MONTREAL PROTOCOL

ON SUBSTANCES THAT DEPLETE

THE OZONE LAYER

UNEP

REPORT OF THE TECHNOLOGY AND ECONOMIC ASSESSMENT PANEL

MAY 2003

PROGRESS REPORT

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Montreal Protocol
On Substances that Deplete the Ozone Layer

Report of the UNEP Technology and Economic Assessment Panel

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May 2003 Report of the Technology and Economic Assessment Panel

Progress Report

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1 Introduction

Subsequent Meetings of the Parties to the Montreal Protocol have taken a number of decisions, which request actions by the UNEP Technology and Economic Assessment Panel (TEAP). Responses of the TEAP to several of the 2002 requests, as well as responses to requests made in earlier Meetings of the Parties, are presented in this May 2003 report.

The May 2003 TEAP report provides the responses from TEAP in the following chapters:

Chapter 2 deals with the essential use nominations and the recommendations by TEAP. This is in accordance with Decision IV/25 and subsequent decisions, which have set the criteria and the process for the assessment of the nominations for MDIs. It also reports on the CFC required for salbutamol-CFC-based MDIs and gives a review of other essential use nominations.

Chapter 3 deals with the critical use nominations for methyl bromide for quantities requested for the year 2005. It contains an evaluation of all nominations on the basis of the technical and/or economic feasibility. The latter was performed by the Agricultural Economic Task Force, which reported to TEAP and its MBTOC. All evaluations for both soils and post harvest and structures are given in Appendices A and B to this Progress Report. The chapter then summarises all recommendations for critical use exemptions as derived by TEAP and its MBTOC.

Chapter 4 summarises the MBTOC response to Decision IX/5(1e) regarding MB alternatives as evaluated in Article 5(1) countries. The full response has been presented in the MBTOC 2002 Assessment Report.

Chapter 5 highlights the present status regarding the evaluation of MB quantities involved in Quarantine and Pre-Shipment (QPS) uses.

The TEAP May 2003 Progress Report does not contain TOC progress reports since progress was recently reported in the 2002 TOC Assessment reports.

Chapter 6 answers to the request made by Parties in Decision XIII/10 to campaign production. It also deals with the status of the transition to alternatives to CFC-based MDIs. It further contains information on non-MDI aerosol products and the update on laboratory and analytical uses following the request made in Decision XI/15. An Annex to the chapter presents the currently available accounting framework for MDIs.

Chapter 7 responds to the request made by Parties in Decision XIII/7 to report annually on the evolution of use and emissions of n-propyl bromide.

In **Chapter 8** the TEAP briefly elaborates on the status of its study regarding the servicing needs of chillers in Article 5(1) countries and on the impediments for transition to non-CFC chillers, as requested in Decision XIV/9.

Chapter 9 provides information on the background for the request made by Parties in Decision XIV/6. It proposes a revision to destruction procedures as dealt with by TEAP and its TFDT in its 2002 report and suggests further criteria to be applied to destruction technologies. It also contains an update of the Code of Good Housekeeping as again requested by the Parties in Decision XIV/6.

Chapter 10 contains the biographies of TEAP members and lists the current composition of the membership of the TEAP and its TOCs. It also gives recommendations by the TEAP how to improve the assessment process by its TOCs via a new orientation of the current TOC structure, in particular via the merging of certain activities in a new TOC and the re-focus of activities in other, currently existing TOCs.

In a second volume TEAP and its HCFC Task Force are reporting on the availability of HCFCs to the Article 5(1) countries in the time frame 2000 – 2015 in response to the request by the Parties in Decision XI/28.

2 Essential Use Nominations

2.1 Review of Essential Use Nominations for Metered Dose Inhalers (MDIs)

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

2.2 Review of Nominations

The review by the Aerosols, Sterilants, Miscellaneous Uses and CTC Technical Options Committee (ATOC) is conducted as follows:

Three members of the ATOC independently review each nomination. Members prepare preliminary reports, which are forwarded to the Co-chairs. For nominations where some divergence of view is expressed, additional expertise or information is sought. The full ATOC considers the results of these assessments and prepares a consensus report.

Concurrent with the evaluation undertaken by the ATOC, copies of all nominations are provided to the Technology and Economic Assessment Panel (TEAP). The consults with other appropriate individuals or organisations in order to assist in the review and to prepare the TEAP recommendations to the Parties.

2.3 Committee Evaluation and Recommendations for 2003 Nominations

Nominations were assessed against the guidelines for essential use contained within the Handbook on Essential Use Nominations (TEAP, 2001). Further information can be requested if nominations are found to be incomplete.

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

In 2003 the following Parties nominated essential use production exemptions for MDIs, (requested quantities in tonnes).

Country	European Community(1)	Hungary	Russian Federation	Poland (1)	Switzer-land	Ukraine	United States
2004			378			98.7	
2005	800	1.75	336	230	0.4		1902

(1) The nominations from the EU and Poland also included requests for laboratory and analytical uses which are not included above (see section 2).

2.4 Exports

As non-Article 5(1) countries enter the latter stages of their transitions, the ATOC observes that nominations from some Parties contain increasing proportions of the requests for the production of CFC MDIs for export, both to developing and non-Article 5(1) countries. This year, the nominations contain details on these exports.

2.5 Recommendations for Parties' Essential Use Nominations

Quantities are expressed in metric tonnes.

European Community

ODS/Year	Quantity
2005	800 tonnes

Specific Use: MDIs for asthma and COPD
Recommendation: Recommend exemption

Comments: The nomination for 2005 is less than 50% of that requested for 2004. In terms of the transition within the EU, it is notable that CFC use for salbutamol has been declared non-essential in 11 of the EU Member States and Norway. The EU also plans to complete a survey of the MDI market and determine if other drugs may also be considered non-essential in 2003. The nomination contains a request for approximately 300 tonnes for domestic consumption in 2005, with approximately 200 tonnes for export to non-Article 5(1) countries and approximately 300 tonnes to Article 5(1) countries.

Hungary

ODS/Year	Quantity
2005	**1.75 tonnes**

Specific Usage: MDIs for asthma and COPD
Recommendation: Unable to recommend

Comments: This nomination appears to represent a company request and does not present full information as to available alternative products. The accounting framework shows an actual use of 0.4 tonnes in 2002. Given the size of the stockpile (1.2 tonnes at the end of 2002) and previous nominations for the years 2003 and 2004, the current nomination seems excessive. ATOC is therefore unable to recommend this nomination based on data available. Hungary has the option to reapply for a 2005 allocation in 2004 with additional information.

Poland

ODS/Year	Quantity
2005	**230 tonnes**

Specific Usage: MDIs for asthma and COPD
Recommendation: Recommend Exemption

Comments: This nomination appears to represent a company request. The majority of CFCs are for MDIs exported to CEIT. The ATOC notes that there is no decline in the request of CFC volumes for essential use over the last three years. This nomination is larger than the volume actually used in 2002. However, CFC MDI production in Poland reportedly will cease by the year 2006. CFC inventories are kept low at about four months worth of production.

Russian Federation

ODS/Year	Quantity
2004	378 tonnes
2005	336 tonnes

Specific Usage: MDIs for asthma and COPD
Recommendation: Recommend exemption

Comments: The CFCs requested are only for the production of salbutamol CFC MDIs. The nominated volumes are declining.

Switzerland

ODS/Year	Quantity
2005	0.4 tonnes

Specific Usage: MDIs for asthma and COPD
Recommendation: Recommend exemption

Comments: The CFCs requested (0.4 tonnes) will be for production of salbutamol MDIs for domestic use. Parties could consider transferring this small volume from existing stockpiles outside the country, if feasible.

Ukraine

ODS/Year	Quantity
2004	98.7 tonnes

Specific Usage: 83.5 tonnes for MDIs for asthma/COPD
15.2 tonnes for angina medication

Recommendation: Recommend exemption only for asthma/COPD

Comments: The nomination is for 83.5 tonnes of CFC for MDIs for asthma/COPD and an additional 15.2 tonnes for angina medication. As last year, ATOC is unable to recommend CFCs for anti-angina sprays, because oral, sublingual, transcutaneous and aqueous sprays are widely available. The nomination for asthma/COPD for 2004 represents an approximate 20% reduction on the 2003 nomination.

United States

ODS/Year	Quantity
2005	1902 tonnes

Specific Usage: MDIs for asthma and COPD
Recommendation: Recommend exemption

Comments: The CFCs are all for MDIs for asthma/COPD and are almost entirely for domestic use. The volume of CFC requested for 2005 is a 28% decrease on the 2004 nomination (2975 tonnes). However it is larger than the volume actually used in 2002 (1581 tonnes). Furthermore, ATOC believe this reduction reflects the commitment of a single company, which has pledged to cease production of CFC MDIs by 2005.

The US nomination reflects the difficulty in predicting the rate of transition. Over 90% of salbutamol MDIs in the US still use CFCs, although two alternative HFC salbutamol MDIs have now been on the market for more than one year. Under the US transition strategy, the process for the assessment of the essentiality of CFC for salbutamol for MDIs should soon commence.

2.6 Countries No Longer Nominating

ATOC notes that no essential use nominations were received from Australia and Japan. For these countries, there is no projected need for CFC essential use production/importation in 2005. The accounting framework from Australia shows that the overall trend of CFC use has been downward and that all CFC MDIs produced in 2002 were exported. The current amount of CFCs on hand at the end of 2002 was 79.49 tonnes, representing more than three year’s worth of use. Japan’s accounting framework shows a similar pattern, but in the case of Japan the production of CFC MDIs is mostly for domestic consumption, increasing slightly in 2002 with respect to 2001. The current amount of CFCs on hand at the end of 2002 represents less than one year's worth of use. This is a substantial reduction in the stockpile from prior years, which had been managed to be closer to two year's production due to Japan's supply lines.

2.7 Procedural Issues

Under Decision VIII/9, Parties have required that nominating Parties provide accounting frameworks for the years when exempted quantities were used or remain in stockpile. ATOC respectfully remind Parties that countries no longer submitting essential use nominations, but still using CFCs for the production of MDIs or holding stockpiles of exempted CFCs, must continue to supply accounting frameworks annually to the Secretariat according to Decision VIII/9. This information is invaluable for conducting deliberations on the current state of transition. For Parties nominating for essential uses, Parties are reminded that nominations and accompanying accounting frameworks must be submitted according to the timetable set out in Decisions V/18 and VIII/9. This year, late submission of a nomination necessitated ATOC rewriting its report.

2.8 Reporting of CFC Required for Salbutamol CFC MDIs

Prior to the transition, 60% of all CFC MDIs contained salbutamol. However, a range of suitable alternatives are now available worldwide and some Parties have already declared CFC salbutamol MDIs non-essential. Given these facts, Parties may wish to consider identifying the proportion of their future essential use allowances for salbutamol, to better inform the evaluation of these nominations.

2.9 Decision XIV/5

Under Decision XIV/5, Parties, or regional economic organisations were requested to "provide to the Ozone Secretariat by 28 February 2003, and annual updates thereafter, information concerning treatment for asthma and COPD that contains CFCs or that does not contain CFCs". By the end of March 2003, the Ozone Secretariat had received information from 25 Parties and the EU, which were sent to ATOC for review (See ATOC´s Progress Report for more information).

2.10 Review of Other Essential Use Nominations

The EU made an emergency use request for 2003 and 2004, for the use of small amounts (0.025 ODP tonnes) of hydrobromofluorocarbons and bromochloromethane, because substances in Annex C are not explicitly included in the global exemption for laboratory and analytical uses (Decision X/19). This request was approved by the Ozone Secretariat.

Poland presented an emergency use request for the year 2003 and nominations for the years 2004 and 2005 to use CFC 113 and CTC for testing of oil, grease and total petroleum hydrocarbons in water. According to Decision XI/5 this use was removed after 2002 from the global exemption for laboratory and analytical uses for controlled substances, approved in decision X/19. The emergency request for 2003 has been approved by the Ozone Secretariat.

Poland

ODS/Year	**Quantity**
2003 (emergency use request)	2.05 tonnes
2004	1.025 tonnes
2005	1.025 tonnes

Specific Usage: Testing of oil, grease and total petroleum hydrocarbons in water

Recommendation: Recommend exemption for 2004

Comments: The nomination indicates that Poland requires more time to implement ODS-free methods and to ensure their accuracy and reproducibility. It further states that final international approval of ODS-free methodology (ISO, CEN) was not expected before 2002-2003. A similar emergency use allocation was approved in 2002 for Norway, Poland and the EU. TEAP recommended the emergency request for 2003, which has been approved by the Ozone Secretariat.

2.11 Report on Status of Existing Essential Use Exemption for Methyl Chloroform

Parties granted an Essential Use exemption to the United States for the use of methyl chloroform for aerospace applications including the manufacture and assembly of solid rocket motors used on the Space Shuttle. One important reason that the EUE was granted is that methyl chloroform is chemically unstable and, in the past, could not be reliably stockpiled for critical uses in aerospace applications where extraordinarily high technical standards must be achieved.

On 1 February 2003 the Space Shuttle Columbia was lost during its re-entry into earth's atmosphere causing the death of the seven astronauts onboard. An extensive accident investigation is underway, with a complete review of every aspect of the Space Shuttle. It is anticipated that testing and approval criteria will be further strengthened for alternatives and substitutes to the current materials and assembly procedures.

In April 2003, representatives from NASA and their solid rocket motor manufacturer ATK Thiokol met with members of the TEAP. NASA/Thiokol reported great progress in reducing and eliminating the use and emissions of methyl chloroform, but also reported that alternatives and substitutes are not yet available for some critical applications.

NASA/Thiokol estimates that the remaining quantity of methyl chloroform granted under the existing Essential Use Exemption should be sufficient for anticipated Shuttle flights. NASA/Thiokol also reported that they intend to deviate from the technically preferred option of manufacturing only the quantity necessary for the immediate future and will instead manufacture, prior to the 1 January 2005 national import and manufacturing deadline, the full quantity of remaining EUE authorisation. NASA described a sophisticated system for leak-tight storage that will assure near-zero emissions. NASA confirmed that they will destroy using destruction technologies approved under Decision XIV/6, any methyl chloroform manufactured under terms of the EUE that is unneeded or unusable.

NASA/Thiokol pledged to keep TEAP fully informed of technical progress in reducing and eliminating methyl chloroform and on the success of the methyl chloroform storage and asked TEAP to promptly review any request for additional quantities of methyl chloroform under terms of the Emergency and Essential Use Exemptions. TEAP explained that Paragraph 10 of Decision VIII/9 (Handbook page 97) allows the Secretariat, on the advice of TEAP, to quickly authorize up to 20 tonnes of ODS for emergency use.

TEAP reaffirms its recommendation for the already-granted EUE and concurs with the NASA/Thiokol technical assessment confirming the importance of the continuing use of methyl chloroform for their critical aerospace applications.

2.12 Rigid Regulations on Use of ODS

TEAP has identified some incidents where regional and national laws and regulations interfere with emergency and essential needs for ODSs in important applications. Parties may wish to consider the advantage of reviewing their national and regional laws and regulations to allow prompt authorisation for unanticipated emergency use affecting national priorities and/or life safety. Such flexibility can help avoid unnecessary loss of life and other assets and can help maintain the confidence and credibility of the Montreal Protocol.

For example:

- A ship experienced an accidental release of halons and requested a replacement supply of halons from the national halon bank where it docked. Although the Montreal Protocol does not restrict use of recycled halons, the regional regulations governing that country prohibited supply of halons to commercial ships with the exception of halon for "inerting on ships." However, in light of the grave risk to life, property and environment, the local authorities decided that the intent of the regulation must have allowed fire protection recharge for this ship and provided the permission to the ship to acquire the halons. An additional consideration was that the United Nations International Maritime Organisation (IMO) Safety of Life at Sea (SOLAS) regulations require that suitable fire protection systems be charged and fully operational. IMO compliance was achieved and a major accident might have been averted.

- A regional regulation prohibited the service and recharge of CFC-12 vehicle air conditioners used for maintenance of air quality in ambulances and other emergency vehicles used in areas contaminated by chemical, biological or radiological agents. At the MOP in Rome, TEAP described this situation and suggested that Parties might wish to examine environmental regulations to ensure that such emergency medical, humanitarian, and security uses are not are not inadvertently restricted.
- A national law might restrict the manufacture or import of ODSs granted under an essential use exemption, causing the enterprise to shift from the use of newly-manufactured methyl chloroform to the secondary preference of a stockpile, which though carefully controlled to avoid deterioration in quality, that could affect the technical performance in essential applications.

These incidents show the importance of allowing flexibility to permit ODS use for critical and emergency use, and particularly for uses necessary for the health, safety or critical for the functioning of society (encompassing cultural and intellectual aspects) and granted an Emergency or Essential Use Exemption under terms of the Montreal Protocol.

Very rigid national or regional regulations, including those banning the use of ODSs, may hamper the prevention of accidents or disasters. As the Montreal Protocol is implemented in Article 5(1) and non-Article 5(1) countries there is a continuing need to harmonise provisions of various environmental treaties and national regulations to avoid unanticipated or unintentional consequences and to coordinate controls.

TEAP would urge the national and regional authorities to build in adequate flexibility into their regulations to ensure that the regulations allow uses of ODS under terms of Emergency, Essential Use, and Critical Use Exemptions approved by the Montreal Protocol and establish mechanisms that would enable the users, particularly in emergency cases, to access the necessary information for acquisition of ODSs needed. For example, regulations could include special authority allowing a high-ranking environmental authority to take exception, on an emergency basis, to laws and regulations restricting

ODS uses. One option is a clearinghouse for information on technical options, necessary experts, emergency sources for ODSs, and pre-planning of financing and logistics to deliver ODSs as quickly as possible. Such a clearinghouse could have a "critical use co-ordinator" charged with collaborative problem solving.

3 Critical Use Nominations for Methyl Bromide

3.1 TEAP Recommendations for Critical Use Exemptions and Emissions Trading for Methyl Bromide

TEAP endorses the recommendation of its Methyl Bromide Technical Options Committee (MBTOC) and/or its Agricultural Economics Task Force (AETF).

TEAP recommends Critical Use Exemptions (CUEs) in cases specified in Table 3-2 - Table 3-5

1) Where options are not technically feasible,

2) Where options are technically feasible but not registered or otherwise available for use, or

3) Where technically feasible options are not economically feasible

TEAP notes that MBTOC recommended reduced CUEs in three circumstances: 1) where dosage is reduced with use of emission control technology as required by Decision IX/6 (1,b,i), 2) where time is required to implement alternatives, and 3) where alternatives are available for a portion of the CUN.

In cases where MBTOC recommended a reduced CUE, TEAP requests nominating Parties to confirm the recalculated quantity qualifying for the CUE, noting specific circumstances where options for both reduced methyl bromide use and emission control are not possible.

TEAP does not recommend Critical Use Exemptions in cases specified in Table 3-2 - Table 3-5

1) Where technically feasible options are registered and available and are commercially used by similarly situated enterprises,

2) Where technically feasible options are registered and available and can be implemented at a cost to enterprises less than the median cost of MLF-funded projects (currently calculated at US$24/ODP kg)1,

3) Where information is not sufficient to complete an assessment under the terms of Decision IX/6 and clarification is sought from the nominating

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[1] Note that US$24/ODP kg at the Montreal Protocol ODP of 0.6 is equivalent to $US36/ODP kg at an ODP of 0.4 (as given in Decision XI/13) and $US14.40 per
un-weighted (metric).

Party so that the assessment can be completed and, possibly, a CUE could be recommended.

TEAP endorses the AETF criteria for an economic feasibility threshold of US$24/ODP kg, noting that this is a conservative estimate that needs to be adjusted upward to reflect the elasticity of demand and up or down to reflect evolving MLF project costs as the phaseout proceeds. Application of this criterion to the 2003 CUNs confirmed the recommendations of MBTOC and indicated that many alternatives will be economically feasible when registered and available. Furthermore, many alternatives are economically more feasible at the lower range of cost estimates, reflecting the expected economies of scale and optimisation that will occur as the phaseout proceeds

Table 3-1 presents the AETF findings for soil fumigation with methyl bromide and alternatives. For the few CUNs with adequate information for analysis, the AETF analysis found that the cost of alternatives for postharvest and structural treatments is higher than the conservative lower bound estimate of US$24/ODP kg. MBTOC recommended these postharvest and structural uses on technical grounds.

Table 3-1: AETF analysis of economic feasibility of alternative to MB for those CUNs with sufficient data for analysis, for the economic threshold of feasibility of US$24,000 per ODP-tonne MB with comparison with MBTOC technical evaluation (next page)

Industry	Party	CUN Number	MB replacement economically feasible based on lower cost estimate?	MB replacement economically feasible based on upper cost estimate?	MBTOC technical evaluation
Cucumber	Portugal	CUN2003/031h	yes	yes	unable to recommend, information incomplete
Cucurbits - field	USA	CUN2003/049	GA only - yes Southeast - no		unable to recommend, information incomplete
Cut flowers	Portugal	CUN2003/031b	yes	yes	reduced allocation
Cut flowers, bulbs	Italy	CUN2003/025	yes	no	reduced allocation
Eggplant - protected	Italy	CUN2003/023	yes	yes	reduced allocation
Forest nursery seedlings	USA	CUN2003/052	South - yes West - yes North - no		unable to recommend, information incomplete
Fruit tree nurseries	USA	CUN2003/055	CA orchard - yes CA Citrus, Avacado- yes Stone fruit - yes Walnut - yes Almonds - yes Raspberry - yes	CA orchard - yes CA Citrus, Avacado - no Stone fruit - no Walnut - yes Almonds - no Raspberry - no	recommended
Ginger production - field	USA	CUN2003/053	no		recommended
Green bean	Portugal	CUN2003/031	yes	yes	unable to recommend, information incomplete
Lettuce and endive - open field	Belgium	CUN2003/007	yes (lettuce)		not recommended
Melon	Portugal	CUN2003/031	yes	yes	unable to recommend, information incomplete
Melon - protected	Italy	CUN2003/024	yes	yes	reduced allocation
Ornamentals (nursery: rose, chrysanthemum)	USA	CUN2003/057	nursery rose - yes chysanthemum - yes	nursery rose - no	reduced allocation
Peppers - protected and field	Portugal	CUN2003/031d	yes	yes	unable to recommend, information incomplete
Peppers - field	USA	CUN2003/058	CA - yes Southeast - yes FL - no	CA - yes Southeast - yes FL - no	unable to recommend, information incomplete
Peppers - protected	Italy	CUN2003/026	yes	yes	not recommended
Strawberries & Raspberrries	UK	CUN2003/040	Strawberries - yes; Raspberries - no		reduced allocation
Strawberry - protected and open field	Portugal	CUN2003/031a	yes	yes	reduced allocation
Strawberry fruit	Italy	CUN2003/027	yes	yes	reduced allocation
Strawberry fruit - field	USA	CUN2003/059	CA - yes FL - no Eastern US - no	CA - no FL - no Eastern US - no	unable to recommend, information incomplete
Sweet potato - field	USA	CUN2003/061	yes	yes	unable to recommend, information incomplete
Tomato	Portugal	CUN2003/031c	yes	yes	unable to recommend, information incomplete
Tomato - field	USA	CUN2003/062	Michigan - no Southeast US - yes		unable to recommend, information incomplete
Tomato - protected	Italy	CUN2003/028	yes	no	unable to recommend, information incomplete
Watermelon	Portugal	CUN2003/031e	yes	yes	unable to recommend, information incomplete

TEAP also endorses the emissions trading options suggested by the AETF, which deserve serious consideration by the MOP as a way to identify and approve qualifying critical uses of methyl bromide in compliance with the criteria already approved by the Parties. This approach avoids adverse impacts on the ozone layer, maintains incentives to develop, demonstrate, and deploy alternatives, and provides a level competitive playing field for enterprises not using methyl bromide. It also avoids the need to micro-manage the critical use process by the governments and the MOPs.

Furthermore, the use of emissions trading will protect the momentum and investment in Article 5(1) countries, which itself is a source of proven technology suitable for use in developed and developing countries alike.

3.1.1 Lessons For Methyl Bromide Critical Uses From Phaseout of Other ODS

It is useful to reflect on why the quantities of MB proposed for Critical Use Exemption in 2003 is so much larger than the quantities of ODS proposed for Essential Use Exemptions in 1995. In 2003 about 30% of the baseline methyl bromide consumption is nominated for CUEs compared to about 2% of ODS use proposed in 1995 as Essential Use Exemptions for CFCs, halons, methyl chloroform and carbon tetrachloride combined. The 30% proportion is particularly high, considering that significant quantities of methyl bromide are already exempted under the Protocol provision for QPS and additional quantities of methyl bromide may be nominated for CUE in 2004. The MBTOC Assessment reports, including the report of 2002, finds that technically feasible alternatives are available for over 93% of uncontrolled methyl bromide consumption at 2000.

One reason that there are so many CUNs is that the registration process for pesticide alternatives to methyl bromide has not been completed in many countries--even for technologies developed many years ago. And some registered alternatives have not achieved high rates of penetration even in countries where they are the alternative for the Critical Uses in the nominations. Registration and accelerated deployment of alternatives can only be promoted by national authorities and not by individual enterprises. The Protocol and decisions of the MOP mandate that national authorities make these efforts before CUNs are submitted. Some national authorities provided no verification that these mandated tasks have been completed.

In the case of other ODS, national authorities have implemented a full range of policy and regulatory measures to promote phaseout and minimise nominations for essential use. These include taxes on ODS, import and export restrictions, use prohibitions, mandated best practices (particularly recovery and recycle), technician training and certification, and many other regulations.

3.1.2 Economic incentives and disincentives can reduce CUNs.

The CUNs for MB quote a large variety of local factors that are claimed to impede adoption of alternatives–e.g.: higher costs, specific soil types, local climate, and structural weaknesses of food processing facilities. It is difficult for TEAP and its MBTOC to either prove or disprove these claims within the limited time available, with the small number of MBTOC experts, and with the limited financial resources available. The Meeting of Parties may also find it difficult to make an informed judgment in all circumstances.

One economic reason for the large number of nominations is that they provide a "cost-free" way to avoid change. An enterprise using MB may be tempted to submit questionable CUNs citing unverifiable local factors and some national authorities unwilling or unable to effectively screen such nominations and might forward them to the Ozone Secretariat. Furthermore, claims of extenuating local circumstances might continue to be made in future. This is in sharp contrast to the consideration of other ODS where alternatives and substitutes proven in one location were considered globally applicable.

This has led to a situation where the CUNs submitted for 2005 for consideration in 2003 add up to about 30% of baseline methyl bromide production. This may lead to "copy-cat" nominations submitted in 2004 for methyl bromide use in 2005, pushing the proportion even higher than 30% and possibly leading to demands for exemptions from Article 5(1) Parties even at intermediate stages of phase out.

