelerated phase down schedules with the Executive Committee of the Multilateral Fund. Information contained in UNEP "*Production and Consumption of Ozone-depleting Substances, 1986-2004*", November 2005, details the agreements to which these countries will abide. The agreements with Argentina and India had already been included in the forecast for future CFC production by TEAP. The impacts of the CFC Production agreements with China, Mexico and Venezuela on CFC production and revised CTC requirements are given in Table 6.3 below:

Table 6.3 CTC requested for the CFC production considering Production Agreements in China, Mexico and Venezuela

Production	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Total CFC Prod	93,511	80,315	71,731	54,324	38,952	16,412	8,032	6,903
Total CTC req'd	**126,240**	**108,425**	**96,837**	**73,337**	**52,585**	**22,156**	**10,843**	**9,319**

(b) For Emissive Uses

CTC requirements for emissive uses such as process agent application and laboratory uses were estimated using CTC consumption data contained in UNEP "*Production and Consumption of Ozone-depleting Substances, 1986-2004*", November 2005, and Annexes XII.29-32 from the Multilateral Fund Secretariat, *Policies, procedures, guidelines and criteria (as at April 2005), pp715-732*.

The methodology used adjusted the UNEP data to remove "negative consumption" numbers and updated the consumption data to take into account the data provided in the report of the Multilateral Fund Secretariat.

As was noted by TEAP in the Report of the Basic Domestic Needs Task Force, "data submitted by Parties on CTC show many inconsistencies"; this is particularly the case for data from non-Article 5(1) countries. In order to enable an estimate to be made, the "make-up" figure for process agent use contained in Decision X/14 was used assuming that this was all CTC and that this quantity was produced annually for non-Article 5(1) process agent applications and would remain unchanged until 2010.

CTC consumption agreements have been concluded with a number of the larger consuming countries, the majority of whom have large process agent applications. The anticipated results of these agreements are included in Table 6.4 below. It should be noted that the data for Article 5(1) countries will be significantly reduced once the agreement (which has been adopted in principle at the 47th Meeting of the Executive Committee) between the Multilateral Fund and China in 2006 is implemented.

Table 6.4 Estimated total CTC requirements for emissive uses, such as process agents

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Article 5(1)	31925	29283	26199	11605	11449	11537	11624	11948	11106
Non-A5(1)	4501	4501	4501	4501	4501	4501	4501	4501	4501
TOTAL	**36426**	**33784**	**30700**	**16106**	**15950**	**16038**	**16125**	**16449**	**15607**

(c) For Other Feedstock Requirements

As detailed above, CTC is used as a feedstock for the manufacture of a number of HFCs, in particular HFC-245fa and HFC-365mfc. These products are alternatives for HCFC-141b which is being phased out under the Montreal Protocol. Ashford et al[2] carried out a detailed analysis on the future requirements of the foam insulation market for HFCs through to 2015. These data were incorporated into the IPCC/TEAP Report, 2005 and have been used to forecast the use of CTC as a feedstock for these products.

Table 6.5 Estimated total CTC requirements as a feedstock for production of HFC products

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
HFC-245fa production	2010	14397	18544	22173	24295	25313	26325	27339	28378
Estimated CTC requirement	2734	19580	25220	30155	33041	34426	35802	37181	38594
HFC-365mfc production	449	3255	5754	6461	7441	7978	8496	8956	9353
Estimated CTC requirement	561	4069	7192	8076	9301	9973	10620	11195	11691
Total CTC requirement	**3295**	**23649**	**32412**	**38231**	**42342**	**44399**	**46422**	**48376**	**50285**

(d) Estimated total CTC requirements for known demand

The estimated total CTC requirements to meet the known demands, taking into account the Multilateral Fund approved Sector Plans are given in Table 6.6

Table 6.6 Estimated total CTC requirements for known demand including Multilateral Fund approved Sector Plans

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
CFC Feedstock	126240	108425	96837	73337	52585	22156	10843	9319	0
Emissive uses	36426	33784	30700	16106	15950	16038	16125	16449	15607
Other Feedstock	3295	23649	32412	38231	42342	44399	46422	48376	50285
TOTAL	**165961**	**165858**	**159949**	**127674**	**110877**	**82593**	**73390**	**74144**	**65892**

6.6.1.2 Estimated demand of CTC 2002-2010 for known requirements, without taking into consideration current Production and Consumption agreements

In order to attempt to estimate the levels of CTC demand to meet known requirements without the adoption of the Multilateral Fund approved CFC and CTC Production Sector and CTC Consumption Sector Agreements a number of assumptions have been required. These are detailed in the specific sectors. It should be noted that one over-lying assumption as a result of starting the analysis from the year 2002, is that CFC reductions resulting from country-specific projects as of the start of the operation of the Multilateral Fund have not been considered.

(a) For CFC Production

The quantities of CFC required to meet the Basic Domestic Needs of Article 5(1) countries and essential uses have been re-produced in this section. Assumptions are, therefore, those made in the Report of the TEAP Basic Domestic Needs Task Force, October 2004. CTC requirements have been calculated as described above.

Table 6.7 Forecast amounts of CTC required to produce CFCs that are available to meet the BDN demand of Article 5(1) countries and essential uses (tonnes)

Production	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Total CFC Prod	93,511	80,315	71,731	55,484	38,039	19,612	15,882	10,553
Total CTC req'd	126,240	108,425	96,837	74,903	51,353	26,476	21,441	14,247

(b) For Emissive Uses

In order to provide an estimation of the impact of the sector agreements, it has been assumed that, for the larger users of process agents (China, India, Democratic Republic of Korea and Pakistan), growth in CTC use as a process agent would increase by 6% per year. For other Article 5(1) countries, CTC consumption has been keep to the levels specified in the Montreal Protocol (85% reduction in consumption from 1 January 2005).

Table 6.8 Estimated total CTC requirements for emissive uses, such as process agents

Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Article 5(1)	31925	29283	26199	28457	30135	31913	33798	35796	37419
Non-A5(1)	4501	4501	4501	4501	4501	4501	4501	4501	4501
TOTAL	**36426**	**33784**	**30700**	**32958**	**34636**	**36414**	**38299**	**40297**	**41920**

(c) For Other Feedstock Requirements

Use of CTC as a feedstock for other products has not changed between the two scenarios (See Table 6.5).

(d) Estimated total CTC requirements for assumed demand without Multilateral Fund approved Sector Plans

The estimated total CTC requirements to meet the assumed demands, not considering the Multilateral Fund approved Sector Plans are given in Table 6.9.

Table 6.9 Estimated total CTC requirements for assumed demands not considering the Multilateral Fund Sector Plans

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
CFC Feedstock	126240	108425	96837	74903	51353	26476	21441	14247	0
Emissive uses	36426	33784	30700	32958	34636	36414	38299	40297	41920
Other Feedstock	3295	23649	32412	38231	42342	44399	46422	48376	50285
TOTAL	**165961**	**165858**	**159949**	**146092**	**128331**	**107289**	**106162**	**102920**	**92205**

6.6.1.2 Differences in Estimated CTC demand 2002-2009 for known requirements, between scenarios with and without current Production and Consumption Agreements

Table 6.10 Estimated total CTC requirements for known demand including Multilateral Fund CFC Production Sector Plans

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total w/o Sector agreements	165961	165858	159949	146092	128331	107289	106162	102920	92205
Total with Sector agreements	165961	165858	159949	127674	110877	82593	73390	74144	65892
Difference	**0**	**0**	**0**	**18418**	**17454**	**24696**	**32772**	**28776**	**26313**

The impact of the Multilateral Fund Sector Agreements on the demand for CTC for known requirements can clearly be seen in Table 6.10 for the period 2005-2010. The impact of the agreements on emissions of CTC will be dealt with in the next section.

6.6.2 Calculated CTC Emissions 2002-2010 from known requirements

Introduction: Emissions from anthropogenic activities

Where CTC is used as a solvent, process agent or reactant in the chemical industry, there are well-known paths for accidental fugitive emissions to occur during transfer of the CTC between storage and/or reaction vessels, and for leakage from valves and other items of equipment. Emissions of CTC can also result from discharge to atmosphere of process gases, or from evaporation from process water or product (in which CTC is retained as an impurity) which is allowed to outgas in contact with the environment.

As distinct from cases where the CTC is deliberately used as solvent, process agent or reactant, it may also be formed as a by-product in reactions, especially those employing elemental chlorine or other chlorinating agents) and ultimately released to the atmosphere in all the ways specified above.

Finally, there is the possibility that CTC is emitted from landfills, which have come to attention recently as temporary sinks from which a number of chemicals substances can be released to the atmosphere. In the case of CTC, the substance might have entered the landfill as a component of wastes, or possibly been generated in the landfill by chemical or (more likely) microbiological action. No reports are available of such emissions but the attention being paid to landfills in recent times could provide confirmation or refutation of this hypothesis.

This section estimates emissions of CTC from known processes using the information from Section 6.1 of this report. A number of countries require reporting of emissions from individual installations; however, in many cases, these data are not readily available. In order to make an estimate of possible CTC emissions for this report, a number of possible scenarios have been considered. These scenarios contain the following assumptions:

Emissions from the production of CTC and its use as a feedstock are calculated using 1%, 2% and 5% emissions by weight of the CTC. It should be noted that, at present, there are only two existing plants that use CTC to produce HFC products. These are situated in non-Article 5(1) countries and have reported CTC emissions of considerably lower than 1% by weight. Furthermore, only two plants in non-Article 5(1) countries manufacture CFCs and emissions reported from both plants are less than 1%.

Process agent applications in Article 5(1) countries are assumed to completely emit their consumption during each year. Whilst it is known that some installations in Article 5(1) countries recover and destroy their process agents, for the purposes of this report total loss only is considered to give an upper boundary.

Process agent applications in non-Article 5(1) countries control their emissions in order to meet the requirements under Decision X/14 Table B.

Estimations of Potential CTC emissions with and without Sector Agreements

Tables 6.11 and 6.12 summarise the estimates of CTC emissions that have been calculated from the information given in Section 6.1. The data are accumulated from applying potential emission levels to the estimated of CTC produced for known applications, emissions from CTC used as a feedstock to produce CFCs and HFCs and from CTC use for emissive applications such as a process agent. Data used to calculate Tables 6.11 and 6.12 are given in Annex to this Chapter (page 97).

Table 6.11 Overall Potential Emissions with Sector Agreements

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
1%	35100	32483	29312	14218	13728	13249	13151	13487	12489
2%	38055	35463	32204	16610	15786	14740	14458	14805	13651
5%	46920	44401	40880	23788	21960	19215	18377	18760	17136

Table 6.12 Overall Potential Emissions without Sector Agreements

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
1%	35100	32483	29312	31270	32576	33915	35759	37672	39065
2%	38055	35463	32204	33862	34796	35697	37499	39328	40490
5%	46920	44401	40880	41639	41457	41042	42720	44294	44765

Emissions estimated from known requirements of CTC are at present (year 2006) between 13,728 and 21,960 metric tonnes. These are significantly lower than those estimated for scenarios if the CFC production and CTC consumption Sector Agreements had not been adopted, in which case, CTC emissions would have been between 32,576 and 41,457 metric tonnes. The major impact of the sector agreements is the reduction of CTC emissions from emissive uses such as process agents.

For the purpose of this report, the impacts of the CTC Production agreements have not been included as this would have resulted in double-counting of the emission reduction as these agreements directly impact only CTC use to produce CFCs or for CTC emissive uses. CTC Production Sector agreements have not yet addressed the production of CTC where it is manufactured for unknown requirements or solely as a by-product of one of the processes described above.

6.6.2 Atmospheric Concentrations of CTC

Since the publication of Lovelock's and Junge's work in the early 1970s, there have been major advances in the understanding of global circulation and atmospheric chemistry. On the first count, it is now understood that substances with reasonably long lifetimes (say, 25 years) continuously released in the northern hemisphere will rapidly distribute over the globe with concentrations in the southern hemisphere being only 2% lower than the northern ones. Secondly, the lifetime of CTC in the atmosphere has been variously measured and estimated as being in the range 17-36 years, with a mean of 26 years. This is much longer than Junge's estimate and means that atmospheric concentrations could be maintained with much lower emission rates than were envisaged by Junge and Lovelock.

These new understandings were taken into account in the international Scientific Assessment of Ozone Depletion: 2002. In Chapter 1 of that report, the authors (Montzka and Fraser) showed estimates of CTC emissions that were based on two global observation networks, the Advanced Global Atmospheric Gases Experiment (AGAGE) and NOAA-CMDL, as shown in the graph below (the vertical scale is mole fraction in ppt).

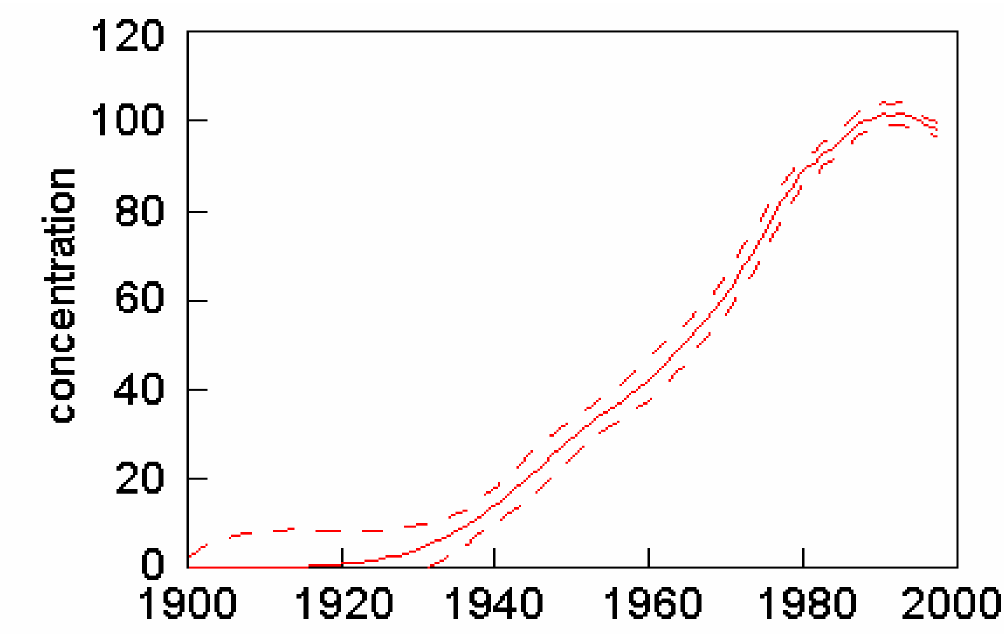


Figure 6.1 Estimated emissions of CTC

According to the calculated CTC emissions estimated from the historically observed atmospheric CTC concentrations, annual CTC emissions peaked at approximately 130 ktonnes (130 000 tonnes) in the mid-1980s, but then declined to about 80 ktonnes (80 000 tonnes) by the late 1990s. Given the range of lifetimes considered for CTC, these figures could involve uncertainties of ±30%. Recent data from the IPCC/TEAP Report, 2005, estimate emissions in 2002 to be 64-76 ktonnes. In summary, the calculated annual emissions are:

Mid-1980s maximum	130±40 ktonnes
Late 1990s	80±25 ktonnes
2002	70±6 ktonnes

The work is covered in some detail in a journal publication[3] from an international group of major contributors to work in this field. The contributions of two critical numerical factors – emission rates and lifetimes – for a number of important gases are estimated by a number of iterative procedures so that calculations based on them will reproduce the observed atmospheric concentrations. A check is maintained on the lifetime data thus adduced by seeking consistency with available laboratory data. The article includes comparisons with estimated industrial emissions in Europe but concentrates on CFCs; no meaningful comparison between the two estimates (from atmosphere and industry) is available for CTC.

Reconciling emission data

There is an emerging conclusion that the discrepancy between emission data calculated from atmospheric concentrations and those derived from consideration of industrial activity is due to under-estimation or under-reporting of the latter. Several new publications show the scale of the discrepancy.

In the first, an American group operating from Hong Kong and Japan in March-April 2001[4] measured atmospheric concentrations and calculated the emission totals that must be assumed to be responsible for them (a 'top-down' approach). Their conclusion was that emissions from China, Japan and Korea are responsible for 'an eastern Asian carbon tetrachloride (CCl_4) source of 21.5 Gg yr^{-1}, several-fold larger than previous estimates and amounting to ≈30% of the global budget for this gas. The respective 'top-down' figures were compared with 'bottom-up' figures derived from the UNEP data cited, as follows:

CTC Emissions (Gg yr^{-1} = thousand tonne)

	Bottom-up	Top-down
China	0.1	17.6±4.4
Japan	0.1	1.3±0.4
Korea	1.3	2.3±0.8
Eastern Asia	1.5	21.5±5.0
Global	47.0*	62.0-72.0

*The global figure is taken from the published literature[5]. As noted above, global totals may have declined in the late 1990s before the measurements of Palmer et al. were undertaken.

The figure for Japan is consistent with those reported in succeeding years when measurements of the vertical profile of CTC (and other species) downwind of Tokyo – by any measure a major industrial/urban complex – were reported by Japanese researchers[6]. This work found that the atmospheric concentrations were up to five times larger than could be accounted for by emissions of CTC reported to the country's Pollution Release and Transfer Registry (PRTR). The annual emissions of CTC required to produce the atmospheric concentrations measured at several times in the period August 2001 – August 2003 were 1.8, 1.4, 1.0 and 0.27 million tones, but the PRTR total for 2002 was 0.07 million tonnes.

Measurements of the mixing ratios of a number of ODS, including CTC, along 8500 km of the Russian trans-Siberian railway in June-July 2001[7] indicate a CTC emission of 600 tonnes (range 300-1,100 tonnes) which the authors note are insufficient in magnitude to play a major role in recent global emission shortfalls.

Some recent results and a brief historical survey are given in a recent article dealing with air trapped in Antarctic ice sheets (firn air)[8]. There is good evidence that CTC is preserved in the firn air and so the observed rise in concentration from near zero in 1920 (a 'natural' background of 5 ppt is suggested) to approximately 100 ppt in 1990 (falling slightly up to 2000) is a good indication of release by anthropogenic source

Natural sources of CTC

The firn results described above suggest that the natural background of non-anthropogenic release of CTC is very small compared to the anthropogenic figures. However, there is a substantial literature on this matter that needs to be considered: G.W. Gribble's monograph 'Naturally Occurring Organic halogen Compounds – a Comprehensive Survey'[9]

Carbon tetrachloride is also found in the oceans and the atmosphere. Natural sources of CCl_4 include volcanoes, drill wells, mine gas and minerals, marine algae, terrestrial plants, arctic ocean, including the bottom, and perhaps via the atmospheric chlorination of CH_4.

In the above monograph and a later dossier compiled for Eurochlor, Gribble cites the Lovelock estimate. It would seem from other work, however, that the emissions to atmosphere from natural sources are likely to be much smaller than those deduced by Lovelock and probably very small in comparison to industrial levels. For example in a recent study of gaseous emissions from a European volcano the maximum concentration of CTC was found to be 1.7±0.1 ppb volume. From this and other data available to the researchers[10], it was calculated that the annual worldwide emissions of CTC from volcanic sources was 3.41±1.0 tonnes. It could be assumed that an active volcano would emit more CTC (and other gases) but no data are available.

Unpublished data obtained by Australian researchers for emissions from bushfires (wildfires) show little emission of CCl_4 or CH_2Cl_2 (despite this substance being regarded globally as being a fire product), but large emissions of $CHCl_3$ and CH_3Cl.

Conclusion

A review of the available research clearly indicates that emissions of CTC from industrial operations are believed to be underestimated. This likely underestimation of emissions would cause of the discrepancy between reported emissions and figures that can be estimated from the observed atmospheric concentrations of this substance and estimates of its atmospheric lifetime.

Estimations carried out in this report on emissions from the known requirements of CTC indicate a significant discrepancy with atmospheric measurements, even when a maximum emission level of 5% is used for the production of CTC and during its use as a feedstock. A doubling of the emission level for CTC and CFC production to 10% for the period 2002-2005 (prior to the adoption of the Sector Agreements) would result in an increased annual emission of CTC by 13,000 metric tonnes but this still does not correspond with the measured atmospheric levels.

Emissive uses in Article 5(1) dominate the emissions' profiles for CTC and will significantly reduce as a result of the Sector Agreements. These estimations are based upon UNEP data on the consumption of CTC and data on CTC consumption from the Multilateral Fund approved Sector Agreements; it is unlikely that these are significantly inaccurate. Emissions from applications such as process agents will significantly decline in the period 2005-10, particularly as a result of the CTC Sector Agreements that have been adopted and the second tranche of the Chinese CTC Sector Agreement that has been adopted in principle at the 47th Meeting of the Executive Committee.

Three potentially significant areas require further investigation to get better data for industrial emissions in Article 5(1) and non-Article 5(1) countries to enable resolution of the discrepancies with atmospheric measurements; the first area is that of CTC production in order to identify, in particular, the production of CTC as a by-product and its subsequent use, re-cycling or destruction; the second area is to identify any other requirements for CTC and the third is the emission of CTC from sources such as landfills.

6.7 Solvents

6.7.1 Technical Progress

Since the signing and ratification of the Montreal Protocol intense research efforts have been underway to replace the critical solvents that were ozone depleting substances. Primarily, CFC-113 and 1,1,1-trichloroethane were used extensively in precision and metal cleaning. The former Solvents Technical Options Committee dedicated several chapters to uses and replacement alternatives for these solvents.

Since the phase-out of the widely used CFCs and 1,1,1-trichloroethane in non Article 5(1) countries a number of new solvents that claim to be replacements are being marketed. The critical parameter for alternatives continues to be that they are non-ozone depleting substances. A notable exception is that some of the HCFCs possess a very low ozone depletion potential but they are scheduled to be phased out by the year 2030.

Several promising alternatives have emerged from the intense research. Hydrofluoroethers (HFEs) and hydrofluorocarbons (HFCs) are some of more widely used as substitutes. These materials fulfil the requirement of being non-ozone depleting substances but unfortunately do not possess the solvent power of the compounds they are replacing. They therefore require additional substances to render them solvent effective. As a result blends or azeotropes are required to replace solvents that were single species which made them attractive as to stability and solvent activity.

Since the ideal replacements have not been found, the trend to return to more conventional and actually less desirable solvents becomes necessary. Some of these include non halogenated organic solvents such as alcohols, aliphatics, ketones, aldehydes and blends of aliphatic, cyclic or aromatic hydrocarbons and derivatives. Chlorinated compounds such as trichloroethylene, perchloroetheylene and methylene chloride have made resurgence in the solvent sector. Volatile methyl siloxanes and chlorinated aromatics have also been evaluated. Perflurocarbons while excessively high in global warming potential are being reconsidered. n-propyl bromide is being widely explored in the United States as a solvent substitute but has considerable disadvantages. This topic is being reported in another section of the report.

Another category of alternative solvents being explored is that of bio-based materials. Essentially these are compound formed from bio-organic products such as corn and soy beans. While there is considerable enthusiasm in this area the likelihood of these replacing solvents that are used for critical cleaning applications appears small at this time.

Stockpiling of critical cleaning solvents continues. Of course when the supply is depleted a critical situation again arises and stockpiling only delays reality.

UNEP and national environmental protection agencies recognize that there are no direct replacement of solvents for high technology projects which were developed predicated on the benefits of the solvent. In these cases a mechanism of essential exemption exists. Proposals are made to continue the use of critical solvents until suitable replacements are found or the project terminates. This is a process that only grants exemptions in very few cases and is not intended to be a method of circumventing continuing research and development.

No new and novel alternatives have been developed. Further it is unlikely that there will be a new solvent alternative break through. Major chemical companies are reluctant to embark on lengthy and expensive research projects, the products of which are subject to extensive scrutiny by federal and state agencies with uncertain results. Thus far only the HFCs, HCFCs and HFEs are leading the field in solvent replacements.

6.7.2 n-Propyl Bromide (n-PB) Update (Decision XIII/7)

Under Decision XIII/7, TEAP has been requested to report annually on n-PB use and emissions.

Annual Use and Emissions of n-PB (n-propyl bromide) for the year 2005 are estimated as follows:

Annual n-PB use as a solvent – 5,000 ~10,000 metric tonnes

Information available as of February 2006:
EU estimate 1,500 tonnes
Japan estimate 1,300 tonnes
US estimate 1,300 tonnes
China estimate 1,000 tonnes

Annual emissions

50% emissions of the above quantities apply. This is a typical ratio suggested by IPCC[11].

In view of the fact this is not a controlled substance, no accurate information is available because there is no yearly reporting by the Parties. In addition due to toxicity concerns (both reproductive and central nervous systems effects), the reported quantities are expected to be lowered.

6.7.3 Essential Use Nomination

A nomination for Essential Use of CFC-113 was received in April 2006 from the Russian Federation, but it came too late for consideration by CTOC and TEAP in 2006.

The CTOC will make a detailed examination of the nomination and report in 2007. Parties may wish to consider a one-year Essential Use Exemption for 2007. (See the Essential Use section in the 2006 TEAP Progress Report)

6.8 Destruction and Other Issues

Under Decision XVII/17(3), the TEAP is requested to review possible synergies with other conventions, such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade and the Stockholm Convention on Persistent Organic Pollutants.

6.8.1 Background on Conventions

Stockholm Convention: To implement measures to reduce or eliminate releases from intentional or unintentional production and use of Persistent Organic Pollutants, considering exemptions for specific uses.

- Substances covered: halogenated organic compounds with characteristics of persistence, bio-accumulation, potential of long-range environmental transport, and adverse effects as aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene, polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and polychlorinated biphenyls (PCBs).
- Main activities that Parties have to do: To make a National Implementation Plan and specific action plans for each substance. This includes inventories of all substances. In order to reduce releases of PCDDs/PCDFs, Parties shall apply Best Available Techniques and Best Environmental Practices (BAT/BEP).
- Wastes have to be managed in an environmentally sound manner and they only can be exported for elimination, according to Basel Convention rules.

Basel Convention: To implement the legal, institutional and technical conditions in a Party, in order to achieve environmentally sound management of hazardous wastes, from its generation to elimination.

- Substances covered: almost all sorts of wastes, including organic-halogenated compounds.
- Montreal Protocol decisions related to the Basel Convention:
  - Decision XII/8: To explore common points with the Basel Convention and other international agreements in order to eliminate contaminated ODS and stockpiles.
  - Decision V/24: To take actions according to both Conventions objectives.
  - Decision VII/31: International transfer of recovered (not regenerated) CFCs and halons is allowed only if the receptor Party has recycling facilities, in order to process them according to the national/international standards or destruction facilities to eliminate them.

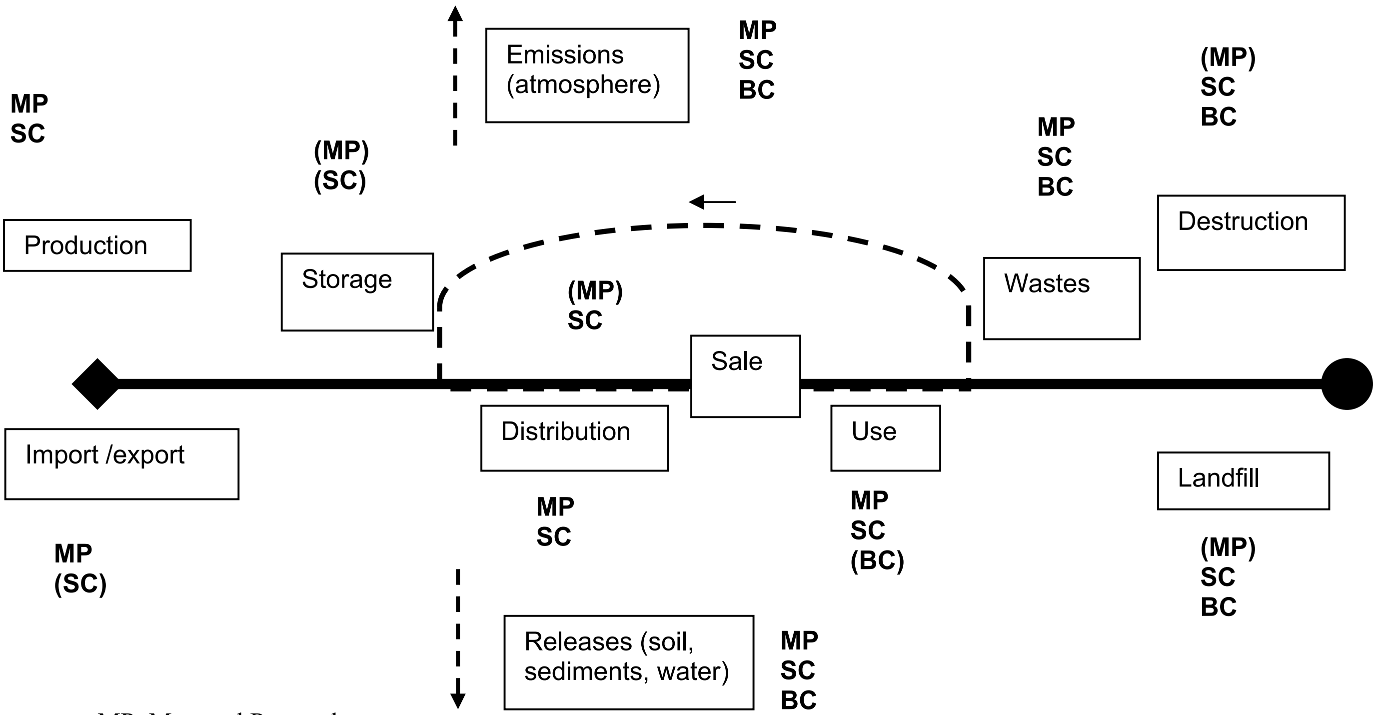
Rotterdam Convention: To monitor and control the trade of hazardous substances. It gives importing countries the power to decide which chemicals they want to receive and to exclude those they cannot manage safely, so the export of a chemical can only take place with the prior informed consent of the importing Party. If trade does take place, requirements for labelling and provision of information on potential health and environmental effects will promote the safe use of these chemicals.

Pollutants Release and Transfer Registry (PRTR): Managed by UNITAR. Its aim is to put all the pollutants monitoring data on a web-based system, which can be viewed by people from various sectors (public, private, university, etc.) with different access levels.

Table 6.13 Comparison between the three Conventions with the Montreal Protocol

Nº	Parameter	Montreal Protocol on ODS	Stockholm Convention on POPs	Basel Convention on hazardous wastes	Rotterdam Convention on international trade of hazardous substances
1	Halogenated organic substances	♦ (Cl, Br)	♦ (Cl)	♦ (Cl, Br, F)	♦ (Cl)
2	Persistence	∇ (Atmosphere)	♦ (All matrix)	∇	∇ (Includes POPs)
3	Releases control	∇ (Good practices)	♦	∇	
4	BAT/BEP	∇ (BEP)	♦	♦ (Best practices)	
5	Customs Control	♦ (License System)	♦	♦	♦
6	ESM (Environmentally sound management) of wastes	♦ (Recycling, Reuse, Reclaiming)	♦	♦	
7	ESM of substances	♦ (Best practices)	♦ (To prevent releases)	∇ (To reduce wastes)	♦ (To reduce risk)
8	Illegal traffic control	♦		♦	♦
9	International trade control (license system)	♦		♦	♦
10	Similar Destruction technologies?	♦ (Cement kiln, plasma, etc.)	♦ (Cement kiln, plasma, etc.)	∇ (For Organic chlorinated)	∇ (OC)
11	Procedure to include new substances	♦ (Scientific Assessment Panel)	♦ (POPs Review Committee)	♦ (Open-Ended Working Group)	♦ (Chemical Review Committee)
12	Effectiveness evaluation of the Convention	♦ (SAP)	♦		
13	Substances can be included in the PRTR?	♦	♦	♦	♦

♦: This means that the parameter is applied in the Convention or Protocol.
∇: This means that the parameter is less applied in the Convention or Protocol.



MP: Montreal Protocol
SC: Stockholm Convention
BC: Basel Convention
RC: Rotterdam Convention
( ): Indirect involvement of the Convention/Protocol

Figure 6.2 Chemicals life cycle, taking into account where Montreal Protocol and Stockholm, Basel and Rotterdam Conventions are involved.

6.8.2 Comparison between the three Conventions and the Montreal Protocol

The Conventions included in the International Chemical Agenda as Basel, Stockholm and Rotterdam are related to the Montreal Protocol in several issues in environmentally sound management of chemicals and wastes.

The Montreal Protocol entered into force on 1987 and has been ratified by 189 Parties. It aims to reduce and eliminate ozone depleting substances according to a gradual schedule.

The Basel Convention entered into force on May 1992 and has been ratified by 168 Parties up today. This Convention aims to implement the legal, institutional and technical conditions in a Party, in order to achieve environmentally sound management of hazardous wastes, from its generation to elimination.

The Stockholm Convention focused on the implementation of measures to reduce or eliminate releases from intentional or unintentional production and use of persistent organic pollutants, also considering exemptions for specific uses. It entered into force on 17 May 2004 and has been ratified by 120 Parties. It is important to mention that in the case of Chlordane and Mirex production, CTC is used as a process agent.

The Rotterdam Convention entered into force on 20 June 2005 and has been ratified by 73 Parties. Its objective is to monitor and control the trade of hazardous substances. It gives importing countries the power to decide which chemicals they want to receive and to exclude those they cannot manage safely, so the export of a chemical can only take place with the prior informed consent of the importing Party. If trade does take place, requirements for labelling and provision of information on potential health and environmental effects will promote the safe use of these chemicals.

One of the main synergies between them exists in the implementation of best practices in order to reduce and eliminate the use of certain chemicals and their waste, also reducing the pollution to the environment.

All these conventions are focused in protecting the environment by enforcing the national capacities by the following:

- To reduce emissions and releases of chemicals which harm the environment in a regional and global manner
- To implement a control of transborder movement of substances and wastes
- The list of controlled substances includes chlorinated compounds in all conventions; most of them persist in the environment
- To introduce clean technology and the enforcement of using it
- To introduce best destruction technologies with totally conversion of the compounds
- To assure the use of available and suitable alternatives and the implementation of them
- To encourage responsible production, use and end of life practices to minimize environmental impact
- To share responsibilities and to consider different types of countries, depending on their economies and controlled substances
- To develop a mechanism to provide suitable financial resources and capacity building in order to help developing countries
- To provide technical assistance to all Parties and to develop an information system between Parties
- To follow a procedure to list new substances/products which are checked by an expert group
- To develop a regulatory framework

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9 *Progress in the Chemistry of Natural Products*, 1996, **68**, 1-498. CTC is covered in section 3.3.4 of the monograph, as follows(excluding reference numbers):

10 Schwandner F. M., T. M. Seward, A. P. Gize, P. A. Hall, V. J. Dietrich (2004), 'Diffuse emission of organic trace gases from the flank and crater of a quiescent active volcano (Vulcano, Aeolian Islands, Italy)' J. Geophys. Res., 109, D04301, doi:10.1029/2003JD003890. .

11 'IPCC/TEAP Special Report on Safeguarding the Ozone Layer and the Global Climate System', p319 (2005)

ANNEX to Chapter 6

Potential CTC emissions with Sector Agreements

From CTC Production for known requirements

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
1%	1660	1659	1600	1277	1109	826	734	741	659
2%	3319	3317	3199	2553	2218	1652	1468	1483	1318
5%	8298	8293	7998	6384	5544	4130	3670	3707	3295

From CTC Use as a CFC Feedstock

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
1%	1262	1084	968	733	526	222	108	93	0
2%	2525	2169	1937	1467	1052	443	217	186	0
5%	6312	5421	4842	3667	2629	1108	542	466	0

From CTC Emissive Use

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
A5C	31925	29283	26199	11605	11449	11537	11624	11948	11106
Non-A5C	221	221	221	221	221	221	221	221	221
Total	32145	29504	26420	11826	11670	11757	11845	12169	11327

From CTC Use as an HFC Feedstock

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
1%	33	236	324	382	423	444	464	484	503
2%	66	473	648	765	847	888	928	968	1006
5%	165	1182	1621	1912	2117	2220	2321	2419	2514

Potential CTC Emissions without Sector Agreements

From CTC Production for known requirements

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
1%	1660	1659	1600	1461	1283	1073	1062	1029	922
2%	3319	3317	3199	2922	2567	2146	2123	2058	1844
5%	8298	8293	7998	7305	6417	5364	5308	5146	4610

From CTC Use as a CFC Feedstock

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
1%	1262	1084	968	749	514	265	214	142	0
2%	2525	2169	1937	1498	1027	530	429	285	0
5%	6312	5421	4842	3745	2568	1324	1072	712	0

From CTC Emissive Use

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
A5C	31925	29283	26199	28457	30135	31913	33798	35796	37419
Non-A5C	221	221	221	221	221	221	221	221	221
Total	32145	29504	26420	28678	30355	32134	34019	36017	37640

From CTC Use as an HFC Feedstock

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
1%	33	236	324	382	423	444	464	484	503
2%	66	473	648	765	847	888	928	968	1006
5%	165	1182	1621	1912	2117	2220	2321	2419	2514

7 Progress in the ODS Phase-out in the Military Sector

7.1 Military leadership and technical progress in developed countries[1]

At the time the Montreal Protocol was signed in 1987, virtually every military system in the developed countries relied on ODS for their manufacture, maintenance and operation. Since then, most countries have made impressive progress in eliminating ODS applications. The primary remaining military ODS use is for halon in applications considered to be critical to operations, lacking technically or economically feasible alternatives, or have not yet been budgeted or scheduled for retrofit or retirement. CFC refrigerants continue to be used in Naval ships because the refrigeration plants were designed specifically to use a particular refrigerant, the plant is sized according to the needs of the ship, the acoustic signature of the ship would be changed by using an alternative, or because the cost of removing the plant and replacing it is cost prohibitive. For example, in some ship designs, the hull of the ship must be opened in order to remove the plant. In non-Article 5(1) countries, these applications continue to be satisfied by recycling existing stocks of ODS. A small number of uses have been met through Essential Use Exemptions previously granted by Parties to the Russian Federation for halon-2402 in specific applications, for ODS solvents to clean torpedoes in Poland, and to the United States for methyl chloroform in manufacture of civilian and military rockets.

Information about military ODS uses and implementation of alternatives is not as readily available as for the commercial sector. However, many countries have provided detailed technical information on uses and alternatives that have been published in TEAP and TOC reports, publications of the US Environmental Protection Agency, the US Department of Defense, UNEP DTIE, and in the proceedings of four global conferences on alternatives and substitutes for military applications held in the United States and Belgium. A workshop on alternatives to halon in military applications is planned for later this year or early next year, most likely in Brussels.

7.2 Uncertain technical progress in developing countries

There is currently little information available to TEAP from developing countries about military ODS usage or efforts to implement alternatives. Sources of information have included participants in TOCs, military workshops and essential use nominations. There has been close cooperation between developed and developing nation military organisations through bilateral and multi-lateral military-to-military exchange projects. Workshops co-sponsored by military organizations from Australia, Canada, the EC and the United States along with the Multilateral Fund and industry and environmental NGOs have invited and financed participation by developing nation military representatives.

There were four workshops on the Military Role in Implementing the Montreal Protocol. The first in 1991 in Williamsburg, VA, the second in 1994 in Brussels, Belgium, the third in Vienna, Virginia in 1997, and the latest in Brussels, Belgium in 2001. Participation included China, India,

[1] This report updates the status of the military phaseout. The complete history of the first 20 years of military phaseout under the Montreal Protocol is being compiled by K. Madhava Sarma, Stephen O. Andersen, Thomas Morehouse and Kristen Taddonio and will be published in 2008 by UNEP.

the Russian Federation, and other developed and developing countries. Military-to-military technology cooperation projects were sponsored by developed countries involving Mexico, Thailand, Turkey, and Malaysia. UNEP sponsored workshops that included military involvement were: one in India, and another involving militaries of the Gulf region held in Amman, Jordan. In September 1996, the US, Canada and Australia sponsored a Defense Environmental Workshop for nations of the Asia Pacific Indian Ocean region with a focus on ODS. Virtually all participating countries sent representatives of their military and environmental ministries. In June 1997, the same tri-lateral group sponsored a conference for nations of the Western Hemisphere. In November 1997, a global conference on military uses of ODSs was organized in conjunction with the annual Conference on Ozone Protection Technologies in Baltimore, Maryland. The United States (U.S.) Navy and Defense Logistics Agency provided training on the use of halon recycling equipment, halon banking strategies and halon alternatives in a number of non-Article 5(1) countries, including India and China. There have been significant efforts over the years to spread awareness of the Montreal Protocol and the availability of measures militaries can take to manage the phase-out.

Parties operating under Article 5(1) may wish to engage their military organisations to report ODS uses and efforts to implement alternatives.

7.3 Continuing mission-critical uses

There are a few continuing mission-critical uses that militaries are meeting through recycling of existing ODS banks. They are mostly halons and refrigerants used in weapons systems or used to support combat operations. The applications include aviation, shipboard, ground combat vehicles and in some cases critical facilities.

7.3.1 Aviation

There are 7 primary aviation uses of halon in both civilian and military:

- Portable extinguishers
- Cargo compartments, including a new requirement to protect class D cargo holds in commercial aircraft
- Engine Nacelles and Auxiliary Power Units (APU)
- Lavatory waste bins
- Dry Bays
- Fuel Tank Inerting Systems
- Ground Support equipment

The first 3 applications on the list, portables, cargo compartments, and lavatory waste bins are essentially identical in civil and military aircraft. Except for lavatories, and portables, halon remains the only fire protection agent used for civil aviation, including for new aircraft being designed today for future production. Dry bays, fuel tank inerting and ground support, are military specific. Engine nacelles and APUs are the same for some classes of military aircraft but not for others. Transport aircraft are often, but not always, variants of commercial aircraft. Combat aircraft (e.g., fighters, bombers) are unique to the military.

Portable Extinguishers

Halon (mostly 1211, but in some cases halon-2402) is used on all civil and some military aircraft. The military has converted some of its halon handhelds on rotary wing aircraft to CO_2, however since CO_2 does not provide comparable performance to halon adoption has been limited.

Engine Nacelles and Auxiliary Power Units

The military has begun producing the first modern aircraft not using halon in engine nacelles. Specifically, the V-22, the upgraded H-1 helicopter and the F-22 Air Force fighter uses HFC-125; and the F-18E/F uses inert gas generators. The U.S. Air Force's new F-22 fighter will use HFC-125 for both engine nacelles and auxiliary power units. The UK is procuring a reconnaissance aircraft with HFC-125 engine nacelle systems. These halon-free designs 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 fuel tanks, that contain electrical cables, hydraulic lines or other equipment and which can be the source of fires or explosions should the fuel tanks be ruptured by incoming rounds or fragments. These areas are of particular concern to the military because unlike civilian aircraft, military aircraft expect to be shot at. The U.S. Navy has implemented inert gas generators aboard the F-18E/F and V-22.