There is a need for the MOP to consider more uniform criteria that would act as an incentive to enterprises to select alternatives to MB, when available.

3.1.3 ODS Phaseout Success with Taxes

The successful phaseout of CFCs, halons, and methyl chloroform was accomplished in many countries with a combination of regulatory and economic incentives including taxes and investment credits. Taxes on ODSs: 1) create incentives for phaseout and rewards for suppliers of alternatives, 2) recover unearned profits as Protocol controls create chemical shortage, and 3) raise funds for needed research, registration, and deployment. Among the countries taxing ODS are Australia, Belarus, Bulgaria, the Czech Republic, Denmark, Hungary, Republic of (South) Korea, Poland, the Seychelles, Singapore, South Africa, Sweden, Thailand, Vietnam and the United States.

Taxes and Fees on Methyl Bromide and other pesticides

In 1995 Australian methyl bromide importers introduced an import charge of US$0.12 per kg, increased to US$0.18 per kg in 2001. The 1998 receipts of $US155 thousand were matched by government funds to total about $US310 thousand for research and demonstration. The increased methyl bromide prices made alternatives more competitive and increased grower support for needed research. From 1996, Australia required methyl bromide import licenses at US$ 6200 for each two-year period plus an activity fee of $56 per tonne of imported methyl bromide. The activity fees support research for phasing out methyl bromide and other ODS. Taxes or fees could encourage methyl bromide phaseout.

Some countries tax pesticides in general. Sweden charges an environmental levy of approximately $US1.50 per kg of active pesticide ingredient, raising about US$3 million per year for research and extension in non-chemical and IPM methods. Denmark collects an environmental tax on pesticides as a 'polluter pays' measure, raising about $US40 million in 1996 for environmental programmes and research on non-chemical techniques. India has an 18% duty on imports of most pesticides.

3.1.4 Organic Certification and Labelling Incentives

Certification and Labelling of organic products exist in an increasing number of countries with the effect of rewarding organic growers with higher market prices. Regulations requiring labelling of products grown or treated with methyl bromide could offer additional incentives, as could voluntary labelling advertising “ozone safe” and “methyl bromide free” produce. Australia, Bulgaria, Canada, China, the Czech Republic, Gambia, Germany, Jamaica, Jordan, Malaysia, New Zealand, Romania, Spain, Sweden, Syria and the USA require special environmental labelling for products containing ODSs; and Malaysia, Syria and the USA require labels on products made with most ODS. Some countries also require or encourage labelling of products not containing ODS. No cases have been identified where countries require labelling of products grown or treated with methyl bromide. Labelling of products produced with (or without) methyl bromide could encourage phaseout.

3.2 Control measures for methyl bromide for Article 5(1) Countries (Decision IX/5)

The analysis by MBTOC shows that projects funded by the Multilateral Fund for methyl bromide alternatives have demonstrated the efficacy of alternatives in the Article 5(1) Party context. Furthermore, the data from the Ozone Secretariat shows an overall fall in consumption of methyl bromide in Article 5(1) Parties. Although only a freeze of consumption by 2002 and 20% reduction by 2005 are mandated by the Protocol, the base-line consumption of about 9,200 ODP-tonnes (average of 1995-1998) has declined to about 6,800 ODP-tonnes in 2000, which is a reduction of more than 25%. Only a few Article 5(1) Parties have shown an increasing trend in consumption. TEAP finds that it is feasible to strengthen the methyl bromide control measures for Article 5(1) Parties, providing that assistance of the Multilateral Fund is commensurately increased. .

3.3 Introduction to MBTOC Review of Critical Use Exemptions

3.3.1 Basis of 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, in recognition that there might be some uses after phase out for which there are no technically and economically feasible alternatives available, the Parties agreed to a provision enabling exemptions for those uses of methyl bromide that can be regarded 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. The Decision IX/6 states that:

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.

Decision IX/6 assigns responsibility for determining the existence of "significant market disruption" specified in paragraph 1(a)(i).

TEAP and its MBTOC prepared a handbook on critical-use nomination procedures, as requested in Decision XIII/11 taken by the Parties at their 13th Meeting. The Handbook on Critical Use Nominations for Methyl Bromide, published in May 2002, sets out a framework, process and the steps leading to a critical use exemption.

3.3.2 MBTOC process for consideration of CUNs

Some Parties submitted nominations to the Ozone Secretariat prior to the originally prescribed 31 January 2003 deadline, while other Parties submitted nominations by the 15 February extended deadline granted by the Secretariat after consultation with the TEAP and its MBTOC. MBTOC cochairs received CUNs from UNEP's Ozone Secretariat during February 2003. These were posted on a passworded Internet site for access by MBTOC members in electronic form, in preparation to the MBTOC meeting to evaluate the CUNs. MBTOC members unable to access this site were supplied with copies of CUNs by other means. MBTOC met in Cape Town, South Africa, from 17-22 March to consider nominations. Check list forms were generated to provide the Committee with the ability to assess the large number of nominations efficiently and equitably. Examples of these forms are given at Annex A. These include reference to the basis for the questions asked as part of the evaluation, specifically relevant sections of Decision IX/6 or the Handbook.

In addition to the normal Disclosure of Interest required under the TEAP/TOC terms of reference, MBTOC members made an additional disclosure relating specifically to their level of national, regional or enterprise involvement in the CUN process. This was required to ensure that those with a high level of involvement and interest did not bias the process of evaluation. Several MBTOC members, as can be expected from the scarcity of expertise on MB issues, have been directly involved in the preparation of particular national CUNs.

To assist evaluations and provide equity in treatment across Parties, nominations for similar uses (crop, commodity or situation) were grouped and considered together. MBTOC experts first came to general conclusions reached on the technical and economic feasibility of alternatives for grouped nominations and then carefully considered and analysed the specific circumstances of each nomination.

CUNs relating to use of MB on soils or other growing media, and for use of MB for fumigation of commodities, postharvest, and for structures were considered by separate subcommittees within MBTOC. The technical information needed to form an evaluation differs substantially for the two use sectors. This is reflected in differing requirements set out for CUNs in the Handbook for Critical Use Nominations for Methyl Bromide. MBTOC has specific expertise relating each sector.

After evaluation by MBTOC, the CUNs and documentation generated by MBTOC were passed to the Agricultural Economic Task Force (AETF) for further advice on the economic aspects of the CUNs. AETF advice was forwarded to all MBTOC members for their consideration. The MBTOC report was then forwarded for consideration by TEAP at its meeting in early May 2003. Some CUNs were referred back to Parties for clarification or provision of additional information to enable a full evaluation of the nomination to be done in advance of the OEWG.

Several CUNs appeared to be very broad and failed to specify exactly why or where the critical use MB was required. MBTOC made best endeavours to identify the particular MB critical use and to only recommend the needed amount of MB consistent with critical uses. In some cases it was not possible from the data to determine the specific critical uses and in these cases a recommendation was not made, but clarifications were sought from the nominating Party.

3.4 CUN – Evaluation

3.4.1 Overview

Most of the CUNs referred to a particular usage of MB (e.g. strawberry fruit production), but some Parties chose to submit one or more nominations that covered more than one use. Some Parties aggregated requests for similar uses from different regions even though the technical feasibility of using alternatives varied between regions, whilst other Parties provided separate CUNs in this circumstance. The latter were more easily assessable by MBTOC. In the former case, it was unclear if the Party had discounted the total amount requested for a specific region on the basis that some alternatives were considered technically feasible. Some also requested an aggregate quantity of MB to cover to a partial or full range of different crop/commodity/structural uses.

For the purposes of technical evaluation of these nominations, it was necessary to disaggregate them to provide nominations for a single usage. Parties submitted 63 CUNs in total. After disaggregation, there were 84 CUNs referring to soil applications, 15 CUNs for applications on various commodities and 8 CUNs for structures.

3.4.2 Information provided by nominating Parties for CUE

Many CUNs contained sufficient information to allow MBTOC to make a full technical and economic evaluation of the nomination in the light of Decision IX/6. To make this evaluation MBTOC needed, as a minimum:

- to be able to determine what use the nomination was for (pest ..), i.e. the nominated critical use;
- the quantity of methyl bromide involved, including the specific quantity of MB used where MB/Pic mixtures were used;
- the dosage/application rates of MB or specified MB-containing mixture
- area of land or volume of commodities or structure to be treated;
- measures to limit the emissions of MB from the proposed critical uses;
- how much, as a proportion of the total crop/commodity/structure, was to be treated with methyl bromide;
- reasons why alternatives could not be used in the specific circumstances of the nomination;
- data and references that technically validate the comparative performance of at least the best alternative(s) compared to methyl bromide for the specific reason that the CUN was submitted;
- evidence that trials (R and D) in the relevant or equivalent region had been conducted to evaluate alternatives for the specified CUN use.
- for alternatives considered technically but not economically feasible: the fixed and variable cost, the change in product yield and market price, and other factors relevant to cost effectiveness analysis; and
- estimates of the price elasticity for the products produced with methyl bromide

Some CUNs were submitted with insufficient information to make a technical and economic evaluation. Areas where nominations lacked information to allow full evaluations are highlighted in the discussion of individual nominations. The most common problems were:

- aggregate or individual requests that did not permit the identification of the specific problems that gave rise to the nomination
- insufficient references or data provided to allow verification of the quantity of methyl bromide requested
- insufficient efforts to analyse all possible alternatives
- no comparative performance data or references for alternatives against MB
- no information identifying whether the Party had already discounted amounts in the CUN to account for technical and regulatory issues
- no plan for development, registration or deployment of alternatives.

Where possible, MBTOC used information available from its own expertise in order to enable a provisional evaluation of an incomplete CUN to be made. Additionally, for CUNs involving preplant use of MB, information contained in related CUNs by other Parties was sometimes used to assist evaluations of incomplete nominations. Nominations with insufficient information for evaluation have been referred back to the Parties for confirmation (or otherwise) of the correctness of MBTOC's assumptions.

MBTOC notes that some of the problems it encountered in making evaluations would be resolved in future through closer adherence to the suggested format of nomination set out in the Handbook on Critical Use Nominations.

3.4.3 Consideration of alternatives

In evaluating the CUNs for soil treatments, MBTOC assumed that an alternative method to MB would allow sufficient pest and weed control and continued production of the crop for which MB was used at some stage. Furthermore, that the crop would be produced to existing market standards. For commodity and structural applications, it was assumed that the objectives of the MB treatment, e.g. lack of infestation in finished product from a mill, would be met by any process considered a technically feasible alternative to MB.

Furthermore, MBTOC relied on the definition of alternatives to MB used in its 2002 Assessment. This reads, in part:

Definition of an alternative

- MBTOC defined 'alternatives' as those non-chemical or chemical treatments and/or procedures that are technically feasible for controlling pests, thus avoiding or replacing the use of MB. 'Existing alternatives' are those in present or past use in some regions. 'Potential alternatives' are those in the process of investigation or development.

- MBTOC assumed that an alternative demonstrated in one region of the world would be technically applicable in another unless there were obvious constraints to the contrary e.g., a very different climate or pest complex.

MBTOC has recently been expanded to include expertise in agricultural economics to assist in evaluation if the economic advantages and constraints of alternatives considered feasible on technical grounds.

TEAP's Agricultural Economics Task Force (AETF) advised on economic aspects of the nominations and will elaborate further on measures of economic feasibility that could be used in future nominations.

3.4.4 Period of nominations, MBTOC's response

Some nominations requested CUEs for one or more years. A number of nominations received in 2003 to commence in year 2005 were for 2 years or more, and some covered an indefinite period. The Handbook on Critical Use Nominations for Methyl Bromide indicates that Parties may apply for exemptions for more than one year.

In view of the evolving situation regarding the future availability of alternatives, particularly relating to the registration and commercial introduction of chemically based alternative processes, MBTOC believes that it would not be appropriate to recommend exemptions for critical uses for a period longer than 1 year. MBTOC found that many nominations for CUE would not be necessary (i.e. feasible alternatives would be available) if some of the new chemical products currently in process are registered and available before 2005. However, should the Parties approve nominations for more than one year, it may be appropriate to review such CUEs annually in the light of updated information from the nominating Party on the situation, *inter alia* regarding the availability of alternatives, and it might be expected that a declining quantity of MB would be nominated as MB alternatives are progressively adopted.

There are a number of technical and economic constraints on introduction of a particular alternative to an existing use of MB. These include:

- costs and time to obtain necessary regulatory approvals
- costs and time for setting up of infrastructure to support the alternative
- time for information transfer, training and local experimentation to optimise the alternative

- costs of transition, such as purchase of new or different application equipment
- marketing plans of the suppliers of materials for the alternatives.

MBTOC's review of the nominations showed that some research had commenced only in the past 2-3 years even though MB has been a controlled substance since 1992. In addition there were very few plans presented that indicated a path for the phase out of MB and the introduction of alternatives: a requirement for a critical use in Decision IX/6 para.1 (b, iii), though many nominations documented the lengthy time period required for registration of new chemicals and the uncertainty that certain chemicals may not ultimately be registered despite evidence of efficacy. As a result, several CUNs contained information that showed the transition away from MB had not started sufficiently early to achieve orderly change to the alternative(s) to meet the 2005 phaseout schedule under the Protocol.

Although a chemical may be progressively registered for various uses in the future, there will be delays in implementation due to the need for training, logistical and economic considerations. There is now insufficient lead time before 2005 to completely introduce a new technology across an industry or sector. In these cases MBTOC viewed 3 years as a reasonable estimate of the maximum period required for commercial scale up. Technically and economically feasible alternatives may well be available and implementable within the time frame of the nomination if they continue to be driven by the incentive of phaseout of MB. MBTOC supported CUNs for uses where feasible alternatives are available but still required time to implement.

MBTOC notes that prolonged authorisations of MB would discourage further development and introduction of these alternatives when alternatives have not yet achieved high penetration into the market or sufficient commercial availability.

Timely implementation of technically and economically feasible alternatives in non-Article 5(1) countries could result in technology being available to accelerate the phaseout in Article 5(1) countries. On the other hand lack of early research for specific uses has delayed registration and implementation of alternatives, and slowed MB phase-out. Continued use of MB in developed countries would result in pressures to retain MB in Article 5(1) countries.

Some CUNs from non-Article 5(1) countries are for uses, which some enterprises in Article 5(1) countries have already phased out. Unless this is fully justified, it could jeopardise MB phase-out efforts in both Article 5(1) and non-Article 5(1) parties. Furthermore it may diminish the opportunities for non-Article 5(1) countries to learn from the technical developments made in Article 5(1) countries.

3.4.5 Plans to develop, register and deploy alternatives

To qualify for a CUE under Decision XI/6, 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, such plans to develop, register or deploy alternatives were not presented by the nominating Parties. In view of the variation in standard of the nominations, MBTOC was only able to support recommendations for one year. MBTOC suggests that no future applications be accepted without evidence of data and references that research trials have proved that available alternatives are not technically and economically feasible. In addition, the nominating Parties should present a valid structured plan for how they intend to phase out MB.

3.4.6 Emission controls

Decision IX/6 requires all technically and economically feasible steps to have been taken to control associated emission of MB as one criterion for a 'critical' use. In its evaluations therefore, MBTOC assessed CUNs where possible for adequacy of MB application rates used and for deployment of emission reduction technologies, such as use of VIF films or other measures, to retain MB gas and achieve at least comparable effectiveness at reduced dosages.

In the soils sector, some CUNs involved the use of MB apparently with polyethylene sheeting (tarping). This process is known to lead to high rates of emission of MB in the absence of other measures such as deep injection. Emission rates can be reduced substantially through use of less pervious tarping, such as VIF, allowing increased retention of MB, extended effective exposure periods and reduced MB application rates compared with use of conventional sheeting.

In such cases, MBTOC has not recommended the quantity of MB sought by the CUN, but instead suggested a reduced allocation based on a reduced application rate of MB in conjunction with chloropicrin, where such mixtures are registered for use on soils. MBTOC considers the maximum application rate of 30 g/m2 as effective in most circumstances. In cases where the 'hot gas' method of application of MB or MB/Pic (98:2) is the only feasible option (small scale use and some protected cropping environments where access is not possible for injection machinery) a maximum application rate of 60 g/m2 has been used to recalculate the quantities required.

In MB treatments of structures and commodities, improved sealing techniques can lead to more efficient use of the fumigant and reduced application rates for the same or better levels of effectiveness. Only one CUN employed recapture technology to reduce emissions after treatments were complete.

3.4.7 Availability of key alternatives

Although there are technically feasible alternatives for nearly all uses of methyl bromide (see MBTOC 2003), the alternatives available to meet the pest control requirements in specific circumstances described by the nominations were limited. Several nominations for soil disinfestation commented on the possibility of the registration for key chemical products not being renewed or continued after 2005 and that this would severely disrupt the implementation of alternatives in this sector.

While there are efforts to develop and deploy non-chemical and sustainable alternatives to MB, chemical treatments, including fumigation, remain the principal alternatives at this time. Soil fumigants, including MB, tend to be highly toxic chemicals to humans and other non-target organisms, as well as target pests. They are also used for the production of foodstuffs. As a result, they are subject to many restrictions to ensure their safe use.

Registration is a major constraint to the introduction of new chemical fumigants, both in cost and also time to generate the data needed to substantiate safe and effective use and to gain acceptance. Despite these barriers, there are some alternative soil fumigants at a near market stage that potentially may become available by 2005 or soon thereafter.

Difficulties with and after the registration of chemicals may renew interest to non-chemical treatments. In many countries, physical treatments such as the application of heat and cold for postharvest pest control do not need to be registered. Liberal access to CUEs will discourage the commercialisation of chemical and non-chemical alternatives.

Two particular chemicals stand out as key components of alternative in-kind processes: chloropicrin for soil treatments and phosphine for many commodity uses.

Chloropicrin (Pic) is a particularly effective fumigant against soilborne plant diseases, but with weaker activity against nematodes and weed seeds. Almost all existing in-kind alternatives to MB require application in conjunction with Pic to obtain the full spectrum of activity required in some soil fumigations. Examples are combination treatments with 1,3-D and metham sodium. Furthermore, MB/Pic mixtures are more effective than MB alone in many situations, allowing reduction in the quantity of MB applied for the same level of effect. At present there is no registered fumigant alternative that provides the complementary activity of chloropicrin to other fumigants.

It is notable that some Parties already do not permit use of chloropicrin as an active ingredient of soil fumigants. Furthermore, Pic is to undergo a re-registration process in both the EU and USA in 2005, with the possibility that regulatory actions may result in further restrictions in use of Pic or even loss of Pic for some or all fumigation uses in these regions. Some CUNs for soil uses submitted by Parties for 2005 had the choice of alternatives restricted because chloropicrin was not permitted in the particular country.

Phosphine is the only broadly registered in-kind alternative to MB for commodity (durables) treatment and some structural fumigation. Development of pest resistance to phosphine, due to improper fumigation techniques in the past, continues to cause serious concern as treatments are generally longer and require higher doses. These factors delay completion of the treatment and increase costs. Parties are encouraged to request fumigators to monitor pest resistance and to fumigate with phosphine using best practices. Maximum workspace exposures for phosphine in air is also under review in some regions and may be lowered to a point where phosphine use becomes impractical for many mills and processing operations.

Parties should be aware that further regulatory or technical restrictions on either chloropicrin or phosphine are likely to give rise to renewed pressures for the reinstatement of MB in the absence of easily applicable, immediate alternatives.

3.4.8 CUNs covering possible future lack of alternatives

In a number of cases, Parties have submitted nominations for critical-use exemptions on a ‘contingency’ basis in case of possible non-availability of alternative treatments in 2005 and/or 2006. These fall into the following categories:

- the alternative is, at the time of the nomination, in the process of being registered, and/or still requires testing under specific conditions, and/or there is no guarantee that it will be commercially available by 2005;
- the alternative is in use at the time of the nomination but either its status/registration is subject to review or there may be other forthcoming regulatory constraints that endanger the availability or possibility of continued use of that alternative.

MBTOC supported nominations in the former category (a), but not the latter (b) if it were the sole grounds of the nomination, as to do so would provide a disincentive to further develop and implement the alternatives. This would be particularly so where the large costs and effort associated with registration are yet to be met.

3.5 Summary of recommendations

The following tables below summarise MBTOCs recommendations of CUNs for soil fumigation (Table 3-2 - Table 3-4), and for treatment of commodities and structures (Table 3-5).

Detailled recommendations and comments are found in Appendices A and B.

Table 3-2: Summary of Recommendations (soils)

Party	CUN Number	(a)	Industry	Quantity nominated		Recommendation (tonnes for 2005)
				t/year	Years	t/year
Australia	CUN2003/001		Cut Flowers - field	40 w/o VIF or 25 with VIF	6	10
Australia	CUN2003/002		Cut flowers - protected	60 w/o VIF or 40 with VIF	6	20
Australia	CUN2003/003		Cut flowers, bulbs - protected	7	2	7
Australia	CUN2003/005		Strawberry fruit - field	90 then 59 (2006) and 58 (2007)	3	24
Australia	CUN2003/006		Strawberry runners	35,75	3	35,75
Belgium	CUN2003/007	-a,b	Lettuce and endive - open field	42,25	(b)	0
Belgium	CUN2003/007	-c	Tomatoes - protected	17,17	(b)	(c)
Belgium	CUN2003/007	-d	Pepper, eggplant - protected	5,27	(b)	(c)
Belgium	CUN2003/007	-e	Cucurbits	0,61	(b)	(c)
Belgium	CUN2003/007	-f	Beans	0,23	(b)	(c)
Belgium	CUN2003/007	-g	Radish	0,14	(b)	(c)
Belgium	CUN2003/007	-h	Asparagus	0,63	(b)	(c)
Belgium	CUN2003/007	-I	Strawberry fruit	3,4	(b)	3,4
Belgium	CUN2003/007	-j	Orchard - pome fruit & berries	1,35	(b)	1,35
Belgium	CUN2003/007	-k	Chicory (Brussels witloof)	0,6	(b)	(c)
Belgium	CUN2003/007	-l	Leek, onions	1,22	(b)	(c)
Belgium	CUN2003/007	-m	Celery	0,56	(b)	(c)
Belgium	CUN2003/007	-n	Cut flowers excl. roses and chrysanthemum	6,11	(b)	0
Belgium	CUN2003/007	-o	Cut flowers-roses	1,64	(b)	0
Belgium	CUN2003/007	-p	Cut flowers-chrysanthemum	1,8	(b)	0
Belgium	CUN2003/007	-q	Ornamental plants	5,66	(b)	(c)
Belgium	CUN2003/007	-r	Nursery	not predictable	(b)	(c)
Belgium	CUN2003/007	-s	Tree nursery	0,23	(b)	0,23
Belgium	CUN2003/007	-t	All crops (yellow nutsedge)	not predictable	(b)	(c)
Canada	CUN2003/009		Strawberry runners	7,952	2	8

Table 3-3: Summary of Recommendations (soils) cont.

Party	CUN Number	(a)	Industry	Quantity nominated		Recommendation (tonnes for 2005)
				t/year	Years	t/year
France	CUN2003/010		Carrots - protected & field	10	4	(c)
France	CUN2003/013		Cucurbits - protected & field	85	4	(c)
France	CUN2003/014		Forest nurseries	10		10
France	CUN2003/015		Orchard and raspberry nurseries	5	4	5
France	CUN2003/016		Cut flowers, bulbs - protected and open field	75	4	60
France	CUN2003/017		Orchard - replant	25	4	25
France	CUN2003/018		Eggplant, pepper, tomato	150 (all solanaceous crops)	4	150
France	CUN2003/019		Strawberry runners	40	4	40
France	CUN2003/020		Strawberry fruit - protected and open field	90	4	90
Greece	CUN2003/021	-a	Beans - protected	300-350 (all crops)		(c)
Greece	CUN2003/021	-b	Cucurbits - protected	300-350 (all crops)	?	(c)
Greece	CUN2003/021	-c	Eggplant - protected	300-350 (all crops)		(c)
Greece	CUN2003/021	-d	Peppers - protected	300-350 (all crops)	?	0
Greece	CUN2003/021	-e	Strawberry - protected	300-350 (all crops)	?	(c)
Greece	CUN2003/021	-f	Tomato - protected	300-350 (all crops)	?	(c)
Israel	CUN2003/022	-a	Cut flowers - protected	175	4	(c)
Israel	CUN2003/022	-b	Melon - protected and field	315	4	(c)
Israel	CUN2003/022	-c	Potato	385		(c)
Israel	CUN2003/022	-d	Propagation material	85	10	(c)
Israel	CUN2003/022	-e	Strawberries -runners & fruit, protected and open field	140	3	(c)
Italy	CUN2003/023		Eggplant - protected	280t	4	137,2
Italy	CUN2003/024		Melon - protected	180	4	88,2
Italy	CUN2003/025		Cut flowers, bulbs - protected	250	1	105
Italy	CUN2003/026		Pepper - protected	220	1	0
Italy	CUN2003/027	-a	Strawberry runners	100	1	50
Italy	CUN2003/027	-b	Strawberry - fruit	510	1	255
Italy	CUN2003/028		Tomato - protected	1300	1	(c)
Japan	CUN2003/029	-a	Melon - protected	94,5	3	47,3
Japan	CUN2003/029	-b	Watermelon - protected	71,4	3	35,7
Japan	CUN2003/029	-c	Green pepper - protected	74,1	3	37
Japan	CUN2003/029	-d	Cucumber - protected	39,4	3	19,7

Table 3-4: Summary of Recommendations (soils) cont.