Fuel Tank Inerting

Two types of aircraft deployed by a dozen or more countries use halon during combat to inert the ullage space in their fuel tanks within wing structures to prevent explosion in the event that the fuel tanks are penetrated by bullets or missiles. The most widely used aircraft with this feature is the F-16, which is operated by a large number of countries around the world.

Cargo Compartments

Some cargo compartments on military transport aircraft have halon systems installed. Only a few types of aircraft are included, and quantities are small.

Lavatory Waste Bins

There are approved HFC-227ea and HFC-236fa systems for this application which were developed under the direction of the international halon working group. It is easily retrofitted into existing aircraft, however uptake in the military sector has been minimal so far.

Ground Support

Halon-1211 is used by some countries in wheeled extinguishers placed adjacent to aircraft parking spaces for "first response" in the event of a ground incident. If operational imperatives require it, an aircraft can take off following a small pooled-fuel fire in an engine nacelle which has been extinguished by halon. The same fire extinguished with other non-gaseous agents may result in grounding of the aircraft until a more extensive examination of the engine is performed.

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 or AFFF (aqueous film forming foam) or a combination of both. The rational for the switch was if the fire is too large to be extinguished with wheeled halon extinguishers, secondary damage caused by the use of a powder agent is irrelevant compared to the damage caused by the fire. Also, halon-1211 is often used on aircraft carrier decks.

The U.S. Army provides ground protection for rotary wing aircraft using dry powder and CAF (compressed air foam). However, it is unclear how widespread this practice is and other military organizations likely continue to rely on halon. Foam is favoured over dry powder because it provides better throw and presents less of a problem with residue. However, it is likely that halon-1211 is used by some military organizations.

7.3.2 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 fire protection decisions are based on a risk management strategy and includes a wide range of factors such as platform configuration and fire loading. For example, the UK Royal Navy uses halon in the machinery spaces of some of its submarines but not in others; Dutch submarines do; U.S. submarines do not. 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 has determined that all halon systems can either be removed or replaced with a non-ODS agent. However, halon alternatives generally require additional space and add weight. On board ships, limited space often precludes adoption of alternatives. On submarines, confined spaces and highly integrated designs limit adoption of alternatives.

The use of halons in ships and submarines falls into the following broad categories:

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

Machinery Spaces

Naval vessel machinery spaces are normally occupied so must continue to be occupied in order to maintain the capability of the ships. Therefore, an effective safe extinguishing system that will allow continued occupation is needed.

The U.S. Navy uses 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 is 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 Inergen or Argonite (inert gases) in total flooding systems. It occupies eight times the volume of halon, and therefore is not practical on submarines or on ships with limited cargo areas, but Denmark finds the space and weight penalty acceptable on its surface ships.

Machinery (Engine) Enclosures

Gas turbine engines and in some cases diesel engines, are enclosed for acoustic attenuation. These enclosures are supplied by the equipment manufacturers, and come with an integral, pre-packaged fire protection system. Halon was the industry standard, so retrofitting an alternative can be problematic. However new vessels use either water mist or HFC-227ea.

Electrical Spaces

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

Flammable Liquid Storage Spaces

Halon-1301 or CO_2 is currently used in some vessels. There are concerns over expanded use of CO_2 for reasons of personnel safety. HFC-227ea is the favoured alternative by the U.S. Navy.

7.3.3 Ground Combat Vehicles

Halons are used in ground combat vehicles for the following applications:

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

Crew Compartments of Ground Combat Vehicles

A number of countries, including Canada, Germany, India, Israel, Russia, the U.K. and the U.S, use halon-1301 total flooding systems for explosion suppression in crew compartments of ground combat vehicle vehicles. These systems activate in less than 250 milliseconds to protect the crew from fire and explosion resulting from combat. Tests and battlefield experiences show significantly improved crew survival rates in vehicles equipped with these systems. The US Army developed a non-halon crew compartment explosion suppression system that is deployed on the Stryker Armored Vehicle. The US

Marine Corps plans on using the same non-halon technology in its new Expeditionary fighting Vehicle (formerly known as the Advanced Amphibious Assault Vehicle (AAAV). Russia currently uses halon-2402 in crew compartments. There are some indications that the Russian Federation may be converting these systems to halon-1301.

Engine Compartments

The U.S. Army and U.K. Army have converted many of their ground combat vehicle engine compartment systems from halon to sodium bicarbonate dry powder or HFC-227ea. The U.S. Army's new Styker Armored Vehicle uses HFC-125 for the engine compartment system.

Germany has adopted nitrogen systems, which occupy approximately twice the space as existing halon systems. Germany is able to use nitrogen, because their systems were originally designed for a double shot of halon to provide the safety of being able to extinguish a fire in the event of re-ignition or to extinguish a second fire caused by combat occurring before the vehicle can exit the battlefield for service. A single shot of nitrogen can be accommodated within the same space. Some military organisations consider a single shot inadequate protection for the crew and reject the nitrogen solution. HFC-125, HFC-227ea and HFC-236fa require approximately the same space as halon, and therefore allow for a double shot. Denmark is using HFC-227ea for engine compartments, but continues to use halon-1301 for crew compartments.

Conversion of engine compartments has been found to be economically feasible in a substantial number of countries where the conversion work is undertaken during scheduled maintenance or upgrade programmes.

Portable Extinguishers

Portable halon fire extinguishers have been replaced by CO_2 extinguishers in ground combat vehicles where the operating scenario permits the crew to dismount. However, this solution is inappropriate in some configurations where the CO_2, which tends to pool in low areas, accumulates at potentially fatal concentrations in the breathing zone of passengers or crew. For this application, the US Army developed and is currently fielding a 50%-50% water – potassium acetate extinguisher that fits in the existing space as the original halon-1301 extinguisher. Externally mounted extinguishers can readily be replaced with powder or other alternatives.

7.3.4 Facilities

Halon in facilities has largely been eliminated in developed countries. Not in kind sprinkler or fine water spray systems have replaced most of the halon systems, including in rooms containing computers and other electronic equipment.

In cases where facilities cannot be adequately protected with water sprinkler systems alone, halon can be replaced or retrofitted with inert gases (Argonite or Intergen), or HFC-227ea.

The halon removed from facilities, especially the halon-1301 total flooding systems, has become the primary source of recycled halon for support of continuing uses in weapons platforms.

7.4 Refrigerants

Some shipboard CFC refrigerant applications will remain for the foreseeable future due to a lack of economically viable retrofit options and high retrofit costs where alternatives are available.

All CFC systems on EU ships and submarines will have been converted to HFC alternatives by the end of 2008 because of a legal mandate. Conversion of CFC-12 and 114 systems is relatively straightforward and economically feasible during major maintenance periods. HCFC refrigerants have found more widespread use than CFCs in recent years and their replacement is more problematic, but is being done in the UK.

Although non-fluorocarbon refrigerants such as hydrocarbons and ammonia are also playing an important role in the commercial sector phase-out, use in military applications is unlikely due to flammability and safety concerns in a battlefield environment.

7.5 Solvents

Methyl chloroform available under an Essential Use exemption is used to manufacture 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 worldwide. Large research and development investments have been made to identify and validate alternatives.

Canada, Germany, Norway, Sweden, the UK and the United States reported that they have virtually eliminated the use of ozone-depleting solvents in other military applications. One possible exception is for the cleaning of oxygen systems where solvent toxicity is a concern or where solvent residues cannot be entirely removed.

Cleaning of Oxygen Systems

Although CFC-113 or HCFC-225 were historically considered to be the only solvents suitable for cleaning oxygen in specific aerospace, submarine, and medical applications, aqueous cleaning options have been successfully developed and implemented. Aqueous cleaning is used by Lockheed Martin for manufacturing new aircraft and missile oxygen systems and the U.S. Air Force 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. Germany's Lufthansa airline is using isopropyl alcohol (IPA) 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. However, small amounts of CFC-113 and HCFC-225 continue to be used for some in-situ cleaning of oxygen systems having complex geometries.

7.6 Special circumstances of legacy equipment

Military systems tend to have very long development and operational lifetimes, lasting half a century or longer in both developed and developing countries. The systems are highly integrated, their designs are highly constrained in terms of space and weight, and modification costs are generally very high. While military organizations tend to be reluctant to disclose actual program costs, informal communications reveal that militaries have spent in aggregate over one billion U.S. dollars equivalent for research, retrofit and ODS stockpile management.

The mission-critical applications described above that are not related to manufacturing are used in legacy systems. Most new systems are being designed without halon or ODS refrigerants. The time scales for the development, production and operational life for military systems is far longer than the time provided for ODS production and consumption phase-out by the Montreal Protocol. And while some systems have been successfully modified during their operational lives to eliminate the need for ODS, the technical hurdles and economic realities to phase-out legacy system ODS use for others have so far proven insurmountable.

Some of the most technically difficult retrofits are for fire protection systems in aircraft, crew protection systems for ground combat vehicles and shipboard machinery spaces. These applications are common to developed and developing countries.

In the 1989 Halon Technical Options Committee report, military experts provided detailed descriptions of weapons system applications for halons that would persist beyond a phase-out date, and predicted new halon production would not likely be necessary provided that existing inventories of halon were managed in a way that preserved them for ongoing military requirements. These estimates and predictions made by the HTOC in 1989 and again in 2002 appear to remain valid today.

It is likely that some ODS will continue to be necessary for legacy systems until mid-century, without technical breakthroughs that can produce additional technically and economically feasible alternatives suitable for the most challenging applications. Currently, after considerable research effort by both governments and industry, such breakthroughs do not appear to be forthcoming.

7.7 Adequate ODS banks by some, but not all, Parties

Halon banking systems are operated by a number of developed and developing countries. In developed countries, there appears to be adequate supplies of halon-1301 to meet critical defence needs. Supplies of halon-1211 are less clearly in surplus with some indications of a shortage in some countries. However, this is probably less likely to impact on the defence sector than on the commercial aviation sector.

There is growing concern about the availability of halon-2402 outside of Russia to support existing uses such as aircraft and military vehicles. In particular, India has reported a growing shortage that could be problematic. India also reported that halon-2402 systems are being routinely converted to halon-1301 to improve safety and help ensure future supplies.

7.8 Importance of flexibility in logistical supply, recovery/recycle, and destruction

While overall global halon supplies appear to be adequate for mission-critical uses, they are not always located in the areas where they are needed. Transnational shipment of halon for use and for reconditioning to allow re-use had become an occasional problem for military organisations. To date, essential use exemptions for military uses have only been approved for fire protection in the Russian Federation, cleaning of torpedoes in Poland, and manufacture of solid rocket motors in the United States. However, as global supplies decline, the need for flexibility in moving halon stocks to locations they are needed is becoming increasingly important. Such flexibility may become a consideration to minimize the likelihood a Party would submit an essential use nomination in order to secure domestic stocks of halon to meet critical military needs when other Parties might have surpluses. Barriers exist to international shipment of halons and refrigerants between Parties, even for military applications considered mission critical and necessary for life safety. Some countries prohibit the export and/or import of recovered ODSs and some have cumbersome approval procedures that can be problematic in the event of national security emergencies.

7.9 Summary

Military organisations have invested significant effort and funding, and have made great strides to reduce their dependence on ODS. Modifications to existing systems and practices have been made where technically and economically feasible alternatives exist. Very few new systems rely on ODS. These are limited aviation applications which the military shares with the civilian sector, and a few unique critical military uses. For those applications that continue to need ODS, military operators of reserve stocks have been diligent in their management of those stocks to prevent leakage and ensure the ODS are only used for approved critical applications.

To ensure continued responsible use of ODS and discourage the need for essential use nominations, Parties may wish to consider:

- Encourage Parties to collect and recycle ODS for military-continuing or critical uses
- Requiring best practices for ODS recovery/recycling, storage, reuse and destruction
- Encourage flexibility that will enable transnational shipment necessary to supply recycled ODS for military-critical needs.

8 Methyl Bromide Technical Options Committee (MBTOC) Progress Report

This chapter updates trends in methyl bromide (MB) production and consumption, and gives progress in the development and adoption of alternatives. Preliminary information on registration, re-registration and deregistration of in-kind MB alternatives is also presented in conformity with Decisions Ex.I/4(i) and Ex.I/4(j). Options which Parties may consider for preventing potential harmful trade of methyl bromide stocks to Article 5(1) Parties as consumption is reduced in non – Article 5(1) Parties (decision ExI/4, paragraph 9) are also briefly analysed.

A comprehensive and updated MBTOC Assessment Report will be available for Parties in January 2007, which will cover these and other pertinent sections in detail.

8.1 Methyl bromide production and consumption update

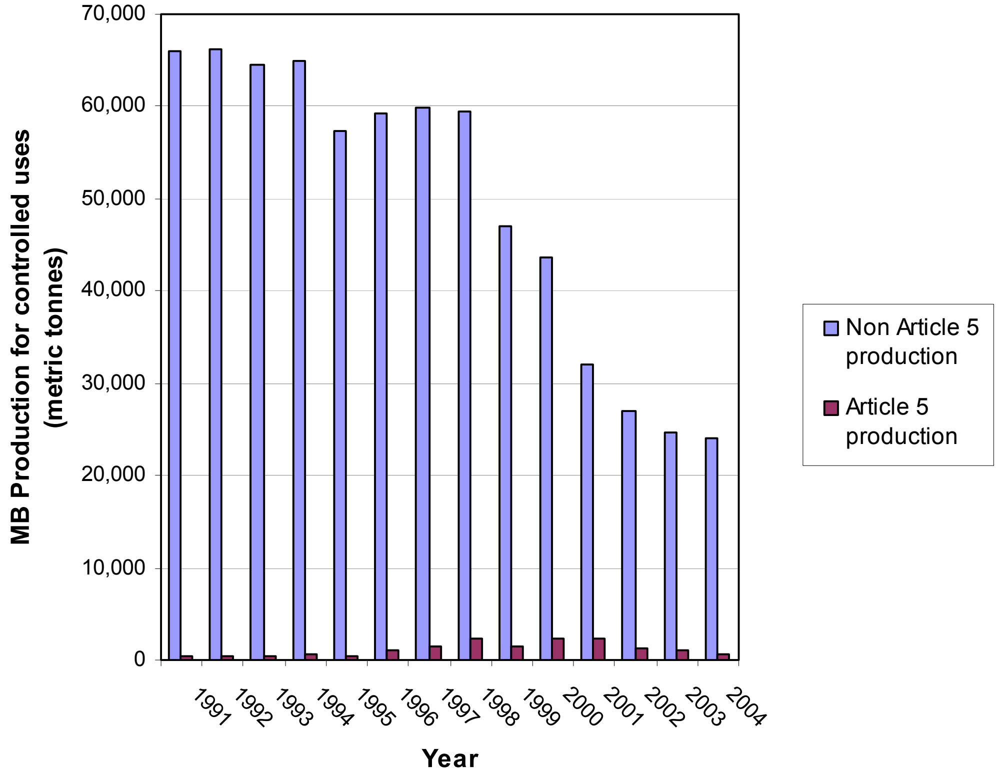
Following is an update on MB production and consumption, compiled primarily from the database on ODS consumption and production of the Ozone Secretariat available in April 2006. Under the Protocol, consumption at the national level is defined as MB production plus MB imports minus exports, minus QPS, minus feedstock; it thus represents the national supply of MB for uses controlled by the Protocol (i.e. non-QPS fumigant). Some countries have revised or corrected their historical consumption data at certain times, and in consequence official figures and baselines have changed. At the time of writing this report, the majority of Parties had submitted data for 2004 and the database for MB is much more complete than in the past. In the few cases where data gaps exist, data from the previous year were assumed to apply.

8.1.1 Production trends

Trends in the reported production of MB for all controlled uses (excluding QPS and feedstock) are shown in Figure 8.1. MB production for controlled uses in 2004 was about 24,635 metric tonnes, which represented 37% of the 1991 official baseline for production level for controlled uses (66,430 tonnes). The baseline for production of MB for controlled uses is being reviewed and further information will be provided in the 2006 MBTOC Assessment Report.

Figure 8.1 Historical trends in reported global MB production for all controlled uses, excluding QPS and feedstock, 1991 - 2004 (metric tonnes)

Data for 1991 and 1995-2004 were taken from the Ozone Secretariat dataset of April 2006. Data for 1992-94 were estimated from Table 3.1 of MBTOC's Assessment Report (2002).



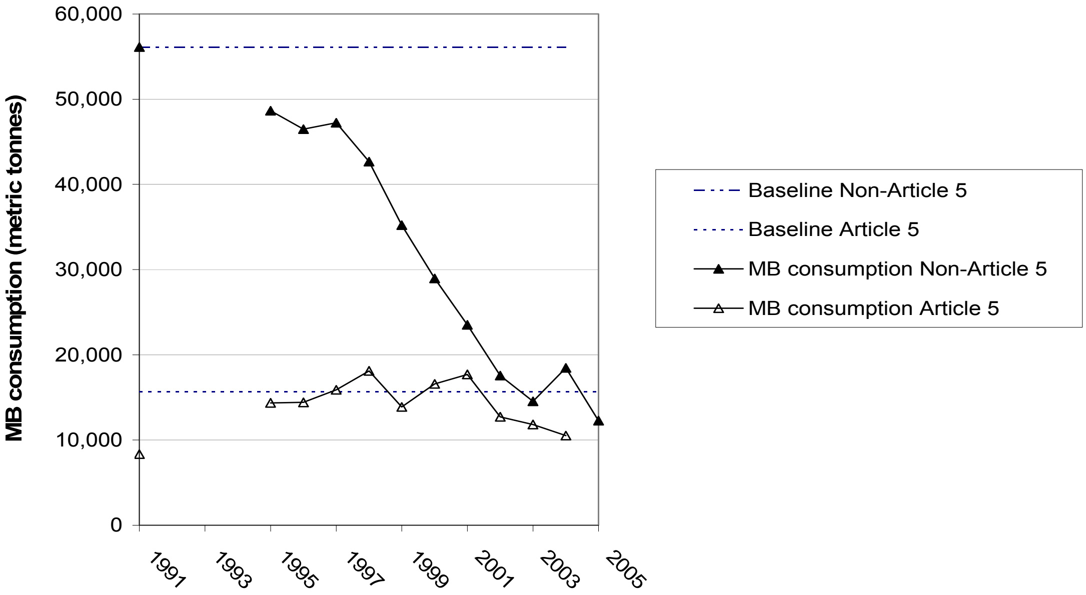
Non-Article 5(1) countries reduced their MB production for controlled uses from about 66,000 tonnes in 1991 (baseline) to less than 24,100 tonnes in 2004. Non-Article 5(1) MB production in 2004 was 37% of the baseline; this included production for export to Article 5(1) countries. Article 5(1) countries reduced their production for controlled uses from a peak of 2,397 tonnes in 2000 to about 536 tonnes in 2004. MB production in Article 5(1) regions fell from 70% of baseline in 2003 to 39% of baseline in 2004 (baseline 1,375 tonnes, average of 1995-98).

A list of known MB production facilities was published in the MBTOC Assessment of 2002 (Table 3.2). In 2004, MB was produced for controlled uses in two Article 5(1) countries (China and Romania) and four non-Article 5(1) countries (France, Israel, Japan and USA). Several other countries were reported to produce MB for QPS and/or feedstock purposes only.

8.1.2 Global consumption

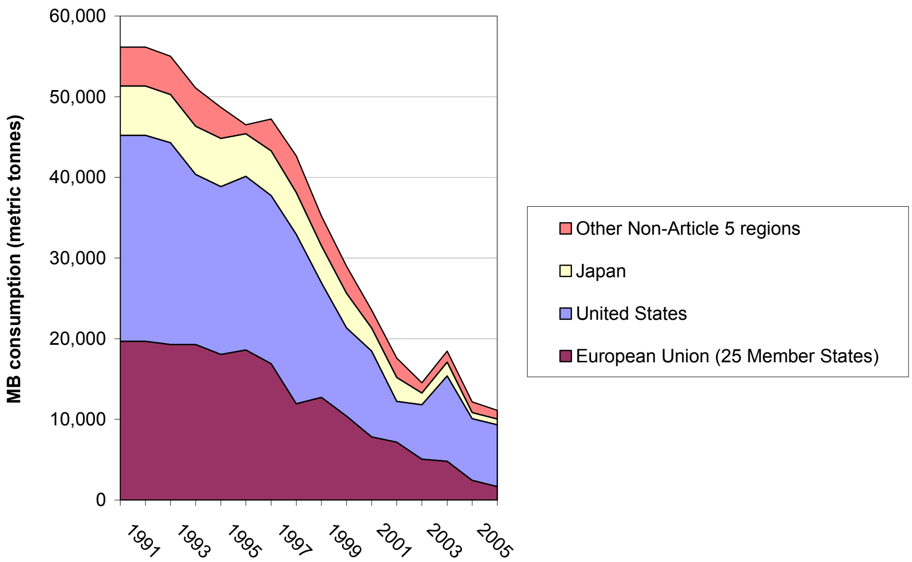
On the basis of Ozone Secretariat data, global consumption of MB for controlled uses was estimated to be about 64,420 tonnes in 1991 and remained above 60 – 63,000 tonnes until 1998. Global consumption was about 45,527 tonnes in 2000, falling to about 26,336 tonnes in 2003.

Figure 8.2 Baselines and trends in MB consumption in non-Article 5(1) and Article 5(1) regions, 1991 – 2005 (metric tonnes)



Source: MBTOC estimates calculated from Ozone Secretariat data of April 2006. Non-Article 5(1) data for 2005 was calculated from MB consumption approved or licensed for CUEs.

Figure 8.3 Trends in MB consumption in the three largest non-Article 5(1) Parties and other non-A5 regions, 1991 – 2006 (metric tonnes)



Source: Ozone Secretariat data of April 2006; data for 2005-6 were calculated from MB consumption approved or licensed for CUEs.

8.1.3 Consumption trends in non-Article 5(1) countries

Figure 8.2 shows the trends in MB consumption in non-Article 5(1) countries for the period between 1991 and 2005. The official baseline for non-Article 5(1) countries was about 56,043 tonnes in 1991. By 2003, this consumption had been reduced to about 14,520 tonnes, representing 26% of the baseline. In 2004, consumption appeared to increase to 18,454 tonnes (33% of baseline), however this occurred primarily because 3,310 tonnes scheduled for export to Article 5(1) countries were not shipped before 31 December of that year and this consignment was counted as part of the official national consumption of a non-Article 5(1) Party. Without this, the total non-Article 5(1) consumption in 2004 would have been approximately 15,144 tonnes, representing 27% of baseline. In 2005, MB consumption was reduced to about 12,270 tonnes in non-Article 5(1) Parties for critical use exemptions (calculated from quantities approved or licensed), accounting for 22% of the total non-Article 5(1) baseline. Further reductions were made in 2006.

Figure 8.3 shows trends in MB consumption in major non-Article 5(1) regions. In 1991 the USA, European Community and Japan used more than 90% of the MB consumed in non-Article 5(1) countries. By 2003 these three Parties had reduced consumption to 26%, 25% and 23% of their respective national baselines. In 2005 the approved or licensed MB consumption in these three Parties was 30%, 13% and 12% of the respective national baselines. (As mentioned above, an apparent substantial increase in consumption occurred in 2004 primarily because 3,310 tonnes MB scheduled for export to Article 5(1) countries were not exported before 31 December of that year.)

MB was consumed for controlled uses by 40 out of 45 non-Article 5(1) countries in the past. The majority of these countries no longer use MB (Table 8.1). Table 8.2 summarises national MB consumption as a percentage of national baseline in countries that were granted critical use exemptions (CUEs) in 2006. Several Parties have made significant reductions in CUEs. The EC, for example, reduced CUEs to 13% and 8% of baseline in 2005 and 2006 respectively.

Table 8.1 Summary of MB consumption in Article 5(1) and non-Article 5(1) countries

Status of MB use	**Number of Parties**		
	Non-Article 5(1) Parties in 2006	**Article 5(1) Parties in 2004**	**Total**
Parties using MB	16	53	**69 (36%)**
Parties that used MB in past and now have zero consumption (a, b)	24	42	**66 (35%)**
Parties that have not consume MB since 1990 (b)	5	49	**54 (29%)**
Total	**45**	**144**	**189 (100%)**

(a) MB consumption reported by Ozone Secretariat
(b) excluding QPS

Table 8.2 MB consumption in relation to national baselines in non-Article 5(1) Parties that currently use MB

Analysis of Ozone Secretariat data of April 2006; reports of Meetings of the Parties; licensing data

Party	MB consumption, tonnes (percentage of national baseline)			
	2003	**2004**	**2005**	**2006**
Australia	182 (26%)	207 (29%)	147 (21%)	75 (11%)
Canada	58 (29%)	58 (29%)	62 (31%)	54 (27%)
European Community	4,921 (25%)	4,789 (25%)	2,431 (13%)	1,655 (8%)
Israel	992 (28%)	1,071 (30%)	1,074 (30%)	880 (25%)
Japan	1,430 (23%)	1,698 (28%)	748 (12%)	741 (12%)
New Zealand	35 (26%)	28 (20%)	41 (30%)	41 (30%)
Switzerland	11 (24%)	12 (29%)	9 (20%)	7 (16%)
United States	6,755 (26%)	10,589 (42%)	7,659 (30%)	7,658 (30%)

8.1.4 Consumption trends in Article 5(1) countries

Figure 8.2 shows the trend in MB consumption in Article 5(1) countries in the period between 1991 and 2004. The Article 5(1) baseline was about 15,683 tonnes (average of 1995-98), rising to a peak consumption of more than 18,100 tonnes in 1998. Recently, total Article 5(1) consumption was reduced from 75% of the baseline in 2003 to 67% of baseline in 2004 (about 10,520 tonnes).

Most Article 5(1) countries have achieved considerable MB reductions at national level, as illustrated by the following information. Further details are presented in Table 8.1 and 8.3.

- The vast majority of Article 5(1) Parties achieved the national freeze level in 2002.
- By 2004, 87% of Article 5(1) Parties (125 out of 144) had achieved the 20% reduction step earlier than the scheduled date of 2005. This indicates that only 19 remaining Parties needed to take action to meet the 20% reduction step in 2005.
- 80% of Article 5(1) Parties (115 Parties) reduced their national MB consumption to less than 50% of national baseline in 2004.
- 77% of Article 5(1) Parties (111 Parties) reported MB consumption between zero and 10 ODP-tonnes in 2004.
- 63% of Parties (91 Parties) reported zero MB consumption.
- Many Article 5(1) countries are implementing MLF projects to reduce or totally phase-out MB. This includes 14 of the 15 largest MB consuming countries (i.e. countries that consumed more than 300 metric tonnes in 2000). The exception is South Africa, which is currently preparing a GEF project for MB phase-out.

Table 8.3 National MB consumption compared to national baselines in Article 5(1) countries

Analysis of Ozone Secretariat data of April 2006

National status	**Number of A5 countries**	
	2003	**2004**
MB consumption was 0% of national baseline	87	91
MB consumption was 0 - 50% of national baseline	106	115
MB consumption was 50 – 80% of national baseline	11	10
MB consumption was more than 80% of national baseline	25	19
Total	**142**	**144**

8.2 Alternatives in Soils sector - update

The major alternatives - 1,3-D/Pic, chloropicrin and metham sodium - alone and/ or in combination with other alternatives are proving as effective as MB and continue to be widely adopted as key alternatives in many preplant soil applications (UNEP, 2005 a,b; Mann *et al.* 2005;Trout and Damodaran, 2004; CDPR PUR data; Spotti, 2004; Carrera *et al.* 2004; Porter, 2005). Some parties previously applying for CUNs particularly in strawberry fruit, tomatoes and vegetable crops, have adopted these alternatives on a wide scale. They are also showing promise for control of pathogens in the more difficult nursery and replant industries where high levels of disease control are required to meet quality standards (e.g. certification requirements). Formulation changes and more adequate application methods continue to improve the effectiveness of several alternatives (Pic EC, 1,3-D/Pic EC) and wider adoption has occurred where these are available. In many instances, this has involved a change in cropping practice, i.e. slightly longer plant back times and a greater awareness of soil conditions which improve the efficiency of alternatives; modification to application machinery, sometimes with economic implications have sometimes been also necessary. Some sectors that were formerly heavily reliant on MB have completely switched to other chemical alternatives and improved crop rotation practices (e.g. tomato and pepper production in Australia); other sectors have adopted more diverse types of alternatives including substrates, steam and various combinations of fumigants, other pesticides, grafted plants and resistant varieties (e.g. Spain, Italy). Key alternatives adopted by the most relevant industries or production sectors are outlined in the sections below.

Combinations of fumigant alternatives (1,3-D/Pic, MNa/Pic) with a range of herbicides have been shown to be effective for nutsedge (*Cyperus* spp), which is the key target pest for many CUN's.

For many nursery industries, parties continue to use MB and apply for CUN's on the basis that MB is the only effective treatment to meet the quality and health standards in the industry. However, the CUNs fail to provide evidence that similar standards cannot be achieved with alternatives. The lack of specific targets and limited research efforts for replant disease makes the identification of efficient alternatives more difficult.

Methods which avoid the need for MB, such as cropping in substrates, grafting plants onto resistant rootstocks and using resistant varieties, have gained wider adoption in the ornamental and vegetable industries requesting CUNs (Cantlifee and Vansickle, 2003; Cantliffe *et al*, 2003; Sawwas, 2003; Tognoni *et al*, 2004; UNEP 2005 a, b).

One key transitional strategy to reduce MB usage has been the adoption of MB:Pic formulations with lower concentrations of MB (e.g. MB:Pic 50:50 or less). Their use can be achieved with application machinery that allows co-injection of MB and chloropicrin or by using premixed formulations. These formulations have proven equally effective for controlling soilborne pathogens as formulations containing higher quantities of MB (e.g. 98:2, 67:33) (e. g. Porter *et al*. 1997; Melgarejo, 2004; López-Aranda *et al*. 2004). At least one Party applying for CUNs reported that MB/Pic formulations can be modified to contain as little as 2% MB and 98% Pic which would dramatically reduce MB dosage. This treatment would be extremely effective for pathogens, but not as suitable for weeds or nematodes.

Low permeability barrier films, LPBF, (e.g. VIF or equivalent) allow increased retention of MB and extended effective exposure periods for pests, thus controlling pathogens and weeds at reduced MB application rates compared to those used with conventional films (e.g. Gilreath *et al*.., 2003; Gilreath *et al*, 2005a; Hamill *et al.* 2004; Minuto *et. al*., 2003; Reuven *et. al*., 2000; Santos et. al, 2005; Wang *et. al.*, 1997). Recent advancements in the cost and technical performance of barrier films have extended their suitability for use with MB and also some of the alternatives. The key advantage is that they allow for a substantial reduction in dosage rate of MB compared with the minimum effective rate under polyethylene film. Typically the reduction in effective MB dosage can be 25 – 50%, for both 98% MB and MB/chloropicrin mixtures (30:70 to 67:33). Barrier films in combination with lower MB/Pic formulations (e.g. 50:50) are improving the efficacy of weed control, including nutsedge. Studies are also proving their use for effective dosage reduction of alternatives, such as 1,3-D (Gilreath, 2004; Noling, 2004; Hamill *et al,* 2004; Fennimore *et al*, 2004). This is important because dosage reduction may increase areas available to be treated with specific fumigants that are limited by township caps and may lead to further reduction in MB use (Gilreath *et al*, 2003; Fennimore *et al*, 2004; Fennimore *et. al.*, 2003).

At present the state of California in the US prohibits the use of certain barrier films (VIF), over concerns of possible worker exposure to MB when seedlings are planted or the film is removed (California Code of Regulations Title 3 Section 6450(e)). Studies to validate emission levels of fumigants with barrier films are presently being conducted to review the regulation. The use of low permeability barrier films (e.g.VIF or equivalent) is compulsory in the 25 member countries of the European Union (EC Regulation 2037/2000).

8.2.1 Metaanalysis report

In response to Decision XVI/5, which provided financial support to MBTOC for expert assistance with the assessment of the critical-use nominations, a statistical analysis or meta-analysis study was conducted to analyse MB alternatives for pre-plant fumigation (Porter *et al,* 2006).

This report provides the Parties with a technical overview of results from current published research. It provides the statistical best estimate of the relative effectiveness of the major chemical alternatives to MB as determined by analysis of information across a large number of studies in different regions and under different pathogen pressures. Effectiveness was assessed by comparing relative yield of the alternative to the respective MB/chloropicrin (MB/Pic) treatment. The study takes account of both registered and unregistered products and concentrates on two major crops, strawberry fruit and tomatoes. Comparisons are made to peppers, melons and other cucurbits and eggplants where possible; much of the information for tomatoes (i.e. effect on target pathogens and weeds) is relevant to the outcomes for these other crops. The meta-analysis also includes a detailed assessment of the effect of alternatives for nutsedge under different pressures and the influence of low permeability barrier films across a range of regions and crops.

Analyses from strawberry fruit trials showed that a large number of alternatives used alone or in various combinations had mean estimated yields which were within 5% of the estimated yield of the standard MB treatment (MB/Pic 67:33). Of these, a number of alternatives and MB/Pic formulations (50:50, 30:70) led to results that were similar to MB/Pic 67:33. These included PicEC (chloropicrin), TC35EC (1,3-dichloropropene/ chloropicrin), TC35 and TC35ECMNa (TC35 EC combined with metham sodium) and MI60 (MB/chloropicrin), which is undergoing review for registration in several countries.

Analyses from tomato trials showed that a range of alternative treatments used alone or in various combinations had mean estimated yields which were within 5% of the estimated yield of the standard MB treatment (MB/Pic 67:33). While some of these treatments contained pebulate, a herbicide which is not commercially available anymore, most treatments did not contain this particular product. Several treatments, PicMNa (chloropicrin combined with metham sodium), 1,3D/Pic in combination with a range of herbicides and MI60 (methyl iodide/chloropicrin) (not registered), provided results similar to MB/Pic 67:33.

8.2.2 Crop specific strategies

The section below provides an overview of the main strategies adopted in the major crops presently applying for CUNs.

8.2.2.1 Ornamental crops

Soil fumigation MB has been commonly used for flower production in many non-A5(1) countries. Non-Article 5(1) Parties presently requesting CUNs for this use include France, Israel, Italy, Spain, Australia and the United States. Other parties previously requesting CUNs (e.g. Portugal, Greece, Belgium) have not reapplied for 2007. The Australian outdoor flower industry for example, no longer uses MB and 1,3-D/Pic and metham sodium in combination with crop rotation is in widespread use. Several member states of the EC have adopted substrates, and different chemical alternatives.

Floriculture is a complex industry in the worldwide context, with hundreds of flower types, production cycles and cropping systems involved. Shifting to alternatives often requires growers to change production practices substantially and implement integrated pest management programs. This may include transition to soilless systems, at times with increased investment, but often with improved quality and yields (Savvas, 2003; Graffiadelis, 2000; Grillas *et al,* 2001).

Constraints to adoption of alternatives that apply to the cut flower sector are generally the same as those of other crops: regulatory issues (e.g. township caps in USA), and registration (e.g. iodomethane; mixtures of fumigants). However, alternatives that do not need registration such as steam and substrates are used by many growers around the world particularly for flowers grown in protected environments.

Roses, carnations and gerberas are the flowers most commonly grown in substrates, but other flower types are also being produced with this cropping system (Nucifora, 2001; Gullino *et al.* 2003; Grillas *et al.* 2001; Pizano, 2005; Savvas, 2003). Substrates are used on about 600 ha (approx. 400 farms) for rose flower production in the Netherlands (De Hoog, 2001; Pizano, 2004). Roses are presently entirely produced in soil-less culture in Israel and this experience is leading the way for adoption of substrates on other crops such as gerbera, lily, anemone and carnation (Ausher, pers. comm. 2004). Although the initial set up cost of a soil-less production system is comparatively expensive, growers are generally able to compensate the extra cost through significantly better yields and quality that result from higher planting density, optimum plant nutrition and better pest and disease control. (Grafiadellis *et al.* 2000; Minuto *et al*., 2005; Akkaya *et al.* 2004; Pizano, 2004; Schnitzler and Grudda, 2002).

Steaming, although expensive, controls soil fungi at levels that are comparable to MB when properly applied (O'Neill *et al*. 2005; Reuven *et al.* 2005; Barel, 2003). Steam has been more widely adopted in ornamental crops in the EC to offset the need for MB (Barel, 2004, LEI, 2004). Steam is generally suited for protected flower production and for sterilizing re-utilised substrates. Costs associated with steaming may be reduced through implementation of IPM strategies and by considering different types of fuels, boiler types and steaming systems (Runia 2000).

Chemical alternatives which are used increasingly in ornamental production include dazomet, metham sodium and 1,3 dichloropropene, the latter often combined with Pic. These have proven equally effective to MB for many kinds of flowers in Israel (Reuven *et al* 2002; Reuven *et al*, 2005), the USA (Schneider *et al.* 2003, Gerik, 2005 a and b, Gerik and Green, 2004), Spain (Peguero, 2004), Australia (Mann *et al,* 2005; Tostovrsnik *et al*, 2005) and other countries. Combined chemicals such as 1,3 D, Pic and metham sodium or dazomet have given good control of pests and diseases in field-grown cut flowers in the United States (Elmore *et al.* 2003; Gilreath *et al*., 2005).

Codes of practice set by supermarket groups and other organisations (e.g. EUREP-GAP, MPS, FLORVERDE) that do not allow fumigation with MB have been adopted widely in Europe, North America and Article 5(1) countries. Membership in such codes is presently offering a commercial advantage.

8.2.2.2 *Strawberry fruit*

Chemical alternatives in strawberry fruit sector

The most effective chemical alternatives for strawberry fruit production include 1,3-D + chloropicrin and drip-applied formulations of either Pic alone or 1,3-D/Pic with or without a follow-up treatment of metham sodium (Carrera *et al.* 2004; De Cal *et al.* 2004; Porter *et al.* 2004a; Ajwa *et al.* 2002, 2003, 2004). These formulations have been adopted widely throughout industries applying for CUN's, and replaced at least 45% of the production area treated with MB/chloropicrin mixtures. Of the parties previously applying for CUN's, most have implemented these alternatives. Australia phased out in 2005 (Tostovrsnik *et al*, 2005) and the United Kingdom has not applied for 2007.

For example, 1,3-D/Pic, whether injected or drip applied, has been consistently effective across major production regions in USA, Spain and Australia and has already been successfully adopted for a substantial proportion of strawberry fruit production in each country (Porter *et al.* 2004a).

The combination of chloropicrin and metham, applied sequentially, has gained new interest, particularly in regions where use of 1,3-D is limited by regulatory restrictions. Previous research has shown that sequential application of metham sodium after reduced rates of 1,3-D/Pic (InLine) or chloropicrin controlled soil pests in strawberry fruit and produced fruit yields equivalent to standard MB/Pic fumigation (Ajwa *et al.* 2004). Demonstration trials confirmed earlier research that metham can be used to reduce application rates of InLine and pic without a loss in yield in strawberry fruit in California, even though pathogen pressure was severe (Ajwa *et al.* 2004).

In China the good efficacy of chloropicrin for strawberry fruit production is accepted by growers, and chloropicrin and dazomet are being extended as MB alternatives in this sector, so the consumption of chloropicrin is increasing gradually in strawberry in China (Cao, pers. comm. 2006).

Among the chemical products that are not registered, methyl iodide, ethanedinitrile (EDN), propylene oxide, ethanedinitrile and sodium azide show promise (Mann, *et al, 2005;* Mattner *et al.* 2003; Norton 2003; Ren *et. al*, 2003 Rodriguez-Kabana, 2005).

Non-chemical alternatives in strawberry fruit sector

Strawberry production in substrates accounts for approximately 5% of world production, mainly in greenhouse production and cool climates with short cropping cycles, targeting early season markets or niche markets. The Netherlands, Japan, Italy, New Zealand, UK and China are some of the key producers using substrates for strawberry fruit production (Lieten, 2004; López-Medina, 2004; Nishi and Takeya, 2006). Whilst soilless systems are widely adopted in northern Europe and certain production regions in the US (North Carolina), their penetration into more temperate production systems has been more difficult. The performance of plants after transplanting into soils has produced variable yields and suitable conditions to produce plugs requires further development. Also, efforts to reduce initial set up costs for substrate systems are expected to increase their adoption as a MB alternative worldwide for this crop.

8.2.2.3 Strawberry nurseries sector

MB is used for the production of strawberry runners in order to meet the stringent certification standards for virtually pest-free strawberry runner stock, which is often grown in high altitudes under cold and wet conditions. In some situations the certification standards officially issued by Parties require the application of MB, however others do not mandate MB or specify a particular fumigant. Since a single strawberry runner grown in year one can expand to several million runners by year five, the adverse impacts of pests is of particular importance.

Presently, three potential alternatives have emerged for this use: The combination of 1,3-D + Pic, where allowed and registered appears to be the most viable alternative to MB at this time (De Cal, 2004; Kabir *et al.,* 2005; Porter *et al.* 2004b). Methyl iodide, which is not yet registered in any country, has provided comparable results to MB/Pic in the USA and Australia (Mann *et al,* 2005). In Australia, Cyanogen, which also is not yet registered, has provided encouraging results. In some countries large buffers restrict the use of 1,3-D + Pic (Kabir *et al.*, 2005). In some circumstances the inconsistent results using 1,3-D + Pic constrain its further adoption for runner production (De Cal *et al*, 2005).

In Japan, a simple, economically feasible system using trays filled with substrate is proving particularly useful for the production of strawberry runners. Various materials are used as substrates (e.g. rock wool, peat moss, rice hulls, coconuts husk and bark) and can be reused after sterilising with solar heat treatment or hot water (Nishi and Tateya, 2006b).

8.2.2.4 Nurseries and propagation material for other crops

As with strawberry runners, propagation material of many types (bulbs, cuttings, seedlings, young plants and trees) is also subject to high health standards. In most situations these standards require high levels of pathogen control, equivalent to that achieved when using MB but do not necessarily prescribe use of MB. Owing to the risk and uncertainty in performance of alternatives, these are often not evaluated or adopted as information on pathogen control is often not available. This same status of cleanliness may be possible with alternatives.

8.2.2.5 Tomato, pepper, eggplant and other vegetables

As discussed in section 8.1.2.1 a recent metaanalysis undertaken by MBTOC has confirmed that a substantial number of chemical and non-chemical alternatives presently used commercially have proved to be as effective as MB for controlling soilborne pathogens attacking tomatoes and other vegetables. These are now adopted in many developed countries such as Belgium, Spain, Italy, Greece and France (Besri, 2004; Leoni *et al*, 2004; Loumakis, 2004; Spotti, 2004; Tognoni *et al*, 2004; Shanks *et al.,* 2004). Effective alternatives include combinations of chemicals such as. 1,3-D, chloropicrin (Mann *et al.* 2005), metham sodium and dazomet) and non-chemical methods (e.g. substrates, grafting, resistant varieties, biofumigation, solarisation) (Besri, 2004, Runia, 2006). In northern Europe the main alternative to MB in tomato production is to grow crops in soilless culture (often in association with other alternatives e.g. resistant cultivars and grafting), while in Southern Europe and the Mediterranean a much more diverse range of alternatives is used, selected according to their suitability to the cropping system and environmental conditions (Besri, 2004). In Japan, grafting with resistant stock and alternative chemicals (1,3-D, pic, metham sodium and fosthiazate when nematodes are present) are used singly or in combination. Also, MB use has been phased out of the tomato sector. Grafting is presently used in 60% of regular tomato production and 90% of cherry tomatoes in the Kumamoto region, where a large proportion of the country's production is concentrated (Nishi and Tateya, 2006a).