Party	CUN Number	(a)	Industry	Quantity nominated		Recommendation (tonnes for 2005)
				t/year	Years	t/year
Portugal	CUN2003/031	-a	Strawberry - protected and open field	30	4	15
Portugal	CUN2003/031	-b	Cut flowers - protected and open field	130	4	50
Portugal	CUN2003/031	-c	Tomato- protected and open field	20	4	(c)
Portugal	CUN2003/031	-d	Peppers - protected and field	5	4	(c)
Portugal	CUN2003/031	-e	Watermelon - protected and open field	4	4	(c)
Portugal	CUN2003/031	-f	Melon - protected	5	4	(c)
Portugal	CUN2003/031	-g	Green bean - protected and open field	3	4	(c)
Portugal	CUN2003/031	-h	Cucumber - open field	3	4	(c)
Spain	CUN2003/032		Strawberry runners	230	2+	230
Spain	CUN2003/033		Cut flowers (Cadiz & Seville) - protected	53	indefinite	53
Spain	CUN2003/034		Cut flowers (Catalonia) - carnation, protected and open field	20	indefinite	20
Spain	CUN2003/035		Strawberry fruit - open field	556	1?	556
Spain	CUN2003/036		Peppers - protected	300 (98:2) or 200 (67:33)	1?	150
UK	CUN2003/039		Ornamental tree nurseries	12	1	6
UK	CUN2003/040		Strawberries & raspberrries - fruit	80	2	68
USA	CUN2003/049		Cucurbits - field	1187,8	3	(c)
USA	CUN2003/050		Eggplant - field	73,6	1	(c)
USA	CUN2003/052		Forest nursery seedlings	192,515	1	(c)
USA	CUN2003/053		Ginger production - field	9,2	1*	9,2
USA	CUN2003/055		Fruit tree nurseries	45,789	1*	45,8
USA	CUN2003/056		Orchard replant	706,176	1*	706,2
USA	CUN2003/057		Chrysanthemum cuttings - rose plants (nursery)	29,412	2	14,7
USA	CUN2003/058		Peppers - field	1085,3	1*	(c)
USA	CUN2003/059		Strawberry fruit - field	2468,873	1*	(c)
USA	CUN2003/060		Strawberry runners	54,988	1*	55
USA	CUN2003/061		Sweet potato - field	224,528	1*	(c)
USA	CUN2003/062		Tomato - field	2865	2	(c)
USA	CUN2003/063		Turfgrass	352,194	1*	(c)
Footnotes:						
(a)	CUN index after disaggregation					
(b)	Period not specified or indefinite					
(c)	Evaluation not completed, pending further clarification sought from the nominating Party					

Table 3-5 Overview of Recommendations (commodities and structure)

Party	CUN Number	Industry	Quantity nominated		Recommendation for 2005
			t/year	Years	Tonnes
Australia	CUN2003/004	Rice	12,3	3	12,3
Canada	CUN2003/008	Pasta and Flour Mills	47,2	2	47,2
France	CUN2003/012	Old buildings and artefacts	8	4	0
France	CUN2003/012	Mills and Processors	55	4	55
France	CUN2003/012	Chestnuts	2,0	4	2,0
France	CUN2003/011	Commodities other than rice	8,0	4	(a)
France	CUN2003/012	Rice	2,0	4	2,0
Japan	CUN2003/029	Chestnuts	4,6	1	4,6
Netherlands	CUN2003/030	Cut flowers (postharvest)	1,2	1	0
United Kingdom	CUN2003/037	Food storage (dry goods)	1,1	2	1,1
United Kingdom	CUN2003/038	Mills and Processors	30,752	2	30,8
United Kingdom	CUN2003/041	Food storage (spices)	1,728	2	1,728
United Kingdom	CUN2003/044	Mills and Processors	16,38	2	16,38
United Kingdom	CUN2003/045	Rice	1,0	2	0
United Kingdom	CUN2003/037	Whitworth	2,4	2	2,4
United Kingdom	CUN2003/046	Cheese stores (traditional)	0,140	2	0,140
United Kingdom	CUN2003/047	Cheese stores (traditional)	1,50	2	1,50
United Kingdom	CUN2003/042	Stored spices	0,030	2	0,030
United Kingdom	CUN2003/043	Tobacco (stored)	0,523	2	0
United States	CUN2003/051	Mills and Processors	536,328	1	536,328
United States	CUN2003/048	Smokehouse Ham	0,907	1	0,907
United States	CUN2003/048	Dried fruit, beans & nuts	86,753	1	86,753
United States	CUN2003/054	Nursery trays for tobacco	1,323	1	0

Footnote:
(a) Evaluation not completed, pending further clarification sought from the nominating Party

3.6 Agricultural Economics Task Force Report

3.6.1 Introduction

The Agricultural Economics Task Force (AETF) developed criteria for determining circumstances where there are 'no 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 applied these criteria to those critical use nominations (CUNs). AETF conclusions in relation to economic feasibility of alternatives for particular CUNs were passed to MBTOC for incorporation in their evaluations of CUNs.

Like the MBTOC, AETF found the first review to be a daunting challenge: applications were received from many countries, many sectors, and covering many local circumstances. The applications were of varying quality, and contained varying degrees of detail. Although several nominations followed a fundamentally sound approach, no nomination provided a fully developed economic analysis that would conclusively establish that alternatives were not economically feasible. In order to enhance the comparability of the economic analysis in future nominations, AETF provided additional economic analysis and methodologies.

In considering CUEs, AETF recognized the importance of a CUE for sectors and applications where feasible alternatives were lacking, including the necessity for customers to have reliable access to products produced with methyl bromide; the potential adverse effects on operations, jobs, and products until alternatives are available; and the potentially large markets available to suppliers of the ultimate alternatives. AETF also took into consideration the importance of avoiding alternatives that are more damaging to the environmental and to humans.

3.6.2 Assessment of Economic Feasibility

The AETF addressed the issue of the "economic feasibility" of methyl bromide phaseout in terms of both the cost-effectiveness of the substitutes and the implicit benefits of the elimination of methyl bromide. "Economic feasibility" cannot mean no increase in production cost or product price because that would imply that only those phaseout that would occur at a profit to MB users would be feasible, and in that case no Protocol would be needed. The Protocol controls imply that some costs would be incurred, if needed, to achieve the phaseout. This does not necessarily mean that the "economically feasible" cost should be borne only by the users of MB. Governments can and do share the costs through subsidies, tax relief, support for technology development, pesticide registration, and deployment. The committee examined data from the Multilateral Fund to determine the global "willingness to pay" to eliminate methyl bromide. The projects to eliminate MB that have been supported by the Multilateral Fund of the Montreal Protocol provide a benchmark for this willingness to pay, because the MF is funded by the governments of the non-Article 5(1) countries (some of which also submitted nominations for critical use exemptions for MB).

The cost per tonne, weighted for Ozone Depleting Potential (ODP-tonne), for methyl bromide elimination varies across projects funded by the MF. The most expensive MF projects do reflect an amount that the Parties have been willing to pay to eliminate methyl bromide, but the more conservative approach endorsed by the AETF is to use a central tendency of the distribution of costs as the "willingness to pay" benchmark. Two such measures of central tendency are (1) the median cost per ODP-tonne for projects that entail specific reductions in methyl bromide usage, or (2) the overall average expenditure on methyl bromide elimination, defined as the dollars spent on elimination (including capacity building and administrative costs) divided by the total amount of methyl bromide so far eliminated. The median cost per ODP-kilogram phaseout was calculated as US$23.98, and the overall average cost is US$23.60. Because the Multilateral Fund has approved projects eliminating various Ozone Depleting Substances (ODS) having much higher cost per ODP-tonne, the AETF finds that these two measures of central tendency represents a ***lower bound*** on "economically feasible" costs to replace methyl bromide and recommends that no CUE be granted if technically feasible alternatives and substitutes can eliminate MB at less that US$24. per ODP kilogram, noting that a lead time may be required to fully introduce the alternative(s).

A number of CUE nominations contain data sufficient to calculate the cost per ODP-tonne eliminated of the potential methyl bromide substitutes. Substitutes with costs below US$24 benchmark established from the MF data are "economically feasible" and ineligible for CUEs.

Furthermore, the cost estimates of substitution contained in the CUE nominations are ***upper bounds*** on the actual cost to producers of methyl bromide elimination, for two reasons. First, the burden of any increase in average unit cost of production will be shared by producers and consumers through a market price effect. If the demand for a product made using methyl bromide is completely inelastic, the burden of the increased cost of the methyl bromide substitute falls entirely on consumers – the cost increase caused by the elimination of methyl bromide will be entirely passed through. In general, the division of the burden of the increased cost will be shared in a way that depends on the elasticities of demand and supply for the final product. Secondly, the data in the CUE nominations is predicated on the notion that the "pesticide intensity" of the products remains unchanged, despite the increase in pesticide cost. This is a limiting case; for most production functions, an increase in the price of one factor will result in substitution away from that factor, and the percentage increase in total unit cost will be less than the percentage increase in cost of the factor. Both the market price effect and the factor substitution effect mitigate to some degree the loss to producers. Hence the cost increases for methyl bromide substitutes shown in the CUE nominations represent upper bounds for the loss to producers that will result from moving away from methyl bromide.

The AETF also finds that the cost of replacing methyl bromide is likely to decline over time as economies of scale and learning effects in the production and distribution of substitutes take hold. This kind of declining cost has been widely observed across a range of industrial products and processes, and has been found in industries' responses to environmental regulation generally. The tendency for unit costs to decline over time can be demonstrated in the MLF data on ODS replacement across all projects; not enough methyl bromide replacement projects have been financed by the MLF to establish the statistical significance of this trend for methyl bromide replacement. Economies of scale and learning effects that reduce the cost of methyl bromide substitutes depend on maintaining the incentive to develop and commercialise such substitutes.

3.6.3 Application of Economic Criteria

The AETF considered the economic criteria that necessarily must be satisfied to recommend a CUE under the Decision of Parties, giving due consideration to economic and market realities.

AETF finds that a CUE **should not** be recommended under circumstances where:

- there is simply 'a change in agricultural or fumigation practices' as a result of the implementation of the provisions of the Montreal Protocol;
- there has been merely 'some increase in production costs or change in product prices' as a result of the implementation of the provisions of the Montreal Protocol;
- there is an alternative practice already in use in the global market, and this alternative is available to the applicant-- that is that there are no insurmountable regulatory barriers to the adoption of the alternative;
- the economic cost of the adoption of a change to technically feasible and available alternatives is lower than the calculated economic value of the adoption of the Montreal Protocol as explained above (US$24 per ODP kilogram).

In deciding on these criteria, AETF was particularly concerned with the unintended economic consequences of the granting of a CUE. Among the more important unintended/ undesirable consequences of too liberal granting of CUEs are:

- Rewarding methyl bromide manufacturers with monopoly profits (i.e. an example of the 'polluter profits' principle);
- Reducing incentives to identify and implement alternatives to the use of methyl bromide;
- Penalizing growers who have phased out the use of methyl bromide. For example, a CUE is provided for crops grown in one country may cause producers of that crop in other countries to argue that they cannot reduce consumption even for intermediate steps of reduction. CUEs granted for a range of uses may thus lead to requests for exemption by all Parties for this range of uses leading to virtual exemption from all controls;
- Encouraging MB users in Article 5(1) countries to question the need for making progress in national phase-out efforts, particularly for crops for which CUEs are approved for non-Article 5(1) Parties.

In addition, AETF was particularly aware of the cost-raising effects of regulatory uncertainty.

Notwithstanding, AETF concludes that a CUE **should** be recommended under the following circumstances

- In cases where there are no technically feasible alternatives
- Uses with technically feasible alternatives that are, however, not registered for use by authorities-of-jurisdiction
- Uses with technically feasible alternatives that are allowed by authorities-of-jurisdiction but nominated for critical use due to economic feasibility, and where the economic cost of adoption of alternatives is greater than the economic value established by AETF;

3.6.4 Recommendations

AETF recommends that all CUEs should be granted only under the following conditions:

- The quantities granted should be for one year and only until such time that technically and economically feasible alternatives are registered and available;
- National authorities ensure that each application of methyl bromide fully complies with all criteria of the CUE, including the requirement that no methyl bromide is available from stockpiled inventory manufactured prior to the phaseout;
- The methyl bromide is used only for uses and enterprises existing prior to 2003, and not for new enterprises, expanded cropping, or new fields and facilities.

3.6.5 Future Outlook

Considering the difficulties in evaluating CUNs, which cite unverifiable local factors as their reason for being unable to adopt alternatives to methyl bromide, AETF recommends that Parties may wish to consider the advantage of emissions trading to facilitate critical uses while preserving economic incentives for phaseout. Emissions trading would simplify administration, create a level global competitive playing field, discourage unnecessary nominations, maintain parity with other ODS sectors, and provide incentives to the development, registration, and deployment of alternatives. For example, Parties could require ODP "offsets" equivalent to the weighted ODP of the methyl bromide used for uses authorized under the CUE. Three emissions trading options are:

- To require the collection and destruction of surplus ODS that will otherwise be vented or will slowly leak from the products where it is contained;
- To require a contribution to the Multilateral Fund sufficient to finance the incremental cost of accelerating the phaseout of Ozone Depleting Substances.
- Require a reduction in emissions from QPS uses where technically and economically feasible but currently not undertaken because the Protocol allows unrestricted use.

AETF recommends that in future the following methodological points should be considered in CUNs:

- Industry/firm income and expenditure statements to the level of Net Farm Income;
- Partial budgets comparing the with-methyl bromide situation with each of the technically feasible alternatives;
- Price elasticities of supply and demand for the commodities in question;
- Capital costs should be appropriately amortized

3.7 Economic Aspects Of Nominations For "Critical Use" Of Methyl Bromide Under Terms Of The Montreal Protocol[*]*

3.7.1 Background and purpose

Methyl bromide was first controlled under the Montreal Protocol on Substances that Deplete the Ozone Layer at the Fourth Meeting of the Parties in Copenhagen, 1992. At that time, only a 1995 freeze (at 1991 levels) by the non-Article 5(1) Parties[2] was agreed (Benedick 1998, pp. 207-209).[3] Subsequently, the stringency of the control regime was increased (Andersen and Sarma 2002). The Protocol now requires, for the non-Article 5(1) countries, a phaseout schedule that production and consumption of MB not exceed 75% of 1991 levels commencing 1 January 1999, 50% commencing 1 January 2001, 30% commencing 1 January 2003, with a complete phaseout to commence 1 January 2005. Countries operating under Article 5(1) are entitled to a 10-year delay in their schedule, with phaseout to occur no later than 1 January 2015 (UNEP Ozone Secretariat 2000a).[4]

The Montreal Protocol allows an "essential use exemption" (EUE) for ozone-depleting substances (ODS) other than methyl bromide and allows "critical use exemptions" (CUEs) for methyl bromide. The text of the Protocol states, "[t]his paragraph [setting the 2005 phaseout date] will apply save to the extent that the Parties decide to permit the level of production or consumption that is necessary to satisfy uses agreed by them to be critical uses" (UNEP Ozone Secretariat 2000a, p. 18). However, the criteria for critical use exemptions are

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[*] This paper was prepared by Stephen J. DeCanio and Catherine S. Norman. DeCanio is Co-Chair of the AETF and a Professor of Economics at the University of California, Santa Barbara. Norman is a graduate student in Economics at the University of California, Santa Barbara.

[2]. Developing countries consuming ODS below the limits specified in Article 5(1) of the Protocol are allowed a grace period of ten years for implementing the control measures of Article 2. These countries are referred to as "Article 5(1) Parties." All other countries are referred to as "non-Article 5(1) Parties."

[3]. According to Benedick, "[a]t the final session the parties agreed on a resolution (weaker in status than a decision) that governments would 'make every effort to reduce emissions of, and to recover, recycle and reclaim, methyl bromide' and, following further scientific and TEAP reviews, would decide no later than the 1995 Meeting of Parties on 'concrete targets,' including a 'first-step' 25 percent reduction in 2000 and 'a possible phaseout date' (p. 209, footnote omitted).

[4]. Production in non-Article 5(1) countries is allowed to exceed the scheduled amount by small amounts to meet the basic domestic needs of Article 5(1) countries (see UNEP 2002 for the precise limits). Amounts used for quarantine and preshipment applications are exempted.

different for methyl bromide than for other ODS. These differences are shown by comparison of the texts in Table 3-6.

In Decision IX/6, the Parties requested "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" and specified that the "decision will apply to Parties operating under Article 5 and Parties not so operating only after the phase-out date applicable to those Parties" (Technical and Economic Assessment Panel and Methyl Bromide Technical Options Committee 2002).

The TEAP is charged with recommending whether the Party nominations meet the requirements of technical and economic feasibility; it is *not* charged with task of determining whether the lack of availability of methyl bromide for that use would result in a "significant market disruption." That determination is left to each Party nominating a MB critical use exemption.

The purpose of the present paper is to provide an economic analysis of what might be meant by "economically feasible" alternatives or steps as laid out in paragraphs a(ii) and b(i) of Decision IX/6. In addition, other economic questions surrounding nominations for critical use exemptions for methyl bromide will be discussed, including issues of measurement and data availability, cost forecasting, regulatory policy, equity, and the relationship of the critical use exemptions to the overall integrity and effectiveness of the Protocol. The goal is to provide economic analysis that will be useful to the Parties as they consider the disposition of the nominations for methyl bromide critical use exemptions.

Table 3-6: Comparison of Criteria for Exemptions

(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:	(a) that a use of a controlled substance should qualify as "essential" only if: (i) it is necessary for the health, safety or is critical for the functioning of society (encompassing cultural and intellectual aspects); and (ii) there are no available technically and economically feasible alternatives or substitutes that are acceptable from the standpoint of environment and health; (b) that production and consumption, if any, of a controlled substance for essential uses should be permitted only if: (i) all economically feasible steps have been taken to minimise the essential use and any associated emission of the controlled

(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, commercialize 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;	substance; and (ii) the controlled substance is not available in sufficient quantity and quality from existing stocks of banked or recycled controlled substances, also bearing in mind the developing countries' need for controlled substances; (c) that production, if any, for essential use, will be in addition to production to supply the basic domestic needs of the Parties operating under paragraph 1 of Article 5 of the Protocol prior to the phase-out of the controlled substances in those countries;
Source: Technical and Economic Assessment Panel and Methyl Bromide Technical Options Committee (2002). The methyl bromide criteria are from Decision IX/6 of the Parties; the criteria for other ODS are from Decision IV/25.	

3.7.2 MB use over time

The Parties are essentially on schedule to phase out methyl bromide. According to the most recent data available (through 2000), consumption in the non-Article 5(1) countries (the only countries for which the phaseout schedule is yet in effect) has met or exceeded the abatement requirements of the methyl bromide consumption schedule, as shown in Figure 3-1. This global aggregate success has also been achieved at the individual country level. Of the 26 non-Article 5(1) countries (counting both the EU and its member States) subject to the phaseout schedule, all but two have met or exceeded the requirements of the MB phaseout schedule as of 2000, and the non-complying states accounted for only 69 tonnes of methyl bromide consumption.[5] The United States has data available through 2001, and this data also shows compliance with the Protocol's phaseout schedule (U.S. Environmental Protection Agency, 2003). The Protocol calls for the Article 5(1) countries to freeze consumption of methyl bromide, at the level of their average consumption over 1995-1998, by no later than 1 January 2002. The base level for the Article 5(1) countries is therefore 9,226 tonnes (computed from UNEP Ozone Secretariat 2002). The data for 2002 are not yet available, but as of 2000 the Article 5(1) countries accounted for a consumption of only 6,814 tonnes. Thus, the reduction schedule has been technically and economically achievable for the non-Article 5(1) countries, and consumption in the Article 5(1) countries is currently well below the Protocol limit.[6]

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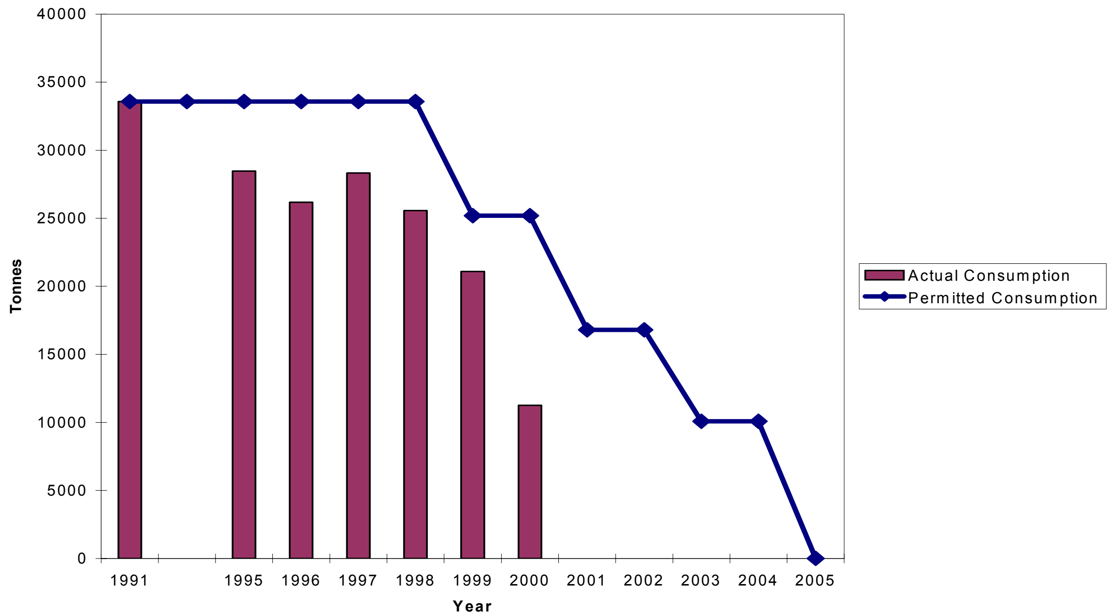
[5]. Two of the non-Article 5(1) countries have not yet reported their 2000 consumption, but for both of these countries 1999 consumption was within the limit specified by the Protocol (UNEP Ozone Secretariat 2002).

[6]. The Protocol mandates a 20% reduction from the baseline starting 1 January 2005 for the Article 5(1) countries, a cutback which had already been achieved by 2000.

Figure 3-1: Methyl bromide consumption phase-out schedule, non-Article 5(1) countries and actual consumption levels



Source: UNEP Ozone Secretariat 2002.

3.7.3 Magnitude and general description of requests for CUEs

Nominations for Critical Use Exemptions have been made by 13 countries for consideration at the 2003 meeting of the Parties. These nominations total about 16.7 thousand metric tonnes, or approximately 31% of these 13 countries' 1991 MB use. The nominations are listed in Table 3-7.

It should be noted that some of these nominations are for specified time periods as long as 10 years or for indefinite exemptions. However, according to the *Handbook on Critical Use Nominations for Methyl Bromide* (TEAP and MBTOC 2002), "[f]ollowing precedent established for nomination, reviews and acceptance of essential use nominations (Decision IV/25), critical use nominations are considered for exemptions on an annual basis. Exemptions granted for more than one year (if any) are subject to the annual review provisions described in paragraph 5 of Decision IV/25. Parties that are given multiple year exemptions may be requested to update their nomination to facilitate that review" (p. 5). Also, "A critical use exemption is granted to the nominating Party for a specific quantity of a specified ODS for a specific time period" (p. 6). Paragraph 112 from the Report of the Thirteenth Meeting of the Parties states that "under decision IX/6 Parties must present a plan to test and switch to alternatives in the near term" (p. 22). Thus, long-term CUEs, if any, must be subject to annual review by the Parties and a presumption that the phaseout will ultimately be accomplished.

Table 3-7– Methyl Bromide CUE Nominations for 2003 Consideration

Country	Amount Requested (in Tonnes per year)	1991 Use (in Tonnes)	Request as fraction of 1991 use	Duration of Request (years)
Australia	261.9 - 293.8	704.5	0.37 - 0.42	2 - 6
Belgium	100.0	312.0	0.32	Indefinite
Canada	55.2	246.0	0.22	2
France	426.0-506.0	4195.0	0.10-0.12	2-Indefinite
Greece[a]	360.0	970.0	0.37	Indefinite
Israel	1100.0	3580.0	0.31	3 - 10
Italy	2840.0	6974.0	0.41	1
Japan	94.5	6106.8	0.02	"at least 3"
Netherlands[b]	?	59.0	?	?
Portugal	200.0	n.r.	?	4
Spain	1059.0	4236.0	0.25	Indefinite
UK	147.5	628.7	0.24	2
USA	9921(2005), 9445.4 (2006)	25529.0	0.37-0.39	2

Notes:

[a] Slight discrepancies for Greece (cover letter says 300 for vegetables and 60 for commodity and building fumigations, supporting materials gives range 300-350);
[b] Netherlands information needs to be translated from the Dutch; the translated portion does not include basic information like the amount of MB requested.

Table 3-8– Nature of Requests for CUE Nominations (exclusive of the application from the Netherlands

Product	Request (in tonnes)	Fraction of Total*
Strawberries	4,471 - 4,486	0.27
Tomatoes	4,230 - 4,242	0.25 – 0.26
Peppers	1,529	0.09
Melons	560	0.03
All Fruits (including Strawberries and Melons)	5,037 - 5,052	0.30
All Vegetables (including Tomatoes and Peppers)	8,482 - 8,545	0.51 – 0.52
Cut Flowers	774 - 809	0.05
Other Decorative plants including grass	1,064	0.06
Commodity and Building Fumigation	278	0.02
Food Processing	536	0.03
All Other requests	396	0.02
Total Requests	16,580-16,693	-

* Does not sum to 1 as some fruits and vegetables are considered separately while still included in the aggregated category.

Table 3-8 gives some descriptive details of the nature of the exemptions requested. This table shows the aggregate requests by product, in both tonnes and as a fraction of the total.

The criteria for MB CUEs are different from the criteria for other ODS in that, for other ODS, an "essential" use is defined as one that "is necessary for the health, safety or is critical for the functioning of society (encompassing cultural and intellectual aspects)" (see Table 3-6 above). CFC applications such as Metered Dose Inhalers (MDIs) having life-and-death criticality have in the past been granted essential use exemptions under the Protocol. The CUE requirements for MB do not include this kind of health and safety criterion; instead the MB requirements are defined in technical and economic terms. Thus, CUEs for methyl bromide have been nominated for applications such as tobacco, pet food, flowers, and golf courses. Given that the MB CUE criteria are less stringent (and more based on economics) than those for other applications, it is appropriate that the Parties pay particular attention to the uniquely economic aspects of the MB CUE nominations and requests.

3.7.4 Evaluating the CUEs from an economic perspective

The TEAP and its MBTOC face challenges in faithfully applying the criteria for MB CUEs laid out in Table 3-7. In particular, "economic feasibility" is not a precisely-defined concept. In the context of the Montreal Protocol, the "economic feasibility" of eliminating methyl bromide obviously cannot mean "no change in agricultural or fumigation practices," because no change would mean that the Protocol in effect does not apply to methyl bromide. "Economic feasibility" of an MB phaseout also cannot mean "no increases in production cost or product prices" because the implication would be that only those phaseouts would be required that could be accomplished at a *net profit* to the methyl bromide users and there would be no need for the Protocol or any other regulatory regime. In such cases, the elimination of methyl bromide could be accomplished entirely by means of information dissemination and reliance upon the good business judgment of the users.

Therefore, "economic feasibility" must be consistent with some level of change in practice and increase in expenses associated with pest control. What cost increase or profit decrease, then, should be considered "economically feasible"? Economic theory suggests at least three possible tests:

1. The societal benefits of avoiding ozone depletion and its impacts on health, agricultural and marine productivity, ecosystems and property.

2. The average cost incurred by comparable enterprises in eliminating ODS in other sectors.

3. The cost incurred by the Multilateral Fund for the Implementation of the Montreal Protocol (hereafter the "Multilateral Fund" or MLF) in methyl bromide phaseout projects.

Because Parties decided to consider methyl bromide separately from other ODS, this analysis concentrates on test number 3. This test is based on the cost increment that the world implicitly has accepted as "feasible" for MB elimination through the support of methyl bromide phaseout projects under the aegis of the Multilateral Fund. The non-Article 5(1) countries contribute to the Multilateral Fund in order to meet the "agreed incremental costs" of phaseout projects in the Article 5(1) countries. Methyl bromide emitted anywhere in the world has the same effect on the ozone layer as emissions anywhere else, so the inherent logic of the creation and maintenance of the Multilateral Fund by the Protocol Parties requires that the benefits associated with Fund-supported phaseout projects be at least as great as the incremental (per tonne) costs of those projects. Hence, ***the cost per tonne of the MB phaseout projects implemented with assistance from the Fund constitutes a lower bound for the "economically feasible" cost for eliminating methyl bromide anywhere in the world***.

This principle does not solve the difficult equity problem of who should bear such costs. In the case of Multilateral Fund projects, the costs are spread over the whole tax base of the non-Article 5(1) countries according the United Nations formula. If the "economically feasible" cost of eliminating methyl bromide in non-Article 5(1) agricultural uses is set at some particular level, it does not follow that this cost must or should be borne exclusively by the agriculturalists and fumigators who have been using the methyl bromide. Social policy might suggest a sharing of such costs, but the question of how to accomplish that (through combinations of subsidies, tax relief, or government supported technology development and transfer) is distinct from the determination of what is "economically feasible." Solving equity disputes requires political decisions by the governments of the Parties; however, these equity issues should not be confused with the problem of determining how much is warranted to be spent to protect the ozone layer.

Non-Article 5(1) countries contributing to the Multilateral Fund to finance ODS elimination projects abroad should be willing to pay at least as much per ODP-tonne[7] to eliminate the chemicals' use at home. Tax dollars spent domestically are probably less burdensome and certainly no more burdensome to the citizens of a non-Article 5(1) Party than the same amount spent overseas. ODS elimination funds spent at home have "multiplier" effects by creating jobs and opportunities for those supplying chemical substitutes and integrated pest management (IPM) services that substitute for the ODS.

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[7]. The cost data reported by the Multilateral Fund are expressed in terms of US dollars per ODP equivalent tonnes or ODP-tonnes. An ODP-tonne is the product of the tonnes of the ODS removed and its ozone depleting potential or ODP. The ODPs of CFC-11 and CFC-12 are set as one; halon-1301, for example, has an ODP of 10, and the current value of the ODP of methyl bromine (according to UNEP) is 0.6 (UNEP Ozone Secretariat 2002).

Given that the net welfare calculation by the non-Article 5(1) parties is such that they find it worthwhile to contribute to the Multilateral Fund, comparable levels of effort to eliminate domestic ODS use are justified.

With these considerations in mind, let us examine the record of the Multilateral Fund in subsidizing methyl bromide and other ODS phaseout projects.[8] Some summary statistics on costs are presented in Table 3-9. To date, the Multilateral Fund database contains information on 234 projects related to MB phaseout; of these, 41 are for projects that directly reduce use of MB. (The remainder of MLF methyl bromide projects are for training programs, community information meetings, demonstration projects on farms or in storage facilities, or information gathering and project planning.) The 41 projects reflect a planned reduction of 2,787 ODP-tonnes in annual MB use at a cost of US$ 44,422,676 in project funds and agency support costs.[9] Thus for projects that directly reduce MB use, MLF-supported spending per ODP-tonne has been US$ 15,939. For individual projects, the cost per ODP-tonne of MB removed ranged from US$ 4,080 to US$ 413,667 (the latter for a phaseout plan for several low volume user nations in Africa), with an average value of US$ 32,215 per ODP-tonne and a median value of US$ 23,982 per ODP-tonne.

It could be argued that the most expensive MB elimination projects reflect the world's maximum "willingness to pay" to eliminate MB and all projects less expensive per ODP-tonne eliminated are a bargain. It is therefore a very conservative approach to characterize the willingness to pay to eliminate MB by the average or central tendency of the cost per ODP-tonne of MLF-approved projects. Small projects have generally higher per-ODP tonne costs than large projects. Hence the measure of the central tendency will vary depending on whether the average is weighted by project size (total expenditures divided by total ODP tonnes eliminated, yielding the abatement cost of the average *tonne*), whether all projects are weighted equally (computing the arithmetic average across all the individual projects, yielding the per tonne abatement cost of the average *project*), or whether the median cost per tonne across individual projects is used (the median being a measure of central tendency that is insensitive to outliers).

Spending on the other 193 MB/fumigant projects totalled US$ 21,348,510. Thus, total spending on MB-related projects has been just over US$ 65.7

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8. All data pertaining to projects supported by the Multilateral Fund are from the database provided by Julia Anne Dearing, MLF Information Management Officer, and credited to Eduardo Ganem (Multilateral Fund 2003).

9. Here and throughout we have converted nominal dollar figures to 2002 dollars using the Producer Price Index for "food and kindred products" (U.S. Department of Labor 2003).

million. These numbers include project funds and agency support costs, which were automatically added to the requested sum for approved projects beginning in 1992. Direct abatement projects have constituted 17.5% of MB projects but account for 67.5% of MB spending by the Multilateral Fund. If the cost for MB abatement includes all MLF costs for MB-related projects (including the capacity-building projects that do not directly reduce MB use), the average dollars spent per ODP-tonne eliminated is US$ 23,599.

Methyl bromide elimination projects have tended to be somewhat more expensive than other ODS phaseouts. The MLF database contains information on 4,397 projects altogether. Spending so far totals just under US$ 1.5 billion. Out of all the projects, 1,975 directly reduce use of an ODS for a total reduction of 172,744 ODP-tonnes at a cost of US$ 1.08 billion. (Direct abatement projects are 45% of all projects and account for 72.5% of spending.) Thus, average spending per ton of direct abatement (weighted by project size) is US$ 6,251. The average weighting each project equally is US$ 12,397, and the median is US$ 9,093. If all MLF project funds are included in the numerator, the average cost of ODS elimination to date has been US$ 8,618 per ODP-tonne.

Table 3-9: Phaseout Costs Per ODP Tonne Under the Multilateral Fund, US 2002 Dollars

	Median	Mean with Project Size Weights	Project Mean, Unweighted
MB *n=41*	US$ 23,982	US$ 15,939	US$ 32,215*
All ODS *n=1975*	US$ 9,093	US$ 6,251	US$ 12,397**

*This figure is very sensitive to outliers; if two dropped outliers (cost per tonne > US$ 100k) are included it rises to US$ 44,755.

** This figure also is sensitive to outliers. If outliers are included, it rises to US$ 16,238.

The historic cost to the MLF per ODP-tonne of MB eliminated has been higher than the cost to eliminate other ODS—reflecting the fact that alternatives are just reaching the market and economies of scale are not yet achieved. Thus, it is the cost per tonne of the MB projects that is the lower bound on the "economic feasibility" of MB alternatives.[10] Thus, projects are

[10]. If the cost per ODP-tonne of MB phaseouts had been less than the cost per tonne of other ODS phaseouts, it might be argued that the ODP cost per tonne of the other ODS projects constituted the lower bound for "economic feasibility" because that number would indicate how much the world is willing to pay to purchase an ODP-equivalent unit of ozone layer protection. Given that the MB phaseout projects are more expensive on average, it follows that the MB phaseout costs provide the appropriate lower bound.

considered “economically feasible” at US$ 15,942 to US$ 32,215 per ODP-tonne, depending on which measure of central tendency is used.

A conservative mid-range estimate would be the median value of US$ 23,982 per ODP-tonne, counting only the cost of projects that result in direct MB reductions. This is very close to the overall average cost for MB elimination of US$ 23,599 per ODP-tonne, including all MLF dollars that have been spent on direct and indirect MB abatement.

3.7.5 What “economically feasible” might mean for methyl bromide users

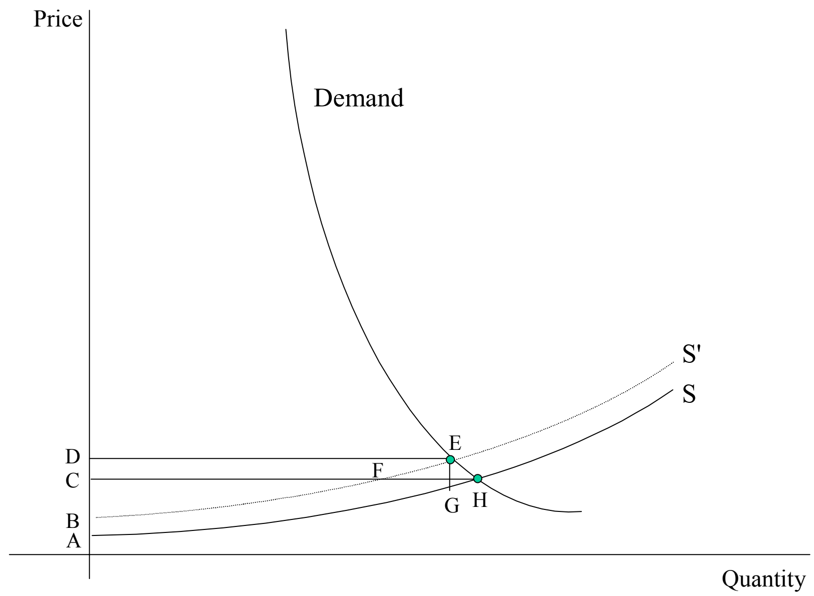
In other sectors of the economy where ODS have been used, chemical producers and their customers have been expected to make adjustments as input prices changed or the regulatory environment shifted. For agriculturalists, normal flexibility entails potential changes of the output mix, substitution of cheaper inputs for ones that have become more expensive, and reallocation of capital in response to market developments. For example, Goodwin et al (2002) note that in the U.S. after the passage of the 1996 Federal Agriculture Improvement and Reform Act, there were large shifts in land use patterns: a 27% decline in acreage in cotton and increases of 12.6% and 15% for corn and soybeans, respectively. No dynamic economy attempts to implement policies that insulate producers from all adverse economic effects of market adjustments.

Some of the loss from the MB phaseout will be borne by consumers of the products that formerly had been produced using MB. (Consumers have made no application for compensation or other relief from any of the ODS phaseouts that have taken place under the Montreal Protocol.) Consider the limiting case of a product for which the demand is completely inelastic. In such a case, the upward shift of the supply curve brought about by the higher production costs associated with the MB phaseout would lead to no loss at all to producers; the entire loss would fall on the consumers because the higher production costs would simply be passed through and subsumed in a higher price paid by consumers for the final product.

In the more general case (with both demand and supply exhibiting some elasticity), the cost of the MB phaseout would be shared between consumers and producers. In that case, the economic loss experienced by producers would be lower than the cost per ODP-tonne calculated in Section IV above as the lower bound on what non-Article 5(1) countries are willing to pay to phase out MB. The economics are illustrated in Figure 3-2.

The industry supply curve is S prior to the MB phaseout, and S' after the phaseout. The S' curve is just the original supply curve shifted up by the amount u (= EG) by which the average cost of production is increased as MB is eliminated. (The incremental cost of MB replacement is like a tax levied on each unit of output produced.) The market-clearing price before the phaseout is given by the intersection of the demand and supply curves at H, and after the phaseout by their intersection at E. The net profit to producers before the phaseout is the area AHC above the supply curve and below the price (the "producers' surplus"). Net profit after the phaseout is area BED. The net loss in profit is given by the area AHFB *minus* the area CFED. The loss caused by a higher cost of production is partially offset by the additional producers' surplus generated because of the higher market price. In other words, some of the increased cost of production is passed on to consumers in the form of a higher price for the product.

Figure 3-2: Gains and losses to producers



It is straightforward to demonstrate algebraically that the division of losses between producers and consumers depends on the elasticities of demand and supply. Suppose the demand and supply functions are given by simple constant-elasticity curves

$$Q_D = AP_D^{-\eta}, \qquad \eta \geq 0 \tag{1}$$

and

$$Q_S = BP_S^{\psi}, \qquad \psi \geq 0 \tag{2}$$

respectively. Then it is easy to show that, disregarding second-order effects,[11] the loss per unit of output to producers resulting from an increase in unit production cost u is given by

$$\frac{L}{Q} = \frac{\eta}{\eta + \psi} u \qquad (3)$$

where L is the net loss to producers and Q is the quantity of output being produced. Equation (3) can be converted to the loss per unit of methyl bromide replaced by multiplying both sides by Q/M, where M is measured in ODP-tonnes of methyl bromide.

$$\frac{L}{M} = \frac{\eta}{\eta + \psi} \Delta \qquad (4)$$

with Δ $(= uQ/M)$ being the increased cost per unit of methyl bromide replaced. This calculation assumes that the "pesticide intensity" of production remains constant despite the increase in the cost of this input, an assumption that will be relaxed below. Equation (4) shows that if demand is completely inelastic ($\eta = 0$), the producers will be able to pass all of the cost increase on to consumers and will experience no loss of profit at all. Similarly, if supply is perfectly elastic ($\psi = \infty$), the producers again will experience no loss, in this case because they are making no net economic profits either before or after the cost increase.

The agricultural economics literature provides some estimates of demand and supply elasticities for products that would be affected by the MB phaseout. A sample of such estimates is presented in Table 3-10.[12] Estimates of elasticities of demand are more common, and they tend to be relatively low (in absolute value) for the products that commonly use methyl bromide in production. Thus, if the elasticity of demand for strawberries is 0.264 and the elasticity of supply is 0.8, the loss to producers per unit of methyl bromide replaced resulting from an increase in unit pesticide cost Δ (assuming constant

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[11]. These second-order effects are changes associated with "triangles" in Figure 3-2such as areas in GHE and GFE that are above and below the original price line. These include deadweight losses resulting from reduced output.

[12]. The estimates in Table 5 are drawn from non-Article 5(1) countries (and within that group, primarily the United States). It would be desirable to expand the coverage to include estimates from Article 5(1) countries as well.

pesticide intensity) would be 0.25 Δ. If the elasticity of supply is 0.2, the increase would be 0.57 Δ.

Equation (4) also illustrates another salient feature of the market. The demand faced by any individual producer will appear to that producer to be infinitely elastic; the competitive producer sells his product at the market price over which he has no control.

Table 3-10: Demand and Supply Elasticity Estimates for Fruits and Vegetables

Author	Product	Country	Estimate
Own Price Demand Elasticity			
Huang (1985)	Apples	USA	-0.20150
	Grapes		-1.37800
	Misc. Fruits		-0.23570
	Lettuce		-0.13710
	Tomatoes		-0.55840
	Misc. Vegetables		-0.21020
Baumes & Conway (1984)	Apples, Fresh	USA	-1.34800
	Apples, Processed		-1.15900
Huang (1993)	Fresh Fruit	USA	-0.41590
	Processed Fruit		-0.15090
	Grapes		-1.17950
You, Epperson & Huang (1998)	Fresh Fruit	USA	-0.27297
	Processed Fruit		-0.29000
	Fresh Vegetables		-0.02880
	Processed Vegetables		-0.10913
	Apples		-0.19622
	Strawberries		-0.26400
	Watermelon		-0.61432
	Celery		-0.03249
	Cucumbers		-0.30218
	Lettuce		-0.01150
	Peppers		-0.25346
	Potatoes		-0.15522
	Tomatoes		-0.37899
Chung (1994)	All Fruits and Vegetables	Spain	-0.967 to -0.983
Own Price Supply Elasticity			
Dinan, Simons & Lloyd (1988)	Peas, SR	USA	0.31000
	Tomatoes, SR	USA	1.35000
	Potatoes, SR	California	0.87000
	Apples, SR	USA	0.11000
Huffman & McCunn (1996)	Fresh Fruits and Vegetables, SR	USA	0.20000
	Fresh Fruits and vegetables, LR	USA	0.80000

Thus, it seems to the individual producer as though his loss per ODP-tonne caused by the MB phaseout would simply be Δ, the magnitude of the increase in the average pesticide cost. This overlooks the price effect that *will be felt throughout the market because the same cost increase is experienced by all the other producers*. This market-wide price effect cushions the cost increase to producers by spreading some of the loss across consumers.[13]

To this point, we have assumed that the "pesticide intensity" of production has not changed, even though unit pesticide cost has increased. However, it is quite likely that the increase in average cost experienced by producers will be lower than the cost increase for the pesticide or fumigation component of production. Any increase in the cost of one input will be partially offset by substitution away from that input. Typically, MB accounts for only a rather small fraction of total production costs,[14] so the percentage increase in the cost of "pesticide services" as MB is phased out is likely to be considerably larger than the resulting percentage increase in average production costs. The difference between the two will depend on the exact form of the production function. If the production function is Cobb-Douglas, for example, the elasticity of average unit cost with respect to the cost of any one factor is that factor's share in total variable cost (Varian 1992). Only if the pesticide input is used in fixed proportions to the other inputs will the increase in pesticide cost lead to no substitution of other factors for this input.

Suppose, for example, that the production function is Cobb-Douglas. Then if the per ODP-tonne cost increase of the pesticide input resulting from the replacement of MB is Δ and the share of pesticide cost in total variable cost is α, the increase in average unit cost of production (measured in dollars per ODP-tonne units) will be $\alpha\Delta$. In this case, equation (4) can be rewritten as

The cost share α is always less than one, so equation (4a) shows that the loss of profit per unit of MB eliminated given by equation (4) must be an *upper bound* estimate. How close the actual loss is to this upper bound depends on

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13. For some industries only one country has applied for an exemption, and in other cases the exemption applies to only a small fraction of the national industry. These are cases in which it might be argued that the elasticity of demand for the users submitting CUEs is effectively infinite if the product of the industry is widely traded, so that the entire burden of the cost increase would be borne by the MB CUE applicant. Of course, these are also cases in which alternatives to MB have demonstrated economic viability and technological effectiveness.

14. For instance, in the UK CUE nomination for strawberries, MB and associated costs amount to 6% of costs over the two-year planting cycle. For raspberries, the figure is 1.2% of costs over a five year cycle. In the Belgian nomination, MB costs are 5.7% of variable costs in lettuce production.

how much substitutability exists between the pesticide input and the other inputs to production.[15]

The estimated cost per ODP-tonne of MB elimination (the value Δ in the notation of equations (1)-(4) above) can be recovered from a number of CUE applications. Many of the applications describe this number as the loss in profit per unit of output experienced by MB users (L/M in our notation), but as we have seen, the actual value of L/M must be smaller than the value of Δ. The incremental pesticide cost increase per ODP-tonne of MB replaced is an *upper bound* on the loss experienced by producers, because of the pass-through of part of the cost increase to consumers and the substitution of other factors of production for the more expensive pesticide input. With this important caveat in mind, the estimates of Δ from a sample of CUEs are presented in Table 3-11.

The rightmost column of Table 3-11 is the one most relevant to our analysis. The median incremental unit production cost increase is US$ 23,350.[16] It is clear from this table that some of the phaseouts would be quite expensive compared to the MLF projects. However, it must be kept in mind that the figures in Table 3-11 are *upper bounds* of the loss to producers from phasing out MB, while the MLF project costs are a *lower bound* on what is "economically feasible." This suggests that are great many of the MB replacement projects described in the CUEs actually are "economically feasible" using the global willingness-to-pay yardstick. Some very high-cost projects may have costs greater than the lower bound estimates from the MLF projects dataset, but quite a number of MB replacements described in the CUEs would lead to losses in profits that are well below the "economically feasible" level.

There is another sense in which even the liberal definition of "economic feasibility" as no net loss to producers is not consistent with some of the CUE requests. A number of the CUEs ask for an *expansion* in the use of MB in order to increase production. Clearly, the economic situation of the producers

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[15]. As noted above, equation (4) holds exactly only if pesticides are used in fixed proportions with the other inputs. Even if the production function has a lower elasticity of substitution between pesticides and other inputs than in the Cobb-Douglas case, equation (4) provides an upper bound for the loss per unit of MB replaced.

[16]. The median is the appropriate measure of the central tendency for two reasons: (1) many of these estimates give only a range, and (2) the mean would be heavily influenced by the handful of estimates with very high estimated cost per ODP tonne (e.g., Pistachio storage at over US$ 1 million/Tm). In the cases in which a range is given, both ends of the range are included in calculation of the median.

before any expansion of their MB use was "economically feasible" – there can be no question of the economic viability of those enterprises at their historical levels of MB usage.

Nevertheless, some of the CUEs submitted by Australia,[17] Belgium,[18] France,[19] Portugal,[20] the United Kingdom,[21] and the United States[22] entail growth (phase-up) of MB usage above historical levels.

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[17]. Victorian Cut Flowers Industry (75% growth) and Victorian Strawberry Runners Industry (5% per annum growth).

[18]. The Belgian nomination for 100Tm notes that they have used 67.7 Tm of MB each year on average over the last four years.

[19]. Carrots (25% growth).

[20]. The Portuguese nomination for 200Tm notes that 150Tm were requested in 1991 as a baseline but that subsequently (1995) they found they required 209 Tm. Note that this would indicate that Portugal has as yet not met the reductions from 1995 levels already required to date. The nomination also notes the need to provide for the expansion of the cut flower trade in particular.

[21]. Cereals (22% increase), Rice (48% increase), and Spices (25% increase).

[22]. Although a number of U.S. CUE requests implied growth in MB usage (Doniger 2003), the USA actually nominated only 9,921 of 15,918 requested tonnes. Requests are detailed in the CUEs but actual nominations are a fraction of the total requests for the whole sector and are not broken out according to the individual CUEs. In some sectors it seems quite likely that expansions would be approved if the nominated amount were approved. For example, the California Sweet Potato Council reports zero MB usage in 2001-2002, and the nominated amount is higher than its usage in 1999 or 2000. The Hawaiian Farm Bureau request for a near doubling of use in ginger cultivation from 2001 levels was cut back to a slight (about 5%) increase. In the commodity sector, which includes nuts, beans, dried fruit and Smithfield hams, the nominated value of almost 88 tonnes is 97 ¼ % of the various subgroups' reported 2001 use, and each individual request to the US authorities was for an increase. A similar situation holds for rice in the 'Food Processing' category.

Table 3-11: – Estimated Costs of Switching from MB from CUE Nominations

Country	Industry/Sector	Curren-cy	Cost per Tm	Cost per ODP Tm	Approx. USD per ODP Tm
Portugal*	Overall: Fruits, Vegetables & Flowers	EUR	8,700-10,707	14,500-17,845	15,588-19,183
UK**	Strawberries	GBP	7,581	12,635	19,837
UK	Raspberries	GBP	95,169	158,615	249,026
Belgium***	Lettuce	EUR	9,916	16,527	17,767
USA****	Cucurbit (GA only)	USD	8,290	13,817	13,817
USA	Cucurbit (Southeast)	USD	23,100	38,500	38,500
USA	Beans (storage)	USD	218,000	363,333	363,333
USA	Prunes, raisins, figs (storage)	USD	414,000	690,000	690,000
USA	Walnuts (storage)	USD	79,000	131,667	131,667
USA	Pistachios (storage)	USD	608,000	1,013,333	1,013,333
USA	Rice Milling	USD	70,400	117,333	117,333
USA	Flour Milling	USD	598,400	997,333	997,333
USA	Bakeries	USD	433,400	722,333	722,333
USA	Pet food	USD	580,800	968,000	968,000
USA	Forestry Seedlings (South)	USD	10,000	16,667	16,667
USA	Forestry Seedlings (West)	USD	14,000	23,333	23,333
USA	Forestry Seedlings (North)	USD	32,000	53,333	53,333
USA	Ginger*****	USD	20,190	33,650	33,650
USA	Sweet Potatoes	USD	5,150-12,880	8,583-21,467	8,583-21,467
USA	Strawberries (California)	USD	8,000-20,000	13,000-33,000	13,000-33,000
USA	Strawberries (Florida)	USD	37,000-57,000	62,000-95,000	62,000-95,000
USA	Strawberries (Eastern US)	USD	24,000-48,000	40,000-80,000	40,000-80,000
USA	Peppers (California)	USD	4,150-14,020	6,917-23,367	6,917-23,367
USA	Peppers (Southeast)	USD	6,690-14,310	11,150-23,850	11,150-23,850
USA	Peppers (Florida)	USD	20,020-31,300	33,367-52,167	33,367-52,167
USA	Tomatoes (Michigan)	USD	97,000	161,667	161,667
USA	Tomatoes (Southeast US)	USD	13,700	22,833	22,833
USA	Mums (propagation material)	USD	8,700	14,500	14,500
USA	Nursery Roses	USD	10,300-21,750	17,000-36,250	17,000-36,250
USA	Stone Fruits	USD	8,000-35,000	13,333-58,333	13,333-58,333
USA	Walnuts (preplant)	USD	2,000-11,000	3,333-18,333	3,333-18,333
USA	Almonds	USD	3,000-15,000	5,000-25,000	5,000-25,000
USA	CA Orchard Nurseries	USD	11,450-14,380	19,083-23,967	19,083-23,967
USA	CA Citrus, Avocado Nurseries	USD	11,660-14,580	19,433-24,300	19,433-24,300
USA	Western Raspberry Nurseries	USD	10,880-28,220	18,133-47,033	18,133-47,033
Italy ******	Peppers/Eggplant	EUR	-9,640-8,420	-16,067-14,033	-17,272-15,085
Italy	Flowers	EUR	-15,140-20,420	-25,333-34,033	-27,233-36,585
Italy	Melons	EUR	-6,040-3,360	-10,067-5,600	-10,822-6,020
Italy	Tomatoes	EUR	-15,560-7,220	-25,933-8,700	-27,878-30,853

Italy	Strawberries	EUR	6,340-4,620	10,567-7,700	-11,360-8,278

Notes to Table 6:

*	Portuguese figure arrived at by taking the difference in cost per hectare of using steam instead of MB and the range of doses (Tonnes) per hectare reported in the CUE.
**	UK figures rely on the CUE estimates of the total margin gap in using MB or a substitute over a 2 yr cycle for strawberries and a five year cycle for raspberries.
***	Belgian figures rely on CUE given changes in profits per square meter from phasing out MB and given dosage rates of MB per hectare.
****	US point estimates use the 'likely' estimates from the CUEs; quite large ranges were given for many of these, including a few that included rising profits without MB. Some of the very large numbers apparently reflect undepreciated capital costs of setting up heat treating systems for buildings.
*****	Ginger estimates included an estimated price decline due to quality issues.
******	Italian figures include all technically possible alternatives, not all of which are technically possible for all the regions where a particular crop is grown. Calculations as in the Belgian case.