8.2.2.6 Cucurbit Sector

In Europe, grafted cucurbits are increasingly being used. When combined with other treatments, grafted plants can avoid the need for MB fumigation (De Miguel, 2004b). In Italy, for example, grafted plants are used with alternative fumigants (e.g. 1,3-D or Pic) as MB alternatives (Spotti, 2004). Applicability of grafted plants may be limited by availability of rootstocks tolerant to local pests and diseases.

In the Mediterranean region, grafting is one of the most commonly used MB alternatives in cucurbits (watermelon, melon and cucumber). Resistant rootstocks are available for pests and pathogens such as *Meloidogyne* sp. and *Fusarium oxysporum* in melon, watermelon and cucumber, *Monosporascus cannonballus* in melon, and *Phomopsis sclerotiodes* in cucumber (Blestos, 2005; De Miguel 2004 a, b, c; López-Galarza, *et al.* 2004). In Israel, grafting is also showing promising results, particularly when this system is carefully adapted to particular growing conditions of each region (Cohen *et al*, 2005; Koren, 2002).

In the USA the main focus has been on alternative fumigants, combined with additional weed control when necessary, and grafted plants have not played a significant role as MB alternatives.

8.2.2.7 Fruit and vine orchards

Replant is a problem affecting orchards of perennial fruit trees and grapevines, which is not fully understood as is often caused by undefined pathogens. A major factor contributing to this problem is the persistence of old, well developed and established deep seated roots of the previous crop, which act as a reservoir and inoculum source of disease, attacking the new trees/vines. Fumigation is thus not only needed against the undefined pathogen complex but also to kill the old roots.

A number of alternatives to MB are presently in use in many countries, particularly where specific pathogens are known to contribute to the problem and/or methods that are effective in removing or killing old roots. These include agronomic practices such as rotation where possible, resistant rootstocks, organic soil amendments, partially replacing old soil with fresh soil and others. The most appropriate chemical alternatives include 1,3-D used singly or with Pic, Metam sodium and Dazomet (Browne *et al*., 2003; Tostovrnisk *et al* 2005). Widespread commercial use of these mixtures occurred in Australia for example, before phase out of MB (Tostovrnisk *et al* 2005; VDPI 2003, 2004).

Constraints to adoption of alternatives exist and are mainly of regulatory nature. In California, USA for example, there is no effective chemical alternative for the killing of roots in heavy or fine textured soil with high moisture content. Although 1,3-D is effective in killing old roots and used in light sandy soils, the dosage needed for the heavy soils exceeds the maximum allowed under California regulations (Schneider *et al,* 2005). Metam sodium and dazomet are inconsistent at the depths required although the development of improved application technologies and effective moisture control in the heavy soils is ongoing (Schneider 2002a, b).
Pic is presently not registered in France and although there is no cap on 1,3-D for killing old roots, there remains the problem of killing the undefined fungi implicated in replant disease. The registration of Pic in the immediate future will open the possibility of using 1,3-D Pic mixtures as an effective alternative.

Further adoption of proven alternatives in replant CUNs depends on better application techniques for Metam sodium or Dazomet and development of better moisture control in fine textured soils

8.3 Alternatives for postharvest and structural treatments

The main alternatives to the disinfestation of flour mills and food processing premises are sulfuryl fluoride (sold in some countries under the Dow AgroScience trade name ProFume) and heat. Phosphine, particularly in fast generating gas forms has also made good progress and become an important alternative in some applications, primarily commodities. There has been progress in the adoption of each of these alternatives.

8.3.1 Sulfuryl fluoride

ProFume (a sulfuryl fluoride formulation owned by Dow AgroSciences LLC and designed for food premises and food products) is sufficiently registered in the US to allow virtually all mills and food processing facilities to test, adapt and consider adoption as a alternative to MB. Additionally, registration coverage in EC countries for numerous milling and food processing applications is broad, and increasing.

The registrant is working to expand maximum residue levels (MRL) for fluorine and registration to expand the use of sulfuryl fluoride in the US and EC and other regions. Use of sulfuryl fluoride for mills and food processing facilities producing foods for export and commodities intended for international trade will be affected by upcoming CODEX decisions concerning the maximum residue levels for fluorine residues in the foods. Following the CODEX decision domestic decisions will be needed by Parties on MRLs before the use of sulfuryl fluoride can be expanded in the sectors that export food. Some Parties, for example Germany and Italy have already set MRLs for fluorine (Reichmuth, 2005) and MBTOC believes these MRLs could result in reduced MB use.

Dow AgroSciences and fumigators in several countries report to MBTOC that extensive trials continue to be conducted by flour and rice millers, and to a lesser extent, by other food processors (Dow AgroSciences, 2005; Hosada, 2005; Muhareb, 2005; Mueller, 2005; Subramanyam, 2005; Watson, 2006 pers. comm..). MBTOC also hears results of these fumigations informally from several sources. MBTOC observes that good efficacy has been achieved in numerous commercial trials under many various circumstances. In some situations, however, particularly larger mills with complex design and/or mills in cooler climates, results have been inconsistent or inadequate. Sometimes these problems have been resolved through additional experience, an understandable learning curve with this new fumigant. However, MBTOC has also observed that where a combination process with heat has been used (temperature at or slightly above 26˚C (80˚F)) pest kill efficacy has been very high, and fumigant costs have been minimized (Reichmuth *et al*, 2003; Watson, 2006, pers.comm.; Prabhakaran, 2006). However, this approach requires careful adaptation on an individual mill basis by knowledgeable and experienced fumigators. Fortunately, training provided by Dow AgroSciences on safe and efficacious use of its fumigant, combined with fumigator's knowledge of heat methods and individual mill situations has resulted in more reliable treatment through the use of the heat and sulfuryl fluoride combination treatment.

8.3.2 Heat treatments

There has been considerable research and commercial phase-in trials of heat treatment in mills and other food processing facilities in the past couple of years. Very little is covered in any published literature. Several manufacturers of heat treatment equipment have advanced with systems designed for flour mills and food processing facilities (Temp-Air 2005; Kassel 2004). Fields (2004), in work done with Canadian flour mills tested two types of heat equipment with varying results, and with an economic analysis that indicated heat treatment was considerably more costly, at least in Canadian circumstances. This work is ongoing. Costs of heat treatment, length of time required for treatment, problems in reliability especially in larger mills, and concerns about heat equipment or temperature distribution damaging mill equipment or structure are given as reasons that limit the use of heat as an MB alternative. MBTOC observes, however, that given the scarcity of published literature, these comments are difficult to evaluate. Parties, applicants and others are encouraged to submit clear and substantive documentation to MBTOC. Furthermore, MBTOC also observes that some food processing facilities through diligent adaptation have been able to achieve reliable pest control when heat treatments usually combined with IPM (Dosland, 2006).

8.3.3 Phosphine

Phosphine usually in fast generating gas forms has largely taken the market for disinfestation of dried fruit and nuts The use of this newly marketed form of an older fumigant has been largely responsible for a considerable reduction in use of MB for commodities. Yet, in this commodity sector, MB continues to be requested when a fast treatment immediately before marketing is required.

8.3.4 Ethyl formate

Ethyl formate in CO_2 (sold in Australia under the BOC Ltd trade name Vapormate) was recently registered in Australia for disinfestation of stored grains, oilseeds, grain storage premises and equipment and horticultural produce. Its action is as rapid as MB against adult pests. Ethyl formate is being evaluated in France as a treatment for fresh chestnuts. Although the work is ongoing, initial results were satisfactory. Use of ethyl formate, if it were to become registered for this purpose, would allow an organic certification for this perishable food, and could allow the use of MB to be eliminated for this use.

8.3.5 Irradiation as a quarantine treatment

Usually quarantine treatments are only approved on a pest and product specific basis, and following bilateral negotiations. This process helps ensure safety against the incursion of harmful pests, but also often requires years to complete. For this and other reasons, replacing MB quarantine treatments is expected to be a long term proposition.

However, in a departure from the usual case by case treatment approval, irradiation has been approved as a quarantine treatment for any fruit or vegetable entering the US, if the pest of concern only includes class *Insecta*, and following regulatory harmonization and inspection agreements (Federal Register, 2006). The regulation also published a new minimum dose for fruit flies and other changes that could allow more fruit and vegetable exporters to use irradiation instead of MB as quarantine treatment. As a result of this regulation, Ghana trade developers have begun work they hope will lead to improved trade with the US by replacing their current MB treatment for yam with irradiation (Marcotte *et al*, 2005). New Zealand has also expanded approval of irradiation as a quarantine treatment, now allowing irradiated for papaya from the US (Hawaii) to enter New Zealand (New Zealand Biosecurity Act, 2006).

8.4 Registration and Re-registration of Alternatives

A full report on registration, re-registration and deregistration of in-kind MB alternatives is to be included in the report of TEAP/MBTOC of October 2006, in conformity with Decisions Ex. I/4(i) and Ex. I/4(j). Some preliminary information appears below. Additionally, the reader is referred to the TEAP Progress and Final Reports (UNEP 2005 a, b).

8.4.1 Registration status of soil alternatives

Registration of one of the major potential alternatives, methyl iodide, has recently been delayed in the United States due to requests for further studies on risk hazard concerns.
Progress with adoption of recently registered alternatives has been observed in Italy, where chloropicrin has been registered and became available in 2002 (Triagriberia, 2002) and is now in use by growers of different crops. Whilst mixtures of chloropicrin with other chemicals such as 1,3-D are still not registered in Italy, sequential applications of these two fumigants are possible and this widely increases the scope to control soil-borne diseases and weeds. Registration of chloropicrin is scheduled to occur in France in 2006 and similar results are expected.

8.4.2 Registration status of alternatives for postharvest and durables

Earlier, MBTOC had reported on progress in registration of sulfuryl fluoride for mills, food processing facilities and commodities. Registration of sulfuryl fluoride for mills, including rice mills in California was achieved in May 2005. Since California is the major wheat flour producing state in the US and a major rice processing state, this registrations was significant (Hosada, 2005)

Conditional registration of sulfuryl fluoride was achieved in Canada early 2006, but this registration only allows trial efficacy experiments under supervision as part of Canada’s registration requirements (Fields, pers comm. 2006). Canadian millers and Agriculture and Agri-Food Canada will conduct supervised tests of sulfuryl fluoride in 2006.

8.5 Recapture, recycling and destruction.

Recapture technology has only been adopted at a limited scale as there is no incentive for fumigators to pay the extra cost of treatment. Use is being considered for several QPS applications where adoption is being driven by local environmental or occupational health and safety concerns.

The Nordiko recapture/destruction system is now in commercial operation in several different situations in Australia (Brash, 2005) and other countries. Ongoing research trials by Value Recovery continue as part of the market development for that system. Recently, the system was tested as a means to recapture MB used in soil fumigation (Joyce, 2005).

8.6 Alternatives for high moisture dates (Decision XVII/12)

Decision XVII/12 requests MBTOC to continually review progress in availability of alternatives for fresh dates. At present MBTOC is unaware of alternatives for high moisture fresh dates. For fresh dates, the nature and extent of the infestation, the product characteristics of this important food, the geographic issues affecting potential for use of alternatives and other circumstances concerning the use of and need for MB requires further investigation. If project funds were to be made available from the Multilateral Fund (UNEP Progress Report 2005, Volume 2), the Parties or Executive Committee of MLF could consider consulting MBTOC about the availability of experts with experience in the field, and with language capabilities in English and French, who could conduct the necessary examination of the issue.

Meanwhile, researchers in Israel have tested and developed effective and practical methods to control pests in their date varieties under their packing house circumstances. It is important to note, however, that the Israel date treatment reports also indicate drying after disinfestation, a factor that may not be compatible with marketing of fresh dates in other countries. This work identified heat (50 - 55˚C) which provided 100% control of *Carpophilus hemipterus* larvae, and which further adapted heat treatment equipment in the circumstances of remote packing houses under difficult conditions (Finkleman *et al*, 2006; Navarro *et al*, 2005). It is unknown whether this technology would be suitable for fresh high moisture dates in other countries.

8.7 Options which Parties may consider for preventing potential harmful trade of methyl bromide stocks to Article 5(1) Parties as consumption is reduced in non –Article 5 Parties (decision ExI/4, paragraph 9)

Decision ExI/4 asked TEAP to identify options which Parties may consider for preventing potential harmful trade of MB stocks to Article 5(1) Parties as consumption is reduced in non–Article 5(1) Parties and to publish its evaluation in 2005.

In its May 2005 Progress Report to the Parties, the TEAP noted that it had been unable to complete this task and promised to do so in 2006.

The TEAP defines harmful trade as any trade that adversely impacts the implementation of control measures by any Party, allows a back sliding from the implementation already achieved, or is counter to the domestic policy of either the importing or exporting Party.

The MB involved in such trade may have 3 sources:

1. Stockpiles in non –Article 5(1) Parties (these have already phased out the consumption of MB but for CU and QPS uses)
2. Production allowed for the non-Article 5(1) Parties for meeting the BDN of Article 5(1) Parties
3. Production and stockpiles of Article 5(1) Parties.

It is possible that some companies in non-Article 5(1) Parties might not have declared stock piles to their governments. Therefore non-Article 5(1) Parties may wish to take special efforts to get all the stock piles declared and ensure that these are not exported except for CUs or QPS

The Protocol allows, until 2015, production by the non-Article 5(1) Parties up to 80% of the average non-Article 5(1) production for meeting the BDN of Article 5(1) Parties for 1995-98. It is this quantity that needs to be regulated carefully to prevent harmful trade. Many Article 5(1) Parties have never consumed MB except for QPS (India for example). Many other Article 5(1) Parties have phased their consumption already with the assistance of the Fund and some others are committed to do so much before 2015 and have reduced their consumption significantly. Please refer to Table 8.1, "Summary of MB consumption in Article 5(1) and non-Article 5(1) countries" at the beginning of this report.

Article 5(1) Parties that have phased out MB or reduced their consumption significantly may not have the regulatory capacity to prevent imports of MB in excess of their needs. In such a situation, the sales skills of the MB distributors may lead to (re) introduction of MB in Article 5(1) Parties for new or renewed uses.

The same danger arises from the production of Article 5(1) Parties unless regulatory systems are in place.

The Parties may wish to consider the following options to prevent harmful trade in MB:

1. Article 5(1) Parties may put stronger systems in place for licensing and follow-up of trade (specifically) in MB, as a part of the licensing regimes they already have or intending to have for CFCs.

2. All producing Parties may insist on prior informed consent of the importing Party before allowing shipment and delivery.

3. Parties may levy appropriate taxes on the trade of MB and tax concessions for alternatives to promote adoption of alternatives. The revenue from MB tax can be used to finance customs enforcement and to subsidize alternatives and alternative research.

4. The Article 5(1) Parties may inform their actual needs for MB periodically and these needs may be lower than the level allowed by the Protocol for production for the purposes of BDN. The Ozone Secretariat may be the repository for this information.

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9 Methyl Bromide - Quarantine and Pre-shipment Task Force Report

9.1 Mandate and scope of this report

Following Decision XVI/10 (1), TEAP set up a task force, the TEAP Quarantine and Pre-shipment Task Force (QPSTF), to report to the Parties on the current uses of methyl bromide for Quarantine and Pre-shipment (QPS) purposes, the quantities of methyl bromide used, and whether there were alternatives to methyl bromide available for these uses.

Copies of decisions guiding the QPSTF and composition of the task force are given in Annexes I and II to this Chapter. Decision XVII/9(8) is not addressed at this time. Decision XVII/11(4) is also not addressed due to lack of submission of information under para.1 of the same decision.

9.2 Definitions of 'Quarantine' and 'Pre-shipment'

The scope of the QPS exemption has been defined in decisions of the Protocol relating to the terms 'Quarantine' and 'Pre-shipment'. TEAP (2002) provided some discussion and examples of cases that might or might not fall within the QPS exemption.

Differences in interpretation of the application of the QPS exemption by individual Parties led to differences in the uses that were reported as QPS in the data received by the QPSTF. These differences may have be partly explained by slight differences in definition of 'Quarantine pest' between that of the Montreal Protocol (Decision VII/5) and that of the International Plant Protection Convention (IPPC) (FAO 1999). The second revision of the IPPC came into force on 2 October 2005. This revision recognises that other definitions, e.g. for Quarantine, may be established under domestic laws or regulations of contracting Parties.

The IPPC includes a concept of 'Regulated non-quarantine pests'. Some Parties may interpret control of 'Regulated non-quarantine pests' as a quarantine action under their particular circumstances and report it as part of their QPS use.

The definition of 'Pre-shipment' is unique to the Montreal Protocol. It is given and elaborated in Decisions VII/5 and XI/2.

Overall, the individual application of the concepts of 'Quarantine' and 'Pre-shipment' to particular uses of MB results in some divergence of what constitutes a QPS use under the Montreal Protocol and thus some lack of precision in the data analyzed below.

Specifically, the Seventh Meeting of the Parties decided in Decision VII/5 that:

> *(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 authorised 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;

The Eleventh Meeting of the Parties decided in Decision XI/12 that pre-shipment applications are "those non-quarantine applications applied within 21 days prior to export to meet the official requirements of the importing country or existing official requirements of the exporting country. Official requirements are those, which are performed by, or authorised by a national plant, animal, environmental, health or stored product authority".

In the International Plant Protection Convention, the following definitions apply:

"Quarantine pest" - a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled;

"Regulated non-quarantine pest" - a non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party.

9.3 Background to this report

Production and consumption of methyl bromide, an ozone-depleting substance, for quarantine and pre-shipment uses is exempted from control under Article 2H, para. 6, of the Montreal Protocol. Only recently have Parties been required to report their production and consumption for QPS purposes (Beijing Amendment, Art. 1, para. O).

Parties have been exhorted to use alternatives to methyl bromide for QPS purposes where technically and economically possible (Decisions VI/11(c) and XI/13(7)). Nevertheless, consumption of methyl bromide for QPS purposes continues to be substantial and may be increasing. TEAP (2004) estimated QPS use of MB to be about 28% of global methyl bromide consumption in 2002, equivalent to 11,245 tonnes. Except where recapture systems are fitted, around 90% of the methyl applied in QPS uses (calculated from MBTOC 2002) is emitted and is potentially ozone-depleting.

Uses of methyl bromide for QPS are diverse, with many specific uses. TEAP and its MBTOC reported on this issue in its 2003 progress report and noted that individual tonnages for uses of methyl bromide for quarantine and pre-shipment treatment of particular commodities were not available on a world-wide basis, though specific surveys were available for several countries. In many countries, records of QPS usage by application have not been routinely kept or easily assessed. This has necessitated a survey approach to the gathering of data to provide a basis for response to Decision XI/13(4). Decision XI/13(6) urged Parties to implement procedures to monitor the QPS uses of methyl bromide by commodity and quantity, but these may not have been in place by the time the survey was conducted, limiting the availability of the information requested. The survey was carried out in 2004 by a consultant commissioned by the European Community[1].

Decision XVI/10(4) requested Parties that had not already submitted data to provide best available data on QPS uses and associated quantities to the task force before 31 March 2005.

Both requests for information from the Parties included requests for what alternatives were available to the individual Party for particular QPS applications, and specifically for the five largest consuming applications.

This report is based on the data submitted under Decision XVI/10(4) integrated with the results of the survey carried out in 2004. It will be seen from the discussions given below that there is still incomplete information available on QPS methyl bromide use. Several major users were unable to provide the detailed data requested or did not submit data. Thus this report provides a sample of QPS use, covering about 65% of reported annual consumption in the 2002-2004 period.

A progress report of the Task Force was presented in the TEAP May 2005 Progress Report (TEAP 2005). A summary of part of the data was presented to the Lisbon Conference on Alternatives to Methyl Bromide, 27-30 September 2004 (Ogden 2004).

A planned meeting of the QPSTF to progress the writing of this report in early March 2006 was cancelled because there was insufficient information available at that time to justify a face-to-face meeting. An informal meeting to discuss the work of the QPSTF was subsequently held in the margins of the Dubrovnik MBTOC meeting on 7 April 2006 with those QPSTF members also attending the MBTOC meeting.

9.4 QPS use by individual Parties according to surveys

Quantities of methyl bromide used by individual Parties, together with the main uses by volume of methyl bromide used, are summarised in Table 9.1.

The data in Table 9.1 is a combination of that from the results of the 2004 survey and of responses obtained from Parties subsequently, up to 10 April 2006. Forty-two Parties responded to the 2004 survey questionnaires. The quantity of methyl bromide used for QPS that was reported by the respondents to the 2004 survey totalled approximately 1,610 metric tonnes. This represents approximately 15% of the QPS usage that was estimated for 2000 by MBTOC in its 2002 Assessment Report. Twenty-four Parties responded to Decision XVI/10(2), with some supplying data to both requests for information. Sixteen of the respondents advised that their use of methyl bromide for QPS was zero.

TEAP and its MBTOC, in its May 2004 Progress Report, reported that more than 11,245 tonnes of methyl bromide was used for QPS purposes according to data reported by the Parties to the Ozone Secretariat.

[1] Permission to use the raw data from the survey is gratefully acknowledged

Table 9.1 Summary of reported consumption or use estimates for QPS

Data source	Year(s) of data[1]	Consumption[2] (metric tonnes)	Use (metric tonnes)	Parties reporting
TEAP 2004	2003	>11,245		-
Art. 7 reporting	2002,2003,2004	10,601		70[3]
This report	2002,2003,2004		6,893	54
Corresponding Art. 7 data	2002,2003,2004	8,003		42

[1] Most recent data available from individual Parties used.
[2] As defined under the Montreal Protocol
[3] Parties reporting non-zero QPS use

Data was not received for 16 of the 70 Parties reporting non-zero consumption of QPS methyl bromide. Five (Australia, Republic of Korea, India, Indonesia and Israel) of the 16 Parties with reported annual consumption for QPS purposes exceeding 100 metric tonnes annually did not report use or use details. Australia reported it did not have a breakdown by use available. Some Parties said they were unable to supply the requested data by the set deadline, but intended to supply it later.

QPSTF identified only 411 metric tonnes for pre-shipment use out of the 6,893 tonnes total QPS use (Table 9.2)

Table 9.2 Summary of reported QPS use by general category

	Use (metric tonnes)	Percentage
Quarantine - commodities	4,791	70
Quarantine - soils	1,692	24
Pre-shipment	411	5.8
Total	**6,893**	

Table 9.3 gives reported use for QPS purposes by individual Party for those responding to the 2004 survey or subsequently to Decision XVI/10(4). A comparison is made of reported usage with reported consumption for QPS for the same year. The most recent data was used where more than one data set was supplied.

Two Parties reported much greater (> +30%) use than consumption, while four Parties reported much greater consumption than use. Possible causes of these discrepancies are discussed in Section 4.

Table 9.3 Use of QPS methyl bromide by Party, compared with reported consumption

PARTY	Year	Reported quantity for QPS (metric tonnes)	Art 7 report for year of data (metric tonnes)	Data source[2]
Bahrain	2002	2	2	2004 survey
Belarus	2002	0.948	NR	2004 survey
Bulgaria	2002	5	5	2004 survey
Cameroon	2002	13.5	NR	2004 survey
Canada	2002	42.833	20.218	Decision XVI/10(4)
Chile	2005	141.35	NR	Decision XVI/10(4)
China	2004	631.63	724.63	Decision XVI/10(4)
Colombia	2004	0.008	NR	Decision XVI/10(4)
Croatia	2004	0.123	NR	Decision XVI/10(4)
Czech Republic	2002	0	1.2	2004 survey
Egypt	2002	224.342	200	2004 survey
Estonia	2002	0.1	0.1	2004 survey
European Community[1]	2002	306.305	716	2004 survey
Georgia	2004	14	NR	Decision XVI/10(4)
Hungary	2002	3	3	2004 survey
Jamaica	2002	2.828	2	2004 survey
Japan	2004	1294	1240.4	Decision XVI/10(4)
Kazakhstan	2002	1.58	29.522	Decision XVI/10(4)
Kyrgyzstan	2002	0.505	NR	2004 survey
Lithuania	2004	3.852	NR	Decision XVI/10(4)
Malaysia	2003	152.95	156.25	Decision XVI/10(4)
Mexico	2002	284.2	155.04	2004 survey
Moldova	2004	0.222	NR	Decision XVI/10(4)
Myanmar	2002	61.373	64.5	2004 survey
New Zealand	2002	100.1	100.1	2004 survey
Nicaragua	2004	13.8	13.8	Decision XVI/10(4)
Nigeria	2002	0.3	NR	2004 survey
Pakistan	2002	31	19	2004 survey
Peru	2002	0.036	NR	2004 survey
Poland	2002	34.78	43.8	2004 survey
Sri Lanka	2002	4.56	4.56	Decision XVI/10(4)
South Africa	2002	384.173	NR	Decision XVI/10(4)
Thailand	2002	381	375	Decision XVI/10(4)
Trinidad and Tobago	2002	0.193	1.37	Decision XVI/10(4)
Turkey	2002	12.942	10	2004 survey
Uruguay	2002	0.6	0.5	2004 survey
USA	2004	2187.433[3]	4115.467	Decision XVI/10(4)
Viet Nam	2002	555.9	NR	2004 survey
Totals		**6893.4**	**8003.4**	

NR = not reported for the year for which survey results are given.
[1] European Community as in 2002.
[2] '2004 survey' refers to data obtained in 2004 by the consultant carrying out the survey of Parties for Decision XI/13(4).
[3] Extrapolated value. Party only gave detailed data for estimated 80% of QPS use.

9.5 QPS use by application according to surveys

In response to the two surveys, response to Decision XVI/10(4) and the 2004 consultant survey, Parties provided information on categories of individual QPS uses and associated quantities of methyl bromide.

Data sufficient for analysis was received from 32 Parties. Several Parties said they were unable to provide the level of detail sought. Some Parties gave specific quantities for several uses but also had a substantial proportion (>20%) of their total QPS use unallocated to specific use.

Table 9.4 ranks the various QPS uses by quantity of methyl bromide applied in specific situations. It can be seen that application to soil as a preplant treatment for propagation stock is the largest single category of use under this analysis, followed by postharvest treatment of grains and other cereals and cereal products at import or export, and then wood, e.g. sawn timber, in trade. Although post-harvest treatment of all commodities is spread across many Parties, pre-plant soil QPS use is restricted to two Parties, USA and Chile (Table 9.4).

The seven categories with the highest usage cover 96% of the total QPS methyl bromide reported with sufficient detail for analysis (5,273 tonnes out of 6,893 tonnes in total). This quantity, 5,273 tonnes, is 49.7% of the 10,601 tonnes estimated QPS global consumption (Table 9.1) or 48.0% of global consumption on the basis of the 11,245 tonnes of methyl bromide estimated for 2003 QPS consumption by TEAP and its MBTOC (TEAP 2004).

Table 9.4 Quantity of methyl bromide used for QPS for 32 Parties reporting quantities by category of use

QPS Use	**Quantity (metric tonnes)**	**% of total**	**Number of Parties reporting**
Soil (preplant)	1527	29	2
Grain and cereals for consumption	1262	24	14
Wood, including sawn timber	868	16	10
Fresh fruit and vegetables	722	14	11
Wooden packaging materials	335	6.4	19
Whole logs	209	4.0	6
Dried foodstuffs	160	3.0	11
Cotton and fibre	91	1.7	10
Equipment	36	0.68	9
Cut flowers and branches	32	0.61	8
Personal effects etc	19	0.37	7
Bulbs, corms, tubers and rhizomes	4	0.075	4
Nursery stock	4	0.072	4
Hay, straw, fodder	3	0.050	2
Seeds for planting	1	0.012	4
Total	**5273**		

9.6 Discrepancies and limitations to data gathered in the surveys

Responses by Parties to the 2004 survey and subsequent information provided under Decision XVI/10(2) cover about 65% of the total reported annual consumption for QPS during the 2002-2004 period.

Some major consumers of methyl bromide for QPS are not covered by the data set and particularly the subset analysed for usage category. Some Parties acknowledged the difficulties in data collection, leading to underreporting. These problems potentially bias the conclusions of the survey analysis. Specifically, the use of QPS methyl bromide for treatment of whole logs and timber appears underrepresented. Independent estimates of the volume of methyl bromide required to treat East Asian and Russian trade in logs suggest that QPS methyl bromide use for this use exceed 4,000 tonnes annually.

The survey period covers years prior to the widespread adoption of ISPM15 (FAO 2002), an international standard phytosanitary (quarantine) measure aimed to control the spread of injurious forest pests in wooden packaging material (e.g. pallets, dunnage). Data is not yet available to judge the impact of this measure on methyl bromide QPS consumption, though it is expected that there will be an increase in methyl bromide use as a result of the measure. ISPM15 includes a non-methyl bromide alternative - heat treatment.

In this report 'consumption' for QPS purposes is compared with 'use'. Under the Montreal Protocol 'consumption' is defined as "production plus imports minus exports", while the Parties were requested to report actual use during a particular year. Differences between the two data sets may arise from several factors, notably changes in inventory during the year of reporting. Use of stocks of material gives a lower consumption compared with reported use, while stockpiling leads to higher consumption compared with use.

9.7 Alternatives for QPS uses

Development of methyl bromide alternatives for QPS applications continues to be a difficult process, exacerbated by the multitude of commodities being treated, the diverse situations where treatments are applied, and a constantly changing trade and regulatory landscape. A variety of technologies are potentially suitable as replacements for some commodities and some circumstances. In many cases, uncertainty about phytotoxic effects and effectiveness against the target pests constrain use of alternatives. There will be considerable cost, effort and time required to gain the registrations and approvals that are required for many quarantine uses. At this time, it is not clear if, when or how this will happen. Changing quarantine regulations and bilateral quarantine agreements are the responsibility of governmental agencies but, in many countries, pesticide registrations are initiated by the private sector. In the past, pesticide companies have been reluctant to invest money to register and market pesticides for small markets represented by many of these quarantine uses. Alternatives that do not require registration such as heat, cold and inert gases may be more easily adapted in cases where their use is appropriate to the commodity, the situation and where they show sufficient efficacy. However, these treatments still require bilateral quarantine agreement or regulation in the importing country before use will be allowed.

The standard of efficacy for quarantine uses is extremely high because the consequences of exotic pests surviving treatments can be catastrophic to regions where the new pest becomes established. Pre-shipment uses on the other hand, are usually for cosmopolitan pests that are already found in the importing country. Consequently, the efficacy standard does not need to be as severe as in the case of quarantine and research requirements to establish efficacy can be less rigorous as well. It would appear that there are fewer obstacles to adopting alternatives for pre-shipment methyl bromide uses.

In both surveys relating to QPS use, Parties were requested to comment on availability of non-methyl bromide alternatives in their situation. In the 2004 survey, Parties reported that 54% of the 1,665 tonnes of QPS usage has available alternatives. In responses to Decision XVI/10(6) there is discussion of alternatives available to individual Parties, summarised in Table 9.5.

Table9.5 Alternative QPS treatments identified by the Parties

QPS category of use	Principal alternative[1]
Soil	1,3-D/chloropicrin
Grain and cereals for consumption	Phosphine
Wood	Heat
Fresh fruit and vegetables	Systems approach
Wooden packaging materials	Heat
Whole logs	Not specified
Dried foodstuffs	Phosphine

[1] May not be applicable or approved in particular situations

The 2002 MBTOC Assessment (MBTOC 2002) provided detailed discussion of alternatives to QPS methyl bromide use in particular circumstances. An updated, comprehensive discussion will be included in the 2006 MBTOC Assessment.

9.8 References

FAO 1999. 1997 - International Plant Protection Convention (New Revised Text). FAO: Rome. https://www.ippc.int/IPP/En/default.jsp

FAO 2002. Guidelines for Regulating Wood Packaging Material in International Trade. ISPM Pub. No. 15, FAO, Rome.

MBTOC, 2002. 2002 Assessment Report of the Methyl Bromide Technical Options Committee. UNEP, Nairobi. 468pp.

Ogden S.C. 2004 Preliminary results of an international survey on the use of methyl bromide for quarantine and preshipment.

TEAP 2002. April 2002 Report of the Technology and Assessment Panel. Volume 1. Progress Report. UNEP: Nairobi. pp. 142-146.

TEAP 2005. May 2005 Report of the Technology and Assessment Panel. Volume 1. Progress Report. Chapter 8. UNEP: Nairobi.

Annex I to Chapter 9: Decisions relating to TEAP QPS task force

Decision XI/13: Quarantine and pre-shipment

The *Eleventh Meeting of the Parties* decided in *Dec. XI/13:*

1. To note that, while the reliability of the survey data was noted by the Technology and Economic Assessment Panel to be insufficient to draw firm conclusions, the Panel's April 1999 report estimates that over 22 per cent of the methyl bromide use is excluded from control under the quarantine and pre-shipment exemption, and that this use is increasing in some countries;

2. To note that the Science Assessment Panel revised the ODP of methyl bromide to 0.4 in its 1998 report;

3. To note that, under an amendment adopted by the Eleventh Meeting of the Parties, each Party shall provide the Secretariat with statistical data on the annual amount of the controlled substance listed in Annex E used for quarantine and pre-shipment applications.

4. To request that the 2003 report of the Technology and Economic Assessment Panel:

(a) Evaluate the technical and economic feasibility of alternative treatments and procedures that can replace methyl bromide for quarantine and pre-shipment;

(b) Estimate the volume of methyl bromide that would be replaced by the implementation of technically and economically feasible alternatives for quarantine and pre-shipment, reported by commodity and/or application;

5. To request the Parties to review their national plant, animal, environmental, health and stored product regulations with a view to removing the requirement for the use of methyl bromide for quarantine and pre-shipment where technically and economically feasible alternatives exist;

6. To urge the Parties to implement procedures (using a form shown in the Panel's April 1999 report, if necessary) to monitor the uses of methyl bromide by commodity and quantity for quarantine and preshipment uses in order:

(a) To target the efficient use of resources for undertaking research to develop and implement technically and economically feasible alternatives;

(b) To encourage early identification of technically and economically feasible alternatives to methyl bromide for quarantine and pre-shipment where such alternatives exist;

7. To encourage the use of methyl bromide recovery and recycling technology (where technically and economically feasible) to reduce emissions of methyl bromide, until alternatives to methyl bromide for quarantine and pre-shipment uses are available.

Decision XVI/10. Reporting of information relating to quarantine and pre-shipment uses of methyl bromide

Recalling the tasks assigned to the Technology and Economic Assessment Panel under decision XI/13 paragraphs 4 (a) and (b) regarding quarantine and pre-shipment uses of methyl bromide, *Recognizing* that in order to complete both of these tasks, the Panel will require better data on the nature of each Party's quarantine and pre-shipment uses and on the availability in each Party of technically and economically feasible alternatives to methyl bromide for these uses,

Noting the advice of some Parties that they would require additional time in order to provide useful and robust data to inform the Panel's work on this issue, particularly on the availability of technically and economically feasible alternatives in their jurisdictions,

Desiring that the Technology and Economic Assessment Panel's implementation of decision XI/13, paragraph 4, should nevertheless take place in as timely and reasonable a manner as possible,

Noting with appreciation that some Parties have already submitted partial data to inform the Panel's work on this issue,

Noting that, given the nature of quarantine and pre-shipment applications, quarantine and pre-shipment uses of methyl bromide and its alternatives can vary considerably from year to year,

Noting that the introduction of standard 15 of the International Standards for Phytosanitary Measures, of March 2002, of the International Plant Protection Convention of the Food and Agriculture Organization of the United Nations, may create a growing demand for the quarantine and pre-shipment uses of methyl bromide, despite the availability of heat treatment as a non-methyl bromide option in the standard;

Noting the current workload of the Methyl Bromide Technical Options Committee and its request at the twenty-fourth meeting of the Open-ended Working Group for additional expertise in some quarantine and pre-shipment applications,

Noting that quarantine and pre-shipment treatments, according to decisions VII/5 and XI/12, are authorized or performed by national plant, animal, health or stored product authorities,

1. To request the Panel to establish a task force, with the assistance of the Parties in identifying suitably qualified members, to prepare the report requested by the Parties under decision XI/13 paragraph 4;

2. To request Parties that have not yet submitted data to the Panel on this issue to provide best available data to the task force before 31 March 2005, identifying as available all known uses of methyl bromide for quarantine and pre-shipment, by commodity and application;

3. In responding to the request under paragraph 2, to request the Parties to use best available data for the year 2002 or data considered by the Party to be representative of a calendar year period;

4. To request the task force to report the data submitted by the Parties under paragraphs 2 and 3, or previously submitted by other Parties in response to the 14 April 2004 methyl bromide quarantine and pre-shipment survey, by 31 May 2005, for the information of the Open-ended Working Group at its twenty-fifth session;

5. Also to request the task force, in reporting pursuant to paragraph 4, to present the data in a written report in a format aggregated by commodity and application so as to provide a global use pattern overview, and to include available information on potential alternatives for those uses identified by the Parties' submitted data;

6. To request the Parties to provide information to the task force, as available and based on best available data, on the availability and technical and economic feasibility of applying in their national circumstances the alternatives identified in paragraph 5, focusing in particular on the

Parties' own uses, for the calendar year period reported under paragraphs 2 and 3, by 30 November 2005, constituting either:

(a) More than 10 per cent of their own total annual methyl bromide consumption for quarantine and pre-shipment consumption; or

(b) In the absence of uses over 10 per cent, which constitute their five highest volume uses; or

(c) Where data is available to the Party, all their known uses;

7. To request the Panel, on the basis of information contained in paragraph 6, to report to the Parties in accordance with decision XI/13, paragraph 4, by 31 May 2006;

Decision XVII/9: Critical-use exemptions for methyl bromide for 2006 and 2007

Noting with appreciation the work done by the Technology and Economic Assessment Panel and its Methyl Bromide Technical Options Committee,

Noting with appreciation that some Parties have made substantial reductions in the quantities of methyl bromide authorized, permitted or licensed for 2005 and have significantly reduced the quantities for 2006,

Noting that Parties submitting requests for methyl bromide for 2007 have supported their requests with a national management strategy,

1. For the agreed critical-use categories for 2006, set forth in table A of the annex to the present decision for each Party, to permit, subject to the conditions set forth in the present decision and decision Ex.I/4, to the extent that those conditions are applicable, the levels of production and consumption for 2006 set forth in table B of the annex to the present decision which are necessary to satisfy critical uses;

2. For the agreed critical-use categories for 2007, set forth in table C of the annex to the present decision for each Party, to permit, subject to the conditions set forth in the present decision and in decision Ex.I/4, the levels of production and consumption for 2007 set forth in table D of the annex to the present decision which are necessary to satisfy critical uses, with the understanding that additional levels of production and consumption and categories of uses may be approved by the Meeting of the Parties to the Montreal Protocol in accordance with decision IX/6;

3. That a Party with a critical use exemption level in excess of permitted levels of production and consumption for critical uses is to make up any such differences between those levels by using quantities of methyl bromide from stocks that the Party has recognized to be available;

4. That Parties shall endeavour to license, permit, authorize or allocate quantities of critical- use methyl bromide as listed in tables A and C of the annex to the present decision;

5. That each Party which has an agreed critical use renews its commitment to ensure that the criteria in paragraph 1 of decision IX/6 are applied when licensing, permitting or authorizing critical use of methyl bromide and that such procedures take into account available stocks of banked or recycled methyl bromide. Each Party is requested to report on the implementation of the present paragraph to the Ozone Secretariat by 1 February for the years to which this decision applies;

6. That Parties licensing, permitting or authorizing methyl bromide that is used for 2007 critical uses shall request the use of emission minimization techniques such as virtually impermeable films, barrier film technologies, deep shank injection and/or other techniques that promote environmental protection, whenever technically and economically feasible;

7. To request Parties to endeavour to use stocks, where available, to meet any demand for methyl bromide for the purposes of research and development;

8. To request the Quarantine and Pre-shipment Task Force of the Technology and Economic Assessment Panel to evaluate whether soil fumigation with methyl bromide to control quarantine pests on living plant material can in practice control pests to applicable quarantine standards, and to evaluate the long-term effectiveness of pest control several months after fumigation for this purpose, and to provide a report in time for the twenty-sixth meeting of the Open-ended Working Group;

9. That each Party should ensure that its national management strategy for the phase-out of critical uses of methyl bromide addresses the aims specified in paragraph 3 of decision Ex.I/4;

10. To request the Technology and Economic Assessment Panel and its Methyl Bromide Technical Options Committee to report for 2005 and annually thereafter, for each agreed critical use category, the amount of methyl bromide nominated by a Party, the amount of the agreed critical use and either:

(a) the amount licensed, permitted or authorized; or
(b) the amount used.

Annex II to Chapter 9: TEAP QPS Task Force membership

The TEAP QPS Task Force membership as at 1 April 2006 was:

Jonathan Banks (chair)	Australia
Mokhtarud-Din Bin Husain	Malaysia
Darka Hamel	Croatia
Takashi Misumi	Japan
David Okioga	Kenya
Ken Vick	USA
EduardoWillink	Argentina
Kathy Dalip	Belize
Fred Bergwerff	Netherlands
Ken Glassey	New Zealand

10 Critical Use Nominations for Methyl Bromide

10.1 Scope of this report

This 2006 interim report provides initial evaluations of MBTOC/TEAP on CUNs submitted by Parties in 2006, in accordance with the timetable set out in the Annex I referred to by Decision XVI/4. The report also provides a preliminary summary of National Management Plans provided by five parties showing the status of future MB critical use. MBTOC has provided MB consumption figures in the progress report and also provided tables and figures of trend lines in critical use exemptions in this report. This information is submitted in order to meet the requirements to review management strategies submitted by Parties pursuant to Decision Ex.I/4 (9d) and to report on the amount of methyl bromide nominated for critical use by the Parties as per Decision XVII/9(10). A further analysis of needs for critical use will be provided in the October TEAP/MBTOC report.

10.2 Critical Use Nominations for Methyl Bromide

10.2.1 Mandate

Under Article 2H of the Montreal Protocol the production and consumption (defined as production plus imports minus exports) of methyl bromide is to be phased out in Parties not operating under Article 5(1) of the Protocol, by 1 January 2005. However, the Parties agreed to a provision enabling exemptions for those uses of methyl bromide that qualify as critical. Parties established criteria, under Decision IX/6 of the Protocol, which all such uses need to meet in order to be granted an exemption. Refer to Annex 1 for a copy of Decision IX/6.

All reviews of CUNs made in 2006 are to be in accordance with the 'Annex I' referred to in Decision XVI/4. This annex also sets out the procedure and timetable for the annual review of critical use nominations. In addition to the criteria for the evaluation provided in Decision IX/6, the Parties have given further guidance for the review of CUNs in Annex 1 of 16 MOP meeting report. Inter alia, this requires that TEAP and MBTOC provide a clear description of why any part of a nomination is not recommended, including references to the relevant studies used as the basis for such a decision. Para. 32 emphasises that exemptions must fully comply with Decision IX/6 and other relevant decisions, and are intended to be limited to the levels needed for critical use exemptions. These are considered as temporary derogations from the phase-out of methyl bromide in that they are to apply only until there are technically and economically feasible alternatives that otherwise meet the criteria in Decision IX/6, and that MBTOC should take a precise and transparent approach to the application of the criteria, having regard, especially, to paragraphs 4 and 20 of Annex I.

Paragraphs 4 and 20 read:

> *4. Although the burden of proof remains with the Party to justify a request for a critical-use exemption, MBTOC will provide in its report a clear explanation of its operation with respect to the process of making determinations for its recommendations, and clearly state the approach, assumptions and reasoning used in the evaluation of the critical-use nominations. When cuts or denials are proposed, the description should include citations and also indicate where alternatives are technically and economically feasible in circumstances similar to those in the nomination, as described in decision Ex.1/5, paragraph 8.*

20. In line with paragraph 4 above, in any case in which a Party makes a nomination which relies on the economic criteria of decision IX/6, MBTOC should, in its report, explicitly state the central basis for the Party's economic argument and explicitly explain how it addressed that factor, and, in cases in which MBTOC recommends a cut; MBTOC should also provide an explanation of its economic feasibility.

10.2.2 Evaluations of CUNs – 2006 round for 2007 and 2008 exemptions

MBTOC met 3-9 April 2006 in Dubrovnik, Croatia. This meeting was held as required by the time schedule for considerations of CUNs given in Annex I referred to in Decision XVI/4. A meeting to consider further input from nominating Parties on their various CUNs, particularly those 'unable-to-assess' in this report, is scheduled for 28 August - 2 September 2006 in Yokohama, Japan. This latter meeting will produce a final report on this round of CUNs.

Fourteen Parties submitted 60 critical use nominations for 2007 and 30 nominations for 2008. These totalled 2557.106 and 7098.094 metric tonnes respectively. These Parties had submitted nominations in previous CUN rounds. The total number of nominations and nominating Parties has been reduced. Four Parties that had CUEs in previous years did not submit further nominations in the final round for 2007.

One Party made arrangements to meet with MBTOC during the Dubrovnik meeting for discussions with regard to their CUNs, in accordance with paragraph 8 of Annex 1 referred to in Decision XVI/4.

In paragraph 20 of Annex 1 referred to in Decision XVI/4, Parties, inter alia, specifically requested that, in cases where a nomination relies on the economic criteria of Decision IX/6, MBTOC's report should explicitly state the central basis for the Party's economic argument relating to CUNs. Table 10.7 provides this information for each CUN that relied on economic criteria.

MBTOC has sometimes suggested quantities of MB for 2007 or 2008 different from that nominated. Grounds used for these changes are given in detail after the relevant CUNs in Table 10.7. The adjustments follow the standard presumptions given in Tables 10.1 and 10.2, unless indicated otherwise.

In general, CUNs resulted mainly from the following issues: regulatory restrictions on one or two specific alternatives, scale up of alternatives, and economic issues. For the most part technical alternatives exist, but often at a less developed state than methyl bromide. As in the previous round, MBTOC has been unable to identify alternatives, or has inadequate information for the following applications: fresh high-moisture dates, some seeds when rapid turn around is required for immediate planting, cheese stores, dry cure ham treatment, and unmovable historical artefacts especially where fungi are of concern. The Parties are requested to consider focusing some research on these applications to adapt and, where required, register effective alternatives.

10.2.3 Disclosure of Interest

Further to the normal Disclosure of Interest required under the TEAP/TOC Terms of Reference, MBTOC members made an additional disclosure to the MBTOC Co-chairs relating specifically to their level of national, regional or enterprise involvement for the 2006 CUN process. This was required to ensure that those with a high level of involvement and interest in developing a particular nomination did not bias the process of evaluation through participation in the detailed review. The Disclosure of Interest form is an internal MBTOC document. The DoI used in previous rounds was used for the 2006 round. As in previous rounds, some members withdrew from a particular CUN assessment or only provided technical advice on request for those nominations where a potential conflict of interest was declared.

10.2.4 MBTOC Process

A soil subcommittee in MBTOC considered the nominations relating to the use of MB for soil fumigation, while a post-harvest subcommittee considered the nominations relating to the use of MB for fumigation of commodities, structures and objects. Drafts arising from the subcommittees were considered in plenary. This report and decisions of the committee were by consensus, recognizing that different perspectives exist within the committee on certain aspects.

All nominations received consistent treatment, however specific circumstances of each nomination were taken into account. Assessments were independent of the size of the exemption requested.

The most recent CUE approved by the Parties for a particular application was used as a benchmark for consideration of continuing nominations. In some instances, this benchmark differed from that used by the nominating Party.

10.2.5 Critical Use Nominations Review

In considering the CUNs submitted in 2006, MBTOC applied the standards contained in Annex I of MOP-16, and, where relevant the standard presumptions given below. The process was similar to that in 2005. In particular MBTOC sought to provide consistent treatment of CUNs within and between Parties while at the same time taking local circumstances into consideration for specific crops and situations, and to provide transparency in its processes and conclusions.

10.2.5.1 Consideration of alternatives

As in previous years, MBTOC used the guidance given in Annex I where 'alternatives' were defined as any practice or treatment that can be used in place of methyl bromide. 'Existing alternatives' are those alternatives in present or past use in some regions; and 'potential alternatives' are those alternatives in the process of investigation or development. MBTOC also used information on the suitability of alternatives for a nomination by considering the commercial adoption of alternatives in regions nominated for CUNs. Also, adoption in regions with similar climatic zone and cropping practices was used as an indication of the feasibility (technical and economic) of an alternative in a similar region. For example, 1,3-dichloropropene/ chloropicrin (1,3-D/Pic), metham sodium alone or in combination with Pic, dazomet, substrates and the use of resistant varieties and grafted plants (for solanaceous crops, melons and other cucurbits) have been adopted to replace MB for a range of crops in industries applying for CUNs and in many regions where MB was once used. MBTOC was 'unable to assess' several nominations that did not explain or provide sufficient evidence why these major alternatives were unsuitable for the specific circumstances of a nomination.

In evaluating the CUNs for soil treatments, MBTOC assumed that a technically feasible alternative to MB would need to provide sufficient pest and weed control for continued production of that crop to existing market standards. For commodity and structural applications, it was assumed that a technically feasible alternative would provide disinfestation to a level that met the objectives of a MB treatment, e.g. meeting infestation standards in finished product from a mill. Technically feasible alternatives do not necessarily provide superior pest control results than are achieved in practice by MB.

MBTOC evaluation of CUNs relating to production of strawberries, tomatoes and some related crops was assisted by information provided by a large number of published studies on MB alternatives. Many of these studies had been subjected to a statistical analysis (refer TEAP Progress Report May 2006). The published studies assisted in providing additional transparency to MBTOC evaluations, as requested by the Parties in Decision 15/4.

10.2.5.2 Period of nominations

CUNs in this report relate to CUEs sought for 2007 and 2008. No nominations in this particular round were submitted for years after 2008. One Party, Australia, submitted nominations for both 2007 and 2008, for cut flowers and rice.

10.2.5.3 Plans to develop, register and deploy alternatives

To qualify for a CUE, Decision IX/6 in part states that Parties must demonstrate that "...an appropriate effort is being made to evaluate, commercialise and secure national regulatory approval of alternatives and substitutes, taking into consideration the circumstances of the particular nomination..." and "…must demonstrate that research programmes are in place to develop and deploy alternatives and substitutes…"

In many nominations in the 2006 round, as in previous rounds, plans to identify alternatives were often not adequate and future plans to phase out MB were not given. As with the 2004 and 2005 rounds, MBTOC did not use lack of phase-out plans as a basis to 'not recommend' a nomination.

Decision Ex.I/4 requires Parties that make "a critical-use nomination after 2005 to submit a national management strategy for phase-out of critical uses of methyl bromide to the Ozone Secretariat before 1 February 2006". In most cases, the National Management Plans submitted for this round made general statements about a desire to reduce MB use, however no firm strategies were presented to show how stepwise reductions of MB were to be made.

Several Parties did however, identify feasible alternatives and reduced their nominations to allow for phase-in of these alternatives. MBTOC did not reduce a Party's requested amount for phase-in of alternatives without technical and economic evaluation and suitable justification.

10.2.5.4 Standard presumptions used in assessment of nominated quantities

The tables below (Tables 10.1, 10.2) provide statements of standard presumptions applied by MBTOC/TEAP in assessing this round of CUNs where continued methyl bromide use is sought. These standard presumptions were proposed in the MBTOC report of October 2005 and were presented to the Parties at the 17th MOP.

Presently the rates and practices adopted by MBTOC as standard presumptions are, in general, conservative. For soil treatments, the dosage levels of methyl bromide given in these presumptions exceed that required in good agricultural practice in all but exceptional circumstances, particularly when used in conjunction with low gas permeability barrier films (LPBF), such as various VIF and metallised barrier films (e.g. CANSLIT). A copy of the actual dosage rate of MB in MB/Pic formulations and those used as standard presumptions is shown in Table 10.2. MBTOC is presently reviewing these guidelines to more accurately reflect feasible doses with methyl bromide/chloropicrin combinations. A copy of the updated presumptions will be presented in the October TEAP report and available for consideration at the 18th MOP.

As in the evaluations in previous years, MBTOC reduced quantities of MB in particular nominations to a standard rate per treated area. MBTOC considers the maximum MB application rate for 98% MB to be either 350 kg/ha (warm sandy soils) or 450 kg/ha (heavier cool soils), in conjunction with low barrier permeability films (e.g., VIF or equivalent), combined with extended exposure periods, as effective in most circumstances when well applied. In cases where use of high chloropicrin-containing mixtures (approximately MB:Pic/67:33 or 50:50) were feasible, maximum dosage rates of 175 kg MB/ha where nutgrass is the key pest and 150 kg/ha for pathogens are regarded as reasonable and were used as the maximum standard presumptions unless there was a regulatory or technical reason indicated otherwise by the Party.

As a special case, MBTOC accepted a maximum rate of 20 g/m2 for certified strawberry runner production in the absence of data that showed certification standards could be met in the circumstances of particular nominations. However, several Parties indicated that rates of 20g/m2 or less (Table 10.4) of MB:Pic 50:50 were effective with barrier films for production of ‘certified’ strawberry runners and may be suitable for other propagative material. Several Parties indicated that 25g/m2 of 98:2 were effectively used in standard commercial application.

The indicative rates used by MBTOC were maximum guideline rates, for the purpose of calculation only. MBTOC recognises that the actual rate appropriate for a specific use may vary with local circumstances, soil conditions and the target pest situation. Some nominations were based on rates lower than these indicative rates.

Table 10.1 Standard presumptions used in assessment of CUNs for the 2006 round – soil treatments

	Comment	CUN adjustment	Exceptions
1. Dosage rates	Maximum guideline rates for MB:Pic 98:2 – 45 g/m^2 (cold, heavy soils) or 35 g/m^2 (sandy soils), both with barrier films (VIF or equivalent); for MB/Pic 67:33 - 15g or 17.5g MB/m^2 for pathogens and nutsedge respectively, under barrier films. All rates on a 'per treated hectare' basis..	Amount adjusted to maximum guideline rates. Maximum rates set dependent on formulation and soil type and film availability.	Higher rates accepted if specified under national legislation or where the Party had justified otherwise.
2. Barrier films	All treatments to be carried out under low permeability barrier film (e.g. VIF)	Nomination reduced proportionately to conform to barrier film use.	Where barrier film prohibited or restricted by legislative or regulatory reasons
3. MB/Pic Formulation: Pathogen control	Unless otherwise specified, MB/Pic 50:50 (or similar) was considered to be the standard effective formulation for pathogen control, as a transitional strategy to replace MB/Pic 98:2.	Nominated amount adjusted for use with MB/Pic 50:50 (or similar).	Where MB/Pic 50:50 is not registered, or chloropicrin (Pic) is not registered
4. MB/Pic Formulation: Weeds/nutgrass control	Unless otherwise specified, MB/Pic 67:33 (or similar) was used as the standard effective formulation for control of resistant (tolerant) weeds, as a transitional strategy to replace MB/Pic 98:2.	Nominated amount adjusted for use with MB/Pic 67:33 (or similar).	Where chloropicrin or chloropicrin-containing mixtures are not registered
5. Strip vs. Broadacre	Fumigation with MB and mixtures to be carried out under strip	Where rates were shown in broadacre hectares, the CUN was adjusted to the MB rate relative to strip treatment (i.e. treated area). If not specified, the area under strip treatment was considered to represent 67% of the total area.	Where strip treatment was not feasible e.g. some protected cultivation or open field production of high health propagative material

Table 10.2 Standard presumptions used in assessment of CUNs – post-harvest treatments

	Comment	CUN Adjustment	Exception
Dosage rate - structural	20 g/m^3	Nominations using higher dosage rates were reduced proportionally	Where approved label rates require higher dosage rate or where substantiated by the Party
Dosage rate – commodities	EPPO standard for bulk commodities as given in MBTOC (1994, 1998)	Nominations using higher dosage rates were reduced proportionally	Where approved label rates require higher dosage rates or where substantiated by the Party

Table 10.3 Actual dosage rates applied during preplant fumigation when different rates and formulations of methyl bromide/chloropicrin mixtures are applied with and without barrier films. Rates of application reflect standard commercial applications rates.

Commercial application rates of formulation	***MB/Pic formulation (dose of MB in g/m²)***			
	98:2	***67:33***	***50:50***	***30:70***
A. With Standard Polyethylene Films				
400	*39.2*	*26.8*	*20.0*	*12.0*
350	*34.3*	*23.5*	*17.5*	*10.5*
300	*29.4*	*20.1*	*15.0*	*9.0*
B. With Low Permeability Barrier Films (LPBF)				
200	*19.6*	*13.4*	*10.0**	*6.0*
175	*17.2*	*11.8*	*8.8*	*5.3*

* Note: Trials from 1996 to 2006 (Table 10.4) show that a dosage of 10g/m² (e.g. MB/Pic 50:50 at 200kg/ha with LP Barrier Films) is technically feasible for many situations and equivalent to the standard dosage of >20g/m² using standard films

10.2.5.5 Use/Emission reduction technologies - Low permeability barrier films and dosage reduction

Decision IX/6 states in part that critical uses should be permitted only if 'all technically and economically feasible steps have been taken to minimise the critical use and any associated emission of methyl bromide'. Decision Ex.II/1 also mentions emission minimization techniques, requesting Parties "to ensure, wherever methyl bromide is authorized for critical-use exemptions, the use of emission minimization techniques such as virtually impermeable films, barrier film technologies, deep shank injection and/or other techniques that promote environmental protection, whenever technically and economically feasible".

In this round, MBTOC assessed CUNs where possible for reductions in MB application rates and deployment of MB emission reduction technologies, such as use of low permeability barrier films, including VIF, or other appropriate sealing and emission control techniques including deep injection of MB, use of formulations with a lower proportion of MB and/ or reduced frequency of application.

A large number of studies under field conditions in a number of regions (Table 10.4), together with the large scale adoption of barrier films in Europe (e.g. VIF), support the use of these films as a means to reduce MB dosage rates. Controlled studies have also shown substantial reductions in MB emissions (Wang 1997). Research and development on low permeability barrier films has been summarised in the 1998 and 2002 MBTOC Assessment Reports (MBTOC 1998, 2002). Typically equivalent effectiveness is achieved with 25 –50% less methyl bromide dosage applied under LPBF compared with normal polyethylene containment films (See Table 10.3). Recent advancements in the cost and technical performance of barrier films, especially metallised polyethylene films have reduced cost and extended their suitability for use with methyl bromide and also some of the alternatives. Previous difficulties with sealing and gluing barrier films are no longer seen as a technical barrier to implementation of barrier films as new application technologies (i.e. glues, polyethylene edges and perforated films) have solved earlier problems.

The use of low permeability barrier films (VIF or equivalent) is compulsory in the 25 member countries of the European Union (EC Regulation 2037/2000). In other regions LPBF films are considered technically feasible except for the State of California in the US, however, which has a regulation which currently prevents implementation of VIF (California Code of Regulations Title 3 Section 6450(e)). This regulation has been set over concerns of possible worker exposure to MB when the film is removed or when seedlings are planted due to altered flux rates of MB.

In 2003 and 2004 (TEAP 2003, 2004), MBTOC/TEAP evaluations of CUNs used conservative maximum allowable dosage rates for use with standard films and barrier films. Since then, high levels of success have been demonstrated in many countries at lower rates of methyl bromide with barrier films (Table 10.4). This information was used to set revised standard presumptions for dose rates of MB/Pic formulations that are effective in conjunction with use of barrier films. These presumptions were reported in the October TEAP report. Studies show that these standard presumptions for MB dosage(150-175 kg/ha) in MB/Pic formulations with barrier films are still conservative. Dosage rates as low as 100 kg/ha of 30:70 or 50:50 MB/Pic have shown similar effectiveness to rates of 335 to 800 kg/ha using standard polyethylene (Fig 10.1).

To assist the adoption of lower dosage rates, researchers, extension specialists and fumigators need to continue to build grower confidence in the effectiveness of lower dosage levels and optimise the methods based on pest pressure and type of low permeability barrier films used in the field. Practical permeabilities for barrier films are identified by suppliers and offer MB users a wider range of opportunities for lowering MB dosages.

10.2.5.6 Adjustments for standard dosage rates using MB/Pic formulations

One key transitional strategy to reduce MB dosage has been the adoption of MB:Pic formulations with lower concentrations of methyl bromide (e.g. MB:Pic 50:50 or less). These formulations are considered to be equally as effective in controlling soilborne pathogens as formulations containing higher quantities of methyl bromide (e.g. 98:2, 67:33) (e.g. Porter et al, 1997; Melgarejo et al, 2000; Lopez-Aranda et al, 2003). Formulations containing high proportions of chloropicrin in mixtures with methyl bromide have been adopted widely by non-Article 5(1) countries to meet Montreal Protocol restrictions where such formulations are registered or otherwise permitted. Their use can be achieved with similar application machinery which allows co-injection of methyl bromide and chloropicrin or by use of premixed formulations. Consistent performance has been demonstrated with both barrier (Table 10.4, Fig 10.1) and non barrier films.

In structures, it is feasible to reduce MB use and emissions by the use of improved sealing techniques, with monitoring to ensure only the minimum effective dosage is used, and longer exposure periods. The average dosage rates now quoted in the CUNs, typically around 20 g/m3 for mills and similar structures, are reasonable.

In commodities, methyl bromide dosage rates vary with commodity temperature and by commodity sorption rates. Accordingly, MBTOC uses the dosage rates published by the European Plant Protection Organization (EPPO) and found in annexes to the MBTOC Assessment Reports published in 1995, 1998 and 2002. Parties are encouraged to use the lowest possible dosage rate appropriate for the circumstances and as allowed by the label.

10.2.5.7 Use of canisters of MB

One Party still used canisters (i.e. small 500 to 750g canisters) for application of MB under plastic films. This practice is not considered as effective for pathogen control as use of MB/Pic mixtures and also leads to high emissions of methyl bromide. Canisters have been eliminated in most countries (most recently in Greece and Chile) as they were considered dangerous. Canisters are used because they provide small land holders with an easy application method and the ability to apply targeted amounts of MB to small areas and injection machinery may be difficult to use in these circumstances.

Table 10.4 Relative effectiveness of MB/Pic formulations applied in combination with low permeability barrier films compared to the commercial standard MB/Pic formulation applied under standard low density polyethylene films.

Country	Region	Commodity	Brand or Type of Barrier Film	Untreated	Methyl Bromide/Chloropicrin Mixtures (Product rate per treated area)													Notes	Reference
				Std film			Barrier Film - Relative yield compared to standard polyethylene												
				Yield	MB/Pic Formula.	Product Rate	Not Spec	98:2	98:2	67:33	67:33	67:33	67:33	67:33	67:33	50:50	33:67		
						kg/ha	300	400	300	98	196	200	294	336	392	200	200		
MB Dosage rate (g/m2)								**392**	**294**	**66**	**131**	**134**	**197**	**225**	**263**	**100**	**66**		
Spain	Vinderos	Strawb. Runner	VIF – Not Spec	74	50:50	400											93	Fusarium, Phytophthora, Pythium, Rhizoctonia and Verticillium	De Cal et al 2004
	Navalmanzano			78	50:50	400											80		
Spain	Vinderos	Strawb. Runner	VIF - Not Spec	68	50:50	400										114	102	Fusarium, Cladosporium, Rhizoctonia	Melgarejo et al 2003
	Navalmanzano			34	50:50	400										76	75		
Spain	Avitorejo	Strawb. Fruit	VIF - Not Spec		50:50	400											97	2003 results	Lopez-Aranda et al 2003
	Malvinas				50:50	400											99		
Spain	Valencia	Strawb. Fruit	VIF - Not Spec	59	Not Spec	600	94											1998 Fusarium at 10cm & 30cm	Bartual et al 2002
				53	Not Spec	600	93											1999 results	
Spain	Avitorejo	Strawb. Fruit	VIF - Not Spec	80	67:33	400										112			Lopez-Aranda et al 2001a
	Tariquejo			54	67:33	400										106		Meloidogyne and weeds (unspec.)	
Spain	Moguer/Cartaya	Strawb. Runner	VIF - Not Spec		50:50	392										99		Inoculum not specified	Lopez-Aranda et al 2001b
Spain	Cabeza, Nav.	Strawb. Runner	VIF - Not Spec	74	67:33	400						105, 92						1998 Two sites	Melgarejo et al 2000
	Arevalo, Nav.			84	50:50	400										104, 104		1999 results, nurseries	
	Vinaderos, Nav.			49	50:50	400										95, 123		2000 results, nurseries	
Spain	Huelva	Strawb. Fruit	VIF - Not Spec	82	67:33	400						101						1997-1998 Inoc.unspecified	Lopez-Aranda et al 2000
				72	67:33	400						102						1998-1999 Inoc. unspecified	
				68	67:33	400						109						1999-2000 Inoc. unspecified	
Spain	Moncada	Strawb. Fruit	VIF - Not Spec	60	98:2	600			95									1998 No major pathogens but Fusarium buried 10cm&30cm.	Cebolla et al 1999
				54	98:2	600			91										

Country	Region	Commodity	Brand or Type of Barrier Film	Untreated	Methyl Bromide/Chloropicrin Mixtures (Product rate per treated area)													Notes	Reference
				Std film			Barrier Film - Relative yield compared to standard polyethylene												
				Yield	MB/Pic Formula.	Product Rate	Not Spec	98:2	98:2	67:33	67:33	67:33	67:33	67:33	67:33	50:50	33:67		
						kg/ha	300	400	300	98	196	200	294	336	392	200	200		
MB Dosage rate (g/m2)								**392**	**294**	**66**	**131**	**134**	**197**	**225**	**263**	**100**	**66**		
France	Douville	Strawb. Fruit	VIF - Not Spec	65	Not Spec	800		99										Inoculum not specified	Fritsch 1998
NZ	Havelock North	Strawb. Fruit	VIF - Not Spec	83	67:33	500								98				Phytophthora present	Horner 1999
USA	Florida	Pepper	VIF Plastopil	69	67:33	392					78							Nutgrass	Gilreath et al 2005
			VIF Plastopil	69	67:33	392				99								present	
			VIF Vikase	69	67:33	392					83								
			VIF Vikase	69	67:33	392				86									
USA	Florida	Strawb Fruit, Cantaloupe	Barrier - Pliant, Metallised		98:2 67:33	Trials on 18 Commercial Farms between 2000-2004; no increase in disease or weeds when rates reduced up to 50% under VIF wrt. polyethylene												Nutgrass and pathogens present	Noling and Gilreath 2004
USA	California	Strawb. Fruit	VIF - Not Spec	72	67:33	336								108				Inoculum not specified	Ajwa et al 2004
				80	67:33	392									96				
USA	Florida	Tomato	VIF - Not Spec	31	67:33	392					111		93		114			Nutgrass and rootknot nematodes	Hamill et al 2004
USA	California	Strawb. Fruit	VIF - Not Spec	75	67:33	392									106				Ajwa et al 2003
				83	67:33	392									111			Watsonville, high pathogen pressure	
				65	67:33	392									102				
USA	Florida	Tomato	VIF - Not Spec		67:33	392	"No significant reduction in yield"												Noling et al 2001
USA	California	Strawb. Fruit	VIF - Not Spec	45	67:33	364									116				Duniway et al 1998
Unweighted averages (relative % yield)				66			94	99	93	93		102		103	108	104	91		

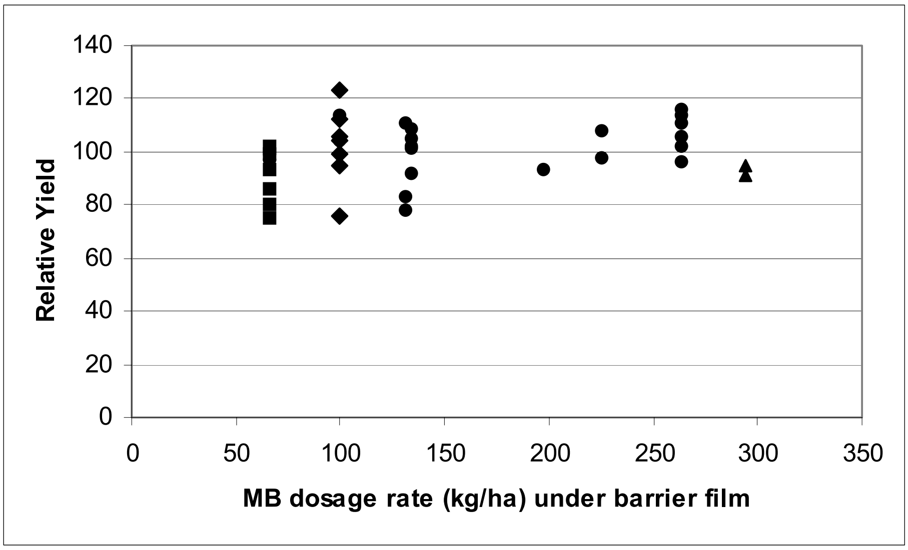

Figure 10.1 Relative yield of crops (strawberries, tomatoes, peppers, cantaloupes) grown under barrier films with different MB/Pic formulations compared to the standard commercial treatment using standard polyethylene from trials between 1998 and 2004 (▲MB/Pic 98:2; ● MB/Pic 67:33; ♦ MB/Pic 50:50; ■ MB/Pic 33:67). Data from Table 10.4.

10.2.5.8 Rate of adoption of alternatives

MBTOC recognizes that time is needed to effect phase-in of alternatives and accepts this as a reasonable technical argument for lack of availability to the user sensu Decision IX/6.

Some CUNs in the 2006 round argued that time was required to allow the relevant industry to transition to available effective alternatives. Some CUNs showed a reduction in nominated quantity requested from that of the preceding year, reflecting progressive adoption of alternatives; while others had the same or similar quantities of MB nominated to the preceding CUNs. Some CUNs showed slow rates of adoption. In some cases alternatives at varying stages of readiness for adoption were identified in the CUN and in others they were identified by MBTOC. In cases where adoption rates indicated by the Party were considered too slow because alternatives were available and had been adopted by users in the nominated region and similar industries elsewhere, MBTOC made a preliminary assessment for uptake of such alternatives and requested the Party to clarify further its possible adoption in the light of new information on alternatives. Data on the commercial use of soil alternatives shows that substantial adoption of alternatives in regions with similar pests and climates to those seeking CUNs has occurred within 4 years or less (e.g. Spain, Italy, Australia, California).

There is limited guidance and data available on what is a reasonable rate of transition to existing and available alternatives, though para. 35 of Annex I referred to in Decision XVI/4 states that "In situations where MBTOC recommends a nomination on grounds that it is necessary to have a period for adoption of alternatives, the basis for calculating the time period must be explained fully in the TEAP report and take fully into account the information provided by the nominating Party, the supplier, the distributor or the manufacturer. Relevant factors for such a calculation include the number of enterprises that need to transition, e.g., the number of fumigation and pest control companies, estimated training time assuming full effort, opportunities for importing alternative equipment and expertise if not available locally, and costs involved."

In this interim report, MBTOC was unable to agree on appropriate adoption rates for alternatives and either used information provided by the Party or left the nomination 'unable to assess' until the Party clarified issues consistent with Annex 1 (Decision XIV/4). In discussion on adoption rates for uptake of alternative technologies in CUN's, MBTOC noted several examples. In the past, where several industries have been heavily dependent on MB, e.g. strawberries, tomatoes and vegetable crops (e.g. EC, Netherlands, Australia) almost complete adoption of alternative technologies (especially those requiring similar application technologies) has been achieved in a 3 to 4 year period. Theses regions have similar climates and pests complexes to those requesting CUN's but may have different regulatory issues. Improved guidance from the Parties, giving expected rates of adoption of alternatives following registration, would assist MBTOC in evaluation of CUNs in future. Rates of adoption for various uses and alternatives have been considered by the European Commission in February 2006 as part of its National Management Plan. Adoption was achieved in periods of about 4 years.

10.2.5.9 Fulfilment of Decision IX/6

Decision XVI/2 directed MBTOC to indicate whether all CUNs fully met the requirements of Decision IX/6. When the requirements of Decision IX/6 1(a)(ii) were substantially met, MBTOC recommended the full amount of the request. Where some parts of a CUN did not meet Decision IX/6 1(a)(ii) MBTOC recommended a decreased amount, depending on its technical and economic evaluation. MBTOC reduced a nomination when a technical alternative was considered effective or, in a few cases, when the Party failed to show that it was not effective. In cases where Decision IX/6 1(a)(ii) was not satisfied to a substantial extent, MBTOC did not recommend the nomination. In this round of CUNs, as in previous rounds, MBTOC considered answers submitted by Parties in response to questions previously sent.

MBTOC did not evaluate and/or did not take into account the use of stockpiles when making recommendations. In this round, accounting frameworks providing information on levels of stocks were provided by several Parties to the Ozone Secretariat. MBTOC made no adjustment for stocks or stockpiles present in various countries. The Parties may wish to consider stocks as stated in Decision IX/6 1 b(ii).

MBTOC's interpretation of fulfilment of Decision IX/6, in the aspect of evaluating alternatives, has become firmer as time has made more information about alternatives known to applicants and Parties. Decision IX/6 b (iii) requires,

(b) That production and consumption, if any, of methyl bromide for critical uses should be permitted only if: [...]

> *(iii) It is demonstrated that an appropriate effort is being made to evaluate, commercialise and secure national regulatory approval of alternatives and*

substitutes, taking into consideration the circumstances of the particular nomination and the special needs of Article 5 Parties, including lack of financial and expert resources, institutional capacity, and information. Non-Article 5 Parties must demonstrate that research programmes are in place to develop and deploy alternatives and substitutes. Article 5 Parties must demonstrate that feasible alternatives shall be adopted as soon as they are confirmed as suitable to the Party's specific conditions and/or that they have applied to the Multilateral Fund or other sources for assistance in identifying, evaluating, adapting and demonstrating such options;

As in past years, some CUN documents indicated that some applicants did not conduct research, evaluate the research of others for adaptation to their circumstance, and/or did not send documents showing their effort to conduct research and evaluate alternatives. In some cases, these were small-operator applicants, or where costs would have been prohibitive. In its evaluations, MBTOC has not required all applicants to conduct research where reasons for the nomination were similar to other crops or commodities, but did require technical justification where CUNs were based on specific issues for that crop or commodity. In some cases, MBTOC relied on its own knowledge to determine if alternatives would have been effective in the circumstances of the nomination.

As knowledge of alternatives is more readily accessible to applicants and Parties, MBTOC has become firmer in asking applicants and Parties to conduct research and/or evaluate the research conducted by others in the circumstances of their nomination, to document that effort and submit the documents to MBTOC. The documents can take the form of research reports, trials in field or in commercial applications, consulting reports etc, but should be directly pertinent to the circumstances of that particular nomination. This further ensures that aspects of Decision IX/6 are met.

In other instances, MBTOC has observed that some applicants have conducted research and made efforts to adapt alternatives without success. There are some difficult challenges for some applicants. In some cases, MBTOC has used its knowledge and made suggestions to Parties about potentially more rewarding research in the hope that these avenues of investigation may assist Parties to evaluate and adopt suitable alternatives.

10.2.5.10 Sustainable Alternatives

In a large proportion of CUNs, the most currently appropriate alternatives are chemical fumigant alternatives, which themselves, like MB, have issues related to their long term suitability for use. In both the EC and USA, MB and most other fumigants are involved in rigorous a review that could affect future regulations over their use. MBTOC urges Parties to consider the long term sustainability of treatments adopted as alternatives to MB, to continue to adopt chemical and non-chemical alternatives for the short to medium term and to develop sustainable IPM or non-chemical approaches for the longer term. Decision IX/6 1(a)(ii) refers to alternatives that are 'acceptable from the standpoint of environment and health'. MBTOC has consistently interpreted this to mean alternatives that are registered or allowed by the relevant regulatory authorities in individual CUN regions.

10.2.5.11 Frequency

In the CUN round for 2005, reductions in MB for both preplant soil and postharvest use could be achieved in some nominations, where effective alternatives were identified, by reducing the frequency of MB fumigations. In some countries, present regulations already restrict the frequency of use of MB (e.g. to every second year) on similar crops and circumstances to those nominated by other Parties. MBTOC suggests that in these and other instances MB only be required every 2, 3 or 4 years and suggests that Parties further consider reductions where appropriate. Alternation of pest control measures may also help provide or extend user confidence and experience in alternatives. New pest control measures may also be good agricultural practice, reducing risk of development of tolerance and providing control of a wider spectrum of pests.

10.2.6 Decisions Ex.I/4 (9d) and Decision XVII/9 (10)

Decision XVII/9 (10) of the 17th MOP requests TEAP and its MBTOC to "report for 2005 and annually thereafter, for each agreed critical use category, the amount of methyl bromide nominated by a Party, the amount of the agreed critical use and either:

(a) The amount licensed, permitted or authorized; or
(b) The amount used

Decision Ex.I/4 requests MBTOC to "submit a report to the Open-ended Working Group at its twenty-sixth session on the possible need for methyl bromide critical uses over the next few years, based on a review of the management strategies submitted by Parties pursuant to paragraph 3 of the present decision. The following sections address these tasks and represent a summary of the information provided at this time.

Decision Ex.I/4 (3) required the Parties making a critical-use nomination after 2005 to submit a national management strategy for the phase out of the critical use of MB. At of the time of this report, five Parties have submitted their national strategies. As requested by the Parties in decision Ex.I/4 (9d), TEAP through its MBTOC reviewed the management strategies to prepare a report to the twenty-sixth meeting of the Open-ended Working Group on the possible need for methyl bromide critical uses over the next few years.

A summary of the five national management strategies and the CUNs/CUEs is given in Table 10.5 below. An update of this table will be provided in the Final CUN report in October 2005. Table 10.6 lists all the nominated and exempted amounts of methyl bromide granted by Parties under the CUE process.

MBTOC is unable to provide a quantitative estimate of the future demand for MB for controlled uses for preplant soil fumigation and post harvest commodity treatments at this time until further information is received from the Parties to complete the current round of CUN nominations. A further assessment of this issue will be made during the MBTOC meeting scheduled to take place in Japan in August, 2006 and presented in the final CUN in October 2006. Since 2005, there has been a progressive trend by all Parties to reduce their consumption and CUN nominations, although this has occurred at different rates.

Table 10.5 Summary of CUE trends and information provided in National Management Strategies for phase-out of critical-use exemptions

Party	CUE industry 2007/2008)	CUEs approved by MOP (tonnes)			CUNs (tonnes)		Expected or planned schedule for MB phase-out for Critical Uses	Constraints to Phase Out and progress with evaluation of alternatives
		2005	**2006**	**2007**	**2007 (new)**	**2008**		
Australia	Rice, strawberry, protected flowers	146.6	75.1	40.88	10.25	51.1	Reduce the imports of methyl bromide to zero by 2010 or earlier. CUE holders to identify and transition to alternatives before 2010. Turf growers and flourmills have been using stocks from before 2005 and have not requested CUEs so far.	Demonstrating technical and economic feasibility for VIF (LPBF) barrier films will require the Australian Industry to overcome some barriers that currently prevent widespread adoption. A national programme tested more than 20 alternatives. A number of non-fumigant treatments (bio-fumigants, steam, hot water and solarisation) have also been tested. Telone C 35, methyl iodide and ethanedintrile are considered to be the prospective in the short term. However all require further trials and/or registration. Telone C 35 (a 1,3- dichloropropene/ chloropicrin mixture) has been identified and registered for the fruit industry, but not yet for the strawberry runner industry.
Canada	Mills, strawberry runners	61.79	53.90	39.99	12.87	36.11	As fast as possible following transition strategy principles to phase-out. No figures provided.	Potential alternatives have been identified for the relevant industries. The government is committed to a priority review of the technology/substances identified and submitted (by the technology owner) as alternatives to methyl bromide. The Canadian National Millers Association (CNMA) has completed one collaborative project to evaluate alternatives with the support of AAFC and is currently managing a second two-year (2005-2006) initiative to assist companies and pest controls service providers in evaluating alternatives. Results of the evaluations will be published by CNMA by the first quarter of 2007.
Japan	Chestnuts, cucumber, ginger, pepper, melons, watermelons	748	741.4	636.172	0	589.6	Will ensure the reduction of critical uses nomination successively. No figures provided NMS to promote the phase-out of uses of methyl bromide as soon as technically and economically feasible. Difficult to suggest standard reduction level in general.	Experimental research plan for the development of pest control for crop diseases and virus (in e.g. peppers); development of alternative technologies ongoing. Prospective alternatives (tests done): • methyl iodide fumigation and storage under low temperature and high humidity to control chestnut weevil • control of melon necrotic spot virus (MNSV) with the use of resistant stock - demonstration field test on the efficacy • green pepper resistant variety with L4 gene against pepper tobamovirus.

Party	CUE industry 2007/2008)	CUEs approved by MOP (tonnes)			CUNs (tonnes)		Expected or planned schedule for MB phase-out for Critical Uses	Constraints to Phase Out and progress with evaluation of alternatives
		2005	**2006**	**2007**	**2007 (new)**	**2008**		
New Zealand	Strawberry fruit, strawberry runners	50	42	0	30.50	-	Government has determined that 2007 will be the last nominations that will be supported for the critical use of methyl bromide by the strawberry industry.	The most likely alternative is Telone C35. It is recognised there are ongoing difficulties with the effectiveness of this product, especially in sub-optimal weather conditions. Current research into alternatives will not be completed until September 2007.
USA	Dried commodities, mills and processors, ham, cucurbits, eggplant, forest seedlings, nurseries, orchard replant, ornamentals, peppers, strawberry fruit, strawberry nurseries, tomatoes, turfgrass, sweet potato	9552.879	8081.753	6749.060	0	15105.78	Manage CUEs in accordance with the policies, procedures and regulations that are in place to address the elements in Ex.I/4(3) (i.e. avoid increases except under unforeseen circumstances; encourage use of alternatives; provide information on the potential market penetration of alternatives; promote emissions reductions measures; provide a description of phase-in of feasible alternatives)	Sector-by-sector description of the status of alternatives is provided.

Figure 10.2(a-f). Amounts of MB exempted for CUE uses in preplant soil industries from 2005 to 2008. Solid lines indicate trend in CUE methyl bromide. Dashed lines indicate quantity of methyl bromide nominated by the Party in either 2007 or 2008.