Similarly, it cannot be an economic necessity to use MB in newly cultivated lands or in fields where it had not previously been employed as a pesticide. An agricultural operation that was viable before the new lands were opened for cultivation, or one that was using other pest control methods in the past, would not require a new application of MB to maintain profitability. In addition, lands that changed ownership after the MB phaseout schedule was known should not be eligible for continued MB use, because the sale price of the land will have reflected the fact that MB could not be used for treatment of the fields in the future. The rate of return on lands that changed ownership after the MB phaseout schedule was in place would reflect the market price of land that could not use MB after the phaseout date. This price might be lower than if MB could continue to be used, but the buyer was able to purchase the land at the lower price. To grant an exemption for continued use of MB in such cases would result in a windfall profit to those who had purchased the land under market conditions anticipating the MB phaseout.

To summarize the analysis so far, it is evident that even under the most liberal definition of "economic feasibility," that is, ensuring no net loss to users of MB, a considerable level of effort to eliminate the substance is economically justified. A lower bound on the resources that governments of non-Article 5(1) countries have been willing to spend to eliminate MB is given by the cost per ODP-tonne of MB elimination projects supported by the Multilateral Fund. The loss of profits would be lower than estimated in the CUEs because of market price effects. In no case is there reason to think that requested expansions of MB use, MB use in previously untreated areas, or use on lands that have changed ownership recently are an economic necessity. The question of how to distribute the costs of the MB phaseout between users, consumers, and taxpayers is distinct from the question of arriving at an appropriate definition of "economic feasibility."

3.7.6 Associated issues

It should not be inferred from the discussion in Section V that a standard of "no net losses to MB users" should be adopted by the Parties to the Protocol. Such a standard would be far more favourable to MB users than to any other sector that has participated in the ODS phaseout to date. Governments in non-Article 5(1) countries have engaged in a wide variety of efforts to support the changeover to products and processes that are friendly to the ozone layer, including promoting information exchange and technology transfer, changing military specifications from process-based to performance-based, speeding regulatory approval of alternatives, underwriting R&D, sponsoring conferences and awards, developing certification programs for those working with new technologies, and offering prizes like the US EPA's "Golden Carrot" for appliance design improvements, but so far there have been no direct subsidies for the phaseouts. Activities of this type also have been undertaken in non-Article 5(1) countries with respect to MB specifically, such as the USDA/EPA MeBr Working Group in the USA, or the Horticultural Research & Development Corporation's Methyl Bromide Alternatives Research Co-ordination Committee in Australia, and many additional government and industry funded efforts that are detailed in the CUEs themselves.

Similar efforts are underway to assist the MB phaseout in the Article 5(1) countries, such as the UN OzonAction Programme's **"**Enhancing the Capability of Local Agricultural Organisations and Non-governmental Organisations in Methyl Bromide Communication" project (partly supported by the Multilateral Fund), the Comité Nacional Pro Defensa de la Fauna y Flora (CODEFF) conferences in Chile, the National Committee on Ozone Depleting Substances (NACODS) in Kenya, and the SEPA MB Steering Group and Working group in China.[23] Nevertheless, in every other sector the affected users and producers of ODS have been called upon to undertake some of the burdens of the transition. MB users have also made considerable efforts along these lines (as evidenced by the decline in MB use in the non-Article 5(1) countries). The requests for CUEs need to be evaluated in the context of what MB and other ODS users have already accomplished.

In this regard, it should be kept in mind that *ex ante* estimates of the cost of compliance with environmental regulations are usually higher than those costs actually turn out to be in practice. Typically the cost of new technologies falls

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[23]. A list of 'NGOs Participating in the NGO/UNEP Partnership on a Methyl Bromide Communications Programme' is given at http://www.uneptie.org/ozonaction/events/mbrpartnership/participants.html.

over time as learning-by-doing and increasing returns to adoption take effect. These two points are related; the realization of cost savings from learning and adoption effects are often difficult to anticipate when making ex ante projections of the cost of regulatory mandates. These phenomena have been observed in the recent past in the case of environmental regulations general, and for the phaseout of ODS in particular.

The general phenomenon of *ex ante* overestimation of costs for environmental and other regulations has been well documented in the literature (see Goodstein 1997 and Harrington et al. 2000 for general surveys; see UNEP 1991, DeCanio 1994, Cook 1996, Hammitt 1997, and DeCanio 2003 for examples specific to ODS). The broader literature on learning-by-doing and increasing returns is extensive, and will not be summarized here. From the very early observation (Wright 1936, cited in Arrow 1962) that the amount of labour required to produce the *n*-th airframe of a particular type was proportional to $n^{-1/3}$ to contemporary manifestations such as Moore's Law,[24] the decline in unit costs as production experience accumulates is one of the most firmly established empirical regularities of the industrial economics literature. In a paper that examined the estimated progress ratio in over 100 studies, Dutton and Thomas (1984) found a distribution with a central tendency in the low eighties.[25] This means that, across a broad sample of products and processes, unit costs have tended to fall to 80% of their original level for each doubling of output.

Estimates of the cost of the MB phaseout have already begun to fall. According to the US Department of Agriculture, "The NCFAP [National Center for Food and Agricultural Policy, Carpenter et al 2000] estimate for preplant uses is considerably below the $800 million estimated by the National Agricultural Pesticide Impact Assessment Program in 1993. The largest reductions occurred for Florida production of tomatoes and other vegetables" (USDA 2000, p. 9), and "[t]he University of Florida researchers, who in 1995 estimated that f.o.b. revenues from Florida tomatoes would fall about $400 million, currently estimate a decline of about $70 million" (*ibid*., p. 10, citing VanSickle et al 2000).

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[24]. This "law," first advanced by Gordon Moore of Intel in 1965, holds that the number of transistors that can be manufactured on a microchip grows exponentially. (The exact rate of doubling is open to dispute, see Toumi 2002.) A corollary is that the price per transistor on a chip has been falling, with the price dropping by half roughly every 18 months (Moore 2003, CNN.com 2003).

[25]. The progress ratio describes the percentage of initial per unit costs that will obtain at the margin once cumulative volume doubles from the initial level. A standard mathematical form of the progress function is $y = ax^{-b}$, where y = input cost for the xth unit, x = cumulative number of units produced, a = input cost for the first unit, and b = progress rate (Dutton and Thomas 1984, p. 236).

Data from the Multilateral Fund projects suggest that that in the specific case of ODS substitutes, the cost per ODP-tonne of the ODS phaseout has indeed declined over time. Table 3-12 and Table 3-13 give summary statistics for abatement project costs by year. Table 3-14 shows the results of regressions of the cost per ODP-tonne for projects as a function of time (measured by the Multilateral Fund meeting number at which the projects were approved) and the scale of the project (measured by the total ODP-tonnes eliminated by the project). Separate regressions are shown for the MB projects and for the entire sample of projects that resulted in a direct reduction in ODS. The methyl bromide projects show no indication of a change in cost per ODP-tonne over time, although the cost per tonne is negatively related to the size of the project. For the entire sample of ODS projects, the time trend is negative and the unit cost is inversely related to project size, at very high levels of statistical significance (Probability-values below 0.01 under the null hypothesis of no relationship). This result holds whether or not sector-specific dummy variables representing the categories each project is assigned to by the MLF are included. The meetings of the Multilateral Fund occurred approximately every four months, so the all-ODS results suggest that the cost per ODP-tonne has been declining by about US$ 480 per year. This finding is consistent with declining costs for ODS elimination as experience has been gained and new technologies developed. It is not consistent with the notion that the Multilateral Fund picked the cheapest projects (so-called “low hanging fruit”) to fund first.

Table 3-12: - All ODS Summary Statistics Over Time (In thousands of US 2000 $

Year	N	Impact (ODP-tonnes)	Avg. Size	Mean Cost per ODP Tonne (Project Size Weights)	Mean Cost per ODP Tonne (Unweighted)	Median Cost per ODP Tonne
1991	13	536.70	41.28	8.45	16.79	
1992	41	18861.66	460.04	1.38	21.91	8.80
1993	56	4547.30	81.20	12.28	35.48	14.58
1994	177	18587.03	105.01	6.88	17.73	10.58
1995	175	14207.26	81.18	7.55	36.03	10.71
1996	181	10239.83	56.57	8.26	16.77	8.87
1997	308	30403.23	98.71	5.22	9.88	8.07
1998	197	16193.99	82.20	5.84	12.88	8.67
1999	293	17374.00	59.30	7.20	12.49	9.21
2000	189	11636.46	61.57	7.30	11.09	8.87
2001	225	14721.29	65.43	6.61	13.25	10.44
2002	120	15434.15	128.62	7.26	13.80	9.37

Table 3-13: Methyl Bromide Summary Statistics Over Time (In thousands of US 2002 $

Year	N	Impact (ODP-tonnes)	Avg. Size	Mean Cost per ODP Tonne (Project Size Weights)	Mean Cost per ODP Tonne (Unweighted)	Median Cost per ODP Tonne
1998	2	48.72	24.36	41.45	71.74	71.74
1999	6	391.70	65.28	21.81	33.04	22.21
2000	8	774.70	96.84	13.66	24.45	17.29
2001	12	428.70	35.73	18.41	43.90	33.73
2002	13	1142.75	87.90	13.46	59.30	21.27

Table 3-14: Ordinary least squares regressions of cost per ODP-tonne on time, project size, and sector variables, Multilateral Fund-approved projects through March 2003

	Sample of Projects					
Variable	MB	MB	All ODS	All ODS	All ODS	All ODS
Constant	81.912 (2.332)**	80.351 (2.622)**	16.212 (18.315)***	16.732 (18.947)***	18.928 (11.888)***	19.325 (12.208)***
Meeting Number	-1.488 (-1.423)	-1.178 (-1.285)	-0.157 (-4.521)***	-0.165 (-4.763)***	-0.158 (-4.533)***	-0.166 (-4.775)***
Proj. size		-0.124 (-3.550)***		-0.124 (-3.550)***		-0.004 (-5.306)***
Fumigant					-2.446 (-1.390)	-2.503 (-1.431)
Aerosol					-3.556 (-1.560)	-3.581 (-1.582)
Foam					-4.728 (-3.246)***	-4.467 (-3.086)***
Halon					-0.969 (-0.471)	-1.032 (-0.505)
Multi-sector					-5.905 (-0.850)	-5.667 (-0.822)
Other					0.168 (-0.031)	0.290 (-0.054)
Process Agent					0.247 (-0.036)	0.208 (-0.030)
Phaseout Plan					2.778 (-0.699)	2.832 (-0.718)
Production					-2.274 (-0.595)	-2.233 (-0.589)
Refrigeration					-1.358 (-0.928)	-1.308 (-0.899)
Several					-2.470 (-1.687)*	-2.389 (-1.642)
Sterilant					-5.596 (-0.806)	-5.740 (-0.832)
Obs.	39	39	1960	1960	1960	1960
Adj.-R^2	0.026	0.259	0.01	0.026	0.02	0.034
Prob > F	0.163	0.002	~0	~0	~0	~0

Notes: (1) Outliers with cost per ODP-tonne > US$ 100k deleted
(2) When sector dummies are included, the excluded variable is solvents
(3) t-statistics in parentheses below coefficient estimates; *two-tailed Probability-value<0.1; ** two-tailed Probability-value<0.05; ***two-tailed Probability-value<0.01

Although the meeting number coefficient is negative in both methyl bromide regressions reported in Table 3-10, the standard errors are large relative to the estimated coefficients. It does seem plausible, however, that the learning-by-doing and scale effects that are likely to ensue if the Protocol's phaseout schedule is adhered to will be weakened if too many critical use exemptions are given. Granting CUEs on the grounds that the alternatives are too expensive may thus be a "self-fulfilling prophecy." Conversely, if aggressive efforts to find MB substitutes are continued, it is likely that the cost of the alternatives will fall as they have for other ODS substitutes.

In a similar vein, the literature on economic regulation is clear in establishing that *regulatory certainty* is a benefit to the regulated industry, for any particular level of regulatory stringency. As Lavey (2002) puts it,

For businesses in regulated industries, uncertainty about future regulations can add to operators' difficulties in attracting capital and making investments in infrastructure, products, and services. The industries and consumers affected by regulations make decisions on investments and other actions, which are inherently multiyear, forcing them to make assumptions about future regulatory conditions. Markets reflect regulatory uncertainties even if regulators do not weigh these consequences. Regulatory uncertainties can harm consumers by diminishing competition, raising costs and prices, reducing investment in innovative services, limiting network deployment and in other ways.

This view is supported in some detail in Porter (1985) and Levy and Spiller (1996). It is always easier to plan for a future that is known than for a future that is uncertain. Regulatory certainty enables producers to anticipate how their technological development should be directed, and it encourages expenditure of funds and effort on research rather than on attempting to influence the regulatory rules. Lobbying, wresting with regulatory agencies, and other forms of rent-seeking activity are generally an inefficient use of productive resources (Krueger 1974, Bhagwati 1982) and can lead to a self-perpetuating cycle of behaviour: "Past rent-seeking experience should reduce the cost of further rent seeking and increase its return. Thus rent seekers may, over time, become more prone to further rent seeking and even become dependent on rent seeking" (Morck et al 2001).

Furthermore, the CUE process, based as it is on government-sponsored nominations and a case-by-case review by the Parties, is likely to introduce a non-level playing field for producers in different countries if a large number of exemptions are granted. Fair competition requires a uniform set of standards for all competitors; if the rules are subject to change because of different policy orientations of different national governments, or because of non-uniformity in the decisions taken by the Parties, equality of treatment at the level of the individual producers can break down. Once the granting of exemptions is established, it may seem necessary for producers to seek exemptions for themselves in order to match or pre-empt similar actions by competitors at home or in other countries. A single standard of behaviour leads to rapid progress on abatement at minimal cost, but the possibility that some producers might receive favoured treatment leads all to seek such treatment, with a corresponding decrease in the effectiveness of the regulatory regime.

In particular, CUEs granted to specific non-Article 5(1) Parties for a range of uses may lead to requests for exemption by all Parties for this range of uses, leading to virtual exemption from all controls on MB within the sector. Knowledge about implementation of alternatives to MB within an industry can be thought of as a public good. When exceptions are unknown or uncommon, those firms in an industry threatened by the loss of MB which are best suited to eliminate use of the compound have strong incentives to move quickly on abatement to gain a competitive advantage over other firms. Possible industry winners from regulation will support strong enforcement of a ban and work together to find and implement alternatives, as was seen in CFC abatement under the Protocol (Maxwell and Briscoe, 1997). Collective action to reduce ODS has been and continues to be critical; cooperation among users reduces the costs of testing alternatives and increases the rate of progress towards finding effective alternatives (Harrison and Easton, 2002).

It is also the case that granting CUEs in non-Article 5(1) countries undermines the efforts made in Article 5(1) countries to eliminate MB, often with financial help from the Multilateral Fund. CUEs in non-Article 5(1) countries offset gains in MB elimination that are being made elsewhere. If too many CUEs are given, MB users in the non-Article 5(1) countries are being protected (by being exempted from the MB phaseout) while Article 5(1) users are compensated for switching to alternatives. Net MB use does not fall and neither set of producers gains relative to the status quo. The only losers are those whose health and well-being is damaged by the ozone depletion that could have been avoided by a more consistent policy.

3.7.7 Summary

The agriculture and fumigation industries have already made great strides in the development of alternatives to MB, as evidenced by the hundreds of papers delivered at the Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions[26] and by the dramatic reductions in MB usage that have been achieved.

However, there are cases where the costs of immediate phaseout may be prohibitive. The Critical Use Exemption process can provide a “safety valve” that allows temporary use while alternatives and substitutes are commercialised and registered by agricultural and environmental authorities. The most successful implementation of the CUE will allow limited uses, will provide economic incentives for phaseout, and will maintain the sense of fairness among all sectors that have struggled (and continue to work) to phase out all ODS. An ongoing sense of fairness will avoid unnecessary efforts by other sectors to receive tailored exemptions from phaseout.

Maintaining a spirit of cooperation, innovation, and commitment has been essential to building an “ozone protection community”[27] that has minimised the cost and accelerated the protection of the stratospheric ozone layer by transforming markets and achieving economies of scale. Parties may wish to consider the advantage of defining alternatives and substitutes to methyl bromide as “economically feasible” for non-Article 5(1) countries if the cost is no greater than the incremental cost of MB elimination in Article 5(1) countries.

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[26]. The conference has been held annually since 1996, and has averaged well over 100 papers per year.

[27]. See Canan and Reichman 2001 for the essential role of community-building in the Montreal Protocol’s success.

3.7.8 References

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4 Alternatives evaluated in Article 5(1) countries – Response to Decision IX/5(1e)

4.1 Summary Response to Decision IX/5(1e)

Under Decision IX/5, agreed at the Ninth Meeting of the Parties to the Montreal Protocol in 1997, the Parties decided *inter alia* that further specific interim reductions on methyl bromide for the period beyond 2005 for Article 5(1) Parties would be decided at the Meeting of the Parties in 2003. This chapter aims to provide Parties with relevant information in response to paragraph 1(e) of Decision IX/5 to assist in deciding on these control measures.

Several MB alternatives have been selected in Article 5(1) countries for extensive adoption as part of MB phaseout (investment) projects, following successful demonstration projects, and progress in MB reductions in Article 5(1) regions.

By December 2002 the Multilateral Fund had approved a total of 232 MB projects in more than 63 countries. This included 44 demonstration projects for evaluating and customising alternatives, 38 MB investment projects for phasing-out MB and 150 other projects for information exchange, awareness raising, policy development and project preparation. Further MB replacement activities have been funded directly by Article 5(1) countries and/or agricultural producers, bilateral assistance and the Global Environment Facility.

MB phaseout projects approved to December 2002 are scheduled to eliminate major uses of MB in 35 Article 5(1) countries. The projects aim to achieve the widespread commercial adoption of alternatives that were found effective during demonstration projects and/or used in similar climates and conditions in other countries.

Demonstration projects have been carried out in Article 5(1) countries using a wide range of chemical and non-chemical alternatives, in diverse situations, climates, soil types and cropping systems, and for many different types of MB users, ranging from small producers with less than 0.5 ha, to medium and large producers, who produce under low, medium and higher levels of technical sophistication (which does not necessarily correlate with size of operation).

Twenty-nine demonstration projects evaluated and customised alternatives in the soil sector, covering all the MB-using major crops in Article 5(1) regions, (tomato, cucumber, pepper, strawberry fruit, melon, cut flowers, nurseries and tobacco seedbeds). About 16 of the projects (completed and on-going) evaluated alternatives for post-harvest uses of MB, such as on stored grains, pulses, peanuts, seeds and dates.

The completed demonstration projects to date show that for all locations and all crops or situations tested, except control of ginseng root rot and stabilisation of high-moisture fresh dates, one or more of the alternatives have proven comparable to MB in their effectiveness in the control of pests and diseases targeted in the projects in these Article 5(1) countries. In many cases, combined techniques have provided more effective results than individual techniques, particularly when they are part of an integrated pest management (IPM) program.

The results indicate that particular attention needs to be paid to appropriate, effective application methods. Adapting the alternatives to the specific cropping environment and local conditions is essential to success. For example, local materials such as coconut coir and rice hulls have made it possible to adapt substrate systems that would normally have required know-how and technically-demanding materials (e.g. rockwool) not widely available in developing countries. These demonstration projects also showed that the tested alternatives could be introduced into an Article 5(1) country and adapted successfully within 2-3 years, in some cases even including registration of pesticide products.

The main techniques found effective in demonstration projects and/or being implemented in follow-up investment projects for the main MB-using crops/uses are:

Tobacco seedbeds: The soilless float system is an effective MB alternative, applicable to most regions where tobacco is grown. Countries now implementing MB phaseout projects in tobacco have primarily chosen to adopt float systems. Their use is increasing in countries such as Brazil, Cuba, Zimbabwe, Argentina, Macedonia and Croatia, and has very good potential in China. In some countries, effective results in tobacco seedbeds were also achieved with dazomet and dazomet + solarisation.

Cut flowers: Steam + IPM, metham sodium, substrates, and dazomet were all identified as effective alternatives to MB in diverse conditions. Countries implementing phaseout projects in the cut-flower sector have chosen to adopt these same treatments. Steam with organic amendments is used commercially in, for example, Colombia. Commercial adoption of substrates in greenhouse flower production is increasing in Colombia, Brazil, Ecuador and many other countries.

Tomato, cucumber, melon, peppers, eggplant and other vegetables: The demonstrations identified solarisation + biofumigation, solarisation + metham sodium or dazomet, and grafting as treatments with effects comparable to MB for the control of soilborne pests and diseases. Examples of commercial use include solarisiation + metham and solarisation + biofumigation in tomato and pepper production in Uruguay. Solarisation with biofumigation is widely used by tomato and cucumber growers in the Jordan Valley. Use of grafted tomato plants + IPM is now a common practice among farmers in Morocco and is being introduced in Lebanon. Countries who are implementing MB phaseout projects for vegetables/melons have chosen to adopt alternatives such as substrates, grafted plants, direct seeding, solarisation combined with fumigants or organic matter or biofumigation, and steam + biocontrol agents.

Strawberries (fruit production): Demonstrations identified metham sodium, dazomet, solarisation and combinations of these as effective alternatives to MB under Article 5(1) conditions. Solarisation alone or in combination with biofumigation or *Trichoderma* was reported as having high potential for commercial adoption in Turkey. Dazomet + 1,3-D and chloropicrin are being adopted commercially in some CEIT countries. Countries that are implementing MB phaseout projects in the strawberry sector have chosen to adopt alternatives such as solarisation combined with metham sodium or with manure and *Trichoderma*. Biofumigation + 1,3-D and steam have also been selected, the precise combination of techniques depending on the climate, the soil type and target pests, as for all other crops.

Banana and fruit trees: Dazomet has proved an efficient alternative to MB for controlling Moko disease of bananas. This chemical is now widely used commercially in banana plantations (e.g. in Colombia and the Philippines). Countries who are implementing MB phaseout projects for banana plan to adopt combinations of steam, 1,3-D, metham sodium or solarisation. For fruit trees Article 5(1) countries plan to adopt alternative fumigants + selected chemicals for replant problems, and steam or steam + biocontrols for fruit tree nurseries.

Stored products (durables): Many former storage uses of MB in Article 5(1) countries have already been replaced by phosphine, as noted in previous MBTOC reports. In most cases the current choice of alternative treatments lies between phosphine, carbon dioxide, combinations of these gases with raised temperatures and high or low pressures, other modified atmosphere systems, heating, and vacuum-hermetic treatments. While the limited choice at present is strategically undesirable, the range of available alternatives is expected to increase in future. However, the techniques available at present can achieve effective (non-QPS) disinfestations of almost all stored products without recourse to MB.

The completed demonstration projects identified one or more technically effective alternatives to MB for all the stored product situations tested, except rapid disinfestations of fresh dates at harvest. Projects generally concluded that alternatives should be implemented together with integrated commodity management (IPM) programmes.

The projects found that phosphine was technically effective against target pests in stored wheat, maize, rice, peanuts for seed, spices and dried fruit. The demonstration project in Egypt concluded that phosphine (combined with improved gastightness) is an effective alternative for grains in bag stacks, silos and warehouses. Vacuum-hermetic treatments were found to provide an effective treatment for cocoa beans in Côte d'Ivoire. Modern hermetic storage has been recently adopted commercially in the Philippines for stored grains.

Countries that are implementing MB phaseout projects have chosen to adopt phosphine with integrated commodity management (ICM) for stored wheat, maize and peanuts. For dried fruits they have chosen carbon dioxide with raised temperature.

The projects described above show that substantial progress has been made in the identification of suitable alternatives in Article 5(1) countries. They indicate that it will be technically feasible for Article 5(1) countries to make substantial reductions in MB use. Experience with demonstration and investment projects to date, such as those supported by the Multilateral Fund, indicate that the many technical, climatic, social and economic barriers to MB alternatives can be successfully overcome in diverse Article 5(1) regions and that alternatives can be adopted within a relatively few years. Commercial availability of certain alternatives for application in Article 5(1) countries is of continued concern.

4.2 Introduction

Under Decision IX/5, agreed at the Ninth Meeting of the Parties to the Montreal Protocol in 1997, the Parties decided inter alia that further specific interim reductions on methyl bromide for the period beyond 2005 for Article 5(1) Parties would be decided at the Meeting of the Parties in 2003. This chapter aims to provide Parties with relevant information in response to paragraph 1(e) of Decision IX/5. Paragraph 1(e) of Decision IX/5 reads:

In light of the assessment by the Technology and Economic Assessment Panel in 2002 and bearing in mind the conditions set out in paragraph 2 of Decision VII/8 of the Seventh Meeting of the Parties, paragraph 8 of Article 5(1) of the Protocol, sub-paragraphs (a) to (d) above and the functioning of the Financial Mechanism as it relates to methyl bromide issues, the Meeting of the Parties shall decide in 2003 on further specific interim reductions on methyl bromide for the period beyond 2005 applicable to Parties operating under paragraph 1 of Article 5(1).

Decision VII/8 para.2 states:

> *That, in considering the viability of possible substitutes and alternatives to methyl bromide, the Technology and Economic Assessment Panel shall examine and be guided by the extent to which technologies and chemicals identified as alternatives and/or substitutes have been tested under full laboratory and field conditions, including field tests in Article 5(1) countries and have been fully assessed, inter alia, as to their efficacy, ease of application, relevance to climatic conditions, soils and cropping patterns, commercial availability, economic viability and efficacy with respect to target pests.*

Controls on MB that currently apply to Article 5(1) countries consist of: a freeze on production and consumption from 1 January 2002 based on the average production and consumption in the years 1995-1998; 20% reduction from 1 January 2005 and 100% reduction by 1 January 2015. This excludes the volumes of methyl bromide produced/consumed for quarantine and pre-shipment applications and after 1 January 2015 additional volumes for those uses deemed 'critical' by the Parties under Decision IX/6.

This section of the TEAP 2003 Annual Report is an edited and condensed version of Chapter 6 of the MBTOC 2002 Assessment Report. TEAP requested MBTOC to provide this report as a response to Decision IX/5(1e). This section identifies the alternatives that Article 5(1) countries have selected for wide scale national adoption as part of MB phaseout projects and progress made in demonstration projects on MB alternatives in Article 5(1) countries. It focuses on demonstrated alternatives in Article 5(1) countries, and examines *inter alia* the extent to which these alternatives have been tested and their commercial availability. Much of the information in this chapter is drawn from the projects of the Montreal Protocol's Multilateral Fund, which were developed in response to Decision IX/5.

Technical descriptions and other background information about alternative technologies can be found in previous MBTOC and TEAP reports and particularly in the MBTOC 2002 Assessment Report (MBTOC 2003).