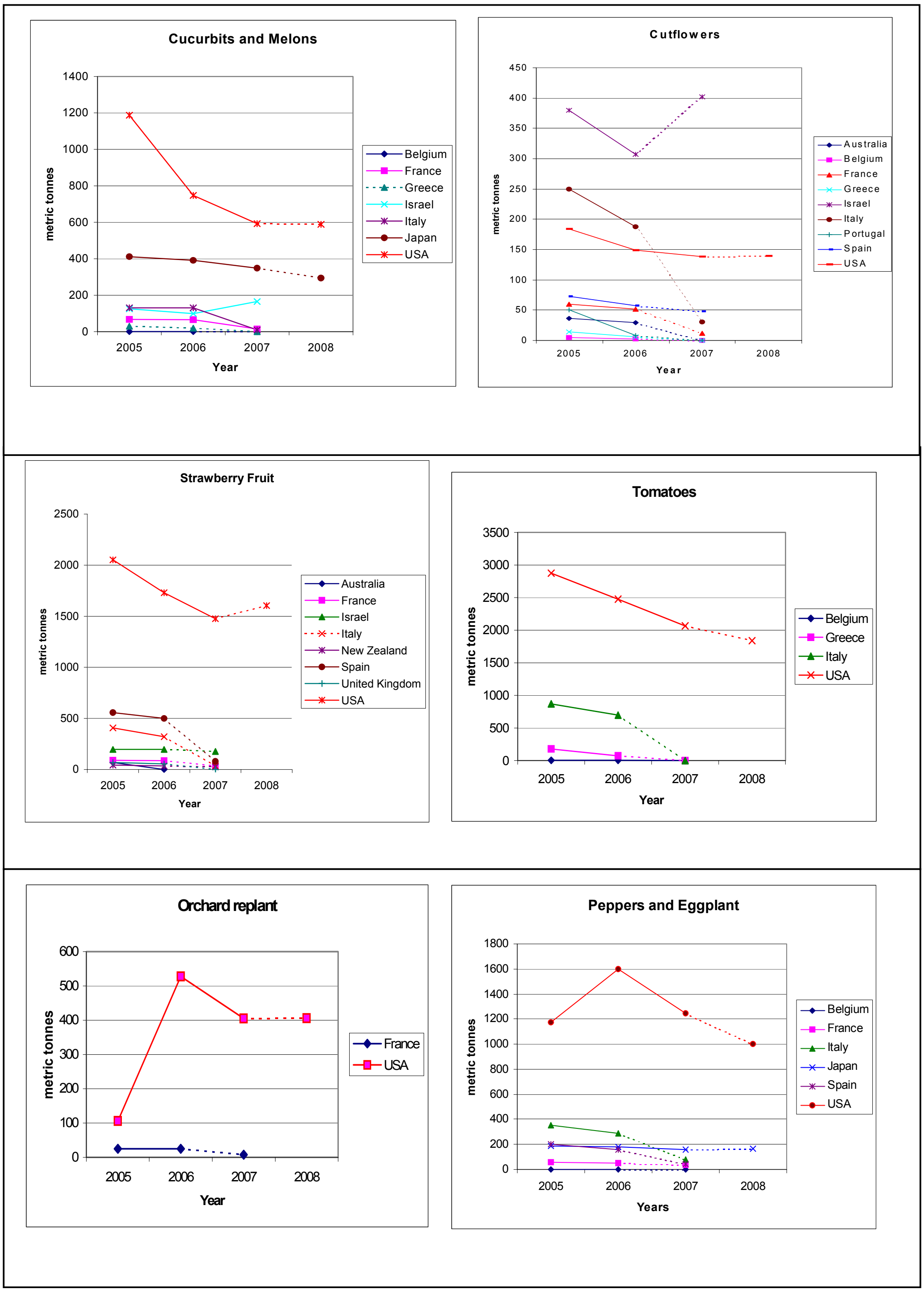

Figure10.2g Amounts of MB exempted for CUE uses in mills and food processing facilities from 2005 to 2008. Solid lines indicate trend in CUE methyl bromide. Dashed lines indicate quantity of methyl bromide nominated by the Party in either 2007 or 2008

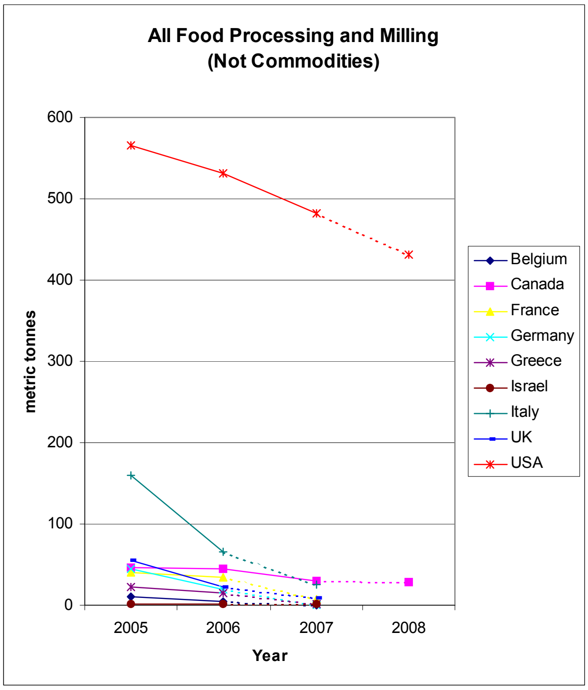

Table 10.6 List of nominated (2005 – 2008 in part) and exempted (2005 – 2007 in part) amounts of methyl bromide granted by Parties under the CUN/CUE process. (Note: A breakdown of CUN and CUE amounts by commodity is given in ANNEX III)

Party	FINAL NOMINATIONS SUBMITTED BY THE PARTIES				QUANTITIES APPROVED BY THE PARTIES (agreed critical use categories)		
	Total Nomination 2005	**Total Nomination 2006**	**Total Nomination 2007**	**Nominations so far 2008**	**2005 (1ExMOP and 16MOP)**	**2006 (16MOP+ 2ExMOP+ 17MOP)**	**2007 (17MOP) so far**
Australia	206.95	81.25	52.145	51.100	146.6	75.1	40.88
Canada	61.992	53.897	52.874	36.112	61.792	53.897	39.988
European Community[1]	5754.361	4213.47	1280.087	-	4392.812	3536.755	-
Israel	1117.156	1081.506	1147.112	-	1089.306	880.295	-
Japan	748	738.7	651.7	589.6	748	741.4	636.172
New Zealand	53.085	53.085	30.500	-	50	42	-
Switzerland	8.7	7	-	-	8.7	7	-
USA	10753.997	9386.229	7417.999	6415.156	9552.879	8081.753	6749.060
TOTALS	**18704.24**	**15615.135**	**10632.417**	**[7091.968]***	**16050.089**	**13418.200**	**[7466.100]***

* [ ] Interim total.

[1] Members of the European Community having CUNs/CUEs in 2005 – 2007 include: Belgium, France, Germany, Greece, Ireland, Italy, Latvia, Malta, Netherlands, Poland, Portugal, Spain, and the United Kingdom.

10.2.7 Interim evaluations of CUNs submitted in 2006 for 2007 or 2008.

10.2.7.1 Details of evaluations

MBTOC/TEAP assessed the 90 CUNs and recommended 47, with 32 placed in the 'unable to assess' category. 11 CUNs were not recommended.

A total of 1721.780 tonnes of MB has been recommended, 1115.319 for 2007 and 606.461 for 2008; 742.964 tonnes were not recommended for 2007 and 148.136 tonnes for 2008 use for a total of 891.100 tonnes of MB not recommended in this round of CUNs.

Table 10.7 includes all evaluations of CUNs made in the interim report on the 2006 round of nominations.

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Table 10.7 Interim evaluations of CUNs submitted in 2006 for 2007 or 2008

Country	Industry	Quantity approved for 2005 (1ExMOP+ 16MOP)	Quantity approved for 2006 (16MOP+ 2ExMOP+ 17MOP)	Quantity approved for 2007 (MOP17)	Quantity nominated for 2007 (additional or new)	Quantity nominated for 2008	MBTOC recommendation for 2007	MBTOC recommendation for 2008	MBTOC comments	MBTOC comments on economics
Australia	cutflowers - bulbs - protected	7.000	7.000	none	6.170	6.150	3.598	3.5	MBTOC recommends a reduced amount of 3.598 tonnes for this CUN for 2007 and 3.5 tonnes for 2008. The CUN states that MB is required to control soilborne fungi and weeds affecting a variety of cut flowers and bulbs grown under cover. The nominated amount has been reduced [11.4 Ha x 35g/m2 = 3.598 and 11 Ha x 35g/m2 = 3.5] to adjust to MBTOC's standard presumptions of 35 g/m2 MB with use/emission control technologies. The Party has conducted research showing that this dosage rate is effective under LPBF and commercial adoption of this material is underway (Mann *et al*, 2005).The CUN states that although some flower types are already being produced in substrates, this technology is not economically feasible in certain cases (lilies, iris). Steam is not feasible due to sloping terrain and techniques like plate steaming are not available. 1,3-D+ Pic and MB formulations with higher chloropicrin content cannot be used in closed greenhouses. Plantback times with other fumigants may be too long but trials are underway to solve this constraint. The Party has also identified that MI is an effective alternative to MB, but is not yet registered (Mann et al, 2005).	CUN states that transition to soil-less culture has occurred for some crops where profits are not compromised, but for lilies, iris, etc. soil-less culture using currently available substrates is not considered to be economically feasible. No economic data on alternatives given
Australia	Rice	6.150	6.150	5.130	4.075	9.200	4.075	U	MBTOC does not recommend the additional 4.075 tonnes for 2007 and is unable to assess the nomination for 2008 at this time. Alternatives exist for at least a proportion of the treatments where time is not a constraint. This application rate has been the EPPO dosage rate for rice treatment (MBTOC; 1994, 1998). MBTOC's assessment is that the applicant needs to implement normal (nonMB) protection and packaging procedures that prevent post packaging insect infestation. The applicant is encouraged to develop a transition plan towards use of such alternative procedures and other control methods.	CUN states that Australian rice growers will consider investing in infrastructure and facilities to fumigate rice after it has been milled but before it has been packaged (intermediate rice); or fumigate inside packs (packaging review project). Current estimates suggest that the cost of an intermediate storage system would be in the region of $20,000,000; with alteration of packaging in the region of $2,000,000 to $3,000,000 per site plus a doubling in packaging costs per unit.

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Australia	Strawberry runners	35.750	37.500	35.750		35.750		28.600	MBTOC recommends a reduced CUN of 28.6 tonnes of MB be approved for 2008. The original amount requested has been reduced to conform to rates of MB shown to be effective for production of 'high health' strawberry runners using LPBF films and other emission control technologies, ie. 20 g/m2 (P13, UNEP/TEAP October 2005). The CUN states that MB is required to meet certification standards and that a key alternative, 1,3-D/Pic, is reported to have been phytotoxic due to the heavy and wet soil conditions during fumigation. The CUN provided recent data from a specific local trial indicated phytotoxicity in runners that result in a doubling of the time required before planting compared to MB. Although 1,3-D/Pic is an effective alternative to MB in strawberry runner production, at this time the effects of this alternative on the number of runner plants produced, the costs of additional weed control measures required are prohibitive. The CUN states that plug plants are a technically feasible alternative but that the costs associated with this technology are too high. The Party is using a rate of MB, 25 g/m2, and is examining the efficacy of 30:70 mixtures of MB:PIC to reduce this rate. MBTOC considers glues and technologies are available to implement LPBF films and this will enable a reduction in MB required. Trials show that still lower rates are effective. The Party notes that two currently unregistered alternative appear promising, methyl idodide and ethane dinitrile (Mann et al, 2005; Mattner et al, 2003). The Party is requested in future nominations to demonstrate that alternatives do not achieve the pathogen and pest tolerance levels to meet certification requirements.	CUN states data are not yet available to enable an economic evaluation of alternatives.
Canada	Mills	47 (included mills and pasta)	34.774	30.167 (included mills only)	none	28.650		28.650	MBTOC recommends 28.650 tonnes for 2008 for this use. This amount represents a 20% reduction over the CUE for 2006, and a further 5% reduction for 2008 over 2007 CUE. The Party continues to conduct field trials of various alternatives adapting heat, phosphine and sulfuryl fluoride. Sulfuryl fluoride currently has registration that only allows experimental trials. The Party has indicated it will reassess the quantity of MB permitted for use should circumstances of the nomination change. If new fumigants become commercially registered, and if efficacy is proven under the Canadian circumstances, and/or if further trials with heat (alone or in combination with other insecticidal treatments) allow further adoption, it should be possible to reduce the amount of methyl bromide allowed.	CUN provided no economic data. CUN based on technical feasibility reasons.

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Canada	Pasta	(see Canada mills)	10.457	none	6.757			U	MBTOC is unable to assess this nomination pending further information from the Party. The Party has reduced its use of MB for this sector by eliminating MB treatments of warehouses where other alternatives can be used. The CUN and response from the Party lists several concerns that heat treatment will damage pasta manufacturing facilities. However, consistent with Decision IX/6, where Parties are required to demonstrate an appropriate effort to evaluate, commercialize and secure approval of alternatives to support the need for a critical use of MB, and to allow MBTOC to diligently evaluate this CUN, the Party is asked to provide documentation evaluating its pasta facilities or other pasta facilities that generated its concerns with alternatives and supporting its claim for critical use. Has the Party tested mitigation methods that would allow the adoption of heat (or other treatments) without damaging the mill. Avenues of investigation may include relocating spot heaters, use of heat tolerant materials etc. Since MBTOC evaluates CUNs on both technical and economic grounds, the Party may wish include documentation showing a clear and detailed cost evaluation of using methyl bromide alternatives, under the circumstances of this nomination. MBTOC can not foresee a viable transition plan for this use if heat or other alternatives are not tested developed and adapted in pasta mills. Additionally, information is sought to explain how the circumstances of this nomination differ from pasta facilities in other countries where IPM procedures have proven adequate to control pests in pasta manufacturing. Additionally, could the Party explain why two Canadian pasta facilities are able to avoid the need for two fumigations in one year, yet one facility requires two fumigations each year.	CUN states that Sulfuryl fluoride is the most promising alternative but its efficacy and cost have not been evaluated as SF was only recently conditionally approved. CUN also states that the cost of heat treatment is at least twice the cost of methyl bromide. This cost increased to three or four times when the cost of monitoring is included.

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Canada	Strawberry runners (Ontario)	none	none	none		6.129		4.000	MBTOC recommends a reduced CUE of 4.0 tonnes for this use in 2008. The CUN states that MB is required to meet certification standards. The original amount requested has been reduced to conform to rates of MB shown to be effective for production of 'high health' strawberry runners using LPBF films and other emission control technologies, ie. 20 g/m2 (P13, UNEP/TEAP October 2005). Trials show that still lower rates are effective. The Party requests MB for the first 2 years of their 3-year production cycle. In the 3rd year the Party uses fish emulsion, compost with kelp seaweed and folic humic acid to suppress soil pathogens and accelerate good biology in the plants. The Party states that due to the very cool weather 1,3-D + PIC has a vastly reduced effectiveness compared to MB. Currently only the 67:33 MB:PIC mixture formulation is registered. The Party is requested in future nominations to demonstrate that alternatives do not achieve the pathogen and pest tolerance levels to meet certification requirements.	CUN argues that although the cost of MBr vs. biological ingredients is comparable, labour costs are some 10% higher for weed control.
Canada	Strawberry runners (PEI)	6.840	6.840	7.995		7.462		5.000	MBTOC recommends a reduced CUE of 5 tonnes for this use in 2008. The CUN states that MB is required to meet certification standards. The original amount requested has been reduced to conform to rates of MB shown to be effective for production of 'high health' strawberry runners using LPBF films and other emission control technologies, ie. 20 g/m2 (P13, UNEP/TEAP October 2005). Trials show that still lower rates are effective. The Party has attempted to replace MB with 1,3-D, but 1,3-D was banned in January 2003 due to groundwater contamination. The Party has initiated trials to determine the feasibility of organic production. Currently only the 67:33 MB:PIC mixture formulation is registered in Canada. Chloropicrin 100 has been recently been provisionally registered in Canada, but the Party has not yet had the opportunity to fully evaluate this alternative. The Party is requested in future nominations to demonstrate that alternatives do not achieve the pathogen and pest tolerance levels to meet certification requirements.	CUN provided no economic data. CUN based on technical feasibility reasons.
France	Chestnuts	2.000	2.000	none	1.800		1.800		MBTOC recommends 1.800 tonnes for this use in 2007. The CUN relates particularly to fresh market chestnuts, which impacts the technical availability of alternative treatments, compared for chestnuts used for processing. Although the Party has conducted research trials on many potential alternatives, there are no registered alternatives that do not harm the quality and marketability of fresh market chestnuts. Unlike other nuts which are durable commodities, chestnuts are a high moisture, semi-perishable food. They are harvested one day, fumigated overnight and sold to consumers the	CUN states that disinfestation by water immersion takes two weeks, hence sellers lose this time in the peak market window. Furthermore, soaking costs 60 times the cost of MBr. Moreover, quality is poorer; hence they will get lower prices.

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									next day or very soon after. Chestnuts in France are subject to pests that requires a longer treatment time than are fresh market chestnuts in some other countries (*Cydia splendana* (Hubner) and *Curculio elephas* (Gyllenhal)). The immediate marketing channel allows the Party to use a low dosage consistent with the need to only kill some life stages. The Party has conducted successful preliminary efficacy tests with ethyl formate, a treatment that may allow an organic certification, but registration and adoption of maximum residue levels has not yet been completed.	
France	Mills	40.000	35.000	none	8.000		8.000		MBTOC recommends 8 tonnes for France mills in 2007. Sulfuryl fluoride was very recently registered for this application (March 2006). Although a rapid adoption rate has been proposed, some time is needed to efficiently transition to alternatives. Given the relatively low amount of MB requested by the Party, in the face of numerous mills that will require pest control, the Party might need to consider allocation strategies that reserve MB for those mills whose size, layout and design, age and/or location make transition most difficult. MBTOC's knowledge of sulfuryl fluoride and heat treatments indicate that more time is required to develop effective strategies to treat the larger, more complex mills in locations with cooler temperatures because sometimes a combination treatment is required.	CUN states that the cost of SF is 2.5 x that of MBr, leading to significant loss in benefit.
France	Seeds	0.135	0.135	none	0.100		0.024		MBTOC recommends 0.024 tonnes for the treatment of alfalfa seeds against nematodes in 2007. MBTOC knows of no alternative for this purpose. MBTOC is unable to assess the remainder of the CUN that pertains to other seed infested by insects because the CUN has not clearly justified why alternatives in use by other seed companies in France and other EU countries cannot be used in the circumstances of this nomination. The CUN does not clearly explain what the 'seasonal activity' referred to by the applicant is, and why it is different than other seed companies in France. Alternatives such as phosphine, various inert gas treatments and packaging, and various heat and cold treatments are technically feasible. The Party may wish to resubmit this nomination with clear justification that shows why technically effective alternatives are not suitable in their circumstances. Further information is sought on whether the CUN meets requirements of Decision IX/6. The CUN should provide the volume of product to be treated, the dosage rate, conditions of treatment and other information requirements as suggested in the Handbook for Critical Use Nominations for Methyl Bromide (www.unep.org/ozone).	CUN states that pesticides, which they argue are partially technically feasible and registered, costs up to 7x as much as MBr to apply. CUN also argues a loss of market opportunity, but lacks data to quantify this.

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France	Carrots	8.000	8.000	none	5.000		1.400		MBTOC recommends a reduced CUE of 1.4 tonnes for 2007. This is for treating 4 Ha at 350 kg per ha with use/ emission reduction technologies according to MBTOCs standard presumptions. Although the Party asked for 5 tonnes, only 4 ha are identified for treatment in section 8 of the nomination. Carrots are grown worldwide without use of MB but the EC has recognized the exceptional circumstances for this crop and disease complex involving *Fusarium solani* for which no technical or economically feasible alternatives to MB have been recognised.	CUN states that, theoretically, Dazomet should result in a decline in net revenue of only 10%, but this argument is based on only a single trial.
France	Cucumbers	60.000	60.000	none	15.000		12.500		MBTOC recommends a reduced amount of 12.5 tonnes of MB for this use in 2007. The calculation of the nomination is based on the standard presumption of 175 kg per Ha under LPBF using use/emission reduction technologies. The nomination is for 35 ha of production area. Although this rate is higher than the standard pathogen control rate of 150 kg/ha, *Phomopsis sclelotioides* is particularly difficult to control and requires the higher rate usually applied for nutsedge control. Limited alternatives are available in France, as chloropicrin or mixtures of this material with other chemicals are not registered. A large proportion of cucumber production is already in soilless culture (75%), but adoption of this alternative in the remaining cropping area is considered uneconomic by the Party. It is anticipated that registration of chloropicrin, use of grafted plants to improve disease control and expansion of soilless culture will further reduce the need for methyl bromide in the near future (Fritsch, 2002). The amount of methyl bromide recommended is a 97% reduction in use of MB since 1997.	CUN states that although the cost of chemical alternatives is lower, yield losses result in lower net revenue (by 15 to 30% depending on source). The loss in net revenue for soilless cultivation (greenhouses) is slightly less

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France	Cut flowers and bulbs	60.000	52.000	none	12.000		U		MBTOC is unable to assess this nomination at this time. The nomination is for soilborne fungi, nematodes and weeds affecting different kinds of flowers grown in open fields and under cover. MBTOC recognises the effort made by the Party in reducing the amount of MB requested over the past years, from 52 tonnes in 2006 to 12 tonnes for 2007. However, MBTOC still requires information on the adoption of substrates, which the Party states could replace at least part of the nominated MB in a period of 5 to 10 years but is economically unfeasible (no economical analysis has been provided). Metham sodium and solarisation have been identified as suitable alternatives for open field crops, particularly if combined with crop rotation. An application for registration of chloropicrin was submitted in 2005 and this alternative is expected to become available in 2006. Information on the adoption schedules for these alternatives is also requested.	CUN states that solarization carries high economic risk because the loss in revenue from the second crop is larger than the cost saving from fumigation, that steam disinfestation costs more than 15000 € per ha, and that adoption of soil-less cultivation requires high capital costs. CUN states that with ranunculus the net revenue for solarization is higher than for MB, while for lilies of the valley metham sodium has lower net revenue than MB
France	Eggplant	125 (eggplant pepper and tomato)	22.000	none	33.250		0 NR		MBTOC does not recommend this CUN. The CUN is for soilborne pathogens affecting eggplants particularly Verticillium dahliae, for which different alternatives are technically and economically feasible: Steam is widely used to control *V.dahliae* and other pathogens in some European countries and can even be used in the 17 ha heavily infested soils that make part of this nomination. Very good root stocks resistant to *V.dahliae* are now available (KNVFFr) and eggplant grafting is widely used in many countries with similar climate and cropping systems (Spotti, 2004). Registration of chloropicrin is expected for 2006 and soon thereafter of mixtures of this material with other chemicals, such as 1,3D+Pic. These alternatives, combined with grafting will provide excellent control options for the nominated areas (Loumakis, 2004; Spotti, 2004; Tognoni *et al,* 2004; Kah, 2005). 3% (15 ha) of the eggplant area is now in soil less culture and this technique can be expanded at least partially in the nominated area (Spotti, 2004; Tognoni *et al*, 2004; Leoni *et al,*2004).	CUN argues that the cost of steam treatment is too high. CUN states that although the cost of chemical alternatives is lower, yield losses result in lower (20 to 35%) net revenue. The loss in net revenue for soilless cultivation (greenhouses) is even higher. CUN also argues that the current cost of investment in relation to the average product price makes it economically infeasible to increase the soilless surface area.

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France	Forest nurseries	10.000	10.000	none	1.500		U		MBTOC is unable to assess this nomination at this time until a fuller economic analysis is provided on the use of containerisation. MBTOC recognises that propagative material requires a very high level of soilborne pest and pathogen control in order to avoid widespread distribution of pests and pathogens into the fruiting fields. Registration of chloropicrin is expected for 2006 and soon thereafter of mixtures of this material with other chemicals, such as 1,3D+Pic but these are not yet available. Substrates are considered uneconomical at 2.5 times the cost of traditional production in soil but no economic analysis has been provided and is requested from the Party. Dazomet is not sufficiently effective to provide a plant quality comparable to methyl bromide (using methyl bromide, return can be enhanced 50% relative to MITC treated plants due to size, shape, and diameter of trees). The minimum rate of methyl bromide allowed by regulation is 50 $g/m^{2,}$ however MBTOC notes that lower rates are in use in other similar industries using LPBF films. MBTOC notes that efforts are being made by that the Party to amend the regulation no. AGRG 0000311 V to permit lower doses of MB and register lower formulations of MB, especially 50:50.	CUN argues that the cost of steam treatment is too high, as is the cost of hand weeding and container cultivation. CUN concludes that alternatives are uneconomic as a result of lower net revenue, and that the need for MBr disinfection will grow in the next 2-5 years with the expected rapid development of micorrhized Douglas pine and oak production.
France	Orchard & raspberry nurseries	5.000	5.000	none	2.000		2.000		MBTOC recommends 2 tonnes for this CUN for 2007. The CUN states that MB is used only in 4% of the production area where populations of nematode and soil fungi, especially Phytophthora, are high. The CUN is for the same quantity licensed for 2006. MBTOC recognises that propagative material requires a very high level of soilborne pest and pathogen control in order to avoid widespread distribution of pests and pathogens into the fruiting fields. Registration of chloropicrin is expected in 2006 but this alternative is not yet commercially available. Dazomet is an effective alternative for areas where fungal populations are low to moderate, but is significantly less effective when disease pressure is high, particularly when Phythophthora is present. 1,3 D is being used in instances when nematodes are the key pest. The Party provides results of new studies with dazomet, 1,3 D and combinations of these two chemicals . MBTOC further encourages the Party to provide more detailed information, if nominations are made in future, on pathogen levels on plants (pathogen tolerance) for those pathogens subject to certification requirements as well as comparative measures of plant vigour. The rate of methyl bromide allowed by regulation is 50 g/m2. MBTOC notes that efforts are being made by that the Party to amend the regulation no. AGRG 0000311 V to permit lower doses of MB and register lower formulations of MB, especially 50:50.	CUN states that alternatives result in a decline of 20-40% in net revenue for apples and raspberries respectively but sanitary quality is not guaranteed.

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France	Orchard replant	25.000	25.000		7.500		7.000		MBTOC recommends a reduced amount of 7.0 tonnes for this CUN for 2007. The CUN is for controlling the orchard replant complex. MBTOC recognises that there may be regulatory restrictions on the minimum dosage allowed in France, but bases its recommendation on the use of 35g/m2 on bed treatment which constitutes 50% of the treated area. This dosage conforms to MBTOC's standard presumption of 350 k/ha of 98:2. Although a number of possible alternatives exist for controlling replant problems, these are based on combinations of chloropicrin with other chemicals and this material is not yet registered in France. MBTOC notes that a large area (80%) is not treated with MB; 18% of such area is presently subjected to crop rotation, treated with Dazomet or otherwise subjected to agronomic practices that help reduce pathogen incidence. The main constraint to the adoption of alternatives is the inability to clearly identify the causal agents of replant disease. The Party is encouraged to extend the use of soil testing to confirm the necessity for MB fumigation.	CUN states that alternatives result in a decline of 10-20% in net revenue.
France	Pepper	(see eggplant)	27.500	none	6.000		6.000		MBTOC recommends a CUE of 6.0 tonnes for this use in 2007. The CUN is for control of *Phytophthora capsici*. Chloropicrin, a suitable alternative, is expected to become registered in 2006 but is not yet available. Although MBTOC's standard presumptions include a dosage rate of 35 g/m2 of MB 98:2, registered doses are higher in France, where 60 g/m2 are required for *P. capsici*, 50 g/m2 for other soilborne pests and 40 g/m2 for nematodes. Presently, different alternatives are technically and economically feasible for this use: Steam is widely used to control *P.capsici* and other pathogens in some European countries (Barel, 2004) and its use could be expanded in the 25 ha of heavily infested soils reported in the CUN. Grafting is also an alternative although MBTOC recognises that its use in peppers is not yet widespread. Registration of chloropicrin should provide further options of control, when used alone or in combination with other chemicals or with grafting Spotti, 2004). 3% (15 ha) of the pepper area is now in soil less culture and this technique can be expanded at least partially in the nominated area. MBTOC notes that efforts are being made by that the Party to amend the regulation no. AGRG 0000311 V to permit lower doses of MB and register lower formulations of MB, especially 50:50.	CUN argues that the cost of steam treatment is too high. CUN concludes that cultivation with existing chemical alternatives will cause a decrease of the revenue of 15 to 30%. Soil-less culture gives higher net revenue, but given the high capital investment required, the total area in soil-less culture is only 20 ha in France. Moreover, these data do not take into account the drastic increase of steel and energy prices that makes soilless culture much less attractive.

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France	Strawberry fruit - protected and open field	90.000	86.000	none	34.000		U		MBTOC is unable to assess this nomination.. The Party states that MB is needed for soil-grown strawberries that carry "terroir" labels, such as Perigord which cannot convert to non-soil systems such as substrates as done in other areas because the terroir standards require production in soil. Several treatments available in France appear to provide yields similar to MB in some circumstances, or enable reduced frequency of MB application, for example metam applied by drip or by specialist equipment, metam + 1,3-D (Fritsch and Rabasse, 2000; CIREF 2005 5-year study; Porter *et al,* 2006). The Party states that MS applied by drip 'seems to be the good way in order to decrease the use of MB'; the product was registered in 2005 and adopted on about 100 ha that year. Uptake may be limited by a longer waiting period due to colder temperatures in certain specific regions. Further information is requested on crop schedules for double-fruiting and non-double-fruiting plants; and identify the percentage of each that uses frigo plants.	CUN states that a net revenue of 12 000 euros (farmers earn net revenue of around 20 000 euros per hectare on 1.5 ha farms) is equivalent to the guaranteed minimum wage. Net revenues lower than this means there is an advantage to being unemployed. Given that the cultivation of strawberries without fumigation and with existing chemical alternatives decreases net revenues by some 50%, this will cause serious social disruption in poorer regions. While net revenues for soilless culture are only 8% lower, the investment is not acceptable for older farmers, where more than 40% of the farmers are older than 50. However, CUN states that metam sodium has a lower cost, hence even if it results in a commercial yield that is 36% lower, it will be possible to use after registration.

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France	Strawberry runners	40.000	40.000		28.000		28.000		MBTOC recommends a CUE of 28 tonnes. The Party states that MB is required to meet the certification standards for strawberry runners. Metham sodium is used in areas of low disease pressure and MB/Pic (98:2) is used on the remaining 80% of land every second year - ie 60 ha. MBTOC acknowledges that the Party has a reduced range of alternatives available because chloropicrin is not registered. The Party's research and testing program indicates several potentially feasible alternatives are being considered, ie. 1,3-D + PIC combination [awaiting the registration of PIC], DMDS [registration not likely before 2009] and methyl iodide [awaiting outcome in the US]. MBTOC notes that efforts are being made by that the Party to amend the regulation no. AGRG 0000311 V to permit lower doses of MB and register lower formulations of MB, especially 50:50. This is considered important as other strawberry runner growing regions in the world use much lower rates of MB. The Party is requested in future nominations to demonstrate that alternatives do not achieve the pathogen and pest tolerance levels to meet certification requirements.	CUN argues (based on trials) that although costs of alternatives such as metam sodium are lower than MBr, alternatives could result in negative net revenue. In addition, certification is not guaranteed.
France	Tomatoes		48.400		33.250		0 NR		MBTOC does not recommend this CUN. MB is no longer used for tomatoes in most European countries (Besri, 2004; Garcia-Alvarez *et al*, 2004; Tello, 2002). According to the CUN, soil disinfestation with MB is the option for controlling corky root, particularly in view of the fact that chloropicrin is not yet registered. Although MBTOC's standard presumptions include a dosage rate of 35 g/m2 of MB 98:2, registered doses are higher in France, where 60 g/m2 are required for *P. capsici*, 50 g/m2 for other soilborne pests, 50 g/m2 and 40 g/m2 for nematodes. Presently, different alternatives are technically and economically feasible for this use: Steam is widely used to control *P.capsici* and other pathogens in some European countries (Barel, 2004) and its use could be expanded in the 50 ha of heavily infested soils reported in the CUN. Grafting is already widely used in France (30 % of the tomatoes grown are grafted, De Miguel, 2004; Besri, 2003; Spotti, 2004), even though resistance to corky root is not always robust, and registration of chloropicrin and Pic mixtures in combination with grafting will further expand the scope of efficient alternatives available. Forty per cent of fresh tomatoes (1200 Ha) are presently produced in soil less culture and this alternative may be further expanded (Besri, 2003; Spotti, 2004; Tognoni *et al,* 2004; Leoni *et al, 2004).*	CUN argues that the cost of steam treatment is too high, while high grafting increases the cost of the plant. CUN states that a net revenue of 12 000 euros (farmers earn net revenue of around 20 000 euros per hectare on 1.5 ha farms) is equivalent to the guaranteed minimum wage. Net revenues lower than this means there is an advantage to being unemployed. Given that the cultivation of tomatoes without fumigation and with existing chemical alternatives decreases net revenues by some 30 to 50%, this wil cause serious social disruption. While net revenues for soilless culture are only 8% lower, the investment costs are high.

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Greece	Dried Fruit	4.280	3.081	none	0.900		U		MBTOC is unable to assess this nomination for 2007. The Party was sent a detailed request for information that may assist in assessing this nomination, but no response has been received by MBTOC. Information is sought on the separate volumes of raisins and the volumes of figs to be treated with MB and conditions of treatment, including temperature, at time of treatment. Further information is also sought on the marketing of raisins and figs including important marketing timeframes and economic arguments and how these factors impact the CUN.. The Party is asked to explain why phosphine cannot be used in the circumstances of this nomination for at least part of this CUN and to explain the need for repeated, frequent fumigations using methyl bromide.	No economic data given
Greece	Mills & Processors	23.000	15.445	none	1.340		1.340		MBTOC recommends a CUE of 1.34 tonnes for this use for 2007. The Party's MB use for this application has shown a steep decline since 2005. The applicant does not give details of the alternatives currently proposed for use. MBTOC advises the Party that the standard dosage rate for mill treatment is 20 g/m^3. MBTOC would wish to encourage the consideration of heat disinfestation and IPM as a means to further the replacement of MB. (Dosland et al, 2006). Given the relatively low amount of MB requested by the Party, in the face of the 20 mills that will require pest control, the Party might need to consider allocation strategies that reserve MB for those mills whose size, layout and design, age and/or location make transition most difficult.	CUN states that carbon dioxide cannot be used because of costs, while both boiling and cold treatment require the installation of boilers along with peripherals in every fumigation facility.
Ireland	Mills	none	0.888	none	0.611		U		MBTOC is unable to assess this nomination. Registration of sulfuryl fluoride was much faster than anticipated and preceded MBTOC's review by only two weeks. The applicant indicated in the CUN that when SF was registered it could immediately begin adoption. In other countries, MBTOC has found that adoption of SF in mills located in northern climes requires time to transition because the treatment must be conducted with concurrent heat treatment, a process that requires study and modelling. However, given the statements in the CUN, we were uncertain whether the applicant needed time to transition and therefore still needed the full amount requested, or in the new circumstances needed a reduced allocation for 2007. MBTOC awaits advice on this matter.	CUN notes sulfuryl fluoride will be at least 2.5 times the cost of methyl bromide, while no accurate cost of heat treatment is available. There are also losses from additional downtime when alternatives are used.

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Israel	Dates	3.444	2.755	none	2.200		2.200		MBTOC recommends 2.2 tonnes for 2007 for this use. The Party has continued its 20% decrease for 2 years. The Party has recently made excellent advancements in research and commercial adaptation of heat treatment under difficult circumstances in remote packing houses. The remaining MB is needed to allow time to transition the most difficult regions with techniques developed in Israel.	CUN recognises a new technology using heat to disinfest and control date pests**.** CUN says that although a cost-benefit analysis has yet to be made, the initial capital expenses were reasonable taking advantage of existing drying facilities and a dryer adapted for heat disinfestation treatment. Furthermore, energy costs are incorporated within the existing costs of drying. Although the technology still could benefit from further fine-tuning, the final results are satisfactory.
Israel	Flour mills	2.140	1.490	none	1.490		U		MBTOC is unable to assess this nomination. Decision IX/6 requires that use of methyl bromide be minimised. For post-harvest and structural users of methyl bromide, MBTOC interprets this as requiring adoption of standard industry techniques of integrated pest management practices in mill sanitation to reduce infestation and reduce frequency of fumigation. Improved fumigation sealing techniques to minimize methyl bromide use are also required. The CUN indicates that improvements could be made in the IPM techniques used in mills. The CUN gives no information about mill sealing and other techniques used to minimise use of methyl bromide in fumigation. The applicant has not provided research data on alternatives and has no transition plan. As an avenue of further adoption MBTOC suggests that heat treatments may well be efficacious and useful in the climate of Israel. (Dosland et al, 2006). MBTOC also notes that two additional mills are included in this CUN this year from the Palestine Territory, which the CUN describes as Article 5(1).	CUN provides no economic analysis.
Israel	Furniture	1.442	0.000	none	1.442		0 NR		MBTOC does not recommend this use. The CUN does not justify the use of MB for wood when numerous alternatives such as CO_2, N_2 and vacuum treatments can be used for this purpose . The applicant has provided no research data on effectiveness or economics of alternatives and supplied no information to show that alternatives are not registered.	CUN provides no economic analysis.

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Israel	Museums	none	none	none	0.600		0 NR		MBTOC does not recommend this use. Alternatives such as CO_2, N_2, vacuum, cold are all technically effective for moveable artefacts. (Navarro, 2006). The Party may wish to resubmit this nomination with clear indication proposing only immovable objects, items contaminated with fungi or entire libraries with infested books, or if the Party has a clear justification that shows why technically effective alternatives are not suitable in their circumstances. In which case, the Party may provide information that the CUN fully meets the requirements of Decision IX/6 and provide the volume of product to be treated, the dosage rate and the conditions of treatment.	CUN provides no economic analysis.
Israel	Broomrape	none	none	none	250.000		250.000		MBTOC recommends 250 tonnes of MB for this use for 2007. The CUN is for broomrape eradication and land rehabilitation of 1000 ha in the Upper Galilee and the Golan Heights. A total of 5700 ha is highly infested with this weed, making it impossible to produce tomatoes in these regions. The recommended CUN is based on a dosage of 250 kg/ha of 98:2 MB with use/ emission reduction technologies. Chloropicrin or MB formulations with higher proportion of Pic are not registered in Israel. MB will be used only once in each region and it is expected to bring the weed parasite population below the damage threshold allowing for other alternatives to be adopted. In addition, the Party expects that in 2007-2008, some alternatives and combinations such as 1,3-D/Pic, sequential application of 1,3-D+ metham sodium and resistant varieties will become registered or available. The Party has also identified other alternatives to control low infestations of Orobanche (e.g. Sulfosulfuron, solarization).	CUN states that broomrape infestation is aggravated by the phase out of MB, as registered alternatives do not prevent area-wide infestation with the parasitic weed. The same is true for agrotechnical means, long-term fallow cropping and biological control which in practice and in economic terms do not cope with the long-term vitality of broomrape seeds and their gradual germination mechanism. CUN also states that prospects for the registration of *Imazapic* are low and the manufacturer, having doubts about the cost-effectiveness of its registration, might refrain from its further development. Further, soil solarization, usually applied on intensive vegetable crops, is too expensive and delicate for extensive outdoor crops.

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Israel	Cucumber	none	none	none	25.000		25.000		MBTOC recommends 25.0 tonnes of MB for this CUN for 2007. The CUN states that cucumbers are grown in open ended polyhouses in 3 cropping cycles per annum in the proximity of the residential houses of cooperative family and private family farms. 70% of the need for MB is concentrated in one village, where the growers specialized for years in the cultivation of indoor cucumbers for the domestic market. The need for MB could be considered as a niche request and was not submitted previously since most of the crop's pathogen control problems were resolved satisfactorily at the commercial level. For two out of the three cropping cycles, solutions were found despite the monoculture production pattern which reflects the specialization of the growers but narrow rotations enhances the pressure from soil-borne pathogens. The two additional reasons for the submission of the request for MB are the appearance of *F. oxysporum f. sp. radicis cucumerinum* for which MB is the recommended control means and there are buffer zone limitations on the use of the MS+1,3-D mixtures. The pathogen is highly virulent and the infestation level particularly high in the affected location and it could devastate entire greenhouses in a short period of time. Furthermore, low soil temperatures prevailing in the fumigation season of December-January constraint the adoption of MB alternatives. The nominated amount is based on a dosage of 250 kg/ha of 98:2 MB in conjunction with use/ emission reduction technologies. Chloropicrin or MB formulations with a higher proportion of Pic are not registered. The Party states that trials on alternatives are proceeding.	CUN states that the costs of grafted seedlings are a limiting factor because the technology in cucumbers is in its infancy. Furthermore, the CUN states that Basamid is not economically feasible due to its high prices and its low efficacy in the winter when prevailing soil temperatures are too low for its safe use.
Israel	cutflowers - bulbs - protected	303.000	240.000	none	321.330		U		MBTOC does not recommend use of 5T of MB for fumigating substrates and is unable to assess this remaining CUN. Economic validation is needed for production of certain flowers such as carnations in substrates, which has proven effective in many parts of the world (Savvas and Passam, 2002; Urrestarazu, 2004). The requested amount of MB is higher than the 2005 nomination due to new flower types being grown and needing fumigated soils. MBTOC commends the Party on the adoption of LPBF (barrier films) and reducing rates to conform to MBTOC standards in a large proportion of the cropping area. Lack of registration of key alternatives and chloropicrin mixtures for many flower types is the major factor affecting substitution of MB at this time. However there is scope for reduction based on adoption of LPBF in the Gaza strip at the Palestinian Authority and reducing rates to or below 35 g/m2. Further, MBTOC does not recommend the use for fumigating substrates used for rose production, since steaming is a feasible option for this	CUN provides partial budgets for MB and the next best alternatives. The net revenue for the next best alternatives is negative in all cases. CUN also states that soil steaming is not cost effective at a cost of $0.88/m^2, and solarisation is not cost effective taking into account the time spent on mulching: 6-8 weeks, the cost of the plastic, fencing, irrigation system and water for soil wetting.

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									use (Barel, 2003,2004; Runia, 2000). Substrates that are high in organic matter and can also be composted. Finally, the Party has identified production of mini-plants for rose propagation as a feasible alternative to MB needed for fumigating substrate in which rose plants are traditionally produced.	
Israel	Cutflowers - open field	77.000	67.000	none	80.755		U		MBTOC is unable to assess this CUN and is awaiting information requested from the Party. In particular, MBTOC requires information on registered herbicides that may be used for weed control in field grown flowers; the feasibility of performing strip treatments for at least some of the flower types involved in the nomination; expected adoption of solarisation for those flower types where this alternative has been identified as feasible; and information on the relative effectiveness of alternatives with respect to MB. The nomination request is higher than that of the previous year due to expansion of the cropping area grown with flowers, particularly proteas (300+ new Ha) and some geophytes (30 new Ha). MBTOC recognises the effort made by the Party in adopting LPBF (barrier films) for 100% of the treated area and reducing the MB dosage to 350 kg/ha conform with MBTOC guidelines in a short period of time. Lack of registration of key alternatives such as 1,3-D+Pic, dazomet and metham sodium and MB formulations with higher chloropicrin content are the major constraints affecting substitution of MB at this time. Solarisation and metham sodium (where registered, at this time only in gladioli) have been identified by the Party as feasible alternatives for a proportion of this nomination.	CUN provides partial budgets for MB and the next best alternatives. The net revenue for treatment with Basamid is higher than with MB, but this product is not registered. The use of metham sodium on solidago results in a 60% decline in net revenue, while alternatives for lizianthus result in negative net revenue.
Israel	Fruit tree nurseries	50.000	45.000	none	10.000		U		MBTOC is unable to assess this nomination until responses to questions posed to the Party have been received. MBTOC recognises that propagative material requires a very high level of soilborne pest and pathogen control in order to avoid widespread distribution of pests and pathogens into the fruiting fields. The information required to assess the nomination includes: A technical reason (including data) to support the reasons why 35 g of MB/m2 in combination with use/ emission reduction technologies (barrier films or lower dose MB/Pic formulations or other methods) are not considered effective; An indication of the expected penetration of substrates for seedling production in the remaining 50% of the fruit tree nursery area, and the constraints to treating substrates with steam before reutilisation. The Party is further requested to confirm the correct nominated amount (10 tonnes or 7.875 tonnes?) and to provide information to substantiate claims that some alternatives such as substrates and steam are not economically feasible.	CUN states that economic assessment is not feasible in this case since the effect of MB or its alternatives impacts the quality of the produced seedlings. The quantitative aspect is not recorded and is not significant economically. The quality of the seedlings is the raison d'etre of the whole industry and a zero tolerance level is imposed on it for bacterial galls and symptoms of nematodes.

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Israel	Melon - protected and field	125.650	99.400	none	140.000		99.500		MBTOC recommends a 99.5 tonnes for a CUN for this use in 2007. *Monosporascus cannonballus* is the key pathogen affecting winter production of melons in the Arava Valley. *Fusarium oxysporum f.sp. melonis* and root-knot nematodes, mainly *M. javanica are also affecting crops*. MBTOC notes that MB has been fully replaced with alternatives for fall production of melons in the same region: 1,3-D, metham sodium, dazomet, solarisation, formaldehyde+MS, and 1,3-D+Pic in the southern Arava. The long plant back time of these fumigants during the winter and the lack of appropriate climatic conditions for solarisation make these options unfeasible in the winter. The nominated quantity has been calculated based on a dosage of 25 g/m2 in conjunction with use/ emission reduction technologies. In the absence of alternatives proving ineffective, the Party, if possible, is urged to consider registration of MB formulations with a higher content of chloropicrin, (eg. 50:50, 30:70) to allow further reduction of MB in the future.	CUN provides partial budgets for the next best alternatives. The net revenue for the next best alternatives is negative.
Israel	Potato	239.000	165.000	none	137.500		137.500		MBTOC recommends 137.5 tonnes of MB for this use for 2007. There are 15,000 Ha of potatoes grown in Israel and alternatives to MB have been implemented for management of key pests and pathogens for all regions. The applicant identified that such alternatives do not work in 550 ha in highly populated areas where winter production occurs, infestations are high and regulatory constraints are in place for feasible alternatives such as 1,3D+ Pic (61:35). This product is prohibited near residential areas in 15% of the potato acreage in this region. The CUN further indicates that mechanical injection machines are being developed for the application of metham sodium and formaldehyde, which will help decrease the environmental contamination caused by these two chemicals making them toxicologically acceptable for the specific conditions of the densely populated Sharon region. It is anticpated these alternatives will be implemented soon. In the absence of complete uptake of these alternatives, the Party, if possible, is urged to seek registration of MB formulations with higher content of chloropicrin in order to further reduce MB use.	CUN shows that the net revenue using MB is negative, while for the next best alternative it is positive. CUN states that the registered alternatives carry environmental and economic costs. CUN also states that potatoes cannot be cultivated under soil-less culture or with plug plants, as once planted in infested soils would lose their advantage and end up with high economic losses. CUN states that Telopic is more cost effective in the Sharon than in the Negev; that Telon II-94%, Cadusafos and Fenamiphos is cost effective, and that Bionem/Bio-safe is used only in organic farming and is not cost effective for mainstream production.
Israel	Strawberry runners	35.000	35.000	none	176.200		U		MBTOC is unable to assess this nomination at this time. The Party is requested to disaggregate the CUN for strawberry fruit and strawberry runners. The CUN states that the introduction of *Macrophomina phaseolina* in 2004 threatens all strawberry fruit and runner growing areas. The Party	CUN shows that the net revenue using MB is lower than for the alternatives. CUN states that the registered alternatives carry

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									further indicates that the fungus had become worse because of reduced MB rates in 14 fields as well as the use of 1,3-D for 3 consecutive years in 2 other fields. The CUN also states that 1,3-D + Pic has been the leading alternative, but that further adoption of is limited by the required 250 m buffer which significantly limits its use in the 2 primary strawberry growing regions – Sharon (332 ha) and Ghaza (120 ha) since they are heavily populated. For Sharon the Party requests a 350 kg/ha 98:2 formulation with LPBF (eg.VIF), and for the Ghaza Strip a 500 kg/ha 98:2 formulation with PE film. MBTOC's standard presumptions require that use/ emission technologies be implemented, and in consequence the Ghaza strip rate will be reduced to 35 g/m2. The Party is requested in future nominations to demonstrate that alternatives do not achieve the pathogen and pest tolerance levels to meet certification requirements.	environmental and economic costs. CUN also states that soilless cultures are a possibility, but not before 2010 due to the high costs of the technology.
Israel	Strawberry fruit	196.000	196.000	none	see str runners		U		MBTOC is unable to assess this nomination at this time. The Party is requested to disaggregate the amount for strawberry runner production from the previous CUN.	
Israel	Tomato	none	none	none	90.000		22.750		MBTOC recommends a reduced amount of 22.750 tonnes for this use in 2007. The reduction is based on adjusting the application rate to conform to MBTOC's standard presumptions of 35g of MB/m^2 in combination with use/ emission reduction technologies. The nomination is for the eradication of the newly introduced soilborne fungus *Verticillum dahliae*, race 2. The CUN states that this request is only for one year and no further requests are expected in the future.	CUN provides no economic analysis.
Italy	Artifacts	5.225	5.225	none	5.000		U		MBTOC is unable to assess this CUN for 2007. The Party has requested that MBTOC delay its review while additional information is being prepared. If the information is received by mid-August 2006, MBTOC can review this CUN at its meeting in late August.	No economic data given
Italy	Mills and processors	160.000	65.000	none	25.000		U		MBTOC is unable to assess this CUN for 2007. The Party has requested that MBTOC delay its review while additional information is being prepared. If the information is received by mid-August 2006, MBTOC can review this CUN at its meeting in late August.	CUN notes that the cost of treatment with sulfuryl fluoride is higher.

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Italy	Cut flowers, bulbs - protected	250.000	187.000	none	30.000		30.000		MBTOC recommends 30 tonnes of MB for this CUN as requested. The Party has rapidly and significantly reduced the requested amounts over the last three years (from 250t in 2005, to 187 t in 2006), and is transitioning to alternatives. MBTOC also recognises efforts made by the Party in reducing dosages of MB to conform to MBTOC standard presumptions including use/ emission reduction technologies and in obtaining registration of key alternatives such as chloropicrin. The CUN states that substrates are not feasible because water supply is insufficient and open substrate systems cause unacceptable contamination of soils. However, in many parts of the world simple and relatively inexpensive systems are in place, by which water can be re-circulated and cleaned, thus avoiding these two problems (Savvas and Passan, 2002; Savvas, 2003; Pizano, 2005). The Party is encouraged to further evaluate the acceptability of such systems.	CUN argues that farms are too small for rotation to be economically viable. CUN provides some data on the cost of alternatives, all of which are lower cost than MB, except for steam and soilless production.
Italy	Eggplant - protected	194.000	156.000	none	15.000		0 NR		MBTOC does not recommend this CUN for 2007. MBTOC recognises the effort made by the Party in reducing the nomination from 96 T in 2005 to 15 T requested for 2007 however effective alternatives exist. The CUN states that eggplant production is mostly concentrated in Southern Italy where local soil and climatic conditions make simultaneous infestations of fungi, weeds and nematodes very common. Key fungal pathogens are *Verticillium wilt, Fusarium* spp.*, Sclerotium rolfsii, Rhizoctonia solani, Phytophthora* spp*,* for which different alternatives are economically and technically feasible. Chloropicrin is registered in Italy and sequential application with 1,3-D is now possible and effective (Loumakis, 2004). Grafting on resistant root stock is now a well validated and adopted technology and many nurseries in Italy now produce grafted eggplant plants (Spotti, 2004; Kah, 2005). Substrates are also widely used and prove technically and economically feasible in many regions with similar climates and also in the nominated area (Spotti, 2004; Tognoni *et al*, 2004; Leoni *et al*, 2004).	CUN provides some data on the cost of alternatives, most of which are lower than MB, but produce lower yields. CUN also mentions the high cost of steam, soilless production and grafted plants.
Italy	Melon - protected	131.000	131.000	none	10.000		10.000		MBTOC recommends 10 tonnes of MB for this use in 2007. The key pests are *Fusarium solani, Fusarium oxysporum f.sp. melonis, Monosporascus cannonballus, Sclerotinia sclerotiorum, Meloidogyne* spp. and *Verticillium* spp. Use of sequential application of 1,3 D and Pic has allowed significant reduction from previous CUN applications of 112 t to 38 t and further to the current amount of 10 t. The rapid transition of a large proportion of growers to alternatives is recognised, and it is anticipated that there will not be a future nomination from this Party for this crop.	CUN provides some data on the cost of alternatives, most of which are lower than MB, but produce lower yields. CUN also mentions the high cost of steam, soilless production and grafted plants.

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Italy	Pepper - protected	160.000	130.000	none	67.000		67.000		MBTOC recommends an amount of 67 tonnes of MB for this CUN. The CUN states the nomination is restricted to areas where alternatives are not available because of economic and technical reasons. Alternatives however, are considered to exist (Loumakis, 2004; Tognoni, *et al,* 2004; Spotti, 2004), however further time is required for transition. Pepper production is mostly concentrated in Southern Italy where, due to local soil and climatic conditions, the occurrence of high level of infestation of fungi and nematodes is very common. Chloropicrin has recently been registered in Italy allowing for sequential applications with other products, but mixtures with other chemicals are not yet registered. Grafting is a technically feasible alternative (Spotti, 2004) but has only been recently introduced and further time is needed to expand its uptake. Other feasible alternatives include steaming and soil less culture.	CUN provides some data on the cost of alternatives, most of which are lower than MB, but produce lower yields. CUN also mentions the high cost of steam, soilless production and grafted plants.
Italy	Strawberry fruit	407.000	320.000		35.000		0 NR		MBTOC does not recommend this nomination. The nomination is based primarily on the short time for which newly registered alternatives have been available. MB is applied every 2 or 3 years. However, 1,3-D EC and Pic EC were registered in 2001 and 2002 respectively and have been adopted on large areas in Italy; 1,3-D traditional formulations and metam were used from earlier years. Several of the alternatives used in Italy provide yields that are statistically similar to MB, such as 1,3-D and Pic (sequentially-applied), metam+ pic, metam drip application, and pic + VIF (Spotti, 2004; Ajwa et al., 2002, 2003, 2004; Haar et al.,2001; Nelson et al., 2001a,b; Fritsch and Rabasse, 2000). The recent annual adoption rate for fumigants in strawberry fruit in Italy is 630 – 650 ha/year, while the CUN is for 120 ha. There appear to be no different or specific circumstances that prevent use of the alternatives in the remaining area of MB use.	CUN provides some data on the cost of alternatives, most of which are lower than MB, but produce lower yields. CUN also mentions the high cost of steam and soilless production.

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Italy	Strawberry runners	120.000	120.000		35.000		35.000		MBTOC recommends an amount of 35 tonnes for this use for 2007. The CUN states that MB is required to meet certification of 100% pathogen-free strawberry runners and this is not technically feasible with the currently registered alternatives. Trials to reduce the dosage of MB:PIC (e.g. 50:50] have been carried out, but only the 98:2 formulation is currently registered. The Party is requested in future nominations to demonstrate that alternatives do not achieve the pathogen and pest tolerance levels to meet certification requirements. Also, in the absence of effective alternatives the Party if possible is urged to consider registration of lower MB formulations/doses to reduce MB dosage rate.	CUN provides some data on the cost of alternatives, all of which are lower cost than MB, except for steam.
Italy	Tomatoes - protected	871.000	697.000	none	418.000		0 NR		MBTOC does not recommend this CUN. Italy is the only member state of the EC requesting a CUN for this use. The CUN states that local tomato varieties are susceptible to soilborne pathogens (fungi and nematodes) and that alternatives presently available are not sufficiently efficient but this claim is not substantiated. Key fungal pathogens are *Verticillium, Fusarium* spp., *Sclerotium, Rhizoctonia, Phytophthora* spp, for which different alternatives are economically and technically feasible. Chloropicrin is registered in Italy and sequential application with 1,3-D is now possible and effective (Minuto, 2003). Grafting on resistant root stock is now a well validated and adopted technology and many nurseries in Italy now produce grafted tomato plants (Besri, 2003, Spotti, 2004). Substrates are also widely used and prove technically and economically feasible in many regions with similar climates and even the nominated area (Besri, 2003; Spotti, 2004; Leoni *et al, 2004; Tognoni* et al, 2004). Combined alternatives e.g. grafting + chemicals, grafting + solarisation and others can be used (Loumakis, 2004; Spotti, 2004, Tognoni et al, 2004).	CUN provides some data on the cost of alternatives, most of which are lower than MB, but produce lower yields. CUN also mentions the high cost of steam, soilless production and grafted plants.
Japan	Chestnuts	7.100	6.800	6.500		6.300		6.300	MBTOC recommends 6.3 tonnes for this use in 2008. The CUN relates particularly to fresh market chestnuts, which impacts the technical availability of alternative treatments, compared for chestnuts used for processing. Although the Party has conducted research trials on many potential alternatives, there are no registered alternatives that do not harm the quality and marketability of fresh market chestnuts. Unlike other nuts which are durable commodities, chestnuts are a high moisture, semi-perishable food. In Japan, they are harvested one day, fumigated on-farm in small lots and moved to marketing channels through short term storage facilities. The pest of concern and the requirement to kill eggs and larvae due to short storage before	CUN provides no economic analysis.

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									marketing has impacted the dosage rate and treatment time for this product. The Party has conducted satisfactory efficacy tests with iodomethane but the necessary registration has not yet been completed.	
Japan	Cucumber	88.300	88.800	72.400		68.600		U	MBTOC is unable to assess this CUN at this time. The nomination is based on the stated need to control a particular virus of cucumber. This virus is transmitted by mechanical inoculation; grafting and contact between plants and by seeds, and can survive in crop debris, especially in fumigated soils. The problem exists because of continuous cropping with cucumbers and is controlled in other countries without MB by using crop rotation, crop sanitation and pathogen free seeds. MBTOC recognises the unique farming system used for cucumbers in Japan which has been in place for many years. The Party is urged to clearly identify what strategies and progress have been made in developing strategies to control soilborne virus pathogens, particularly from the crop debris and assess the feasibility of expanding simple substrates-based production systems. Cucumber production on substrates is a widely used technique in many countries. Cheap and simple systems (buckets, bags, etc.) are available for this kind of production and are used in many developing countries, and by small growers in Italy, Hungary, Greece and others (Leoni & Ledda, Budai, 2002; Savvas and Passam 2002). Substrate production, when implemented correctly can produce higher yields than MB (MBTOC, 2002; Batchelor 2000, 2002; Savvas and Passam 2002). Large numbers of growers can be trained on substrates systems in a short period of time as experienced in many MLF projects (Barel, pers.comm., 2006; UNEP/TEAP, 2004). A high rate of adoption of this technology for cucumber production is reported in various countries (EC, 2006). MBTOC asked the Party about the feasibility of these systems in their specific circumstances, and the Party provided economic information showing they would not be profitable for the growers. However, the type of soilless system used was not described and further information is sought from the Party. Also, use/ emission technologies, such as LPBF films, are technically feasible and available and can be used with an associated reduced dosage rate as per MBTOC's standard presumptions.	CUN states that soilless culture is economically infeasible.

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Japan	Ginger (field)	119.400	119.400	109.701		112.100		U	MBTOC is unable to assess this CUN at this time.The nomination is for control of *Pythium* spp. *(Pythium ultimum var. ultimum, Pythium zingiberium)* in ginger fields using MB (99.5%) applied from small cans. Chloropicrin is registered in Japan but the Party states that the plant back time for chloropicrin is 40 days which could disrupt crop scheduling and result in delays in planting and lower yields compared to MB treatment. In addition, the proximity of residential areas limits the use of chloropicrin in some areas. The CUN states that metalaxyl does not control Pythium efficiently as resistant strains to this fungicide have been reported. The CUN does not indicate that cultural practices such as soil drainage, sowing date, organic amendments (Smith et al 1988) or fungicides specific to oomycetes, such as phosphonates widely used worldwide to control diseases cause by *Phytophthora cactorum*, have been tested. There also appears to be scope for further reduction in MB amount by adoption of MB/Pic mixtures in flat areas where mechanization can be used. Also, use/ emission technologies such as LPBF films are technically feasible and available and can be used with an associated reduced dosage rate as per MBTOC's standard presumptions. This nomination has been submitted several times with no change in production and cultural practices to minimize disease although seed sanitation is being improved. MBTOC is expecting that future nominations will provide much more data as what progress has been made in management of ginger diseases in Japan.	CUN states that the net revenue for the next best alternatives is negative. CUN also shows that, because the treatment period of Chloropicrin and Dazomet (which are expensive) is as long as about 40 days, hence the yield of the previous crops decreases or the planting period of gingers is delayed, which makes the cultivation period shorter and results in the yield decrease for ginger. CUN also states that hot water and steam soil treatment is costly.
Japan	Ginger (protected)	22.900	22.900	14.471		14.800		0 NR	MBTOC does not recommend this CUN. Pythium in protected systems can be easily controlled by management of water, by changes in cultural practices, by seed sanitation that promote good drainage and by the use of fungicides specific to Oomycetes such as phosphonates. Alternatives such as deep injection of chloropicrin are promising and may prove to be effective.	CUN states that the net revenue for 1,3D Pic (the next best alternative) is positive, but smaller than net revenue for MB. CUN also shows that, the treatment period of Chloropicrin and Dazomet (which are expensive) is as long as about 40 days, hence the yield of the previous crops decreases or the planting period of gingers is delayed, which makes the cultivation period shorter and results in the yield decrease. CUN also states that hot water and steam soil treatment is costly.

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Japan	Melon	194.100	203.900	182.200		182.200		U	MBTOC is unable to assess this CUN at this time. The nomination is based on the stated need to control a particular virus of melons. This virus is transmitted by mechanical inoculation; grafting and contact between plants and by seeds, and can survive in crop debris, especially in fumigated soils. The problem exists because of continuous cropping with melons and is controlled in other countries without MB by using crop rotation, crop sanitation and pathogen free seeds. MBTOC recognises the unique farming system used for melons in Japan which has been in place for many years. The Party is urged to clearly identify what strategies and progress have been made in developing strategies to control soilborne virus pathogens, particularly from the crop debris and assess the feasibility of expanding simple substrates-based production systems. Melon production on substrates is a widely used technique in many countries. Cheap and simple systems (buckets, bags, etc.) are available for this kind of production and are used in many developing countries, and by small growers in Italy, Hungary, Greece and others (Leoni & Ledda, Budai, 2002; Savvas and Passam 2002). Substrate production, when implemented correctly can produce higher yields than MB (MBTOC, 2002; Batchelor 2000, 2002; Savvas and Passam 2002). Large numbers of growers can be trained on substrates systems in a short period of time as experienced in many MLF projects (Barel, pers.comm., 2006; UNEP/TEAP, 2004). A high rate of adoption of this technology for melon production is reported in various countries (EC, 2006). MBTOC asked the Party about the feasibility of these systems in their specific circumstances, and the Party provided economic information showing they would not be profitable for the growers. However, the type of soilless system used was not described and further information is sought from the Party. Also, use/ emission technologies, such as LPBF films, are technically feasible and available and can be used with an associated reduced dosage rate as per MBTOC's standard presumptions.	

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Japan	Pepper (green & hot)	187.200	190.700	156.700		162.300		U	MBTOC is unable to assess this CUN at this time. The nomination is based on the stated need to control Pepper Mild Mottle Virus. This virus is transmitted by mechanical inoculation; grafting and contact between plants and by seeds, and can survive in crop debris, especially in fumigated soils. The problem exists because of continuous cropping with peppers and is controlled in other countries without MB by using crop rotation, crop sanitation and pathogen free seeds. MBTOC recognises the unique farming system used for peppers in Japan which has been in place for many years. The Party is urged to clearly identify what strategies and progress have been made in developing strategies to control soilborne virus pathogens, particularly from the crop debris and assess the feasibility of expanding simple substrates-based production systems. Pepper production on substrates is a widely used technique in many countries. Cheap and simple systems (buckets, bags, etc.) are available for this kind of production and are used in many developing countries, and by small growers in Italy, Hungary, Greece and others (Leoni & Ledda, Budai, 2002; Savvas and Passam 2002). Substrate production, when implemented correctly can produce higher yields than MB (MBTOC, 2002; Batchelor 2000, 2002; Savvas and Passam 2002). Large numbers of growers can be trained on substrates systems in a short period of time as experienced in many MLF projects (Barel, pers.comm., 2006; UNEP/ TEAP, 2004). A high rate of adoption of this technology for pepper production is reported in various countries (EC, 2006). MBTOC asked the Party about the feasibility of these systems in their specific circumstances, and the Party provided economic information showing they would not be profitable for the growers. However, the type of soilless system used was not described and further information is sought from the Party. Also, use/ emission technologies, such as LPBF films, are technically feasible and available and can be used with an associated reduced dosage rate as per MBTOC's standard presumptions.	CUN states that there is no technically and economically feasible alternative to control soil-borne viruses, and that hydroponics is not a technically and economically feasible alternative.
Japan	Watermelon	129.000	98.900	94.200		43.300		U	MBTOC is unable to assess this CUN at this time. The nomination is based on the stated need to control a particular virus of watermelons. This virus is transmitted by mechanical inoculation; grafting and contact between plants and by seeds, and can survive in crop debris, especially in fumigated soils. The problem exists because of continuous cropping with watermelons and is controlled in other countries without MB by using crop rotation, crop sanitation and pathogen free seeds. MBTOC recognises the unique farming system used for peppers in Japan which has been in place for many years. The Party is urged to clearly identify what strategies and progress have been made	CUN states that soilless culture is economically infeasible.

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									in developing strategies to control soilborne virus pathogens, particularly from the crop debris and assess the feasibility of expanding simple substrates-based production systems. Watermelon production on substrates is a widely used technique in many countries. Cheap and simple systems (buckets, bags, etc.) are available for this kind of production and are used in many developing countries, and by small growers in Italy, Hungary, Greece and others (Leoni & Ledda, Budai, 2002; Savvas and Passam 2002). Substrate production, when implemented correctly can produce higher yields than MB (MBTOC, 2002; Batchelor 2000, 2002; Savvas and Passam 2002). Large numbers of growers can be trained on substrates systems in a short period of time as experienced in many MLF projects (Barel, pers.comm., 2006; UNEP/ TEAP, 2004). A high rate of adoption of this technology for watermelon production is reported in various countries (EC, 2006). MBTOC asked the Party about the feasibility of these systems in their specific circumstances, and the Party provided economic information showing they would not be profitable for the growers. However, the type of soilless system used was not described and further information is sought from the Party. Also, use/ emission technologies, such as LPBF films, are technically feasible and available and can be used with an associated reduced dosage rate as per MBTOC's standard presumptions.	
Netherlands	Strawberry Runners	0.120	0.120	none	0.120		0.120		MBTOC recommends a CUE of 0.12 tonnes for 2007 for this use. The Party states that time is still required to complete trials on several alternatives currently in progress. MBTOC notes the nominated MB fumigations are carried out in chambers fitted with recapture systems.	CUN provides no economic data

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New Zealand	Strawberry fruit	42.000	34.000	none	24.780		U		MBTOC is unable to assess this nomination. Trials in other regions have shown that Pic alone is effective (Carrera *et al* 2004, De Cal *et al*, 2004, Porter *et al* 2004) and MBTOC is unclear why this alternative is unsuitable. Further evidence is required on why this product used alone or with metham sodium is not suitable, and if not, whether the nomination can be further reduced by greater uptake of formulations with lower dosages of MB which have been shown by the Party to be effective. The main pest is *Phytophthora cactorum*. The nomination indicates that very heavy soils, high rainfall and high humidity mean that 1,3-D/Pic requires a long waiting period which cannot be accommodated in the crop cycle at present. The MB/Pic 30:70 formulation is registered and can be expected to improve fungal control due to the higher proportion of Pic. MBTOC recognizes that the transition to more resistant varieties will make TC35 more effective.	CUN states that VIF or equivalent is not economically feasible due to the cost of imports, therefore 40 micron polythene is used as an alternative. CUN provides an updated economic feasibility report to support this re-nomination. This provides typical costs and returns for strawberry fruit production by New Zealand growers, and evaluates the potential impacts of Telone C35 on strawberry growers. Telone C35 fumigation on soil previously fumigated with methyl bromide reduces yield by ten to twelve percent. In fruiting bed trials with Telone C35 fumigation for a second year, yield was reduced by thirty percent. This results in a 17% reduction in gross profit margin for the first year and a 53% reduction for subsequent years.

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New Zealand	Strawberry runners	8.000	8.000	none	5.720		4.676		MBTOC recommends a reduced CUE of 4.6755 tonnes for this CUN for 2007 The CUN states that MB is required to meet the certification standards for strawberry runners. MBTOC acknowledges the efforts made to use low dose MB formulations of MB/Pic wehich has enabled the Party to use average dosage rates of 18.4 g/m2 which is below that used by some other Parties for production of 'high health' strawberry runners without barrier films. Further reductions are possible with LPBF and the Party is urged to implement these films to further reduce the MB nominated. The Party states that 1,3-D + PIC is the most promising registered alternative but does not control disease adequately in heavy soils and does not have acceptable plant back times due to soil retention and resulting phytotoxicity. The Party states that the most promising unregistered alternative is MI. MBTOC recognizes that New Zealand has registered a MB:PIC 30:70 mixture to further reduce MB use and emissions. The Party states that VIF is technically and economically infeasible, but they have initiated injection at a deeper level along with the use of 40 micron polythene film to reduce emissions to the atmosphere. MBTOC's standard presumption is 200 kg/ha for the production of with low permeability barrier film (LPBF). Does New Zealand have any evidence that this reduced rate with LPBF would prevent the certification standards from being met for strawberry runners?	CUN states that VIF or equivalent is not economically feasible due to the cost of imports, therefore 40 micron polythene is used as an alternative. CUN states further that the use of Telone C35 decreases gross revenue of the runner grower. In addition, supply of infected runner plants to fruit growers has significant downstream effects on the gross and net revenue of those fruit growers.
Poland	Coffee & Cocoa Beans	See Medicinal Herbs	2.160	none	2.000		U		MBTOC is unable to assess this nomination for 2007. The Party has not justified use of MB by explaining why their circumstances result in the inability to use phosphine as is used in comparable northern EU countries for these commodities. The Party has requested an increase in MB use for 2007 over the amount granted by the Parties in 2006, but the additional use was also not justified. The Party has not provided the actual separate volumes of coffee and cocoa that it wants to treat with MB.	CUN states that gas form phosphine (which is not registered, inter alia because of the expected small market is 30% more expensive, largely as a result of additional costs associated with fumigation time of 12 days; high cost of speed boxes and phosphine generators. These additional costs make the fumigation treatments with phosphine more expensive by 50 Euro per ton. CUN states that irradiation is expensive because of the high cost of transportation to the facility.

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Poland	medicinal herbs and mushrooms	4.100	3.560	none	1.800		1.800		MBTOC recommends 1.800 tonnes for this use in 2007. These products are contaminated with both insects and pathogens. The Party has moved towards chamber treatments which allowed the use of lower dosage rates for a portion of the commodity, resulting in considerable decrease in MB use. The usual treatments for these commodities against insects, phosphine and CO_2, are not effective against pathogens. The Party is encouraged to consider steam treatments and irradiation in use in other EU countries since they are effective against insects and pathogens. The Party is actively trying to encourage the registration of sulfuryl fluoride as part of their transition plan, although its effectiveness against pathogens needs further investigation.	CUN states that phosphine (which is not registered, inter alia because of the expected small market) is more expensive, largely as a result of additional costs associated with fumigation time of 12 days; high cost of speed boxes and phosphine generators. These additional costs make the fumigation treatments with phosphine more expensive. CUN states that irradiation is expensive because of the high cost of transportation to the facility.
Poland	Strawberry runners	40.000	40.000	none	25.000		24.500		MBTOC recommends a reduced amount of 24.5 tonnes for this CUN for 2007 The reduction has been made to account for the Party including the entire amount of the formulation in their nomination [400 kg/ha of 98:2] instead of the MB portion only [392 kg/ha]. The CUN states that MB is needed to meet the certification standards for strawberry runners. Potentially effective alternatives such as 1,3-D + Pic and Pic alone are not currently registered, nor are MB formulations with higher proportions of chloropicrin. While dazomet and MS are registered, their slow decomposition and long plant back time in the early spring precludes expanded use due to production timing using currently available application equipment. Poland is currently acquiring improved application equipment.	CUN provides data on costs and net revenue of alternatives, and argues that net revenue using Dazomet will range from 50% lower to 10% higher than MBr. CUN mentions that organic amendments and crop rotations cannot be considered as direct replacement for MB because of high production costs of plug plants for export.
Spain	Cut flowers (Andalucia and Catalonia)	73.000	57.000	none	35.000		47.840		MBTOC recommends a reduced CUN of 30.65t for Andalucia and the full amount of 12,84 t for Catalonia for 2007. The reduction is based on a rate adjustment conforming to MBTOC's standard presumptions (175 g/m^2) in combination with use/ emission reduction technologies for situation where high infestations of nutsedge exist. Fusarium wilt of carnations and root knot nematodes are also reported as key pests in the CUN. Dosage rates for Andalusia have been adjusted to conform to MBTOC standard presumptions. MBTOC recognises the effort made by the Party in reducing the requested amount with respect to the CUE of last year. In future nominations further clarification is required to substantiate the claim that substrates are	CUN states that 1,3-D, Telone presents economic disadvantages because of the longer waiting period and longer application period and because it is corrosive (C), while 1,3-D + Chloropicrin leads to a loss of yield and steam has economic disadvantages. CUN argues that substrates are not economically feasible because of the cost. CUN

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									economically unfeasible for this nomination particularly for some flower types such as carnations and bulbs. A key and efficient alternative, 1,3-D+pic (Peguero, 2004, Melero-Vara *et al, 2005)* has recently become registered for carnations, which make up a large proportion of this nomination and rapid transition is considered possible. .	states that substrates require high investment and increases the costs of the crop. Adoption needs a gradual process of farm modernization, and is expensive. CUN cites data that show that an investment of 270,455 € is necessary on an area of 5,000 m^2, and the enterprise is unprofitable for the first five years. CUN also states that the transformation cost for the industry in Catalonia is estimated at more than 108 million €.
Spain	Peppers	200.000	155.000	none	45.000		45.000		MBTOC recommends 45 tonnes for this use in 2007. MBTOC recognises the efforts made by the Party in substantially reducing the amounts requested for this crop going from 150T in 2005 to 45 T in the present nomination. The CUN states that the nomination is restricted to where alternatives are not available because of economic and technical reasons. Pepper production is mostly concentrated in Murcia and Valencia where, due to local soil and climatic conditions, the occurrence of high levels of infestation of fungi and nematodes is very common. *Phytophthora capsici, Meloidogyne incognita*and nutsedge are the main key pests. The recommended amount is considered necessary for final transition to alternatives and it is expected that this is the last nomination from this Party for this use. Alternatives are presently available for pepper production in Spain: Chloropicrin, 1,3 D, steaming, soil less culture (Barel, 2004; Spotti, 2004; Tognoni *et al, 2004; Leoni* et al, 2004). Grafting is now developing for this crop in Spain just like in other Mediterranean countries (Spotti, 2004). Substrates are used in about 80 ha pepper in Spain and it is expected that this acreage could be expanded in the future.	CUN provides data on costs and net revenue of alternatives, and argues that net revenue using Dazomet will range from 50% lower to 10% higher than MBr. CUN mentions that organic amendments and crop rotations cannot be considered as direct replacement for MB because of high production costs of plug plants for export.
Spain	Strawberry fruit	556.000	499.290	none	80.000		0 NR		MBTOC does not recommend this nomination. The main grounds of the nomination were uncertainty about the on-going EC review of pesticides and a longer waiting period when using alternatives in heavier soils. MBTOC recognizes that several available alternatives, for example, 1,3-D/Pic, Pic alone (or with LPBF), are technically feasible alternatives as indicated in the data presented in the nomination and from studies recently carried out in Spain (De Cal *et al, 2004;* Lopez-Aranda et al., 2002, 2003, 2004, 2005).	CUN states that wider adoption of soil-less cultivation systems is unviable economically and technically and adoption would be catastrophic for the sector; the adoption of plug plants would suppose a great convulsion in the

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									Alternatives were adopted for strawberry fruit in Spain at the average annual rate of at least 1627 ha/year since 2004 according to data in the nomination, and the EC National Management Plan indicates adoption of up to 1627 – 2000 ha/year. The area nominated for 2007 is 800 ha which represents 8% of the historical MB use. The impact of the longer plant back times suggested by the Party is not substantiated by data in the nomination, nor trials in similar production regions of other countries for this crop.	system because of costs of transport; while the adoption of steam is hampered by the cost of providing the necessary infrastructure and equipment for its application. CUN also states that the cost of 1,3D + Pic is lower than MB in the 2nd year, but higher in the 3rd year. Finally, CUN states that diverse factors restrain the large-scale adoption of LPBF, including the costs of changing from polyethylene.
Spain	Strawberry runners	230.000	230.000	none	230.000		230.000		MBTOC recommends 230 tonnes for this use for 2007. The difficult growing conditions of high elevation nurseries in Spain substantially limit the feasibility of alternatives to control target pests in order to meet certification standards of strawberry runners. The CUN states that there are no technically feasible alternatives available at this time. The Party has also indicated that a key potential future alternative (methyl iodide) has been withdrawn from consideration for EU registration at this time. The nomination is based on use of rates of 20g/m2 or less or LPBF films which MBTOC considers are appropriate to meet certification standards for this crop.	CUN provides data on the costs and net revenue of alternatives to MB, but not that of MB itself. CUN states that yields of alternatives are 14.6 to 17.1% lower. CUN also argues that the adoption of LPBF is constrained by high costs.
United Kingdom	Aircraft	none	none	none	0.165		0.165		MBTOC recommends 0.165 tonnes MB for this use in 2007. The CUN requested MB to control rats and mice in large aircraft. The two alternatives used in neighbouring countries within the European Union, CO_2 and HCN, are not registered for aircraft in the UK. CO_2, when used to kill rodents, as opposed to insects, is fast and the applicant is encouraged to pursue registration. However, efficacious fumigations and aerations will require the use of fans and other mixing devices, similar to that required during methyl bromide fumigations as indicated in the CUN. The Party is asked to submit its cited report on economics of use of CO2 for aircraft to assist MBTOC's review. Members of the TEAP expressed concern that MB would be used in aircraft where flight safety may be jeopardized if MB deteriorates materials used in aircraft construction. Parties using MB on aircraft will want to consult with aircraft manufacturers and aviation safety authorities to verify whether such MB use is prudent.	CUN argues that the next best alternative (CO_2) is too high because of the large and unmanageable quantities as well as logistic constraints of application and distribution within all areas of the aircraft fuselage. In addition, the costs of disruption to airline operations must be accounted for, as an aircraft unserviceable on the ground costs £100-£750 per minute depending on aircraft type.

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United Kingdom	Cereal Processing Plants	16.384	8.131	none	3.480		3.480		MBTOC recommends 3.480 tonnes for 2007. This amount represents a 57% reduction over the CUE for 2006. The CUN includes 5 companies that are part of the trade association for wheat, maize and rice processing. The Party is asked to clarify its reporting of measurement of gastightness in rice mills. Sulfuryl fluoride, the intended alternative was registered for these cereal food processors in December 2005. Several trials are in progress to adapt the treatment method for cereal processors and time is needed to continue this transition process.	CUN states that the immediate economic implications in the absence of MB for fumigation include increased production costs, increased down time and extra labour costs, with the ultimate risk of product and brand failure and unquantifiable economic loss due to lack of public confidence. On alternatives, CUN states that Hydrogen Cyanide, which was used before MB would be difficult and expensive to re-register, and uneconomic for a small potential market, while sulfuryl fluoride and heat treatment are from 2 to 3 times as expensive as MB. CUN also states that there is no economically viable system for the recapture of MB for use in buildings in the UK.
United Kingdom	Cheese	1.640	1.248	none	1.248		1.248		MBTOC recommends 1.248 tonnes for this use in 2007. The applicant has investigated diatomaceous earth which was unsuccessful, and ozone which caused taint. Work is continuing on UV light. At present MBTOC knows of no alternative treatment for control of mites in cheese stores when cheese is present. Further avenues of investigation for cheese stores might include peer-industry information exchange, reviews of pertinent literature, pest control through temperature manipulation and improvements in IPM approach and sanitation that will reduce infestation until the cheese can be removed from the store. Since there may be a lengthy requirement for the use of MB in cheese stores and since the stores are fairly gastight, the Party may wish to consider the use of recapture equipment to reduce emissions from this continued use.	CUN states there are no economically feasible alternatives based on lack of technically feasible alternatives. CUN presents no economic data or analysis.
United Kingdom	Commodities (Herbs & Spices)	0.035	0.037	none	0.030		0 NR		MBTOC does not recommend this use. In the instance of the occasional infestation that occurs with the small amount of spice and food products included in this CUN the Party is encouraged to use alternatives, such as freezing, steam treatments, irradiation or to use modified atmosphere treatments.	CUN states that phosphine or CO2 would cost 5 times and irradiation would cost 7 times as much as MB treatment, CUN notes losses would result from additional downtime when alternatives are used.

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United Kingdom	Mills (consolidation of 13 mill CUNs)	30.750	10.195	none	4.509	none	4.509		MBTOC recommends 4.509 tonnes for flour mills in 2007. The Party provided 13 flour mill CUNs detailing specific information for the mills which are included in this consolidated response. The Party is asked to submit its cited document on risk assessment of heat treatment to assist MBTOC's review. The Party is in transition to sulfuryl fluoride, which has been registered for two years. The applicants have invested in extensive lab and field research to optimize the efficacy of sulfuryl fluoride for mills located in temperate and cool climates. As a result, the applicants have developed new application methods for a combined heat and sulfuryl fluoride treatment, but it has not yet been completed for all mill configurations. Although a rapid adoption rate has been proposed, some time is needed to efficiently transition to alternatives. Given the relatively low amount of MB requested by the Party, in the face of numerous mills that will require pest control, the Party might need to consider allocation strategies that reserve MB for those mills whose size, layout and design, age and/or location make transition most difficult. MBTOC's knowledge of sulfuryl fluoride and heat treatments indicate that more time is required to develop effective strategies to treat larger, more complex mills in locations with cooler temperatures because sometimes combination processes are required.	CUN states that, in addition to not being technically feasible, Sulfuryl Fluoride is at least 2.5 times the costs of MB. In addition, as the structural treatment has not yet reached commercialisation, the costs of heat treatment are unknown.
United Kingdom	Mills,Food Processing (Biscuits)	2.525	1.787	none	0.479		0.479		MBTOC recommends 0.479 tonnes for 2007. This amount represents approximately a 70% reduction over 2006 use levels. The CUN includes one company, a manufacturer of rye bread crackers. Sulfuryl fluoride, the intended alternative, was registered for these cereal food processors in December 2005. Several trials are in progress to adapt the treatment method for cereal processors and time is needed to continue this transition process.	CUN states that, in addition to not being technically feasible, Sulfuryl Fluoride is at least 2.5 times the costs of MB. In addition, as the structural treatment has not yet reached commercialisation, the costs of heat treatment are unknown.
United Kingdom	Structures (Herbs & Spices)	4.728	1.872	none	0.908		0.908		MBTOC recommends 0.908 tonnes for 2007. This amount represents a 50% reduction over 2006 CUE. The CUN includes several companies in the association of spice processors. Sulfuryl fluoride, the intended alternative, was registered for spice processing facilities in December 2005. The companies have begun using heat and modified atmosphere treatments and improved IPM tools. Trials are in progress to adapt sulfuryl fluoride treatment methods for spice processors and time is needed to continue this transition process.	CUN states heat or SF treatment would cost 200% more than MB treatment.