4.3 Major uses of MB in Article 5(1) regions

4.3.1 Characteristics of MB use in Article 5(1) countries

MB users in Article 5(1) countries are diverse, ranging from small farmers, cultivating 0.5 ha and less, to medium and large enterprises. There is also much variation with respect to the level of technical expertise required, which is not necessarily correlated to the size of the operation, but possibly more to the destination of the crop - local market or export. The latter generally imposes stringent quality demands and in consequence is more technically demanding.

Consumption of MB is however not restricted to technically advanced enterprises. Simple, low technology methods of MB fumigation using small MB canisters (e.g. one-pound cans) are available in many Article 5(1) countries. This situation has undoubtedly stimulated use of MB in some regions as it avoids the need for large and expensive injection rigs and individual small-scale farmers can apply the fumigant without professional assistance.

4.3.2 Major MB uses

MBTOC carried out a survey of ozone offices and experts in Article 5(1) countries from November 2001 to March 2002, to provide estimates of the breakdown of MB uses in 2000. The survey focused primarily on countries that consume more than 100 tonnes MB, but some lower consumption countries were included in cases where data was readily available. Based on the survey results and Ozone Secretariat data of 2000, Article 5(1) countries were estimated to use approximately 22% (range 19-24%) MB for QPS and approx. 78% (range 76-81%) for controlled uses. Of the total volume of MB consumed, including that for QPS, about 68% was for soil fumigation and approx. 32% was used on durable commodities, structures and perishable commodities.

The survey indicated that controlled uses comprise about 87% MB for soil fumigation (i.e. for treatment of soil before planting crops), approximately 12% for postharvest application on durable products and 1-2% for structures (excluding QPS). The major crops that utilised MB in 2000 as a preplant fumigant were tomato (24%), cucurbits (i.e. melon, cucumber and similar crops) (20%), tobacco seedbeds (20%), strawberry (15%), cut flowers and ornamentals (9%), peppers (3%), tree fruit (2%) and other crops (7%). The major uses of MB in the postharvest sector were on stored grains (about 79%), other stored products (8%), food facilities/buildings/empty warehouses and transport (2-3%), artefacts (2%), stored timber (1%) and other or unidentified uses (7-8%).

The MBTOC Assessment of 2002 (MBTOC 2003) provides detailed information about MB production and consumption in Article 5(1) regions.

4.4 Projects on MB Alternatives

The Multilateral Fund (MLF) provides developing countries with financial and technical assistance to address the phaseout of ozone depleting substances. By December 2002, the MLF had approved a total of 232 MB projects in more than 63 Article 5(1) countries. This includes all types of

MB-related activities: demonstrations, technical assistance, project preparation, training, workshops, awareness raising and, more recently, MB phaseout projects (which are mainly classified as 'investment projects'). The MLF projects can be classified into the following broad categories:

- 44 demonstration projects.
- 52 information and awareness-raising activities, including workshops, technical assistance, and information exchange on MB phaseout and alternatives, policy development and various other activities.
- 98 for the preparation of new projects, including collection of data on MB uses; and
- 38 phaseout projects, some of which include demonstration stages.

Lists of projects are given in Tables 6.7 and 6.8 of MBTOC 2002 Assessment Report.

In addition, a number of MB demonstration projects have been funded from sources other than the MLF, by Article 5(1) countries themselves - for example China – or bilateral assistance such as from the governments of Australia, Germany (GTZ), Italy, Canada and the Global Environment Facility (GEF). In some countries farmers or exporters associations have also financed experiments to identify alternatives to MB; examples include those in Morocco, Egypt, Jordan, Lebanon and Kenya.

4.5 Demonstration Projects

4.5.1 Objectives of demonstration projects

In 1997 the Parties to the Montreal Protocol decided to use MLF resources for identifying, evaluating, adapting and demonstrating MB alternatives in Article 5(1) regions, as stated in Decision IX/5(1b). As a result the MLF approved a number of demonstration projects.

Demonstration projects transferred technologies to Article 5(1) regions from countries that already used alternatives, and established test plots on farms and research stations to evaluate and compare the efficacy (pest control), yields and practical viability of alternatives compared to MB. The aim was to test existing MB alternatives in the different climates and diverse agricultural practices and local conditions found in Article 5(1) countries. The demonstration projects were not intended to carry out research, but primarily to evaluate existing alternatives transferred from other regions. MB users and other relevant stakeholders participated in the demonstration projects and experts assisted in transferring important expertise and know-how. The demonstration projects did not aim to reduce MB consumption directly.

A full list of the demonstration projects, the crops involved, status of the project, and the implementing agency, can be found in Table 6.3 of the MBTOC 2002 Assessment Report. About 29 of the MLF demonstration projects evaluated alternatives in the soil sector, covering all the major MB-using crops in Article 5(1) countries and specifically tomato, strawberry, cucurbits and tobacco. About 16 projects evaluated alternatives for post-harvest and structural uses of MB.

The projects covered a range of chemical and non-chemical techniques (listed in Table 6.4 of the MBTOC 2002 Assessment Report) that were relevant to Article 5(1) agricultural conditions. Some alternatives were trialled in research stations but in almost all cases alternatives were also trialled on working farms or by companies/organisations who use MB in the case of post-harvest uses. Agricultural materials and equipment for alternatives were sourced locally where possible, but imported if necessary. The equipment, materials and methods were adapted to suit local conditions as appropriate.

Projects normally concluded with workshops that discussed the results of the evaluation trials with MB users, extension staff, agricultural organisations, government departments and other stakeholders involved with MB usage. Detailed information and reports on the results of demonstration projects can be obtained from the implementing agencies and experts who carried out the projects. Some of the reports are now available on a joint website of UNEP/UNIDO (www.uneptie.org/ozonaction/unido-harvest/projects.html), and other agencies also plan to publish project reports on the web.

4.5.2 Project results

More than 30 demonstration projects have been completed to date. The information gathered allows for a general analysis on the efficacy of alternatives in different crops and locations. MBTOC requested experts in charge of projects completed in 2002 to report their results to MBTOC in a standard format, so that the relative efficacy of alternatives and MB could be evaluated. A statistical analysis was provided in most cases. Final project reports were the preferred data source, where available. MBTOC made a comparative analysis of the results received for soil and post-harvest uses.

The projects have trialled a wide range of chemical and non-chemical alternatives, in diverse countries, climatic zones, soil types and cropping systems, and for many different types of MB users and economic situations, ranging from small producers with less than 0.5 ha, to medium and large producers, who produce under low, medium and higher levels of technical sophistication. The projects selected and customised alternatives so that they would suit the needs and conditions of the different types of MB users.

In general, one or more of the alternatives tested in each crop situation have proven comparable to MB in their technical effectiveness for the control of pests and diseases. It is important to note that experts in charge of the projects and growers implementing alternatives have frequently pointed out that these give best results when the alternative is a component of an integrated pest management program - which primarily includes sanitation, disease-free propagation materials and scouting to detect pests or diseases at the earliest possible stage. In many cases, combined alternatives have given the most effective results. The capability of adapting alternatives to a certain cropping environment and local conditions is essential to the success of any alternative.

In Section 4.6 alternatives found to be most effective for the elimination of MB are described by crop. Detailed technical information on these alternatives, their implementation and general efficacy against specific target pests is provided in Tables 6.4 and 6.5 and Chapters 4 and 5 of the MBTOC 2002 Assessment Report. Commercial adoption of some of these alternatives is already occurring and this is summarised in Section 4.8 below. Case studies on commercial adoption of different alternatives in many countries may be found in Chapter 9 of the MBTOC 2002 Assessment Report.

It has been apparent for a number of years that one technology, alone, will not replace all uses of MB: a range of technologies is needed to replace the diverse uses of MB. As stated previously, factors relating to application method, climate, soil type, target pests, geographical location and others, clearly influence the efficiency of alternatives, so it is necessary to select the most appropriate technique for each situation. Further, the capability of adapting alternatives to a certain cropping environment and local conditions is essential to success. For example, locally available materials such as coconut coir and rice hulls have made it possible for many growers to use hydroponic systems usually requiring more technically-demanding and imported (or unavailable) materials such rock wool or peat. Further adaptations and improvements of this kind are being implemented in some MLF MB phaseout projects.

4.6 MB Phaseout Projects

4.6.1 Overview of MB phaseout projects

The first MLF MB phaseout project was approved in 1998. By December 2002 the MLF had approved a total of 38 MB phaseout projects (mainly classified as 'investment' projects), which aim to phaseout major uses of MB in 35 Article 5(1) countries. These countries have opted for MB phaseout faster than the Protocol schedule mainly due to the following:

a) effective alternatives are available;

b) Article 5(1) countries want to catch up with non- Article 5(1) in terms of new technologies and

c) Article 5(1) countries want to ensure continuity of exports and market access to non- Article 5(1) countries who may not accept products grown using MB after 2005.

The projects normally provide assistance for farmers and other MB users to adopt MB alternatives, by assisting with the procurement of alternative equipment and materials and by training large numbers of farmers/MB users and extension staff how to apply alternatives effectively. The projects also carry out other activities to overcome barriers to the widespread adoption of alternatives.

The projects are typically executed by countries themselves with assistance from the implementing agencies UNDP, UNIDO and the World Bank, and several bilateral agencies (Germany/GTZ, Italy and France). The crops covered by projects approved to August 2002 are listed in Table 6.7 and 6.8 of Chapter 6 of the MBTOC 2002 Assessment Report. To date, 34 projects address uses of MB in the soil sector, such as strawberry, tomato, cucurbits, peppers, replant, cut flowers, tobacco seedbeds. Eight projects address post-harvest uses: stored grains, dried fruit and other stored products. Additional phaseout projects are currently being developed, with the aim of ensuring that all Article 5(1) Parties will be able to meet the MB freeze, 20% reduction step and phaseout commitment under the Montreal Protocol.

4.7 Alternatives selected in phaseout projects

National MB phaseout projects are adopting on a commercial scale the alternatives identified as effective and viable by demonstration projects and/or used in similar climates and conditions. For example, Jordan is introducing solarisation within an IPM system for several vegetable crops, sometimes with the addition of biological controls, mainly *Trichoderma*, on a wide scale in suitable regions of Jordan, after identifying it as an effective alternative. The project is also trialling different alternatives for other climatic regions of Jordan, as part of a national project that will lead to the complete phaseout of MB. Likewise, Cuba identified floating trays + *Trichoderma* as an effective alternative for tobacco seedlings, and is now introducing this alternative on a wide scale in a MB phaseout project.

The main alternatives that countries have selected for adoption in their MB phaseout projects to date vary with the cropping or storage situation. For tobacco seedbeds, the prime alternative is floating trays. For cut flowers, the selected alternatives are steam + hygienic practices, 1,3-D, metham sodium, solarisation, substrates, dazomet and other chemicals used within IPM systems. For strawberry fruit, the alternatives selected for adoption in Article

5(1) regions include steam, solarisation + metham sodium or 1,3-D, solarisation + dazomet, solarisation + organic matter, solarisation + biological controls, and biofumigation. In the case of tomatoes, cucurbits, peppers, eggplant and other vegetables, the alternatives selected for adoption include solarisation + metham sodium, solarisation + 1,3-D, solarisation + dazomet, solarisation + organic matter, biofumigation, substrates, grafted plants, direct seeding, and steam + biocontrols for vegetable nurseries. In most cases the alternatives are being adopted with an IPM approach.

A number of Article 5(1) countries have developed strategies and workplans for MB phaseout that are being implemented as part of the MB phaseout projects. These strategies and methods provide useful models and show a way forward for other countries around the world. Experience to date in the MB phaseout projects has shown that it is feasible to rapidly train large numbers of farmers in the successful use of alternatives. The projects have also overcome problems of lack of availability in the soil sector by initially importing the necessary equipment and materials, and then by promoting the local supply and/or manufacture of this equipment/materials, to ensure that the necessary inputs will be available to growers for the future.

Alternatives selected for phaseout projects in the post-harvest sector appear in Table 6.8 of the MBTOC 2002 Assessment report. These are as reported by the MLF Secretariat's reviews of projects and by national experts of projects. The alternatives selected for adoption to date are phosphine + integrated commodity management (ICM) for grains, peanut seeds, dried fruit and nuts; vacuum-hermetic storage for grains; and carbon dioxide + raised temperature and vacuum + raised temperature for dried figs and other dried fruit.

4.8 Demonstrated alternatives to MB by crop

The situation for Article 5(1) alternatives is summarised below, by crop, outlining the most effective alternatives identified by trials and demonstration projects, examples of alternatives used commercially on farms

4.8.1 Tobacco seedbeds

The demonstration trials concluded that the float system is an effective MB alternative, applicable to many regions where tobacco is grown. In some countries, effective results were also achieved with dazomet and dazomet + solarisation. The tobacco-producing countries that are now implementing MB phaseout projects have primarily chosen to adopt floating tray systems. Adoption of this technique is presently increasing in countries such as Brazil, Cuba, Zimbabwe, Argentina, Macedonia, Croatia and China.

Despite the initial high investment required for floating seed-tray systems for tobacco seedlings, they have gained wide acceptance among farmers. In Cuba, about 2000 farmers trained through extension have already adopted this technology with satisfactory results. 60% of farmers in Rio Grande do Sul, the major tobacco-producing state of Brazil, presently produce tobacco seedlings in floating trays and this proportion is expected to increase in the near future. The tomato sector in this country has also adopted this technique. By 2001, about 20% of the tobacco sector in Croatia had adopted floating trays, and it is expected to grow to 30% in 2002. A number of small and medium-scale tobacco producers in Argentina have adopted floating trays as a result of MLF projects. The floating seed-tray system is also being successfully and widely adopted in China.

4.8.2 Cut flowers

The demonstrations identified steam + sanitation practices, metham sodium, substrates and dazomet, as effective alternatives to MB. Countries implementing phaseout projects in the cut flower sector have chosen to adopt these same treatments.

Steam + organic amendments are used commercially in Colombia and Costa Rica, for example. Adoption of soilless cultivation is becoming a significant commercial trend in some intensively produced crops in many countries, e.g. cut flowers, strawberries and vegetables. For example, about 25% of all cut flowers grown in Colombia are presently grown in substrates and some rose growers in Kenya are converting production systems to soilless culture in pumice and coco peat.

4.8.3 Tomato, cucumber, melon, peppers, eggplant and other vegetables

The demonstrations identified solarisation, solarisation plus biofumigation, solarisation + metham sodium or dazomet and grafting, as treatments with effects comparable to MB for the control of soil-borne pests and diseases.

Solarisation is widely used in farms in the Jordan Valley for protected cultivation of tomato, cucumber, pepper and strawberry, with excellent results. The melon sector of Costa Rica has adopted this alternative for weed and pest control in over 500 ha of the production. It has also shown wide commercial potential for controlling broomrape (*Orobanche ramosa)* in melons grown under plastic tunnels in Morocco.

Biofumigation plus solarisation is cheaper than MB in Jordan and a popular alternative among farmers that has real potential for further adoption. Solarisation alone or in combination with biofumigation or metham sodium has been very successful in Uruguay where, as a result, around 20% of commercial tomato and pepper growers in the main production area have adopted biofumigation and related techniques. Biofumigation + solarisation is used commercially in Macedonia in some greenhouses producing tomato and cucumber and, following successful demonstration results, will be widely adopted in the vegetable sector.

Countries that are implementing MB phaseout projects for vegetables/melons, have chosen to adopt alternatives such as solarisation + metham or 1,3-D or dazomet, solarisation + organic matter, biofumigation, substrates, grafted plants, direct seeding, and steam + biocontrols for vegetable nurseries.

In Morocco grafting + metham sodium, together with cultural practices such as sanitation, organic amendments, etc, have been widely adopted at the commercial level for tomato. The potential for use of grafting in Lebanon has been reported as excellent.

4.8.4 Strawberries (fruit production)

Demonstrations identified metham sodium, dazomet, solarisation and solarisation in combination with either of these two fumigants as effective alternatives to MB for Article 5(1) conditions.

Solarisation alone or in combination with biofumigation or *Trichoderma* was reported as having high potential for wide commercial adoption in Turkey. Dazomet + 1,3-D and chloropicrin are being adopted in countries like Poland at the commercial level.

Countries who are implementing MB phaseout projects in the strawberry sector have chosen to adopt alternatives such as solarisation + metham sodium or solarisation + manure and *Trichoderma*. Biofumigation + 1,3-D and steam have also been selected, the precise combination of techniques depending on the climate, the soil type and target pests.

4.8.5 Banana and fruit trees

Dazomet has proved an efficient alternative to MB for controlling Moko disease of bananas. This chemical is now widely used commercially in banana plantations in countries like Colombia and the Philippines. Metham sodium combined with IPM is used in Colombia.

Countries who are implementing MB phaseout projects for banana plan to adopt combinations of steam, 1,3-D, metham or solarisation. For fruit trees, Article 5(1) countries plan to adopt alternative fumigants + selected chemicals for replant problems, and steam or steam + biocontrols for fruit tree nurseries.

4.8.6 Postharvest

Many former uses of MB in Article 5(1) countries have already been replaced by phosphine, as noted in previous MBTOC reports (1995, 1998). Compared to the soil sector, there was a smaller range of alternatives available for testing in post-harvest demonstration projects. In most cases the current choice of alternatives treatments lies between phosphine, carbon dioxide, combinations of these gases with raised temperatures and high or low pressures, other modified atmosphere systems, and vacuum-hermetic treatments. While the limited choice at present may be cause for concern – dependence on a few processes is not good strategically – the range of available alternatives is expected to increase in the next few years when several new fumigant products are likely to be registered. However, the techniques available at present can achieve effective disinfestations in virtually all stored products that do not need QPS treatments.

Phosphine has been identified as a suitable alternative to MB for a wide range of stored grains, pulses, dried fruit and nuts. The demonstration project on grains in Egypt, for example, concluded that phosphine (combined with improved gas-tightness) is an effective and viable alternative for bagged grains (bag stacks), silos and warehouses. In Syria, CO_2 was found to be an efficient alternative in bagged wheat, and control of pests attacking stored grains in Thailand with a combination of carbon dioxide + phosphine was comparable to MB. Vacuum-hermetic treatments were found to provide 3-day alternative treatments for durable commodities in Turkey and Côte d'Ivoire, for example.

Countries who are implementing MB phaseout projects have chosen to adopt phosphine + ICM for stored wheat, maize, rice and peanut seeds. Additionally, for dried fruits and nuts, they have chosen carbon dioxide + raised temperature.

In the stored grain sector, phosphine is used in many Article 5(1) countries, such as Indonesia and Vietnam. Modified atmosphere treatments are also being adopted in some countries. For example, Turkey is adopting carbon dioxide + raised temperatures for dried fruit. Cyprus uses hermetic storage for more than 216,000 tonnes of stored grain. Modernised hermetic storage has been adopted commercially in the Philippines, India, Ivory Coast and the West Asia for stored paddy, milled rice, maize, wheat and seeds.

4.8.7 Uses of MB for which no alternatives were identified

The demonstration projects in China did not identify effective alternatives to MB for root rot in ginseng replant among the techniques tested. Experts have identified several potential techniques that need to be trialled.

For the postharvest sector, MBTOC noted that the demonstration projects have identified one or more effective alternatives for each of the common stored products tested. However, the techniques tested to date did not identify rapid alternatives for controlling contamination with Carob moth larvae in dates directly received into storage at harvest. One of the implementing agencies is planning to trial further techniques for fresh dates in the near future.

4.9 Alternatives Adopted at Commercial Level

MBTOC identified many situations where alternatives have been developed at commercial level, with clear potential for wider adoption. Table 4-1 lists examples of alternatives that in most cases were introduced by farms previously using MB for soil fumigation or post-harvest disinfestations. In some cases MB is still used but to a much lesser extent. Case studies in relation to these and other alternatives appear in Chapter 9 of the MBTOC 2002 Assessment Report.

Commercial trends to reduce the environmental impacts of pesticides in agriculture may increasingly affect Article 5(1) producers of export crops. Consumer concerns have led to the development of special agricultural production standards and eco-labels that establish environmental (and sometimes social) standards, including measures to reduce the use of pesticides. Some such labels or programs are starting to prohibit fumigation with MB as a condition of meeting the standards. In the cut flower sector, for example, the MPS (Milieu Programma Sierteelt) environmental grade standards have been adopted by about 5,000 farms in 22 countries, including Costa Rica, Ecuador, France, Italy, Israel, Kenya, Netherlands, USA, Zambia and Zimbabwe. Growers who participate in the MPS system are generally not permitted to use MB. Another example is FLORVERDE, the environmental program of the Colombian flower industry, which requires careful monitoring of all chemicals used in the production process and prohibits use of some compounds among them methyl bromide. European supermarkets have developed 'EUREP-GAP' agricultural production standards for fruit and vegetables, aiming to decrease environmental impacts and raise consumer confidence. *Inter alia*, EUREP-GAP requires any MB fumigation to be justified in writing and used only as a last resort; growers have to demonstrate that they have explored alternatives. EUREP-GAP discourages use of MB in a voluntary way at present, but this may become compulsory in future. Sainsbury's supermarket chain in Europe specifically prohibits its suppliers from using MB in certain crops. Two other supermarket chains in the UK have announced new codes of practice, which will prohibit the use of MB and certain other pesticides by suppliers, as a result of consumer concerns about the environment.

Table 4-1: Examples of MB alternatives introduced commercially in Article 5(1) countries

Alternative	Crops	Pests controlled	Examples of countries where adopted commercially
Floating trays	Tobacco Tomato	Weeds (*Amaranthus* spp., *Cynodon* spp., *Cuscuta* spp., *Portulacca* spp and others). Fungi (*Fusarium* spp., *Pythium* spp.). Nematodes (*Meloidogyne* spp.) Bacterial wilt (*Ralstonia solanacearum*). Fungi (*Fusarium* spp., *Verticillium dahliae, Phytophthora infestans)*. Weeds (*Cyperus* spp. and others)	60% growers in southern Brazil Widely adopted in Argentina and Cuba and by larger tomato growers in Brazil Good adoption in Macedonia, China
Solarisation + Biofumigation	Peppers, tomato	Nematodes (*Meloidogyne spp.*), Fungi (*Phytophthora spp.*, *Fusarium spp.*, *Verticillium spp.*) Weeds (various species)	20% of growers in north Uruguay Use is expanding in Macedonia
Soilless substrates	Carnations Roses	*Fusarium oxysporum* f. sp. *dianthi* Rose replant, Nematodes *Meloidogyne* spp.	25% of flower growers in Colombia Adoption increasing in Kenya, Ecuador, Brazil
Solarisation	Melon	*Broomrape (*Orobanche ramosa). *Weeds (*Cyperus *spp.). Nematodes (*Meloidogyne *spp.). Fungi*	Potential in Morocco 10% of melon sector in Costa Rica
	Tomato, Pepper	Nematodes (*Meloidogyne* spp.)	Widely adopted in Jordan
Grafting and metham sodium	Tomato	*Fusarium oxysporum* f.sp. *lycopersici* (races 1 and 2), *Verticillium dahliae* (races 1 and 2), *Meloidogyne* spp.	Wide commercial adoption in Morocco
Metham sodium + glyphosate and IPM	Bananas	Moko disease (*Ralstonia solanacearum,* race 2)	MB has been phased out from this sector in Colombia
Phosphine	Stored milled rice, wheat, maize and other grains	Beetles including *Sitophilus* spp., *T. castaneum*, *O. surinamensis, R. dominica,* *Ahasverus advena and Cryptolestes minutus*. Moths including *Corcyra cephalonica*.	World-wide commercial adoption

4.10 Conclusions

MBTOC concluded that trials and demonstration projects have played a useful role in identifying alternatives that are suited to the production environments in Article 5(1) regions. For the major crops where MB is used, the demonstrations successfully tested and evaluated a wide range of chemical and non-chemical alternatives in research plots and under full field conditions. They assessed the efficacy of alternatives with respect to target pests, suitability to the diverse climatic conditions, soils and cropping patterns in Article 5(1) countries. The projects also evaluated important factors such as the ease of application, commercial availability and economic costs and viability. The trials covered diverse countries and many different types of MB users and economic situations, ranging from small producers with less than 0.5 ha, to medium and large producers, who produce under low, medium and higher levels of technical sophistication (not necessarily correlated to the size of operation).

About 29 demonstration projects evaluated and customised alternatives in the soil sector, covering the major crops such as tomato, strawberry, curcurbits, cut flowers and tobacco grown in Article 5(1) conditions. About 16 of the projects (completed and on-going) evaluated alternatives for postharvest uses of MB, such as stored grains, pulses, peanut seeds and dried fruit. These activities identified effective, viable alternatives for the vast majority of uses in Article 5(1) countries, and also demonstrated it is feasible to adapt and implement alternatives successfully within a couple of years in Article 5(1) countries.

Demonstration projects showed the importance of utilizing new, effective application methods for alternatives, and the need for transference of appropriate know-how. Demonstration trials have assisted countries and productive sectors to adapt alternatives to their specific situation, and to develop alternative methods that use materials or infrastructure that are locally available, in order to make them applicable and cost effective. Thorough training of farmers/MB users is essential to ensure that alternatives will be applied properly and effectively, and for the widespread adoption of alternatives to occur. This is especially urgent in view of farmers in some countries being used to simple, low technology methods such as one-pound MB canisters.

By December 2002 the MLF had approved a total of 232 MB projects in more than 60 countries. This includes 44 demonstration projects, 38 phaseout projects and about 150 other projects for information exchange, awareness raising, policy development and project preparation, etc. Additional activities to trial and/or introduce alternatives have been funded by Article 5(1) governments and/or agricultural producers (e.g. in China, Kenya, Lebanon, Morocco), and by bilateral assistance from governments (e.g. with Australia, Germany/GTZ, Italy, Canada) and the GEF.

The results analysed indicate that substantial progress has been made in the identification of suitable alternatives in Article 5(1) regions. The MB phaseout projects currently underway will phaseout major uses of MB (and in some cases all uses of MB in the country, except for QPS), and reduce Article 5(1) MB consumption by about 5,470 tonnes. The projects are scheduled to phaseout more than 70% of this by 2005, and about 82% before 2006, making step-wise MB reductions throughout the projects.

The speed of scheduled MB reductions depends on a variety of factors, such as the initial consumption level, MB uses/crops and national policies. In the countries that plan 100% elimination, MB is scheduled to be reduced at an average annual rate of about 22.5% per year, in a total of 4.4 years on average (range 3-6 years). This includes countries that are small, medium and large MB consumers. Experience in implementing projects to date has shown that alternatives can be adopted within a relatively few years in Article 5(1) countries.