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United Kingdom	Structures (Whitworth)	1.1	0.880	none	0.257		0.257		MBTOC recommends 0.257 tonnes for 2007. This CUN includes the facility of one company which packs and stores numerous food commodities and raw materials. The nearly 70% reduction expected for 2007 over the amount granted by the Parties for 2006 reflects that this company uses other treatments for pest control and to avoid infestation. It may be possible to continue the advancements in the use of IPM tools to continue to avoid infestation, eliminating the requirement for MB in the near future.	CUN reports no economic data on alternatives. Party's response to EC states costs for SF would be up to 5 times the costs of methyl bromide.
United States	Commodities	89.166	87.719	78.983		67.699		23.811	This CUN includes walnuts, dried fruit, beans and dates. MBTOC recommends the 0.021 tonnes planned to support alternatives research for these commodities. MBTOC is unable to assess the amount of methyl bromide required by walnut sector pending the Party's reassessment of MB needs as circumstances are in flux. MBTOC awaits results of trials with the newly registered alternative propylene oxide (PPO), a potentially useful method if the sector's currently used vacuum chambers can be switched to PPO instead of MB. Two EU countries have adopted maximum residue levels (MRL) for fluoride that may facilitate the adoption of sulfuryl fluoride by this sector. MBTOC also requests information on the potential for decreased MB requirement by walnut sector if vacuum treatment time was increased by one hour, with the resulting 20% decrease in required dosage rate. MBTOC recommends 17.410 tonnes for dried fruit. Currently, dried fruit sector only plans a 7% reduction in 2008 over 2007 use levels. The Party could ensure that Decision IX/6 is more fully met by ensuring dried fruit sector only uses MB when short turn around or immediate treatment before holiday marketing is required. Beans and dates sectors have planned reductions greater than 30% in 2008 over 2007 use levels. Accordingly, MBTOC can recommend 4.371 tonnes for beans and 2.009 tonnes for dates. Bean sector has investigated using cylinderized phosphine finding it useful for product in storage but too time consuming for the immediate post-harvest treatment before holiday marketing. The Party has indicated it will review transition rates for this sector when more is known about adoption of sulfuryl fluoride, which may depend on adoption of MRLs by importers.	
United States	Cocoa beans (NPMA subset)	61.519	55.367	64.082	none	53.256		U	MBTOC is unable to assess the part of the NPMA CUN that relates to cocoa beans. Although the Party has indicated it could achieve a 17% decrease over the amount granted by the Parties for this use in 2006 (resulting in 53.188 tonnes), MBTOC is unable to assess if this entire amount of MB is critical use under Decision IX/6. Currently the Party indicates a need for two fumigations	

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									per year of the cocoa beans: the first fumigation upon import and a second fumigation immediately before shipment to the chocolate manufacturers. However, MBTOC requests the Party to recalculate the impact on MB volume required for this CUN if alternatives were used, especially to replace the second fumigation before shipment to chocolate manufacturers, to the extent that this could be achieved by 2008. For the first fumigation, changed logistics that may allow increased use of phosphine including in-transit treatments conducted at time of export from producing countries may be useful in reducing the need for the first fumigation (Watson et al, 2000) For the second fumigation, the Party may wish to base its determination on further research of techniques that allow weekend fumigation using treatments that only target post-embryonic stages, since egg kill should not be a requirement if the chocolate manufacturers quickly use the cocoa beans shipped to them. Avenues of investigation for cocoa might include furthering the applicant's current work with the recently registered sulfuryl fluoride. Propylene oxide is also registered for use in cocoa beans, although suitable chambers would have to be installed. IPM approach improvements such as enhanced cocoa inspection programs and methods could be investigated to determine if the fumigation before shipment to chocolate manufacturers could be avoided during winter or in other circumstances. Also, cylinderized phosphine or sulfuryl fluoride timed for weekend fumigation may prove sufficient for the post-embryonic treatment required prior to shipment to chocolate manufacturers who immediately use the cocoa beans.	
United States	NPMA food processing structures (cocoa beans removed)	83.344	69.118	82.771	none	71.690		69.208	MBTOC recommends 69.208 tonnes for food processing facilities included in this CUN. This CUN originally included cocoa beans, but MBTOC has disaggregated the CUN and comments on cocoa beans in another section. The amount recommended was determined based on the Party's report that it can achieve a 17% transition in 2008 over 2007 levels. However, MBTOC's recommendation was based on a 17% reduction from the amount granted by the Parties for 2007 for processed foods (62.153 tonnes) and herb and spice facilities (4.059 tonnes). MBTOC did not apply the transition rate to cheese stores (2.996 tonnes) because MBTOC knows of no alternative to control mites in cheese stores when cheese is present. The CUN reports that the absence of adopted maximum residue levels (MRL) for fluoride by the European Union restricts the wider adoption of sulfuryl fluoride by this Party's food processing facilities. Although MBTOC recommends 4.059 tonnes for herb and spice facilities, MBTOC does not find that the use of MB	CUN states that the economic impacts cannot be assessed since the applicant is not the end-user. Economic impacts arise from three contributing factors: direct pest control costs increase because of increased labor time required for longer treatment time and increased number of treatments; capital expenditures may be required to adopt phosphine for accelerated replacement of plant and equipment due to its corrosive nature; and additional production downtimes for

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									for herb and spice commodity to be consistent with Decision IX/6 since several alternatives are available and in widespread commercial use. The Party is requested to ensure herb and spice commodity are not included in facility fumigations using MB. Cheese stores are only treated with MB upon requirement of inspectors from United States Department of Agriculture in response to pest infestation. To ensure the requirements of Decision IX/6 are met, the Party should conduct research to find alternatives and/or methods to reduce infestation and the requirement to use MB. Further avenues of investigation for cheese stores might include peer-industry information exchange, reviews of pertinent literature, pest control through temperature manipulation and improvements in IPM approach and sanitation that will reduce infestation until the cheese can be removed from the store. Since there may be a lengthy requirement for the use of MB in cheese stores and since the stores are fairly gastight, the Party is encouraged to consider the use of recapture equipment to reduce emissions from this continued use.	the use of alternatives are unavoidable.
United States	Mills and processors	483.000	461.758	401.889	none	362.952		348.237	MBTOC recommends 348.237 tonnes for this use in 2008. This CUN includes quantities requested for the following disaggregated sectors: rice mills, bakeries, pet foods and flour mills. For rice mills, 66.543 tonnes is recommended for 2008. This amount was calculated based on the amount of MB granted by the Parties for this sector in 2007 (64.150 tonnes), plus the amount determined by US government to have been removed in their error in 2007 (17 tonnes). This total (81.150 tonnes) was then decreased by a transition rate of 18% for the likely adoption to alternatives, as determined by USG. For flour milling, MBTOC recommends 240.765 tonnes MB for 2008. This amount represents a 12.3% reduction over 2007 levels, part of a continued downward trend in MB use. For bakeries MBTOC recommends 14.269 tonnes. This amount represents an approximate 40% decrease over the levels granted by the Parties in 2007, reflecting of both adoption of alternatives and resolution of a facility design problem highlighted in the 2007 CUN. For pet foods, MBTOC recommends 26.660 tonnes which is a 32% decrease over 2007 MB amount granted by the Parties. Sulfuryl fluoride was registered last year, and adoption of heat and phosphine treatments increased, which resulted in a decrease in MB requested by the Party. In spite of these successes, the CUN states that, currently, 25% of pet food facilities, 28% of bakeries and 42% of wheat mills and 10% rice mills will not be able to transition to alternatives even after several years. The Party is encouraged to conduct and strengthen its research program and assist commercial adaptation of	

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									alternatives to ensure the requirements of Decision IX/6 are fully met for all sectors included in this CUN and to avoid these future requirements for MB. The Party has indicated it will reassess the quantity of MB to be permitted through domestic regulation if the circumstances of the nomination change. For example, as more experience is gained with sulfuryl fluoride and heat by 2008, it should be possible to decrease the need for MB in flour and rice milling to allow these sectors to more closely mirror decreases made in pet foods and bakeries.	
United States	Smokehouse ham	67.907	40.854	18.998	none	19.669		18.998	MBTOC recommends 18.998 tonnes for this use in 2008. Although the Party requested an increase for 2008, it did not justify the use of an amount greater than granted by the Parties in 2007. Although alternatives for this use are unknown to MBTOC, the onus rests on the Party to ensure use of methyl bromide is minimized as much as possible. The Party has begun a survey of facility gastightness in this sector; low facility gastightness is a major contributing factor to MB use by two of the applicants included in the CUN. However, two other applicants, Nahunta Pork and Gwaltney of Smithfield have already invested in improved facilities that reduce MB use. MBTOC expects that facilities operated by members of American Meat Association and National Country Ham Association will be required to improve gastightness as a condition of MB use by 2008. The Party is encouraged to conduct research and reduce emissions by improving gastightness to ensure the requirements of Decision IX/6 are fully met for this sector and to minimize use of methyl bromide. Research on the effectiveness of sulfuryl fluoride alone or in combination with other processes, on other treatments such as cold, to improve IPM tools to avoid infestation, and on changing processing logistics to allow treatment by phosphine might be helpful in finding avenues to reduce MB use.	The industries that use methyl bromide are, in general, subject to limited pricing power, changing market conditions, and government regulations. Companies operate in a highly competitive global market with high sales volumes, low profit margins, and rapid turnover of inventories. In addition, producers' associations generally manage companies of this type, and, therefore, making new capital investment is often difficult.
United States	Cucurbits (field)	1187.800	747.839	592.891		588.949		U	MBTOC recommends 19.89 tonnes for Michigan and 0.941 tonnes for research,and is unable to fully assess the remaining nomination pending further informaton from the Party. In the absence of this information, MBTOC has come to a preliminary finding. MBTOC can recommend 298.78 tonnes for the South East and Georgia and will adjust this recommendation up or down if the nominating Party can provide technical or economic justification for why their proposed reduction schedule is significantly slower than the phase out schedules that have been achieved in other countries that have halted use for the same pest on the same crop. The Party acknowledges that some	CUN states next best alternative in all regions is 1,3-D with chloropicrin with expected yield losses of 6 percent in Michigan and 29 percent in Southeastern States and Georgia. CUN states 1,3-D with chloropicrin is considered technically feasible in Michigan. However, CUN noted that for Michigan in addition to the yield

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									alternatives are effective for a proportion of the nominations and have stated it will take 7 years to transition to these alternatives. MBTOC considers several alternatives available for the nomination, and that uptake of alternatives for this crop in regions with similar pests and climate has occurred within 4 years or less (eg Spain, Italy, Australia)(Leoni and Leda, 2004; Webster and Culpepper, 2005; Tostovrsnik et al 2005;Minuto et al, 2003). Reduction in the nominated amounts conform or will conform to the standard presumptions for dosage rate of MB/Pic formulations with use/emission reduction technologies of either of 17.5 g/m2 for nutsedge or 15 g/m2 for pathogens unless the Party can provide documentation to justify why in the circumstances of this nomination the achievment of the standard presumptions can not be met. Modifications of formulations of e.g. MB/Pic 50:50 are available and versions of LPBF, (eg.VIF and metalized films) have been widely tested since 2000 and have shown equivalent effectiveness to MB at approximately 50% of the commercial dosage rate. In Michigan, the key pests are Phytophthora capsici and Fusarium. The Party states that 1,3-D + Pic may be an effective alternative but growers will miss the optimal market window due to longer plant back times. According to the Party, this treatment cannot be applied in autumn because of the bad climatic conditions. In addition, a fall application of a methyl bromide is not feasible because, over the fall and winter months deer and other animals damage the plastic and irrigation tape. In SE and Georgia, the key pest is nutsedge. 1,3-Dchloropropene + chloropicrin + herbicides (trifluralin, napropamide, halosulfuron and s-metalochlor) and, Pic and MNa, are the most promising alternatives. MBTOC acknowledges that karst topography limits the use of alternatives which include 1,3-D on 40% of the growing acreage. The Party states that metam sodium or metam potassium are also promising alternatives but still do not provide consistent control under the circumstances of the nomination and require further trialling. In addition, the Party states that trials are underway to investigate lower MB/Pic formulations such as 50:50 as there are no regulatory restrictions to the use of these formulations.	loss, delayed planting and harvest with the alternatives results in lower average price received from missed market windows and negative net revenue. In remaining regions yield losses significantly reduce net revenues. CUN notes other regions may also experience lower prices because of missed market windows.

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United States	Eggplant (field)	76.712	81.162	85.363		79.546		U	MBTOC recommends 2.880 tonnes for Michigan for use in 2008 and 0.444 tonnes for research and is unable to fully assess the remaining nomination pending further informaton from the Party. In the absence of this information, MBTOC has come to a preliminary finding. MBTOC can recommend 43.16 tonnes for Florida and Georgia and will adjust this recommendation up or down if the nominating Party can provide technical or economic justification for why their proposed reduction schedule is significantly slower than the phase out schedules that have been achieved in other countries that have halted use for the same pest on the same crop. The Party acknowledges that some alternatives are effective for a proportion of the nominations and have stated it will take 7 years to transition to these alternatives. MBTOC considers several alternatives available for the nomination, and that uptake of alternatives for this crop in regions with similar pests and climate has occurred within 4 years or less (eg Spain, Italy, Australia) (Leoni and Leda, 2004; Tostovrsnik et al 2005;Minuto et al, 2003). Reduction in the nominated amounts conform or will conform to the standard presumptions for dosage rate of MB/Pic formulations with use/emission reduction technologies of either of 17.5 g/m2 for nutsedge or 15 g/m2 for pathogens unless the Party can provide documentation to justify why in the circumstances of this nomination the achievment of the standard presumptions can not be met. Modifications of formulations of e.g. MB/Pic 50:50 are available and versions of LPBF, (eg.VIF and metalized films) have been widely tested since 2000 and have shown equivalent effectiveness to MB at approximately 50% of the commercial dosage rate. In Michigan, the key pests are *Phytophthora capsici* and Verticillium. The Party states that 1,3-D/chloropicrin may be an effective alternative but growers will miss the optimal market window due to longer plant back times. According to the Party, this treatment cannot be applied in autumn because of the bad climatic conditions. In addition, a fall application of a methyl bromide is not feasible because over the fall and winter months deer and other animals damage the plastic and irrigation tape. In Florida, the key pests are nutsedge, nematodes, sclerotinia clover, and southern blight. In Georgia, the key pests are nutsedge Phytopthora, nematodes, southern blight, Pythium. In Georgia and Florida, trials on key pathogens and weeds of tomatoes and peppers with similar pests to eggplants have recently shown that technical alternatives exist for nutsedge and other key pests in both karst and non karst topography. MBTOC acknowledges that karst topography limits the use of alternatives which include 1,3-dichloropropene. The Party states that metam sodium or metam potassium are promising alternatives but still do not	CUN states next best alternative in all regions is 1,3-D with chloropicrin with expected yield losses of 6 percent in Michigan and 29 percent in Georgia and Florida. CUN states 1,3-D with chloropicrin is considered technically feasible in Michigan. However, CUN noted that for Michigan in addition to the yield loss, delayed planting and harvest with the alternatives results lower average price received from missed market windows and negative net revenue. In Florida and Georgia yield losses significantly reduce net revenues. CUN notes Florida and Georgia producers may also experience lower prices because of missed market windows.

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									provide consistent control under the circumstances of the nomination and require further trialing. In addition, the CUN states that trials are underway to investigate lower MB/Pic formulations such as 50:50 as there are no regulatory restrictions to the use of these formulations. Trials on similar pests to those on eggplants have shown that there are technical alternatives for both karst and non-karst areas in Florida and Georgia. In tomato trials conducted in Florida, 1,3-D/Pic 65:35 with and without VIF, 1,3-D/Pic 65/35 & metolachlor & trifloxysulfuron and MNa/Pic provided similar yields as MB/Pic 67:33 in 3 trials over the spring and fall of 2003 and spring of 2004 (Santos, et al, Crop Protection, 2006) even with moderate to severe nutsedge infestations. In other studies involving commercial scale fields, (ref). similar yields have been realised.	
United States	Forest nursery	192.515	157.694	122.032		133.140		U	MBTOC is unable to assess this nomination. MBTOC requests clarification from the Party of whether a dosage rate of 20gm/m^2, which is effective for production of certified planting material from other industries (eg. strawberry runners, p13. UNEP/ TEAP 2005), is suitable for this nomination using use/emision reduction technologies. (Further, the Party is requested to provide information on a feasible plan to transition to alternatives). The CUN is based on economic infeasibility of using substrates and the lack of effective alternatives for control of nutsedge and a range of fungal pathogens. It covers certified seedling production in 7 forest nursery regions. Research is ongoing to determine if Pic with metham sodium, 1,3-D alone or in combination with Pic and /or herbicides can provide acceptable control of moderate to severe levels of nutsedge (Muckensfuss, 2005, Wang, 2005, 2006). To date, metham sodium and chloropicrin in combination showed promising results, but when used without plastic sheeting caused severe crop injury. The Party acknowledged that this treatment (and others) when used in conjunction with LBPF barrier films, may provide an effective technical alternative and avoid crop injury. MBTOC also considers glyphosate can be used as a pretreatment to reduce pressure from nutgrass and 1,3-D/Pic + metham sodium (or glyphosate) should be further evaluated for control of nutsedge as results in trials have been promising (Fraedrich, 2005; Culpepper and Langston, 2004). An increase of 24 Ha and 9.2 tonnes in the nomination area is observed with respect to last year's CUN (after discounting Michigan herbaceous perennials which are now included in the ornamentals CUN).	MBTOC recommends a reduced CUE of 122.032 tonnes be approved for this use for 2007. Regions B (22.279 t) and E (9.637 t) are recommended without change, but amounts have been adjusted in regions A (61.88 t), C (1.820 t), D (8.58 t), F (8.736 t), G (5.98 t) and H (3.12 t) to conform with MBTOC guidelines with use of MB/Pic mixtures (i.e. 67:33 – 260 kg/ha for control of nutgrass and 200 kg/ha for pests and pathogens other than nutgrass), which the Party indicates is an effective formulation. The CUN is based on economic infeasibility of using substrates and the lack of effective alternatives for control of nutsedge and a range of fungal pathogens. It covers certified seedling production in 7 forest nursery regions and one region in Michigan growing herbaceous perennials. Certification requires that seedlings must be pest/pathogen free. The Party states that all regions use

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										broadacre fumigation, but with different mixtures and rates of MB/Pic. MBTOC recognizes that the key pest is nutsedge. Research is ongoing to determine if Pic with metham, 1,3-D and /or herbicides can provide acceptable control of moderate to severe levels of nutsedge To date, metham sodium and chloropicrin in combination showed promising results, but when used without plastic sheeting caused severe crop injury. The Party acknowledged that this treatment (and others) when covered with plastic films, particularly LPF barrier films, may provide an effective technical alternative and avoid crop injury. MBTOC considers new films and glues are available for broadacre tarping under most conditions, however the Party will need time to trial and scale up this alternative. Although no further reductions have been made by MBTOC to the nomination, the Party is urged to consider adoption of LPF barrier films to reduce dosage rates in regions where their use is permitted. Broadacre use of LPF barrier films exists in other regions worldwide. MBTOC also considers glyphosate can be used as a pretreatment to reduce pressure from nutgrass and 1,3-D/Pic + metham sodium (or glyphosate) should be further evaluated for control of nutsedge as results in trials have been promising

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										(Culpepper and Langston, 2004). The nomination states that containerised plants are not economically feasible for regions A through G. MBTOC considers substrates to be an effective technical alternative for most forest nurseries, however understands that present costs ($US0.12 vs. $0.04 per seedling) make this practice economically infeasible at the present time.
United States	Nurseries stock (fruit, nut, flower)	45.800	64.528	28.275		51.102		U	MBTOC is only able to assess part of this nomination at this time and recommends 1.400 tonnes for roses, 7.000 tonnes for deciduous fruit and nuts and 1.506 tonnes for research. MBTOC is not able to assess the raspberry portion of this nomination at this time. The Party has been requested to explain why the area nominated for raspberries has increased from 47 ha to 143 ha and to provide the proportion of the nominated area that lies outside California. MBTOC has adjusted the original amounts requested for roses and decidious fruits and nuts to conform to standard presumptions including use/ emission reduction technologies. This nomination is for propagation materials that needs to be certified as free of pests and diseases. Certification is mandatory for California and is voluntary in Washington. MBTOC has identified studies (McKenry,1999) which indicate that 1,3-D at high rates (greater than 390 kg/ha) can be effective at controlling pests and killing old perennial roots up to 1.5 me deep. Although these high rates are not allowed by regulation in California, it appears that the high rates would be allowed in Washington.	No economic data on alternatives given

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United States	Orchard replant	706.176	527.600	405.400		405.666		U	MBTOC is unable to assess this nomination at this time. Further clarification is required from the Party on why MB/Pic formulations (50:50 or 30:70) and EC formulations of 1,3-D/Pic are not suitable for at least a proportion of the nomination. A recent study has demonstrated effective control of nematodes at 35 gal/ha with 1,3-D and 1,3-D/pic EC across a number of sites and trials (Schneider and Trout, 2005) and further clarification is required on why these results are not relevant. Also, MB/Pic 70:30 and 50:50 mixtures were used in replant industries in other countries before MB was phased out for this use. These formulations are available for use in California and MBTOC requests clarification on why they can not be adopted or are considered ineffective. The Party advised that coinjection of MB/Pic formulations at any rate is allowed California. The area to be treated is similar to the 2007 CUE and does not constitute an increase in MB use. The Party states that three alternatives,1,3-D alone and 1,3-D combined with chloropicrin or metam sodium, are available for treatment in light soils. Regulatory constraints (maximum label rate) prevent the use of 1,3-D at the rates needed for effective kill of old roots and the associated pathogens in deeper soil layers for heavier (fine-textured) soils. Regulatory restraints further prevent the use of LPBF barrier films with methyl bromide in California. The CUN states that the historical use of MB for this sector for 2003 was 796.309 tonnes. Figures released by Trout (2005) for the same period indicates that 355.35 t was used.	An economic analysis was not done for this sector because most of the losses cannot be quantified. Factors that contribute to losses include delayed planting, fallow, additional use of herbicides, tree loss, replant costs to replace tree losses, loss of trees replanted, yield loss of fruit or nuts, delayed achievement of full yield potential, earlier loss of productivity of whole orchard.
United States	Ornamentals	154.000	148.483	137.835		138.538		U	MBTOC is unable to assess this nomination at this time. MBTOC appreciates the additional information received from the Party, however several issues still require further clarification. This nomination is over 98% for field grown flowers in California and 100% field flowers in Florida, and one of the key issues is cleaning fields of bulbs and tubers left from previous crops. MBTOC needs clarification on the feasibility of using other strategies (ie herbicides eg. glyphosate in combination with 1,3 -D/Pic or metham and Pic alternative fumigants) for at least part of the nomination (Gerik, 2005 a and b, Gerik and Green, 2004; Elmore et al. 2003; Gilreath et al., 2005b). The Party states that MB application frequency may be reduced for at lest a proportion of the flowers involved in this nomination. Could the Party further elaborate on such a proportion? Additional further information is sought from the Party: In Florida, what proportion of the nomination is impacted by the presence of muck soils? What is the typical depth at which caladium tubers are planted? In Michigan, further information is needed as to the particular characteristics of the nominated area which is less than 1% of the total cropping area in the	CUN reports yield losses of 20-25 percent with alternatives. Operating costs were assumed same as with methyl bromide. CUN reports substantial decreases in gross and net revenues. Negative net revenues predicted for calla lilies and bulbs in California and for caladiums in Florida. Alternatives for herbaceous perennials in Michigan show 3-5% decrease in yield.

Country	Industry	Quantity approved for 2005 (1ExMOP+ 16MOP)	Quantity approved for 2006 (16MOP+ 2ExMOP+ 17MOP)	Quantity approved for 2007 (MOP17)	Quantity nominated for 2007 (additional or new)	Quantity nominated for 2008	MBTOC recommendation for 2007	MBTOC recommendation for 2008	MBTOC comments	MBTOC comments on economics
									nomination and what conditions prevent the use of formulations with higher chloropicrin content than 98:2. Do certification requirements apply to this portion of the nomination and, if yes, do they make MB use mandatory? Finally the Party is asked to provide reasons for the lack of transition to alternatives for all sectors at this time, when the nomination mentions ongoing research and promising results with various alternatives. Adjustments for dosage rates for MB/Pic formulations should be made to conform to MBTOC's standard presumptions with use/emission reduction technologies of either of 17.5 g/m2 for nutsedge or 15 g/m2 for pathogens or provide documentation to justify why in the circumstances of this nomination the accomplishment of the standard presumptions can not be achieved.Versions of metalized films are being widely tested by several researchers and growers and show promise; it should be possible to apply these in all areas excluding California.	
United States	Peppers (field)	1094.782	1243.542	1106.753		919.006		U	MBTOC recommends 8.550 tonnes for Michigan for use in 2008 and 2.844 tonnes for research, but is unable to fully assess the remaining nomination, but has come to a preliminary finding. With the available information, MBTOC can recommend 549.865 tonnes for the South East Georgia and Florida and will adjust this recommendation up or down if the nominating Party can provide technical or economic justification for why their proposed reduction schedule is significantly slower than the phase out schedules that have been achieved in other countries that have halted use for the same pest on the same crop. The Party acknowledges that some alternatives are effective for a proportion of the nominations and have stated it will take 7 years to transition to these alternatives. MBTOC considers several alternatives available for the nomination, and that uptake of alternatives for this crop in regions with similar pests and climate has occurred within 4 years or less (eg Spain, Italy, Australia) (Leoni and Leda, 2004; Tostovrsnik et al 2005; Minuto et al, 2003). Reduction in the nominated amounts conform or will conform to the standard presumptions for dosage rate of MB/Pic formulations with use/emission reduction technologies of either of 17.5 g/m2 for nutsedge or 15 g/m2 for pathogens unless the Party can provide documentation to justify why in the circumstances of this nomination the achievment of the standard presumptions can not be met. Modifications of formulations of e.g. 50:50 MB/Pic are available and versions of LPBF, (eg.VIF and metalized films) have been widely tested since 2000 and have shown equivalent effectiveness to MB at approximately 50% of the commercial dosage rate. In Michigan, the key pests	CUN states next best alternative in all regions is 1,3-D with chloropicrin with expected yield losses of 6 percent in Michigan and 29 percent in other regions. CUN states 1,3-D with chloropicrin is considered technically feasible Michigan. In Michigan delayed planting and harvest with the alternatives results in lower average price (7.5%) received from missed market windows, and negative net revenue. In remaining regions yield losses significantly reduce net revenues.

Country	Industry	Quantity approved for 2005 (1ExMOP+ 16MOP)	Quantity approved for 2006 (16MOP+ 2ExMOP+ 17MOP)	Quantity approved for 2007 (MOP17)	Quantity nominated for 2007 (additional or new)	Quantity nominated for 2008	MBTOC recommendation for 2007	MBTOC recommendation for 2008	MBTOC comments	MBTOC comments on economics
									are Phytophthora capsici and fusarium The Party states that 1,3-D/chloropicrin may be an effective alternative but growers will miss the optimal market window due to longer plant back times with this alternative. According to the Party, this treatment cannot be applied in autumn because of the bad climatic conditions. In addition, a fall application of a methyl bromide is not feasible because over the fall and winter months deer and other animals damage the plastic and irrigation tape. Phytopthora is controlled in many regions by foliar sprays and grafting. For Georgia, the southeast and Florida, MBTOC believes there are technical and economic alternatives for nutsedge and for nematodes, sclerotinia and Phytopthora in areas of Karst and non Karst areas. In Florida, the key pests are yellow and purple nutsedge, Phytophthora, nematodes, Pythium and sclerotinia. In GA the key pests are yellow and purple nutsedge, Phytophthora, nematodes, southern blight and Pythium and sclerotinia. In the southeast the key pests are yellow and purple nutsedge, Phytophthora, Pythium and plant parasitic nematodes. Karst topography limits the use of alternatives which include 1,3-Dichloropropene, which are the best alternatives for these pests on 40% of the growing acreage. The Party states that metam sodium or metam potassium are promising alternatives but still do not provide consistent control under the circumstances of the nomination and require further trialing. In addition, the Party states that trials are underway to investigate lower MB/Pic formulations such as 50:50 as there are no regulatory restrictions to the use of these formulations. MBTOC has concluded that there are technical alternatives for both karst and non-karst areas in Florida, Georgia and the southeast. In tomato trials conducted in Florida, 1,3-D/pic 65:35 with and without VIF, 1,3-D/pic 65/35 & metolachlor & trifloxysulfuron and MNa/Pic provided similar yields as mb/pic 67:33 in 3 trials over the spring and fall of 2003 and spring of 2004 (Santos, et al, 2005) even with moderate to severe nutsedge infestations. In other studies involving commercial scale fields, similar yields have been realised. Since some of the alternative systems involve herbicides, the Party is requested to verify that they are registered on peppers and whether or not there are plant back restrictions or crop interactions that interfere with double cropping systems.	
United States	Strawberry (field)	2052.846	1730.778	1476.019		1604.669		U	MBTOC is unable to assess this nomination. The Party acknowledges that some alternatives are effective for a proportion of the nominations and have stated it will take 7 years to transition to these alternatives. MBTOC considers effective alternatives are available for the nomination, and that uptake of similar alternatives for this crop in regions with similar pests and climate has	CUN reports costs for three next best alternatives for California, Florida, and Eastern United States. 1,3-D with chloropicrin is reported to reduce yield by 14 percent. Resulting lower

Country	Industry	Quantity approved for 2005 (1ExMOP+ 16MOP)	Quantity approved for 2006 (16MOP+ 2ExMOP+ 17MOP)	Quantity approved for 2007 (MOP17)	Quantity nominated for 2007 (additional or new)	Quantity nominated for 2008	MBTOC recommendation for 2007	MBTOC recommendation for 2008	MBTOC comments	MBTOC comments on economics
									occurred within 4 years or less (eg Spain, Italy, Australia).. Further clarification of feasible rates of adoption of alternatives in the three regions is required. For California, the Party nominated 1,233.8 tonnes for 2008, indicating a proposed reduction of 214 tonnes compared to 2004 usage of about 1,447 t ±10% (PUR data). The nomination is based on the grounds that township caps limit further adoption of 1,3-D, hilly terrain prevents the use of drip-applied alternatives, and missed market windows due to longer set-up or treatment times. In the case of township caps, alternatives that do not contain 1,3-D (such as Pic, Pic EC and Pic + metham applied sequentially) are effective for the target pests (Ajwa et al 2002, 2003, 2004, Haar et al. 2001, Nelson et al. 2001a,b). A large number of studies have shown that Pic EC gives an average of 99% yield compared to MB, with low variance (refs). MBTOC recognizes that alternatives (based on 1,3-D, Pic and metam) were commercially adopted on about 5000 ha by 2004, and that the annual adoption rate was 860ha/year in 2003-4. Hilly terrain can use pressure-compensated drip systems or injection in some cases. In order to assess the question of missed market windows, MBTOC kindly requests the Party to provide an excel sheet showing itemized variable costs for 1,3-D/Pic, Pic EC and Pic+ metham sodium, showing the applied quantity of MB and current MB price. The Party is also requested to clarify why the key pest impact was 0% in the BUNI for 2007 and 100% in BUNNIE for 2008. The Party states that no futher transition to alternatives is possible, however nearly all other Parties submitting CUN's will have phased out MB by 2007and all of these were able to transition quickly to a number of alternatives. Owing to this factor, MBTOC considers that full adoption of alternatives should be possible within 4 years or less (EC, Australia, Spain, Italy). MBTOC acknowledges that there are regulatory constraints on the use of LPBF/VIF in California at present. For Eastern US, the Party nominated 137 tonnes. The nomination is based on moderate to severe pest pressure (*Meloidogyne spp., Pythium, Rhizoctonia, Phytophthora cactorum, Cyperus escultentus, C. rotundus, Lolium spp.*) affecting 37% of the crop area, and small farm buffer zones on 40% of the crop area which affects use of 1,3-D formulations. MBTOC considers that alternatives are available for areas of low and moderate pest pressure and even for areas of high pest pressure (1,3-D/Pic, and for areas affected by buffer zones Pic formulations, metham + Pic). The Party stated it will take 7 years to transition to these alternatives. Uptake of alternatives for this crop in regions with similar pests and climate has occurred within 4 years or less (EC, Australia, Spain, Italy) or less.	production leads to loss of net revenue of 42% (Eastern USA), 87% (California), and 94% (Florida). Planting and harvesting delays with alternatives are reported to lead to lower average prices received in all regions, but are only shown in the revenue analysis for California.

Country	Industry	Quantity approved for 2005 (1ExMOP+ 16MOP)	Quantity approved for 2006 (16MOP+ 2ExMOP+ 17MOP)	Quantity approved for 2007 (MOP17)	Quantity nominated for 2007 (additional or new)	Quantity nominated for 2008	MBTOC recommendation for 2007	MBTOC recommendation for 2008	MBTOC comments	MBTOC comments on economics
									For Florida the Party nominated 220.302 tonnes. The Party states that for areas of moderate to severe pest pressure (primarily nutsedge, affecting 37% of area), protocols for commercial application of alternatives are not sufficiently developed to be implemented for the 2007 season. MBTOC notes that 718 ha has low pest pressure (on karst) and that alternatives such as pic+metam, pic+LPBF provide yields that are statistically similar to MB (Fennimore et al. 2003, Gilreath et al 2003, Nelson et al 2002, Ajwa et al 2003, 2004; Gilreath 2005a) and does not recommend MB for this area. MBTOC considers that the areas of moderate to high pest pressure can also adopt alternatives (add refs). MBTOC is compiling information about feasible rates of adoption (as required in para. 35 of Decision xxx Annex I) and requests the Party to provide estimates. MBTOC requests further technical data to support the area affected by moderate to severe nutgrass and to substantiate the claim that 40% of the cropping area is affected by surface karst topography.	
United States	Strawberry runners	54.988	56.291	4.483		8.838		U	MBTOC recommends a CUE of 4.69 tonnes for CA and 0.454 tonnes for researh but is unable to assess the nomination for the SE. The CUN states that MB is required to meet the certification standards for strawberry runners. The Party indicates that key alternatives include 1,3-D + PIC, 1,3-D + PIC + MS, and 1,3-D + MS and Daz + Pic but that these have not been sufficiently developed to provide adequate disease and nematode control throughout the root zone (up to 1 m deep). In future nominations, the Party is requested to provide supporting data to validate the impact of this on the disease ;evels observed on strawberry runners for MB and alternatives. California's certification requirements specify minimum amounts of MB that must be applied. Furthermore, California regulations prohibit the use of LPBF. MBTOC encourages the Party to explore possible modifications of these regulations that may allow reduced dosages of MB. Reduced dosages of MB/Pic have been shown to be effective for production of 'certified' strawberry runners ie. 20 g/m2 (P13, UNEP/ TEAP October 2005) and could be applicable to SE. MBTOC has assumed there is an error in the 2008 BUNNI which shows strip treatments instead of broadacre treatments for MB/Pic formulations in the SE.	CUN identifies 1,3-D with chloropicrin as the next best alternative with a 10-percent yield loss in California and the Southeastern States. Operating costs with 1,3-D plus chloropicrin are marginally higher in the Southeast and marginally lower in California. In both regions the alternative is predicted to result in a 46 percent decrease in net revenues.

Country	Industry	Quantity approved for 2005 (1ExMOP+ 16MOP)	Quantity approved for 2006 (16MOP+ 2ExMOP+ 17MOP)	Quantity approved for 2007 (MOP17)	Quantity nominated for 2007 (additional or new)	Quantity nominated for 2008	MBTOC recommendation for 2007	MBTOC recommendation for 2008	MBTOC comments	MBTOC comments on economics
United States	Sweet potato slips	0.000	80.830	0.000		18.144		U	MBTOC is unable to assess this CUN at this time. The nomination appears to be at least partially for contingency use. MBTOC seeks clarification on the proportion of the nomination that is known to consistently be unavailable due to township caps and what portion is a contingency in case amounts are used more quickly than in previous years. The Party has identified 1,3-D as a technically and economically feasible alternative which is in fact preferable to MB for this industry.	No economic data on alternatives given. Factors that contribute to losses include delayed planting due to use of alternatives; fallow; additional use of herbicides; losses due to weeds, insects and diseases resulting in smaller, less attractive produce (quality loss)
United States	Tomatoes (field)	2876.046	2476.364	2065.246		1840.100		U	MBTOC recommends a reduced CUE of 20.520 tonnes for Michigan and 2.844 tonnes for research for these uses in 2008, and is unable to fully assess the remaining nomination pending further informaton from the Party. Absent this information, MBTOC has come to a preliminary finding. With the available information, MBTOC can recommend 1153.47 tonnes and will adjust this recommendation up or down if the nominating Party can provide technical or economic justification why their proposed reduction schedule is significantly slower than the phase out schedules that have been achieved in other countries that have halted use for the same pest on the same crop. The Party acknowledges that some alternatives are effective for a proportion of the nominations and have stated it will take 7 years to transition to these alternatives. MBTOC considers several alternatives available for the nomination, and that uptake of alternatives for this crop in regions with similar pests and climate has occurred within 4 years or less (eg Spain, Italy, Australia) (Leoni and Leda, 2004; Tostovrsnik et al 2005;Minuto et al, 2003). Information is also sought to clarify the actual number of production hectares requiring MB fumigation. Reduction in the nominated amounts conform or will conform to the standard presumptions for dosage rate of MB/Pic formulations with use/emission reduction technologies of either of 17.5 g/m2 for nutsedge or 15 g/m2 for pathogens unless the Party can provide documentation to justify why in the circumstances of this nomination the achievment of the standard presumptions can not be met. Modifications of formulations of e.g. MB/Pic 50:50 are available and versions of LPBF, (eg.VIF and metalized films) have been widely tested since 2000 and have shown equivalent effectiveness to MB at approximately 50% of the commercial dosage rate. In Michigan, the key pests are Phytophthora capsici and fusarium. The Party states that 1,3-D + chloropicrin may be an effective alternative, but growers will miss the optimal market window due to longer plant back times with this alternative. According to the Party, this treatment	CUN reports yield losses for 1,3-D with chloropicrin as the next best alternative ranging from 17% (Michigan) to 22% (SE USA). Net revenue declines reported for all regions. Changes in pest control costs are less than 4 percent of total variable costs so have little impact on economic measures. Missed market window in Michigan cited as main reason.

Country	Industry	Quantity approved for 2005 (1ExMOP+ 16MOP)	Quantity approved for 2006 (16MOP+ 2ExMOP+ 17MOP)	Quantity approved for 2007 (MOP17)	Quantity nominated for 2007 (additional or new)	Quantity nominated for 2008	MBTOC recommendation for 2007	MBTOC recommendation for 2008	MBTOC comments	MBTOC comments on economics
									cannot be applied in autumn because of the adverse bad climatic conditions. In addition, a fall application of MB is not feasible because over the fall and winter months deer and other animals damage the plastic and irrigation tape. Phytophthora is controlled in many regions by foliar sprays and grafting. In the southeast, Florida and Georgia the key pests are nutsedge, fusarium, nematodes and phytophthora. Trials have identified that there are technical alternatives for both karst and non-karst areas in these regions. In recent tomato trials conducted in Florida, 1,3-D/Pic 65:35 with and without LP barrier films, 1,3-D/Pic 65/35 and the herbicide combinations of either metolachlor & trifloxysulfuron or treflan and napropamide, and improved application of Pic with MNa provided similar yields as MB/Pic 67:33 in a number of consecutive trials over the spring and fall of 2003 and spring of 2004 (Santos et al, 2005). In further studies, (Locascio et al, 2000, Nelson et al, 2002, Gilreath et al., 2005) similar pest and weed control and/or yields have been realised.	
United States	Turfgrass	206.827	131.600	78.040		52.189		NR	MBTOC does not recommend MB for use in USA sod production. Effective alternatives have been found for 99% of all turf production and the Party has significantly reduced the nomination requests for this use from 207 t in 2005 to 78 t in 2007. Alternatives such as dazomet provide equal control of weedy grasses and slightly better control of broadleaf weeds when compared to MB, (Unruh et al., 2002). 1,3-D and 1,3-D + Chloropicrin can be used if nematodes are the primary pest, or possibly in conjunction with dazomet or metam-sodium. Metam-Sodium / Chloropicrin provided comparable control (vs. MB) of weedy grasses and nutsedge (e.g., Unruh and Brecke, 2001; Unruh et al., 2002).	CUN is for turf production intended to be sold as certified sod. CUN identifies dazomet as next best alternative to methyl bromide and states quality losses with dazomet would exclude much of production from certified market leading to substantial losses in gross and net revenue. CUN states price for non-certified sod is 75 percent lower than price for certified sod.

ANNEX I to Chapter 10

Decision IX/6

1. To apply the following criteria and procedure in assessing a critical methyl bromide use for the purposes of control measures in Article 2 of the Protocol:

(a) That a use of methyl bromide should qualify as "critical" only if the nominating Party determines that:
- *(i) The specific use is critical because the lack of availability of methyl bromide for that use would result in a significant market disruption; and*
- *(ii) There are no technically and economically feasible alternatives or substitutes available to the user that are acceptable from the standpoint of environment and health and are suitable to the crops and circumstances of the nomination;*

(b) That production and consumption, if any, of methyl bromide for critical uses should be permitted only if:
- *(i) All technically and economically feasible steps have been taken to minimise the critical use and any associated emission of methyl bromide;*
- *(ii) Methyl bromide is not available in sufficient quantity and quality from existing stocks of banked or recycled methyl bromide, also bearing in mind the developing countries' need for methyl bromide;*
- *(iii) It is demonstrated that an appropriate effort is being made to evaluate, commercialise and secure national regulatory approval of alternatives and substitutes, taking into consideration the circumstances of the particular nomination and the special needs of Article 5 Parties, including lack of financial and expert resources, institutional capacity, and information. Non-Article 5 Parties must demonstrate that research programmes are in place to develop and deploy alternatives and substitutes. Article 5 Parties must demonstrate that feasible alternatives shall be adopted as soon as they are confirmed as suitable to the Party's specific conditions and/or that they have applied to the Multilateral Fund or other sources for assistance in identifying, evaluating, adapting and demonstrating such options;*

2. To request the Technology and Economic Assessment Panel to review nominations and make recommendations based on the criteria established in paragraphs 1 (a) (ii) and 1 (b) of the present decision;

3. That the present decision will apply to Parties operating under Article 5 and Parties not so operating only after the phase-out date applicable to those Parties.

Para. 2 of Decision IX/6 does not assign TEAP the responsibility for determining the existence of "significant market disruption" specified in paragraph 1(a)(i).

TEAP assigned its Methyl Bromide Technical Options Committee (MBTOC) to determine whether there are *no technically and economically feasible alternatives or substitutes available to the user that are acceptable from the standpoint of environment and health and are suitable to the crops and circumstances of the nomination*, and to address the criteria listed in Decision IX/6 1(b).

ANNEX II to Chapter 10

Report of the Sixteenth Meeting of the Parties to the Montreal Protocol (Annex I), Prague, 22–26 November 2004), paragraph 15.

(Decision XVI/4. Review of the working procedures and terms of reference of the Methyl Bromide Technical Options Committee)

> "15. An annual work plan will enhance the transparency of, and insight in, the operations of MBTOC. Such a plan should indicate, among other things:
>
> (a) Key events for a given year;
>
> (b) Envisaged meeting dates of MBTOC, including the stage in the nomination and evaluation process to which the respective meetings relate;
>
> (c) Tasks to be accomplished at each meeting, including appropriate delegation of such tasks;
>
> (d) Timing of interim and final reports;
>
> (e) Clear references to the timelines relating to nominations;
>
> (f) Information related to financial needs, while noting that financial considerations would still be reviewed solely in the context of the review of the Secretariat's budget;
>
> (g) Changes in the composition of MBTOC, pursuant to the criteria for selection;
>
> (h) Summary report of MBTOC activities over the previous year, including matters that MBTOC did not manage to complete, the reasons for this and plans to address these unfinished matters;
>
> (i) Matrix with existing and needed skills and expertise; and
>
> (j) Any new or revised standards or presumptions that MBTOC seeks to apply in its future assessment of critical-use nominations, for approval by the Meeting of the Parties. "

ANNEX III to Chapter 10

List of nominated (2005 – 2008 in part) and exempted (2005 – 2007 in part) amounts of methyl bromide granted by Parties under the CUE process for each crop or commodity.