Additional MB phaseout projects are under development by the MLF and other organisations. The existing and anticipated projects are due to lead to the phaseout of about 10,000 tonnes MB before about 2007, eliminating more than 50% of the peak MB consumption in Article 5(1) regions.

The activities described above indicate that it will be feasible for Article 5(1) countries to make additional, substantial MB reduction steps before 2015, provided that the necessary support continues for countries that need technical and financial assistance. Experience with demonstration and phaseout projects shows that the technical, climatic, social and economic barriers to MB alternatives can be overcome successfully for major MB uses in diverse Article 5(1) regions.

4.11 References

MBTOC 2003. 2002 Report of the Methyl Bromide Technical Options Committee UNEP, Nairobi. 468 pp.

5 Quarantine and Pre-Shipment Uses of Methyl Bromide – Response to Decision XI/13

Decision IX/13(4) requests the TEAP to evaluate the technical and economic feasibility of alternative treatments and procedures that can replace methyl bromide for quarantine and pre-shipment (QPS), and to estimate the volume of methyl bromide that would be replaced by the implementation of such alternatives reported by commodity and/or application.

Methyl bromide is widely used at present for QPS treatment, mainly for the control of insect and mite pests in goods in trade. MBTOC estimated the global QPS consumption of methyl bromide to be 10,475 – 11,800 tonnes in 2000, accounting for 19 – 21 % of global production. Major uses of QPS methyl bromide include international trade in timber, and numerous varieties of fruit and vegetables. There is a large and diverse set of minor uses.

The major constraints to introduction of alternatives to methyl bromide for QPS are the requirement to show very high effectiveness against specific target pests and then to negotiate acceptance of these measures by regulatory authorities, including national plant protection organisations. In many particular applications the quantity of MB used is relatively small, less than 1 tonne annually. This is insufficient to support commercial development of proprietary alternatives, or to encourage research into alternatives, without specific incentives.

Alternatives to MB for quarantine treatments are difficult to develop and commercialise. The success of any replacement for MB depends on a number of factors that include: proven treatment efficacy; commodity tolerance; equipment design and commercial availability; regulatory approval, often including bilateral or multilateral agreements; cost competitiveness; and technology transfer, logistical capability and ease-of-use. Given all of these factors, the time from conception to implementation of an alternative disinfestations treatment as a quarantine treatment for perishable and durable commodities can vary from 2 to more than 10 years, depending mainly on the technical difficulties. On the other hand, a pre-shipment treatment that, by definition, targets non-quarantine pests may require less time for implementation if the proposed treatment is non-chemical, but it could be equally as long as a quarantine treatment if registration for use on foodstuffs is necessary.

MBTOC in its 2002 details the large number of alternative QPS-treatments approved for specific goods in trade. MBTOC noted country-specific regulatory approval for alternative measures such as heat treatment, various chemical treatments, irradiation and pest-free zones for specific goods in trade.

Individual tonnage uses of QPS methyl bromide for particular commodities are not available on a world-wide basis at this time, though specific surveys are available for several countries. A survey has been commissioned by the EC that is scheduled to be available for 2004

6 ATOC Progress Report

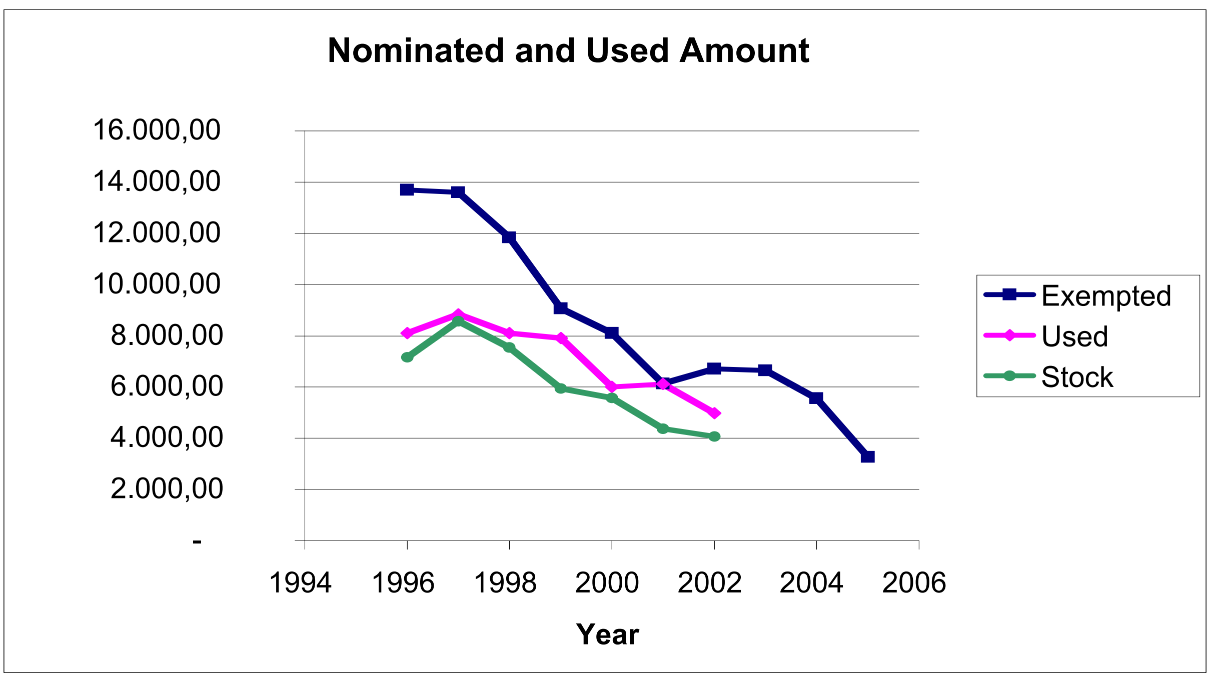
6.1 Executive Summary

6.1.1 Metered dose inhalers

Trends in CFC consumption for MDI production

Trends in CFC use for MDIs have been drawn from the accounting frameworks submitted by non-Article 5(1) countries manufacturing CFC MDIs, in response to Decision VIII/9. The figure below illustrates an encouraging gradual decline in amounts of CFCs exempted, consumed and contained in stock. These numbers do not reflect the use of CFC for the production of MDIs for asthma and COPD in Article 5(1) countries. Figures after 2002 include amounts exempted under nominations made by the Russian Federation and Ukraine.

Figure 6-1 Relevant quantities regarding the use of CFCs for the production of MDIs



For the year 2005 essential use amounts requested (but not yet approved) total 3,270 tonnes, which represents a decrease of over 75% since essential use exemptions started in 1996. Total reported use of CFCs for MDIs for non-

Article 5(1) countries manufacturing MDIs for asthma and COPD has fallen by almost 40% since 1996. ATOC estimates that approximately 6,700 tonnes of CFCs were used world-wide for MDI manufacture in 2002.

It should be noted that in some cases (e.g. the European Community and Poland) significant consumption of CFCs is for manufacture of MDIs for export. Phase out of CFC MDIs for export will either occur because of multinational decisions, or because of transition policies in importing countries.

Data submitted to the ATOC in accounting frameworks continues to show reductions in stockpile quantities that parallel declines in use. ATOC believes the uncertainties in the transition beyond 2005, and the uncertainties in the availability of newly produced CFCs, render it premature to make definite plans for campaign production at present. However, Parties should be mindful that they might need to consider making supplemental nominations in 2004 for any campaign production necessary for 2005.

Transition to alternatives to CFC MDIs

Today there are approximately 30 countries where there are two or more salbutamol (short acting beta-agonist) HFC MDIs marketed and there has been a rapid increase in the introduction and acceptance of multi-dose powder inhalers. However, it is clear that the development of HFC MDIs, their registration and launch into a market cannot alone lead to a full uptake in the market without additional regulatory action.

Transition Strategies

ATOC notes that no additional countries have submitted transition strategies in the last twelve months. The CFC MDI transition has proved to be complicated, as it is influenced by medical, technical, economic and regulatory factors. It appears that the most effective management of the transition (i.e., phase out of CFC MDIs) has been through the cooperation of industry and government in working towards a common goal of having target dates for the cessation of sale of CFC MDI products.

To achieve an effective phase-out of CFCs, individual Parties may wish to consider implementing a target and timetable approach to achieve domestic CFC MDI phase out by a certain date. It is likely that this date will differ between Parties, depending on the rate of introduction of alternatives within that Party and the individual circumstances of their healthcare systems.

Price Considerations

While HFC MDIs have generally been priced competitively with their branded CFC counterparts, they rarely are priced comparably to CFC generics, where these exist. This increased price would need to be borne by the patient, the insurer, and/or the government, according to the specifics of the healthcare system.

The loss of cheaper generic CFC MDIs or the loss of locally produced CFC MDIs may mean that large segments of the population are denied access to inhaled therapy due to economic considerations. This would be an unacceptable turn of events. Concerns regarding differential pricing are not new, but the ATOC sees their resolution as a critical factor in the successful final phase-out of CFC use in MDIs for the treatment of asthma and COPD.

Article 5(1) countries and CEIT

There may be as much as 1,600 tonnes of CFCs used for MDIs for the treatment of asthma and COPD in Article 5(1) countries. These quantities appear to be increasing. While multinationals that export to these countries may determine how their own exported products are phased out, there are no clear strategies for that proportion of CFC MDIs produced by local manufacturers.

The production and consumption of CFC MDIs in CEIT is complex. The ATOC does not have sufficient data for many of these countries to make a full and reasonable assessment of the state of transition, nor to make reasonable technical recommendations on how to assure an effective transition. It appears that the use of CFCs for MDIs for asthma and COPD in CEIT is currently over 500 tonnes. However, quantities of CFCs used for this purpose may be increasing in some countries and falling in others. Only 2 of 17 CEIT have submitted transition strategies to the Secretariat.

6.1.2 Aerosol products (other than MDIs)

There are no technical barriers for the transition to alternatives for aerosol products other than MDIs. However, some consumption of CFCs in aerosols still remains in Article 5(1) countries.

Table 6-1: Estimated CFC consumption in non-MDI aerosols in 2002 (metric tonnes)

ASEAN Countries*	650
China	1,800
South Asian Countries**	200
Latin America	400
Middle East, Africa	200
Russian Federation	0
Other CEIT and CIS***	0
Total	3,250

* Brunei, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam

** Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka

*** CIS: Successor States of the former Soviet Union

The reformulation of non-MDI medical aerosol products and industrial/technical aerosols may require technical and financial assistance.

6.1.3 Laboratory and Analytical Uses

The Finnish Environment Institute has carried out a study on the use of ozone depleting substances in this area. This study evaluates the situation in the Nordic region for oil in water analysis and describes alternatives for many other laboratory and analytical uses of ODS. It is available on: http://www.norden.org/pub/miljo/miljo/sk/TN03_516.asp?lang=1

A further study is underway covering the European Union.

No new non-ODS methods have been forthcoming which would enable the TEAP to recommend the elimination of further uses of controlled substances for analytical and laboratory uses.

The TEAP re-states its suggestion that the Parties may wish to consider holding a workshop on the elimination of controlled substances in laboratory and analytical uses. Such a workshop could review the new methods that have enabled the phase out of the uses as defined under Decision XI/15. This could expedite the incorporation of new analytical methods into national and international standards.

An emergency request for 2003, and essential use nominations for 2004 and 2005 was presented by Poland to continue use of ODS for testing of oil, grease and total petroleum hydrocarbons in water. The arguments for this application are funding requirements and time to implement non-ODS methods, which are accurate and consistent.

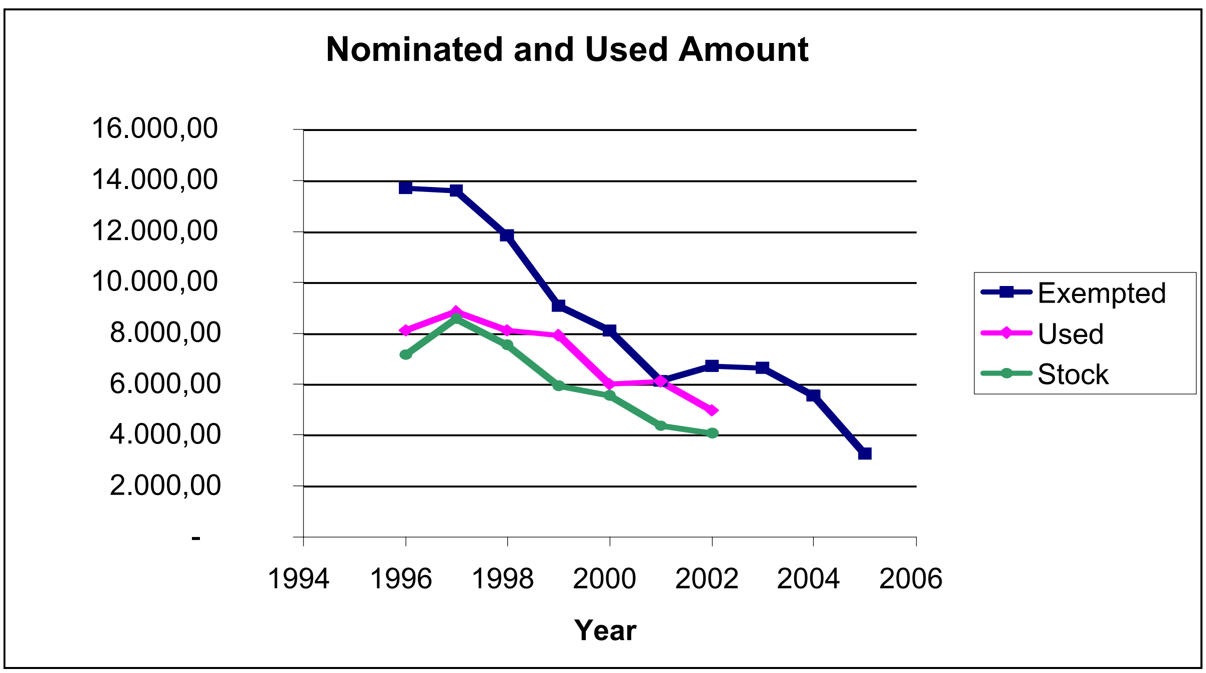
Parties may also wish to consider the convenience of adding substances in Annex C to the global exemption for laboratory and analytical uses for controlled substances. The same provisos that apply to substances in Annex A and B would apply to substances in Annex C.

6.2 Trends in CFC consumption for MDI production

The following trends in CFC use for MDIs have been drawn from the accounting frameworks submitted by non-Article 5(1) countries manufacturing CFC MDIs, in response to Decision VIII/9. In their annual accounting frameworks, Parties report quantities of ODS produced and consumed under essential use exemptions granted in previous years. In addition, independent sources have been used to estimate consumption in Article 5(1) countries that do not submit annual accounts.

With regard to the use of CFCs for the production of MDIs, there are three relevant quantities: 1) the amount exempted; 2) the amount consumed for MDI production; and 3) the amount contained in stock. The figure below illustrates an encouraging gradual decline in all three total values. These numbers do not reflect the use of CFC for the production of MDIs for asthma and COPD in Article 5(1) countries. Figures after 2002 include amounts exempted under nominations made by the Russian Federation and Ukraine.

Figure 6-1: Relevant quantities regarding the use of CFCs for the production of MDIs



There continues to be a decline in the volumes requested and used for essential use. For the year 2005 essential use amounts requested (but not yet approved) total 3,270 tonnes, which represents a decrease of over 75% since essential use exemptions started in 1996. Total reported use of CFCs for non-Article 5(1) countries manufacturing MDIs for asthma and COPD has fallen by almost 40% since 1996. ATOC estimates that approximately 6,700 tonnes of CFCs were used world-wide for MDI manufacture in 2002, including an estimated 1,600 tonnes used in Article 5(1) countries.

Table 6-2: Actual use of CFCs for the production of MDIs according to Accounting Frameworks

Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Australia	244.9	291.1	259.87	135.58	97.21	46.43	22.84
Canada	126	132.3	11	12	12		
Czech Republic	41.8						
European Community	4822	5592	4660.4	4418	3089.3	3322.413	2763
Hungary	11.6	4.9	3.2	0.932	0.949	0.46	0.39
Israel	7						
Japan	142.10	133.6	122.4	103.1	84.67	60.16	60
Poland	526.6	314.2	245.72	187.46	171.41	178.56	178
Russian Federation		181.92	285.5	NA	101	138,6	396
Switzerland	0.75	0.75	0.52				
Ukraine				NA	NA	NA	119.7
United States	2368	2255	2425.5	2644.6	2492.5	2375	1581
Total	**8291**	**8906**	**8014**	**7502**	**6085**	**6122**	**5121**

The European Community and the United States, account for approximately 80% of total CFC used for MDI manufacture in non-Article 5(1) countries in 2002. Both the European Community (-17%) and the United States (-33%) have reported reductions in amounts of CFCs used compared to 2001. Given that these reductions have largely been driven by the activities of only a few companies there is the possibility that this decline could flatten off, unless other companies do likewise. It should be noted that in some cases (e.g. the European Community and Poland) significant consumption of CFCs is for manufacture of MDIs for export. Phase out of CFC MDIs for export will either occur because of multinational decisions, or because of transition policies in importing countries. Section 1 of the Annex presents a summary of the accounting frameworks received to date by UNEP, which are the source of the numbers shown above.

6.3 Stockpiles and Campaign Production (Decision XIII/10)

Data submitted to the ATOC in accounting frameworks continues to show reductions in stockpile quantities that parallel declines in use. In previous years, ATOC has stated that it believed that as stepwise reductions in the need for CFCs continued in individual countries, those countries could manage their final transitions from their stockpiles alone. Indeed, this is already occurring in Japan and Australia. ATOC understands that CFC production in the Netherlands is still expected to cease by the end of 2005. This may present issues, particularly for the US, if need for CFCs continues beyond 2005 in quantities that exceed the stockpiles at that time and no alternate supply of fresh CFCs is identified. In such a case, some level of campaign production may be needed. While ATOC has reviewed the nominations for 2005, ATOC believes the uncertainties in the transition at that point and beyond, and the uncertainties in the availability of newly produced CFCs, render it premature to make definite plans for campaign production at present. However, Parties should be mindful that they might need to consider making supplemental nominations in 2004 for any campaign production necessary for 2005.

6.4 Transition to alternatives to CFC MDIs

6.4.1 Inhaled Therapies

It is now almost 10 years since the first introduction of an HFC based salbutamol MDI in the United Kingdom. Today there are approximately 30 countries where there are two or more salbutamol (short acting beta-agonist) HFC MDIs marketed and it is estimated that at least 25% of salbutamol MDIs marketed around the world today contain HFC as a propellant. It is unclear however if further reduction in CFC volumes for salbutamol MDIs will occur without additional regulatory action.

In addition to the introduction of beta-agonist HFC MDIs (fenoterol is now available in some countries), there are a growing number of controller medications available as HFC MDIs. These include beclomethasone, fluticasone, sodium chromoglycate and nedocromil sodium. However it is clear that the development of HFC MDIs, their registration and launch into a market cannot alone lead to a full uptake in the market. There are additional steps necessary to make an effective transition (e.g., ceasing the supply of CFC MDIs where alternatives exist). Some pharmaceutical companies with HFC MDI production have committed to cease production of CFC MDIs, whilst others have not.

In the past decade, as well as the introduction of HFC MDIs, there has been a rapid increase in the introduction and acceptance of multi-dose powder inhalers. This has been partly fuelled by the availability today of new therapy options (a combination of a long-acting beta-agonist and a corticosteroid) represented by at least two widely accepted powder inhalers. This increased acceptance of dry powder inhalers has further reduced the need for CFCs for the production of MDIs.

6.4.2 Transition Strategies

ATOC notes that no additional countries have submitted transition strategies in the last twelve months.

Starting in 1997, various non-Article 5 (1) countries have developed and published a range of transition strategies depending on their market circumstances and the way that asthma/COPD is treated in that country. Initial strategies based on a therapeutic approach to CFC MDI phase out have given way to the phase out of individual drug substances. In some cases (e.g., the European Union) this has lead to a determination that CFCs for use in salbutamol MDIs is non-essential with a resultant reduction in CFC use.

The CFC MDI transition has proved to be complicated, as it is influenced by medical, technical, economic and regulatory factors. To date, it appears that the most effective management of the transition (i.e., phase out of CFC MDIs) has been through the cooperation of industry and government in working towards a common goal of having target dates for the cessation of sale of CFC MDI products. This appears to have been successfully accomplished in Australia, Japan and Canada. In addition, although transition strategies can help with the management of MDI consumption within the nominating party, it is increasingly evident that export of MDIs (primarily to Article 5(1) countries) will need to be managed carefully for those Parties that have significant exports (e.g., European Union, Poland).

In the non-Article 5(1) countries transition is well underway. However, non-Article 5(1) countries still have much to do. It is likely that in some Parties increased regulatory involvement will be needed as the transition reaches the point where production of CFC salbutamol by companies who do not have access to HFC technology continues and a few CFC MDI products remain that are either technically or economically not feasible to reformulate. Pharmaceutical companies need to indicate to Parties how they plan to serve the needs of patients who currently take these medicines.

In reviewing all possible methods of transition it is clear that action by the pharmaceutical industry will not alone drive the transition. Several countries have developed and implemented effective transition processes. Japan is a good example of such a country and is expected to phase out CFC MDIs by 2005. This has been accomplished by the collaboration of the various pharmaceutical companies and the relevant government authorities. Whilst Parties are now submitting data under Decision XIV/5, further specific data may be needed as a part of nominations. This will aid in the development of effective transition plans.

To achieve an effective phase-out of CFCs, individual Parties may wish to consider implementing a target and timetable approach to achieve domestic

CFC MDI phase out by a certain date. It is likely that this date will differ between Parties, depending on the rate of introduction of alternatives within that Party and the individual circumstances of their healthcare systems. Current experience is that transition plans will only be successfully implemented if there is open discussion among the major stakeholders, that is, MDI producers, healthcare concerns and environmental agencies.

6.4.3 Price Considerations

It has become increasingly clear that economic considerations have a major impact on the transition and will complicate the final phase-out in non-Article 5(1) countries, Article 5(1) countries and CEIT. While HFC MDIs have generally been priced competitively with their branded CFC counterparts, they rarely are priced comparably to CFC generics, where these exist. For salbutamol, in particular, this price differential can pose serious obstacles to the transition either at an individual patient level or in an entire market. This increased price would need to be borne by the patient, the insurer, and/or the government, according to the specifics of the healthcare system.

In non-Article 5(1) countries where there is not universal reimbursement for pharmaceuticals (e.g., the United States), a higher price for salbutamol (albuterol) HFC MDIs can represent an important disincentive to switching at the patient level. Further, if salbutamol CFC MDIs were to be precipitously removed from such a market without other compensatory mechanisms being first put into place, some patients may not be able to afford their needed medication. This could have serious repercussions for the treatment of asthma and COPD within such countries. In other countries with universal medication reimbursement, this increased cost of the HFC salbutamol has been absorbed.

In some Article 5(1) countries and CEITs, the loss of cheaper generic CFC MDIs or the loss of locally produced CFC MDIs may mean that large segments of the population are denied access to inhaled therapy due to economic considerations. In such cases, patients may need to turn to inferior, though cheaper, treatments (such as oral theophylline). This would be an unacceptable turn of events.

There has been a general lack of awareness by healthcare providers regarding the need for change from CFC to CFC-free inhalers and the potential cost impact on their healthcare systems. ATOC cannot over emphasize that for the final transition to be seamlessly and safely implemented, the issue of price needs to be fully explored, understood, and dealt with effectively. While concerns regarding differential pricing are not new, the ATOC sees their resolution as a critical factor in the successful final phase-out of CFC use in MDIs for the treatment of asthma and COPD.

6.4.4 Company Data for 2003

A number of companies responded to an ATOC request for information on progress to CFC free inhalers. It is clear that companies are at different stages and have different strategies.

Armstrong's Research and Development Department "have been working to develop a CFC–free Albuterol (salbutamol) Inhalation Aerosol for the past 8 months. These efforts will continue until such a time that a submission to the US Food and Drug Administration can be made"

Astra Zeneca's transition of marketed CFC MDIs focuses on the transfer to corresponding DPI alternatives. During 2002, the proportion of Astral Zeneca DPIs prescribed to patients exceeded 90% of the aggregate MDI and DPI production. HFC reformulation is ongoing in parallel and transition of remaining CFC products is expected to be complete in non-article 5(1) countries during 2005.

Aventis' Tilade (nedocromil sodium) and Intal (sodiumcromoglycate) have been launched in CFC free form (primarily HFC MDI, but also DPI) in several European markets (including Austria, Belgium, Denmark, Germany, Spain, Sweden, and the Netherlands), as well as other major markets around the world including Australia, Japan, and most recently Russia (July 2002). Aventis is actively pursuing launch of CFC-free products in the United States and several other countries. Applications for Azmacort and Nasacort (Triamcnolone) have been pending before the US FDA for several years.

Boerhinger Ingelheim (BI) has introduced HFC Berodual and Atrovent (and withdrawn the CFC versions) in Germany. By the end of 2003, all BI inhalers in Germany will be CFC-free, and most other EU countries will complete transition in 2004. In addition, the new CFC free Berodual Respimat device is registered in Europe and will be introduced in 2004.

Chiesi has completed the reformulation of salbutamol and beclomethasone as HFC MDIs and is awaiting regulatory approval in Europe. HFC salbutamol is now marketed in Italy.

Glaxo Smith Kline is "actively transitioning its global CFC MDI business to either HFC MDIs or DPIs. GSK will require no essential use allocations in the USA or EU after 2004. GSK will seek to discontinue all global CFC MDI manufacture by 2006."

IVAX is "actively moving to CFC-free formulations for all its products (including MDIs, breath-operated inhalers, and DPIs). The past year the transition of salbutamol has progressed substantially in Europe". In 2003 approvals of other reformulated products manufactured by IVAX are expected. "In January 2003, IVAX filed its application for a CFC-free albuterol (salbutamol) in the United States and is also currently marketing QVAR (HFC beclomethasone) in the United States".

A direct response by 3M was not received. 3M was the first company to reformulate salbutamol and beclomethasone as HFC MDIs. These products are now available world-wide and have proved safe and effective. 3M continue to manufacture CFC MDIs for the same drug moieties.

6.5 Article 5(1) Countries and CEIT

6.5.1 Article 5(1) Countries

Communication with experts in a number of countries has revealed a similar situation in most, but there are some country-specific issues. In all countries, the limited information that is available suggests that the airway diseases of asthma and chronic obstructive pulmonary disease (COPD) are common and increasing in prevalence.