A. Preplant Soils Applications

Party	Industry	TOTAL CUN MB Nominated				Total CUE MB Approved		
		2005	2006	2007	2008	2005	2006	2007
Australia	Cut Flowers - field	40.000	22.350			18.375	22.350	
Australia	Cut flowers - protected	20.000				10.425		
Australia	Cut flowers, bulbs – protected Vic	7.000	7.000	6.170	6.150	7.000	7.000	
Australia	Strawberry Fruit	90.000				67.000		
Australia	Strawberry runners	35.750	37.500	35.750	35.750	35.750	37.500	35.75
Belgium	Asparagus	0.630	0.225			0.630	0.225	
Belgium	Chicory	0.600	0.180			0.180	0.180	
Belgium	Chrysanthemums	1.800	0.720			1.120		
Belgium	Cucumber	0.610	0.545			0.610	0.545	
Belgium	Cut flowers - other	6.110	1.956			4.000	1.956	
Belgium	Cut flowers - roses	1.640						
Belgium	Endive	sep.from lettuce	1.650				1.650	
Belgium	Leek & onion seeds	1.220	0.155			0.660		
Belgium	Lettuce(& endive)	42.250	22.425			25.190		
Belgium	Nursery	Not Predictable	0.384			0.900	0.384	
Belgium	Orchard pome & berry	1.350	0.621			1.350	0.621	
Belgium	Ornamental plants	5.660				0.000		
Belgium	Pepper & egg plant	5.270	1.350			3.000	1.350	
Belgium	Strawberry runners	3.400	0.900			3.400	0.900	
Belgium	Tomato (protected)	17.170	4.500			5.700	4.500	
Belgium	Tree nursery	0.230	0.155			0.230	0.155	
Canada	Strawberry runners (PEI)	14.792	6.840	7.995	7.462	(a)14.792	6.840	7.995
Canada	Strawberry runners (Quebec)		1.826	1.826		(a)	1.826	1.826
Canada	Strawberry runners (Ontario)			6.129				
France	Carrots	10.000	8.000	5.000		8.000	8.000	
France	Cucumber	85 revised to 60	60.000	15.000		60.000	60.000	
France	Cut-flowers	75.000	60.250	12.000		60.000	52.000	
France	Forest tree nursery	10.000	10.000	1.500		10.000	10.000	
France	Melon	10.000	10.000			7.500	6.000	
France	Nursery: orchard, raspberry	5.000	5.000	2.000		5.000	5.000	

Party	Industry	TOTAL CUN MB Nominated				Total CUE MB Approved		
		2005	2006	2007	2008	2005	2006	2007
France	Orchard replant	25.000	25.000	7.500		25.000	25.000	
France	Pepper	Incl in.tomato cun	27.500	6.000			27.500	
France	Strawberry fruit	90.000	86.000	34.000		90.000	86.000	
France	Strawberry runners	40.000	4.000	35.000		40.000	40.000	
France	Tomato (and eggplant for 2005 only)	150(all solanaceous)	60.500	33.250		125.000	48.400	
France	Eggplant		27.500	33.250			48.400	
Greece	Cucurbits	30.000	19.200			30.000	19.200	
Greece	Cut flowers	14.000	6.000			14.000	6.000	
Greece	Tomatoes	180.000	73.600			156.000	73.600	
Israel	Broomrape			250.000				
Israel	Cucumber - protected new 2007			25.000				
Israel	Cut flowers – open field	77.000	67.000	80.755		77.000	67.000	
Israel	Cut flowers - protected	303.000	303.000	321.330		303.000	240.000	
Israel	Fruit tree nurseries	50.000	45.000	10.000		50.000	45.000	
Israel	Melon – protected & field	148.000	142.000	140.000		125.650	99.400	
Israel	Potato	239.000	231.000	137.500		239.000	165.000	
Israel	Seed production	56.000	50.000			56.000	28.000	
Israel	Strawberries – fruit	196.000	196.000	176.200		196.000	196.000	
Israel	Strawberry runners	35.000	35.000			35.000	35.000	
Israel	Tomatoes			90.000				
Italy	Cut flowers (protected)	250.000	250.000	30.000		250.000	187.000	
Italy	Eggplant (protected)	280.000	200.000	15.000		194.000	156.000	
Italy	Melon (protected)	180.000	135.000	10.000		131.000	131.000	
Italy	Pepper (protected)	220.000	160.000	67.000		160.000	130.000	
Italy	Strawberry Fruit (Protected)	510.000	400.000	35.000		407.000	320.000	
Italy	Strawberry Runners	100.000	120.000	35.000		120.000	120.000	
Italy	Tomato (protected)	1300.000	1030.000	418.000		871.000	697.000	
Japan	Cucumber	88.300	88.800	72.400	68.600	88.300	88.800	72.4
Japan	Ginger - field	119.400	119.400	112.200	112.100	119.400	119.400	109.701
Japan	Ginger - protected	22.900	22.900	14.800	14.800	22.900	22.900	14.471
Japan	Melon	194.100	203.900	182.200	182.200	194.100	203.900	182.2
Japan	Peppers (green and hot)	189.900	200.700	169.400	162.300	187.200	200.700	156.700
Japan	Watermelon	126.300	96.200	94.200	43.300	129.000	98.900	94.2
Malta	Cucumber		0.096				0.127	
Malta	Eggplant		0.128				0.170	
Malta	Strawberry		0.160				0.212	

Party	Industry	TOTAL CUN MB Nominated				Total CUE MB Approved		
		2005	2006	2007	2008	2005	2006	2007
Malta	Tomatoes		0.475				0.594	
New Zealand	Nursery material	1.085	1.085				0.000	
New Zealand	Strawberry fruit	42.000	42.000	24.780		42.000	34.000	
New Zealand	Strawberry runners	10.000	10.000	5.720		8.000	8.000	
Poland	Strawberry Runners	40.000	40.000	25.000		40.000	40.000	
Portugal	Cut flowers	130.000	8.750			50.000	8.750	
Spain	Cut Flowers - Cadiz	53.000	53.000	35.000		53.000	42.000	
Spain	Cut Flowers - Catalonia	20.000	18.600	12.840		20.000	15.000	
Spain	Pepper	200.000	155.000	45.000		200.000	155.000	
Spain	Strawberry Fruit	556.000	499.290	80.000		556.000	499.290	
Spain	Strawberry Runners	230.000	230.000	230.000		230.000	230.000	
UK	Cut flowers		7.560				6.050	
UK	Ornamental tree nursery	12.000	6.000			6.000	6.000	
UK	Strawberry (& raspberry in 2005)	80.000	63.600			68.000	54.500	
UK	Raspberry nursery		4.400				4.400	
USA	Chrys. Cuttings/roses	29.412				29.412	0.000	
USA	Cucurbits - field	1187.800	747.839	598.927	588.949	1187.800	747.839	592.891
USA	Eggplant - field	76.761	101.245	96.480	79.546	76.721	82.167	85.363
USA	Forest nursery seedlings	192.515	157.694	152.629	133.140	192.515	157.694	122.032
USA	Ginger	9.200				9.200	0.000	
USA	Orchard replant	706.176	827.994	405.415	405.666	706.176	527.600	405.4
USA	Ornamentals	210.949	162.817	149.965	138.538	154.000	148.483	137.835
USA	Nursery stock - fruit trees, raspberries, roses	45.789	64.528	12.684	51.102	45.800	64.528	28.275
USA	Peppers - field	1094.782	1498.530	1151.751	919.006	1094.782	1243.542	1106.753
USA	Strawberry fruit – field	2468.873	1918.400	1733.901	1604.669	2052.846	1730.828	1476.019
USA	Strawberry runners	54.988	56.291	4.483	8.838	54.988	56.291	4.483
USA	Tomato - field	2876.046	2844.985	2334.047	1840.100	2876.046	2476.365	2065.246
USA	Turfgrass	352.194	131.600	78.040	52.189	206.827	131.600	78.04
USA	Sweet potato	224.528			18.144			

ANNEX III to Chapter 10 (Cont')

List of nominated (2005 – 2008 in part) and exempted (2005 – 2007 in part) amounts of methyl bromide granted by Parties under the CUE process for each crop or commodity.

B Post-harvest Structural and Commodity Applications

Party	Industry	TOTAL CUN MB Nominated				Total CUE MB Approved		
		2005	2006	2007	2008	2005	2006	2007
Australia	Almonds	1.900	2.100			1.900	2.100	
Australia	Rice consumer packs	12.300	12.300	10.225	9.200	6.150	6.150	5.130
Belgium	Artefacts and structures	0.600	0.307			0.590	0.307	
Belgium	Antique structure & furniture	0.750	0.199			0.319	0.199	
Belgium	Churches, monuments and ships' quarters	0.150	0.059			0.150	0.059	
Belgium	Electronic equipment	0.100	0.035			0.100	0.035	
Belgium	Empty silo	0.050	0.043			0.050	0.043	
Belgium	Flour mill see mills below	0.125	0.072			See mills below	0.072	
Belgium	Flour mills	10.000	4.170			9.515	4.170	
Belgium	Mills	0.200	0.200			0.200	0.200	
Belgium	Food processing facilities	0.300	0.300			0.300	0.300	
Belgium	Food Processing premises	0.030	0.030			0.030	0.030	
Belgium	Food storage (dry) structure	0.120	0.120			0.120	0.000	
Belgium	Old buildings	7.000	0 .306			1.150	0.306	
Belgium	Old buildings and objects	0.450	0.282			0.000	0.282	
Belgium	Woodworking premises	0.300	0.101			0.300	0.101	
Canada	Flour mills	47.200	34.774	30.167	28.650	(a)47	34.774	30.167
Canada	Pasta manufacturing facilities	(a)	10.457	6.757		(a)	10.457	
France	Seeds sold by PLAN-SPG company	0.135	0.135	0.100		0.135	0.135	
France	Mills	55.000	40.000	8.000		40.000	35.000	
France	Rice consumer packs	2.000	2.000			2.000	2.000	
France	Chestnuts	2.000	2.000	1.800		2.000	2.000	
Germany	Artefacts	0.250	0.100			0.250	0.100	
Germany	Mills and Processors	45.000	19.350			45.000	19.350	
Greece	Dried fruit	4.280	3.081	0.900		4.280	3.081	
Greece	Mills and Processors	23.000	16.000	1.340		23.000	15.445	
Greece	Rice and legumes		2.355				2.355	
Ireland	Mills		0.888	0.611			0.888	
Israel	Artefacts	0.650	0.650	0.600		0.650	0.650	
Israel	Dates (post	3.444	3.444	2.200		3.444	2.755	

Party	Industry	TOTAL CUN MB Nominated				Total CUE MB Approved		
		2005	2006	2007	2008	2005	2006	2007
	harvest)							
Israel	Flour mills (machinery & storage)	2.140	1.490	1.490		2.140	1.490	
Israel	Furniture– imported	1.422	1.422	2.042		1.422	0.000	
Italy	Artefacts	5.500	5.500	5.000		5.225	0.000	
Italy	Mills and Processors	160.000	130.000	25.000		160.000	65.000	
Japan	Chestnuts	7.100	6.500	6.500	6.300	7.100	6.800	6.500
Latvia	Grains		2.502				2.502	
The Netherlands	Strawberry runners post harvest		0.120	0.120		0.120	0	
Poland	Medicinal herbs & dried mushrooms as dry commodities	4.000	3.560	1.800		4.100	3.560	
Poland	Coffee, cocoa beans	(a)	2.160	2.000			2.160	
Spain	Rice		50.000				42.065	
Switzerland	Mills & Processors	8.700	7.000			8.700	7.000	
UK	Aircraft			0.165				
UK	Mills and Processors	47.130	10.195	4.509		47.130	10.195	
UK	Cereal processing plants		8.131	3.480		(a)	8.131	
UK	Cheese stores	1.640	1.248	1.248		1.640	1.248	
UK	Dried commodities (rice, fruits and nuts) Whitworths	2.400	1.256			2.400	1.256	
UK	Herbs and spices	0.035	0.037	0.030		0.035	0.037	
UK	Mills and Processors (biscuits)	2.525	1.787	0.479		2.525	1.787	
UK	Spices structural equip.	1.728				1.728	0.000	
UK	Spices stored	0.030				0.030	0.000	
UK	Structures buildings (herbs and spices)	3.000	1.872	0.908		3.000	1.872	
UK	Structures, processors and storage (Whitworths)	1.100	0.880	0.257		1.100	0.880	
UK	Tobacco equipment	0.523				0.050	0.000	
UK	Woven baskets	0.770				0.770	0.000	
USA	Dried fruit and nuts (walnuts, pistachios, dried fruit and dates and dried beans)	89.166	87.719	91.299	67.699	89.166	87.719	78.983
USA	Dry commodities/ structures (cocoa beans)	61.519	61.519	64.028	52.256	61.519	55.367	64.082

Party	Industry	TOTAL CUN MB Nominated				Total CUE MB Approved		
		2005	2006	2007	2008	2005	2006	2007
USA - NPMA	Dry commodities/ structures (processed foods, herbs and spices, dried milk and cheese processing facilities) NPMA	83.344	83.344	85.801	72.693	83.344	69.118	82.771
USA	Smokehouse hams (Dry cure pork products) (building and product)	136.304	135.742	40.854	19.669	67.907	81.708	18.998
USA	Mills and Processors	536.328	505.982	401.889	362.952	483.000	461.758	401.889

11 Terms of Reference for the Study called for under Decision XVII/17 on Technical and Financial Implications of the Environmentally Sound Destruction of Concentrated and Diluted Sources of ODS

The Parties to the Montreal Protocol in Decision XVII/17, called on the Technology and Economic Assessment Panel "to prepare terms of reference for the conduct of case-studies in Parties operating under paragraph 1 of Article 5 of the Protocol, with regional representation, on the technology and costs associated with a process for the replacement of chlorofluorocarbon-containing refrigeration and air-conditioning equipment, including the environmentally sound recovery, transport and final disposal of such equipment and of the associated chlorofluorocarbons" and to submit the said terms of reference to the Parties at the twenty-sixth meeting of the Open-ended Working Group.

The following Terms of Reference have been prepared for consideration of the Parties:

1. Studies should be developed "*in Parties operating under paragraph 1 of Article 5 of the Protocol, with regional representation*", on the technology and costs associated with a process for the management, transport and final disposal of CFC containing equipment and associated ODS at the end of life or earlier if feasible.

2. In carrying out these studies, the entity selected should:

(a) Review non-Article 5(1) country experiences on ODS Recovery and Destruction Technologies with respect to refrigerant and/or blowing agent and specific reference to types and scale of operations, and transport (including relevant conventions), storage and disposal issues;
(b) Build models based on the studied real examples highlighting critical issues and factors for success;
(c) Collect relevant data for selected Article 5(1) regions based on inputs from local industry, national and local government, academia, energy supply companies and other stakeholders;
(d) Test the data gathered against the critical factors previously identified in (b);
(e) After preparing an indicative cost estimate assess the social, economic and environmental impact of the different recovery and destruction options in the specific regions and compare their cost-benefit.

3. In carrying out these studies, the entity selected should take into account:

(a) The economic incentives which may be available, either inherent or external to the process, that would encourage users to reduce emissions and/or phase-out specific categories of equipment;
(b) The viability and potential cost of using existing destruction facilities;
(c) The annual reductions of ODS which will likely be attained through the implementation of the various options using, where relevant, the recovery and destruction efficiency parameter proposed by the TEAP in its Report of the Task Force on Foam End-of-life Issues (May, 2005);

(d) The evaluations done by the MLF on issues associated with transport, recovery, recycling and disposal issues, and the related UNDP projects;

(e) The studies done by TEAP and other conventions on destruction technologies and related issues.

4. The conveners of the study should provide a progress report to the Secretariat, and through them, to the 28th meeting of the Open-ended Working Group at least six weeks before the meeting, and a final report to the Secretariat, and through them, to the 19th Meeting of the Parties, at least 6 weeks prior to the Meeting.

12 TEAP/TOC Organisation Issues

12.1 Membership and Budget

As non-Article 5(1) Parties have largely phased out their ODS uses from most sectors, with a few notable exceptions, companies and governments are finding it increasingly difficult to justify donating the time for their employees to participate as TEAP and TOC members or to fund their travel to meetings. As a consequence, TEAP and its TOCs are facing the imminent loss of some of their most experienced members who are critically important to their work. Some of the most knowledgeable and productive members from non-Article 5(1) Parties have changed jobs since they first began serving on TOCs, such as becoming consultants, but remain willing to participate without having their time compensated.

Due to these changes, the TOCs have identified a number of members from non-Article 5(1) Parties, who remain important to the quality of the TEAP and TOC work but are no longer able to secure a source of travel funding.

The TEAP conducted a survey at their April 2006 meeting to estimate the time donated by TEAP and TOC members to produce an Assessment Report for the Parties, and to identify those critical non-Article 5(1) country members who are without travel support. The TEAP estimates that over 4,000 person-days of effort by 176 people are necessary to meet the requirements the Parties have asked of the TEAP in this assessment year. This includes participation in meetings as well as the non-meeting time needed to conduct research and write and edit reports. The TEAP has identified an ongoing need for additional funded travels to support specific members who meet the following criteria:

- non-Article 5(1) member;
- critical expertise in implementing alternatives not available from other funded members;
- produces a high quantity of high quality work.

The TEAP now has an urgent need for funding for 13 members from non-Article 5(1) Parties to make 26 travels for 2007.

12.2 Conflict of Interest

In June 2005, Canada circulated a non-paper suggesting improvements to the TEAP Terms-of Reference (TOR) regarding Conflict-of Interest (CoI), which are found in Annex V of the Eighth Meeting of the Parties.

The non-paper was discussed by Parties at the 2005 OEWG and in side-meetings with TEAP Co-Chairs. Parties agreed to submit their own comments and invited TEAP to comment. Canada collected these comments and placed a revised draft on the Ozone Secretariat web site for a second round of comments.

TEAP has comprehensively responded to the non-paper. TEAP Co-Chairs have discussed the concerns among themselves and have met with the Canadian authors and other authorities to understand and elaborate the concerns. The non-paper was circulated to TEAP, TOC, and Task Force members by internet and TEAP submitted a written response in October 2005 based on text edited by TEAP members via the internet. As the Canadian non-paper presented procedures for CUE and EUE deliberations based on the MBTOC CUE handbook, the MTOC combined and adapted the underlying principles for the conduct of the 2006 meeting on EUEs for metered-dose inhalers. The original Canadian non-paper (and the revised version downloaded from the Ozone Secretariat web site) was discussed at recent TEAP and TOC meetings with detailed recommendations from MBTOC and MTOC. TEAP had an extensive discussion at its annual meeting in April 2006, and came to consensus on how to respond.

The current ToR requires: "TEAP, TOC and TSB (Temporary Subsidiary Body) Members to disclose activities, including business or financial interest in production of ozone-depleting substances, their alternatives, and products containing ozone depleting substances and alternatives, which might call into question their ability to discharge their duties and responsibilities objectively. Members must also disclose any financing from a company engaged in commercial activities, for their participation in TEAP, TOC or TSB."

The Canadian non-paper recommends disclosure of interests within 30 days of appointment and annually thereafter, due diligence by Parties in reviewing interests prior to submitting a nomination, and an expanded role in monitoring and periodically reviewing the process. It suggested that disclosure be expanded to include prior employment and financial interests of spouses and partners.

TEAP thanks the Government of Canada for its efforts to further improve the Terms of Reference and agrees with many of the recommendations. TEAP believes that added efforts can be made to avoid actual conflict-of-interest. TEAP and TOC Co-chairs, in cooperation with the Ozone Secretariat, intend to increase efforts to avoid the appearance of conflict-of-interest. While erring on the side of caution in accepting a new member or removing an existing member, TEAP and TOC Co-Chairs should ensure not to jeopardize the confidence of Parties that TEAP provides nothing but objective policy-relevant technical information. Of course, this review process must be carefully and fairly undertaken to preserve the participation of volunteer experts from government, industry, and NGOs who will welcome scrutiny so long as it is constructive and unobtrusive.

TEAP has already taken steps to elaborate the disclosure of interests of TEAP members that is published in this and previous TEAP Progress Reports and TEAP will respond to Canada with a draft suitable for discussion at the Twenty-sixth meeting of the OEWG scheduled for July 2006 that shows how TEAP proposes to implement changes in the existing Terms of Reference.

13 TEAP and TOC Membership Information

TEAP Member Biographies

The following contains the background information for all TEAP members as at May 2006.

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Radhey S. Agarwal, Co-chair of the Refrigeration, Air-conditioning, and Heat Pumps Technical Options Committee since 1996, is the Professor of Mechanical Engineering at the Indian Institute of Technology (IIT Delhi), Delhi, India. He co-chaired the 2003 HCFC Task Force and the 2004 Chiller Task Force. IIT Delhi makes in-kind contribution for wages. Costs of travel, communication, and other expenses related to participation in the TEAP and the Refrigeration TOC, and relevant Montreal Protocol meetings are paid by UNEP's Ozone Secretariat.

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Stephen O. Andersen, Co-chair of the Technology and Economic Assessment Panel since 1989, is Director of Strategic Climate Projects in the Climate Protection Partnerships Division of the U.S. Environmental Protection Agency. He chaired and co-chaired the Solvents TOC from 1989 to 1995 and co-chaired the 2002 Task Force on Collection, Recovery and Storage; the 2003 HCFC Task Force; and the 1992 Methyl Bromide Assessment. He also chaired the 1999 HFC and PFC Task Force. He served on the Steering Committee to the "IPCC/TEAP Special Report Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons" and he participates in the Science Assessment Panel. Stephen's spouse works for the U.S. EPA Office of Pesticide Programs and Toxic Substances in a division that registers bio-pesticides, including potential substitutes for methyl bromide. The U.S. EPA makes in-kind contributions of wages, travel, communication, and other expenses and some travel is sponsored by the U.S. DoD. With approval of its government ethics officer, EPA allows expenses to be paid by other governments and organisations such as the United Nations Environment Programme (UNEP).

Mr. Paul Ashford
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Paul Ashford, Co-chair of the Rigid and Flexible Foams Technical Options Committee since 1998 is the owner and managing director of Caleb Management Services, a consulting company working in the sustainability arena. He co-chaired the "TEAP Supplemental Report to the IPCC/TEAP Special Report: Safeguarding the ozone layer and the global climate system: issues related to hydrofluorocarbons and Perfluorocarbons". Until 1994, he worked for BP chemicals in the division that developed licensed foam technology using ODS and its alternatives. He has over 25 years direct experience of foam related technical issues and is active in several studies informing future policy development for the foam sector. His funding for TEAP activities, which includes some sponsorship of time, is provided under contract by the Department of Trade and Industry in the UK. Much of his recent work on banks and emissions, performed to inform both IPCC and TEAP processes has been supported by the US EPA. There is increasing cross-over with IPCC and UNFCCC in support of emissions reporting by Governments. Other related non-TEAP work is covered under separate contracts from relevant commissioning organisations including international agencies (e.g. UNEP DTIE), governments, industry associations and corporate clients. Most work with private clients relates to the lifecycle assessment of products based on ODS alternatives.

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Jonathan Banks, Chair of the QPS Task Force, is a private consultant. He was a member of the 1992 Methyl Bromide Assessment and from 1993 to 1998 and 2001 to 2005 co-chaired the Methyl Bromide TOC. Previously, he worked for Australian Commonwealth Scientific and Industrial Research Organization (CSIRO). He is co-owner of an organic apple orchard and serves on agricultural community and marketing associations and he is the inventor of carbonyl sulfide, which is an alternative to methyl bromide in some applications. His spouse is co-owner of their orchard. He serves on some national committees concerned with ODS and their control, and he receives contracts from UN, UNEP, and other institutions and companies related to methyl bromide alternatives and grain storage technology--including fumigation technology and recapture systems for methyl bromide. In 2005 he received support from UNEP for TEAP and MBTOC activities. Previous funding has been through grants or contracts from the Department of Environment and Heritage, Australia and from UNEP.

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Mohamed Besri, Co-chair of the Methyl Bromide Technical Options Committee since 2005, is Professor of Plant Pathology and Integrated Diseases Management at the Hassan II Institute of Agronomy and Veterinary Medicine, Rabat and was previously Dean of the Faculty of Agriculture and the Graduate School. He is mainly working on alternatives to Methyl Bromide for vegetable production. He is a consultant for many agricultural organizations, including the UN Food and Agricultural Organization (FAO), US Agency for International Development (USAID), UNDP, UNEP, the International Centre for Advanced Mediterranean Agronomic Studies (ICAMAS), Greenpeace, Foreign Agricultural Disease Eradication Support (FADES), GTZ, the European Union, World Bank, and the Inter Academy Council (IAC). He is member of many international executive committees and governing boards particularly of the International Association for the Plant Protection Sciences (IAPPS) and of the International Association for Biological control (IOBC) and was President of the Arab Society for Plant Protection. Costs of travel, communication, and other expenses related to participation in the TEAP, its Methyl Bromide TOC, and relevant Montreal Protocol meetings, are paid by UNEP's Ozone Secretariat.

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David Catchpole, Co-chair of the Halons Technical Options Committee since 2005, works part time for Petrotechnical Resources Alaska (PRA), a company that provides consulting services to oil companies in Alaska. From 1991 to 2004 he was a member of the HTOC. Until 1999, he was an employee of BP Exploration Alaska, where he worked for the environmental department on alternatives to halon and on halon banking. Mr. Catchpole advises BP Exploration Alaska on fire detection and halon issues as his main activity for PRA. Funding for participation by Mr. Catchpole on the HTOC is provided by the United States Environmental Protection Agency and the United States Department of Defense. Mr. Catchpole also receives funding support for halon related activities from BP Exploration Alaska and the Halon Recycling Corporation, which is a not-for-profit industry coalition.

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Dr. Biao Jiang, Co-chair of the Chemicals Technical Options Committee since 2005, is Professor of Chemistry of Shanghai Institute of Organic Chemistry, Chinese Academy Of Sciences and a member of editorial advisory board of Chemical Communication, Royal Society of Chemistry, United Kingdom. Professor Jiang involves in the research of the development new methodology of organic synthesis, medicinal chemistry, fluorine chemistry as well as organic process research and development of clean chemistry. Costs of travel, communication, and other expenses related to participation in the TEAP, its Chemicals TOC, and relevant Montreal Protocol meetings, are paid by UNEP's Ozone Secretariat.

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Lambert Kuijpers, Co-chair of the Technology and Economic Assessment Panel since 1992 and Co-chair of the Refrigeration, Air-conditioning and Heat Pumps Technical Options Committee since 1989, works on a part-time basis for the Department "Technology for Sustainable Development" at the Technical University Eindhoven, The Netherlands. He co-chaired the 1996, 1999, 2002, and 2005 Replenishment Task Forces, the 2002 Task Force on Destruction Technologies and the 2003 Task Force on HCFCs. He served on the Steering Committee to the "IPCC/TEAP Special Report "Safeguarding the ozone layer and the global climate system: issues related to Hydrofluorocarbons and Perfluorocarbons" and he co-chaired the Task Force for the TEAP Supplementary Report to the IPCC/TEAP Special Report. He also chaired the 2004 TEAP Basic Domestic Needs Task Force and the 2004 Chiller Task Force. Until 1993, he worked for Philips in the development of refrigeration, air conditioning, and heat pump systems to use alternatives to ozone-depleting substances. He is supported (through the UNEP Ozone Secretariat) by the European Commission and some EU governments for all his activities related to the TEAP and the Refrigeration TOC (including follow-ups to the IPCC/TEAP Special Report, the IPCC AR4 and his participation on the Science Assessment Panel). He is a consultant to governmental and non-governmental organisations, such as the World Bank, UNEP DTIE and the Multilateral Fund (for the 2006 Expert Meeting). Dr. Kuijpers is also an advisor to the Re/genT Company, Netherlands (R&D of components and equipment for refrigeration, air-conditioning and heating).

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Tamas Lotz, Senior Expert Member since 2002, is a consultant on the global and long range transboundary air pollution control to the Ministry of Environment and Water in Budapest, Hungary. He was one of the authors of the Hungarian Country Programme for the phase-out of ODSs. His travel, per diem and other costs are covered by the Ministry of Environment and Water of Hungary.

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Michelle Marcotte, Co-chair of the Methyl Bromide Technical Options Committee since 2005, is a consultant to governments and agri-food companies in agri-environmental issues, food technology, regulatory affairs, and radiation processing. She was a member of 1992 Methyl Bromide Assessment and subsequent Methyl Bromide Technical Options Committees until 2004. Until 1993, she worked for Nordion (now MDS Nordion) a supplier of radiation processing equipment, which is an alternative to the use of methyl bromide in some commodity applications. Michelle's spouse works for the United States Department of Agriculture as a manager of research into alternatives to methyl bromide in pre-plant and post-harvest applications and is a member of the MBTOC. In the field of methyl bromide alternatives, Michelle Marcotte has published case studies in pest control in food processing facilities, in stored commodities, in alternatives for quarantine, and in greenhouse use. She is a member of Canadian Industry-Government Methyl Bromide Working Groups and the Canada–US Methyl Bromide Working Group. She has consulted for the Canadian and United States governments on methyl bromide and other issues and for the International Atomic Energy Agency (IAEA) and USAID on irradiation as an alternative to methyl bromide and trade. She consulted directly with companies or through organizations in eight countries. Consulting fees and costs of travel and other expenses for participation on MBTOC are partially paid by the Government of Canada and from her own company funds.

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Thomas Morehouse, Senior Expert Member for Military Issues since 1997, is a Research Adjunct at the Institute for Defense Analyses (IDA), Washington D.C., USA. From 1989 until 1996 he co-chaired the Halons TOC. From 1986 to 1989 he was an officer in the United States Air Force responsible for developing alternatives to halon. From 1989 until 1994 his responsibilities as an Air Force officer included broader environmental and energy policy issues for the U.S. Department of Defense. Tom's spouse works for the U.S. National Oceanographic and Atmospheric Administration (NOAA) in a position that plans long term spending for NOAA, including research and operations affecting stratospheric ozone and climate. 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 Federally Funded Research Center (FFRDC) that undertakes work exclusively for the US Department of Defense. He also occasionally consults independently to corporate clients, national laboratories and other government agencies on environmental and energy related issues.

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Marta Pizano, Co-chair of the Methyl Bromide Technical Options Committee since 2005, is a consultant on methyl bromide alternatives for cut flowers and has actively promoted methyl bromide alternatives among growers in many countries. She is a regular consultant for the Montreal Protocol Multilateral Fund (MLF) and its implementing agencies. In this capacity, she has contributed to the methyl bromide phase-out programs in nearly twenty Article 5(1) countries around the world. She is a frequent speaker at national and international methyl bromide conferences and has authored numerous articles and publications on alternatives to this fumigant, including a thorough manual on successful flower growing without methyl bromide published by UNEP. Costs of travel, communication, and other expenses related to participation in the TEAP, its Methyl Bromide TOC, and relevant Montreal Protocol meetings, are paid by UNEP's Ozone Secretariat.

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Jose Pons Pons, Co-chair of the Technology and Economic Assessment Panel since 2003 and Co-chair Medical Products Technical Options Committee since 1991. He co-chaired the 2002 Task Force on Collection, Recovery and Storage, the 1999 Replenishment Task Forces, and served on the Steering Committee to the "IPCC/TEAP Special Report Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons". He is President and co-owner of Spray Quimica. His spouse is also co-owner of Spray Quimica. Spray Quimica is an aerosol products filler who produces its own brand products and does contract filling for third parties. Jose is chair of the Venezuelan Aerosol Association. Spray Quimica, purchases HCFCs and HFCs for some of its products. Costs of travel expenses related to participation in the TEAP, its CTOC and MTOC, and relevant Montreal Protocol meetings, are paid by UNEP's Ozone Secretariat. Spray Quimica makes in-kind contributions of wage, and miscellaneous and communication expenses.

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Dr Ian Porter, Co-chair of the Methyl Bromide Technical Options Committee since 2005, is the Statewide Leader of Plant Pathology with the Victorian Department of Primary Industries (DPI). He is a member of a number of National Committees regulating ODS, has led the Australian research program on methyl bromide alternatives for soils and has 26 years experience in researching sustainable methods for soil disinfestation of plant pathogens. He has been a member of MBTOC since 1997 and acted as the lead consultant for UNEP in developing programmes to assist China and CEIT countries to replace methyl bromide. The Victorian DPI makes in-kind contributions to attend MBTOC and UNEP meetings. The Victorian Department of Primary Industries sponsors the time of his participation. The Australian Federal Government Research Funds and the Ozone Secretariat have provided funds to support travel and expenses for MBTOC activities.

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Prof. Miguel W. Quintero, Co-chair of the Foams Technical Options Committee since 2002, is professor at the Chemical Engineering Department at Universidad de los Andes in Bogota, Colombia, in the areas of polymer processing and transport phenomena. He is also a regular consultant for the Montreal Protocol's implementing agencies. Mr. Quintero worked 21 years until 2000 for Dow Chemical at the Research & Development and Technical Service & Development departments in the area of rigid polyurethane foam. He owns stock in companies that now or previously manufactured ozone-depleting substances and products made with or containing ozone-depleting substances and their substitutes and alternatives. His time in dealing with TEAP and TOC issues is covered by Universidad de los Andes. Costs of travel expenses related to participation in the TEAP, its Foam TOC, and relevant Montreal Protocol meetings, are paid by UNEP's Ozone Secretariat.

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Dr. Rae, Co-chair of the Chemicals Technical Options Committee since 2005, is Honorary Professorial Fellow at the University of Melbourne, Australia, and a member of advisory bodies for several Australian government agencies, including on implementation issues for the Montreal Protocol and the Stockholm Convention. He also co-chaired the 2001 and 2004 Process Agent Task Forces. His spouse owns stock in a company that distributes ODSs and ODS alternatives. He is a member of the POPs Review Committee for the Stockholm Convention. On occasions, he acts as consultant to government agencies and to universities and companies and he has been an expert witness in a case involving alleged patent infringement involving HFC-134a and its lubricants. He contributes the time for his own participation in TEAP activities. The Australian Government Department of the Environment and Heritage finances the cost of travel and accommodation for Dr. Rae's attendance at meetings of CTOC, TEAP, OEWG and MOP.

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K. Madhava Sarma, Senior Expert Member since 2001, retired in 2000, after nine years as Executive Secretary, Ozone Secretariat, UNEP. Earlier, he was a senior official in the Ministry of Environment and Forests (MOEF), Government of India and held various senior positions in a state government in India. He works occasionally as a consultant to UNEP and is an unpaid member of the Technical and Finance Committee of the Ozone Cell, MOEF, Government of India. He is working on a research and writing project on technology transfer and change for the protection of the ozone layer financed by the Global Environmental Facility (GEF) and the International Network for Environmental Enforcement and Compliance (INECE). Costs of travel, communication, and other expenses related to participation in the TEAP and relevant Montreal Protocol meetings, are paid by UNEP's Ozone Secretariat.

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Helen Tope, Co-chair Medical Technical Options Committee since 1993, is a Senior Policy Officer – Global Issues, EPA Victoria, Australia. Helen's spouse is an independent consultant working in areas of environmental engineering and energy efficiency for mining, oil and gas, and other interests. EPA Victoria makes in-kind contributions of wage and miscellaneous expenses. The Ozone Secretariat provides a grant for travel, communication, and other expenses of the Medical Technical Options Committee out of funds granted to the Secretariat unconditionally by the International Pharmaceutical Aerosol Consortium (IPAC). IPAC is a non-profit corporation.

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Dr. Verdonik, Co-chair of the Halons Technical Options Committee since 2005, is the Director, Environmental Programs, Hughes Associates, Baltimore, MD, USA. From 1991 to 2004 he was a member of the HTOC. He is a consultant in fire protection and environmental management to the US Department of Defense, the US Army, the US EPA and corporate clients. Dan's wife works for the United States Army as a civilian environmental protection specialist. Funding for participation by Dr. Verdonik on the HTOC is provided by the United States Environmental Protection Agency and the Department of Defense.

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Dr. Ashley Woodcock, Co-chair Medical Technical Options Committee since 1996, is a Consultant Respiratory Physician at the NorthWest Lung Centre, Wythenshawe Hospital, Manchester, UK. Prof. Woodcock is a full-time practising physician and Professor of Respiratory Medicine at the University of Manchester. The NorthWest Lung Centre carries out drug trials (including those on CFC-free MDIs and DPIs) for pharmaceutical companies, for some of which Prof. Woodcock is the principal investigator. Prof. Woodcock has received support for his travel to educational meetings and occasionally consults for pharmaceutical companies on the development of study designs to evaluate new drugs. He is a consultant to a company developing a dry powder inhaler for treatment of Cystic Fibrosis, which will not be a replacement for current CFC or HFC MDIs used in the treatment of Asthma or COPD. He does not receive any consultancy fees for work associated with the Montreal Protocol and does not own shares in any relevant drug companies. Wythenshawe Hospital makes in-kind contributions of wages and communication. The UK Department of Environment, Food and Rural Affairs sponsors travel expenses in relation to Prof. Woodcock's Montreal Protocol activities.

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Dr. Masaaki Yamabe, Co-Chair of the Chemical Technical Options Committee since 2005, is research coordinator (Environment and Energy) at the AIST. He also co-chaired the 2004 Process Agent Task Force. He was a member of the Solvents TOC during 1990-1996. Until 1999, Dr. Yamabe was Director of Central Research for Asahi Glass Company, which previously produced CFCs, methyl chloroform, and carbon tetrachloride, and currently produces and distributes HCFC, carbon tetrachloride, and HFCs. He is the co-inventor of HCFC-225, which is controlled under the Montreal Protocol as a transitional substance in the phase-out of ozone-depleting substances and is a substitute for CFC-113 in solvent and process agent applications. He owns stock in Asahi Glass Company that produces ozone-depleting substances and their substitutes. He also works for the Japan Industrial Conference for Ozone Layer and Climate Protection (JICOP) as a senior advisor. AIST pays wages, travelling and other expenses.

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14 TEAP-TOC Membership Lists

TEAP-TOC Membership Lists

Technology and Economic Assessment Panel (TEAP)

Co-chairs	Affiliation	Country
Stephen O. Andersen	Environmental Protection Agency	USA
Lambert Kuijpers	Technical University Eindhoven	Netherlands
Jose Pons Pons	Spray Quimica	Venezuela

Senior Expert Members	Affiliation	Country
Tamás Lotz	Consultant to the Ministry for Environment and Water	Hungary
Thomas Morehouse	Institute for Defense Analyses	USA
K. Madhava Sarma	Consultant	India
Shiqiu Zhang	Peking University	China

TOC Chairs	Affiliation	Country
Radhey S. Agarwal	Indian Institute of Technology Delhi	India
Paul Ashford	Caleb Management Services	UK
Jonathan Banks	Consultant	Australia
Mohamed Besri	Institut Agronomique et Vétérinaire Hassan II	Morocco
Biao Jiang	Shanghai Institute of Organic Chemistry	China
David Catchpole	Petrotechnical Resources Alaska	UK
Michelle Marcotte	Marcotte Consulting LLC and Marcotte Consulting Inc	Canada
Marta Pizano	Consultant	Colombia
Ian Porter	Department of Primary Industries	Australia
Miguel Quintero	Universidad de los Andes	Colombia
Ian Rae	University of Melbourne	Australia
Helen Tope	EPA, Victoria	Australia
Ashley Woodcock	Wythenshawe Hospital	UK
Daniel Verdonik	Hughes Associates	USA
Masaaki Yamabe	National Institute of Advanced Industrial Science and Technology	Japan

TEAP Chemicals Technical Options Committee (CTOC)

Co-chairs	Affiliation	Country
Ian Rae	University of Melbourne	Australia
Masaaki Yamabe	National Institute of Advanced Industrial Science and Technology	Japan
Biao Jiang (interim)	Shanghai Institute of Organic Chemistry	China

Members	Affiliation	Country
D. D. Arora	Tata Energy Research Institute	India
Steven Bernhardt	Honeywell	USA
Olga Blinova	Russian Scientific Center "Applied Chemistry"	Russia
Nick Campbell	Arkema Group	France
Bruno Costes	Airbus	France
Jianxin Hu	Center of Environmental Sciences, Beijing University	China
A.A. Khan	Indian Institute of Chemical Technology	India
Michael Kishimba	University of Dar es Sallam	Tanzania
Abid Merchant	DuPont	US
Koichi Mizuno	National Institute of Advanced Industrial Science and	Japan

	Technology	
Claudia Paratori	Environmental Consultant	Chile
Hans Porre	Teijin Twaron	Netherlands
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Shuniti Samejima	Asahi Glass Foundation	Japan
John Stemniski	Consultant	US
Fatima Al-Shatti	Kuwait Petroleum Corporation	Kuwait
Peter Verge	Boeing Manufacturing	US
Robert Nee Yive	University of Mauritius	Mauritius

TEAP Flexible and Rigid Foams Technical Options Committee (FTOC)

Co-chairs	**Affiliation**	**Country**
Paul Ashford	Caleb Management Services	UK
Miguel Quintero	Universidad de los Andes	Colombia

Members	**Affiliation**	**Country**
Kyoshi Hara	JUFA	Japan
Mike Hayslett	Maytag/AHAM	US
Mike Jeffs	ISOPA	Belgium
Shigeru Wakana	Dow	Japan
Suzie Kocchi	Environmental Protection Agency	US
Candido Lomba	ABRIPUR	Brazil
Yehia Lotfi	Technocom	Egypt
Christoph Meurer	Solvay	Germany
Mudumbai Sarangapani	Polyurethane Council of India	India
Ulrich Schmidt	Haltermann/Dow	Germany
Bert Veenendaal	RAPPA	US
Mark Weick	Dow	US
Dave Williams	Honeywell	US
Jinhuang Wu	Huntsman	US
Qiang Xu	Shanghai Haohai Chemical Corporation	China
Allen Zhang	Owens Corning	China

TEAP Halons Technical Options Committee (HTOC)

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Geok Kwang Boo	Civil Defence Force	Singapore
Fareed Bushehri	UNEP	Bahrain
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Matsuo Ishiyama	Halon Recycling & Support Committee	Japan
H.S. Kaprwan	Consultant	India
Nikolai P. Kopylov	All Russian Research Institute for Fire Protection	Russia
Barbara Kucnerowicz-Polak	State Fire Services Headquarters	Poland
David Liddy	Ministry of Defence	UK
Guillermo Lozano	G.L. & Associados	Venezuela
Bella Maranion	US EPA	US

Anna Sordi	Embraer	Brazil
John O'Sullivan, MBE	British Airways	UK
Erik Pedersen	World Bank	Denmark
Donald Thomson	MOPIA	Canada
Robert Wickham	Wickham Associates	US
Hailin Zhu	Retired	China

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Paulo Jorge	Embraer	Brazil
Vasily Pivovarov	All Russian Research Institute for Fire Protection	Russia
Jawad Rida	National Concorde Est.	Jordan
Mark Robin	DuPont	US
Joseph Senecal	Kidde-Fenwal	US
Ronald S. Sheinson	Naval Research Laboratory - Department of the Navy	US
Ronald Sibley	Defense Supply Center, Richmond	US

TEAP Medical Technical Options Committee (MTOC)

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Helen Tope	EPA Victoria	Australia
Ashley Woodcock	University Hospital of South Manchester	UK

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Hisbello Campos	Centro de Referencia Prof. Helio Fraga, Ministry of Health	Brazil
Christer Carling	Retired	Sweden
Mike Devoy	Schering	Germany
Charles Hancock	Charles O. Hancock Associates	USA
Eamonn Hoxey	Johnson & Johnson	UK
Javaid Khan	The Aga Khan University	Pakistan
Robert Meyer	Food and Drug Administration	USA
Hideo Mori	Otsuka Pharmaceutical Company	Japan
Robert Morrissey	Johnson & Johnson	USA
Tunde Otulana	Aradigm Corporation	USA
John Pritchard	3M	UK
Jacek Rozmiarek	GlaxoSmithKline Pharmaceuticals	Poland
Raj Singh	Apollo Hospital	India
Roland Stechert	Boehringer Ingelheim (Schweiz)	Switzerland
Adam Wanner	University of Miami	USA
Kristine Whorlow	National Asthma Council Australia	Australia
You Yizhong	Journal of Aerosol Communication	China

TEAP Methyl Bromide Technical Options Committee (MBTOC)

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Mohamed Besri	Institut Agronomique et Vétérinaire Hassan II	Morocco
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Marta Pizano	Consultant	Colombia
Ian Porter	Department of Primary Industries	Australia

Members	**Affiliation**	**Country**
Alessandro Amadio	UNIDO	Italy
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Aocheng Cao	Chinese Academy of Agricultural Sciences	China
Peter Caulkins	US Environmental Protection Agency	US
Fabio Chaverri	IRET-Universidad Nacional	Costa Rica
Ricardo Deang	Consultant	Philippines
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Abraham Gamliel	Agricultural Research Organisation	Israel
Darka Hamel	Inst. For Plant Protection in Ag. and Forestry	Croatia
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Nahum Marbán Mendoza	Universidad Autónoma de Chapingo	México
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Melanie Miller	Consultant	Belgium
Andrea Minuto	Agroinnova Universitá di Torino	Italy
Takashi Misumi	MAFF	Japan
Kazufumi Nishi	Nat Institute of Vegetables and Tea Science	Japan
David Okioga	Ministry of Environment and Natural Resources	Kenya
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Jordi Riudavets	IRTA – Department of Plant Protection	Spain
Ariane Elmas Saade	UNDP	Lebanon
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Jim Schaub	US Department of Agriculture	US
Sally Schneider	US Department of Agriculture	US
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Nick Vink	University of Stellenbosch	South Africa
Chris Watson	IGROX	UK
Jim Wells	Environmental Solutions Group	US

TEAP Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee (RTOC)

Co-chair	Affiliation	Country
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Lambert Kuijpers	Technical University Eindhoven	Netherlands

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Makoto Kaibara	Matsushita Electric Industrial Corporation	Japan
Ftouh Kallel	Sofrifac	Tunisia
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