In Brazil, there are approximately 180 million people and an estimated asthma prevalence of 10%. Exact prevalence figures for COPD are not available. MDIs are from multinational companies that currently sell 5 million CFC MDIs every year. DPI sales are increasing. Short acting beta-agonists are the most prescribed inhaled medicines (74% of 6 million prescriptions of inhaled medicines). Inhaled corticosteroid use is low (6% of inhaled medication). At the moment, there is only one salbutamol HCF MDI on the market. Since local production of MDIs is negligible, the multinational pharmaceutical companies that supply the market will likely drive Brazil's transition.

In Mexico, there are five producers of MDIs. However one multinational company dominates the market, producing 80 – 85% of all MDIs. This company has indicated that it will stop producing in Mexico in 2003. This will lead to reductions in CFC use within Mexico. In 2002, consumption of CFCs was approximately 450 tonnes, but anticipated 2004 consumption will likely be less than 100 tonnes.

In China, there were approximately 20 million MDIs produced for the treatment of asthma and COPD, accounting for 450 tonnes of CFC. This is approximately 20% of the CFC volume used in all medical aerosols, with non-MDI aerosols accounting for the other 80%. Fourteen different drug moieties are contained in the CFC MDIs and are produced by 14 Chinese manufacturers and 4 multinational joint ventures. China also imports about 1 million MDIs. Two local manufacturers produce DPI capsules (12 million total capsules, which is equivalent to approximately 100,000 multi-dose MDIs), amounting to a very small total use. Research on MDI alternatives is proceeding, though no CFC free MDIs are currently produced in China.

In India, a country of approximately 1 billion people, it is estimated that 10% of people have airway diseases. For various economic, cultural and health delivery reasons, only 1% of these people are currently treated with MDIs. Two multinational companies produce MDIs locally (accounting for less than 20% of India's use) and five domestic companies have facilities for MDI production. One of these domestic companies produces HFC MDIs, but local sales of these HFC MDIs are small. Total MDI sales are approximately 30 million units, with CFC usage in excess of 400 tonnes. This includes a substantial export component.

In Malaysia, as in most Article 5(1) countries, there are regulations in place governing pharmaceutical products produced either locally or imported. Under these regulations, all MDIs are subject to registration with the Ministry of Health. There are no MDIs produced in Malaysia, so all current requirements are imported. This country of approximately 25 million inhabitants uses about 1.5 million MDIs annually. In contrast, in Indonesia most respiratory medications sold are oral medications. All registered MDIs are imported. A larger number of MDIs – especially the less expensive ones – are imported and distributed informally.

In summary, there may be as much as 1,600 tonnes of CFCs used for MDIs for the treatment of asthma and COPD in Article 5(1) countries. These quantities appear to be increasing. While multinationals that export to these countries may determine how their own exported products are phased out, there are no clear strategies for that proportion of CFC MDIs produced by local manufacturers.

6.5.2 CEIT

The production and consumption of CFC MDIs in CEIT is complex. The ATOC does not have sufficient data for many of these countries to make a full and reasonable assessment of the state of transition, nor to make reasonable technical recommendations on how to assure an effective transition. There have, for instance, been some irregular submissions of nominations, so that reliable annual data on the status within every country may not be available.

Information available to ATOC indicates that four CEIT are manufacturing CFC MDIs for the treatment of asthma and COPD – Hungary, Poland, Russia and Ukraine.

In Poland, there are two manufacturers of CFC MDIs, one is a research institute that produces small amounts of inhalers. The other is a multinational company producing locally. This manufacturer reportedly does not plan to produce CFC MDIs in Poland beyond the year 2005. Last year use of CFCs for MDIs in Poland was less than 200 tonnes.

In the Russian Federation, there are two MDI manufacturers that produce only salbutamol CFC MDIs for asthma and COPD. Both of these companies are reportedly researching alternative propellant technologies. The use of CFCs for MDIs amounted to 230 tonnes in 2002. It is projected to increase through 2003, and decrease thereafter. There are at least five HFC MDIs and at least eight DPIs approved in the Russian Federation but no data are available on uptake, which may be hindered by price differences.

In the Ukraine, there are three companies that produce CFC-containing medical products, only two of which produce MDIs for asthma and COPD. One of these two produces only small-scale research batches; the other is a large manufacturer producing the majority of the CFC MDI products for domestic use. The use of CFCs for MDIs in the Ukraine was less than 100 tonnes in 2002. The Ukraine nomination also reports some discussions with multinational companies on alternative products.

Data are not readily available for many other CEIT. This is a diverse group of seventeen countries of which two are considered Article 5(1) countries in the context of the Montreal Protocol. Other CEIT have applied to become members of the EU. It appears that the use of CFCs for MDIs for asthma and COPD in CEIT is currently over 500 tonnes. However, quantities of CFCs used for this purpose may be increasing in some countries and falling in others.

Important issues behind the CFC use in CEIT, and its apparent increase in some markets, are the affordability of alternatives and the challenging economic circumstances in many CEIT. This is further complicated by evolving medical practice, which appropriately is turning to inhaled therapy with greater frequency for the management of asthma and COPD. These diseases in turn are increasing in prevalence in many countries. An additional economic issue impacting on CFC use in CEIT is the cost of converting any domestic production of CFC MDIs to non-CFC alternatives.

In some countries, there is a lack of clear transition strategies. Only 2 of 17 CEIT have submitted transition strategies to the Secretariat – Poland and Hungary. Without transition strategies in place, affecting a smooth and timely transition may be difficult within a given country.

ATOC believe that more information on the status of transition within individual CEIT is needed and will welcome experts from countries other than the Russian Federation and Poland, which are already represented in ATOC.

6.6 Decision XIV/5

Under Decision XIV/5, Parties, or regional economic organisations were requested to "provide to the Ozone Secretariat by 28 February 2003, and annual updates thereafter, information concerning treatment for asthma and COPD that contains CFCs or that does not contain CFCs".

By the end of March 2003, the Ozone Secretariat had received information from 25 Parties and the EU (See list in Section 2 of Annex). ATOC notes that Parties have adopted different database templates. Parties might wish to consider harmonising databases to provide a more consistent picture and allow a uniform analysis. Some of the data contains inaccuracies, which were to be expected given the complexity of the subject. For example, there are cases where one country reports exports of a product to another country, but the importing country does not acknowledge importing that product. Identifying discrepancies like these was one of the goals of this decision. ATOC also noted cases where a country noted exports of a product to another country, which ATOC know are not happening because the product has not been approved yet in the importing country.

6.7 Aerosol products (other than MDIs)

There are no technical barriers for the transition to alternatives for aerosol products other than MDIs. However, some consumption of CFCs in aerosols still remains in Article 5(1) countries. The main uses for the CFCs apart from MDIs in these countries have been identified as:

- Non-MDI medical aerosols, such as local anaesthetics, throat sprays, nasal sprays, wound sprays, vaginal products and traditional Chinese medicines;
- Industrial/technical aerosols such as electronic cleaners, spinnerette sprays, anti-spatter sprays and tire inflators;
- Personal hygiene products filled in small volume cans; and
- Insecticide and disinfectant sprays for use aboard aircraft.

Comprehensive CFC consumption data for non-MDI aerosol products is difficult to obtain. An estimated regional break down of CFC consumption for 2002 is presented in Table 6-3:

Table 6-3: CFC consumption in non-MDI aerosols in 2002 (metric tonnes)

ASEAN Countries*	650
China	1,800
South Asian Countries**	200
Latin America	400
Middle East, Africa	200
Russian Federation	0
Other CEIT and CIS***	0
Total	3,250

** Brunei, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam*

*** Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka*

**** CIS: Successor States of the former Soviet Union*

Concerning the consumption of China, over 90%, or 1,700 metric tonnes is used for non-MDI pharmaceuticals. The reformulation of non-MDI medical aerosol products and industrial/technical aerosols may require technical and financial assistance.

6.8 Laboratory and Analytical Uses

Under Decision X/19, the TEAP is asked 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 and B of the Protocol," in order to enable the Meeting of the Parties to "decide on any uses of controlled substances which should no longer be eligible under the exemption for laboratory and analytical uses and the date from which any such restriction should apply."

6.8.1 Update on Laboratory and Analytical Procedures

The Finnish Environment Institute have carried out an extensive study on the use of ozone depleting substances for laboratory and analytical uses. This study evaluates the situation in the Nordic region for oil in water analysis and describes alternatives for many other laboratory and analytical uses of ODS. It is available on:
http://www.norden.org/pub/miljo/miljo/sk/TN03_516.asp?lang=1

A further study is underway covering the European Union.

6.8.2 Elimination of ODS in Laboratory and Analytical Uses under Decision XI/15

The Eleventh Meeting of the Parties decided in Dec. XI/15 to eliminate the following uses from the global exemption for laboratory and analytical uses for controlled substances, approved in decision X/19, from the year 2002:

(a) Testing of oil, grease and total petroleum hydrocarbons in water;

(b) Testing of tar in road-paving materials;

(c) Forensic finger-printing.

An emergency request for 2003, and essential use nominations for 2004 and 2005 was presented by Poland to continue use of ODS for testing of oil, grease and total petroleum hydrocarbons in water. The main arguments for continued use of ODS in this application are funding requirements and time to implement non-ODS methods which are accurate and consistent.

The EU also requested emergency allocations for the years 2003 and 2004 for very small amounts of hydrobromofluorocarbons and bromochloromethane. These substances belong to Annex C, Groups II and III respectively, and the global exemption for laboratory and analytical uses for controlled substances covers only substances in Annex A and B. Both, the request from Poland and from the EU were recommended for approval to the Ozone Secretariat.

6.8.3 Recommendations

No new non-ODS methods have been forthcoming which would enable the TEAP to recommend the elimination of further uses of controlled substances for analytical and laboratory uses.

The TEAP re-states its suggestion that the Parties may wish to consider holding a workshop on the elimination of controlled substances in laboratory and analytical uses. Such a workshop could review the new methods that have enabled the phase out of the uses as defined under Decision XI/15. This would assist Parties, especially in Article 5, to revise their analytical standards and thereby eliminate ODS use. The workshop could also identify remaining uses of controlled substances and their potential substitutes. This could expedite the incorporation of new analytical methods into national and international standards.

Parties may also wish to consider the convenience of adding substances in Annex C to the global exemption for laboratory and analytical uses for controlled substances. The same provisos that apply to substances in Annex A and B would apply to substances in Annex C.

ANNEX A: ACCOUNTING FRAMEWORKS FOR MDIS RECEIVED TO DATE BY UNEP

Australia

A	B	C	D	E	F	G	H	I	J	K	L
Year of Essential Use	Amount Exempted for year of Essential Use	Amount Acquired by Production	Amount Acquired for Essential Uses by Import	Total Acquired for Essential Use	Authorise d but not Acquired	On Hand Start of Year	Available for Use in Current Year	Used for Essential Use	Quantity Contained in Products Exported	Destroyed	On Hand End of Year
2002	11.00	-	9.80	9.80	1.20	93.52	103.32	22.84	22.84	0.99	79.49
2001	11.00	-	9.44	9.44	1.56	133.04	142.48	46.43	31.73	3.19	92.86
2000	110.00	0.56	9.45	10.01	99.99	219.95	229.96	97.21	60.17	1.42	131.33
1999	309.00	-	274.21	274.21	34.79	75.69	349.90	135.58	85.96	2.91	211.40
1998	223.00	-	194.86	194.86	28.14	142.10	336.96	259.87	92.37	1.41	75.69
1997	195.00		183.90	183.90	11.10	232.60	416.50	291.00	88.63	0.79	124.71
1996	259.50		252.51	252.51	6.99	6.13	258.64	244.89	49.15		13.75

Canada

A	B	C	D	E	F	G	H	I	J	K	L
Year of Essential Use	Amount Exempted for year of Essential Use	Amount Acquired by Production	Amount Acquired for Essential Uses by Import	Total Acquired for Essential Use	Authorise d but not Acquired	On Hand Start of Year	Available for Use in Current Year	Used for Essential Use	Quantity Contained in Products Exported	Destroyed	On Hand End of Year
2000			10.04	10.04	0	44.00	54.04	12.00	10.00	4.00	38.04
1999	140.00	-	-	-	140.00	56.00	56.00	12.00	6.00	-	44.00
1998	513.00	-	43.00	43.00	470.00	37.00	80.00	11.00	6.00	13.00	56.00
1997	648.00		136.00	136.00	512.00	33.00	169.00	132.30	5.00	0.60	36.10
1996	599.00		129.00	129.00	470.00	29.00	158.00	126.00			32.00

European Union

A	B	C	D	E	F	G	H	I	J	K	L
Year of Essential Use	Amount Exempted for year of Essential Use	Amount Acquired by Production	Amount Acquired for Essential Uses by Import	Total Acquired for Essential Use	Authorised but not Acquired	On Hand Start of Year	Available for Use in Current Year	Used for Essential Use	Quantity Contained in Products Exported	Destroyed	On Hand End of Year
2002	2,785.00	2,465.60	-	2,465.60	319.40	2,331.90	4,797.50	2,763.70	1,145.30	48.70	1,985.10
2001	2,604.58	2,205.47	-	2,205.47	399.11	3,317.73	5,523.20	3,322.41	1,579.28	240.35	1,960.44
2000	3,770.00	3,416.20	32.00	3,448.20	321.80	2,887.40	6,335.60	3,089.30	1,390.00	118.30	3,128.00
1999	4,429.00	3,683.90	-	3,683.90	745.10	4,271.60	7,955.50	4,822.70	1,604.00	113.00	3,019.80
1998	5,462.50	4,883.40	20.40	4,903.80	558.70	4,118.40	9,022.20	4,660.40	1,717.60	90.30	4,271.50
1997	6,636.00	5,514.00	-	5,514.00	1,122.00	4,373.00	9,887.00	5,592.00	2,577.00	392.00	3,903.00
1996	7,542.00	5,203.00		5,203.00	2,339.00	3,321.00	8,524.00	4,822.00	1,529.00	247.00	3,455.00

Hungary

A	B	C	D	E	F	G	H	I	J	K	L
Year of Essential Use	Amount Exempted for year of Essential Use	Amount Acquired by Production	Amount Acquired for Essential Uses by Import	Total Acquired for Essential Use	Authorised but not Acquired	On Hand Start of Year	Available for Use in Current Year	Used for Essential Use	Quantity Contained in Products Exported	Destroyed	On Hand End of Year
2002	1.75	-	0.30	0.30	1.45	1.27	1.57	0.39	-	-	1.19
2001	1.75	-	-	-	1.75	1.73	1.73	0.46	-	-	1.27
2000	1.75	-	0.98	0.98	0.77	1.70	2.68	0.95	-	-	1.73
1999	9.23	-	0.60	0.60	8.63	2.04	2.64	0.93	0.37	-	1.70
1998	10.18	-	1.26	1.26	8.92	3.96	5.22	3.20	2.15	-	2.03
1997	10.00	-	3.92	3.92	6.08	5.08	9.00	4.89	2.72	0.13	3.97
1996	10.00	-	-	-	10.00	16.87	16.87	11.59	7.84	0.20	5.08

Japan

A	B	C	D	E	F	G	H	I	J	K	L
Year of Essential Use	Amount Exempted for year of Essential Use	Amount Acquired by Production	Amount Acquired for Essential Uses by Import	Total Acquired for Essential Use	Authorised but not Acquired	On Hand Start of Year	Available for Use in Current Year	Used for Essential Use	Quantity Contained in Products Exported	Destroyed	On Hand End of Year
2002	45.00	-	19.56	19.56	25.44	114.20	133.76	69.62	0.43	-	64.14
2001	88.20	-	6.00	6.00	82.20	184.89	190.89	60.16	0.55	17.52	113.21
2000	98.20	-	9.65	9.65	88.55	259.91	269.56	84.67	0.50	-	184.89
1999	136.50	-	43.16	43.16	93.34	322.67	365.83	103.10	0.35	2.82	259.91
1998	181.50	-	168.10	168.10	13.40	258.49	426.59	122.41	0.79	0.50	303.68
1997	240.00	-	60.40	60.40	179.60	335.26	395.66	133.58	0.37	3.40	258.68
1996	240.00	-	0.20	0.20	239.80	481.00	481.20	142.05	0.23	3.89	335.26

Poland

A	B	C	D	E	F	G	H	I	J	K	L
Year of Essential Use	Amount Exempted for year of Essential Use	Amount Acquired by Production	Amount Acquired for Essential Uses by Import	Total Acquired for Essential Use	Authorised but not Acquired	On Hand Start of Year	Available for Use in Current Year	Used for Essential Use	Quantity Contained in Products Exported	Destroyed	On Hand End of Year
2002	300.00	-	196.54	196.54	103.46	61.30	257.84	194.67	-	-	63.17
2001	320.00	-	178.33	178.33	141.67	64.66	242.99	178.56	108.83	2.62	61.81
2000	400.00	-	173.42	173.42	226.58	75.83	249.25	185.12	67.50	-	64.11
1999	380.00	-	179.23	179.23	200.77	84.04	263.27	187.44	78.00	-	75.83
1998	380.00	-	252.87	252.87	127.13	76.89	329.76	245.72	74.70	-	84.04
1997	380.00	-	304.90	304.90	75.10	86.30	391.20	314.20	135.10	-	77.00
1996	700.00		551.30	551.30	148.70	155.40	706.70	526.60	141.10	-	180.10

Russian Federation

A	B	C	D	E	F	G	H	I	J	K	L
Year of Essential Use	Amount Exempted for year of Essential Use	Amount Acquired by Production	Amount Acquired for Essential Uses by Import	Total Acquired for Essential Use	Authorised but not Acquired	On Hand Start of Year	Available for Use in Current Year	Used for Essential Use	Quantity Contained in Products Exported	Destroyed	On Hand End of Year
2002	396.00					230.00	230.00	230.00			-
2001					-	338.60	338.60	138.60			230.00
2000				101.00	101.00		101.00	101.00			-
1999				-	-		-				-
1998	452.00	277.00	-	277.00	175.00	508.50	785.50	285.50	-	-	500.00
1997	832.00	693.50	-	693.50	138.50		693.50	181.92	-	-	511.58
1996				-			-				-

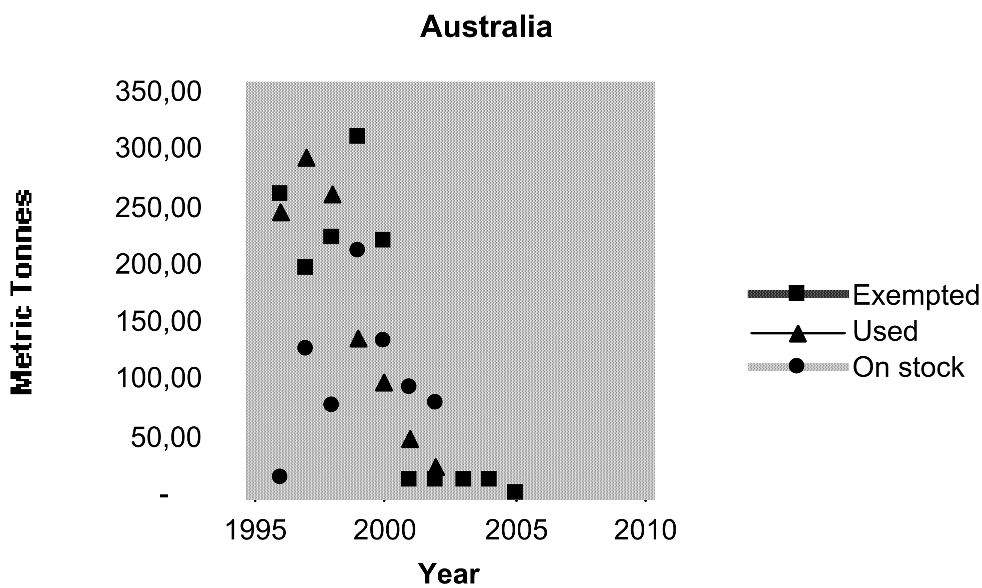
Ukraine

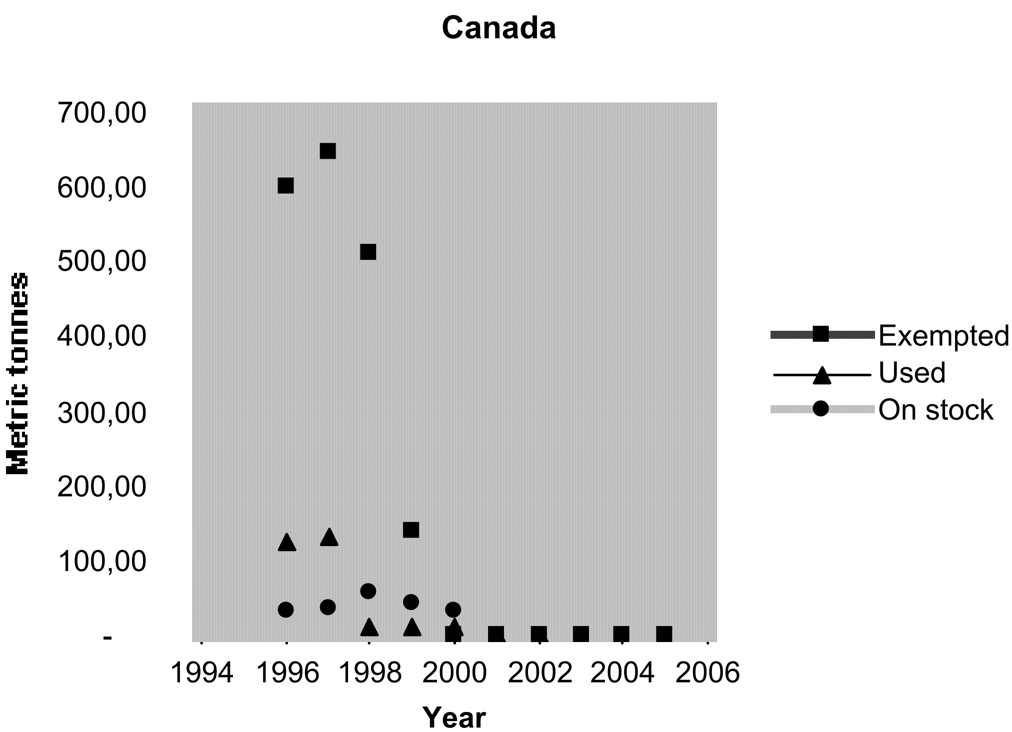
A	B	C	D	E	F	G	H	I	J	K	L
Year of Essential Use	Amount Exempted for year of Essential Use	Amount Acquired by Production	Amount Acquired for Essential Uses by Import	Total Acquired for Essential Use	Authorised but not Acquired	On Hand Start of Year	Available for Use in Current Year	Used for Essential Use	Quantity Contained in Products Exported	Destroyed	On Hand End of Year
2002	144.00		119.70	119.70	24.30		119.70	119.70			-
2001				-	-		-	-			-
2000				-	-		-	-			-
1999				-	-		-	-			-
1998			-	-	-		-	-	-	-	-
1997	-	-	-	-	-	-	-	-	-	-	-
1996				-			-	-			-

USA

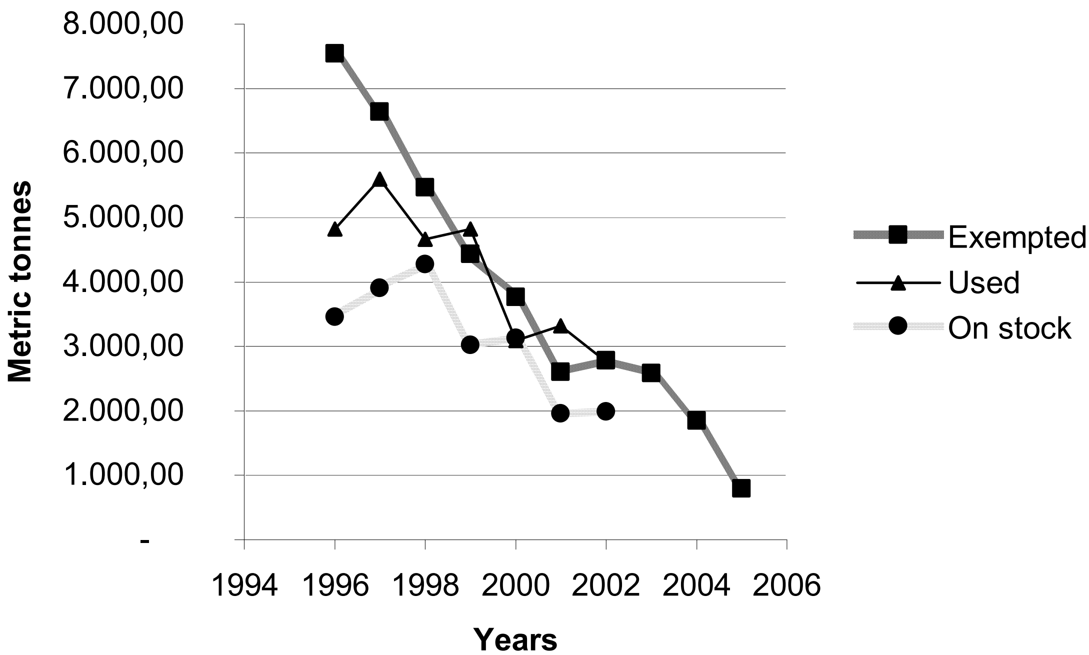
A	B	C	D	E	F	G	H	I	J	K	L
Year of Essential Use	Amount Exempted for year of Essential Use	Amount Acquired by Production	Amount Acquired for Essential Uses by Import	Total Acquired for Essential Use	Authorised but not Acquired	On Hand Start of Year	Available for Use in Current Year	Used for Essential Use	Quantity Contained in Products Exported	Destroyed	On Hand End of Year
2002	3,032.00	180.00	1,636.00	1,816.00	1,216.00	1,910.00	3,726.00	1,581.00	87.00	274.00	1,871.00
2001	3,101.00	135.00	2,674.00	2,809.00	292.00	1,877.00	4,686.00	2,375.00	168.00	400.00	1,911.00
2000	3,735.00	101.50	2,603.00	2,704.50	1,030.50	2,029.40	4,733.90	2,492.50	141.50	364.50	1,877.00
1999	3,665.40	-	2,630.50	2,630.50	1,034.90	2,383.60	5,014.10	2,644.60	157.90	340.20	2,029.40
1998	4,363.00	-	2,235.60	2,235.60	2,127.40	2,910.80	5,146.40	2,425.50	125.00	337.30	2,383.60
1997	4,656.00	-	2,032.30	2,032.30	2,623.70	3,197.20	5,229.50	2,255.10	14.40	63.60	2,910.80
1996	4,235.70	1,541.10	667.30	2,208.40	2,027.30	3,300.00	5,508.40	2,368.00	14.40		3,140.40

COUNTRY TRENDS BASED ON ACCOUNTING FRAMEWORKS AND NOMINATIONS

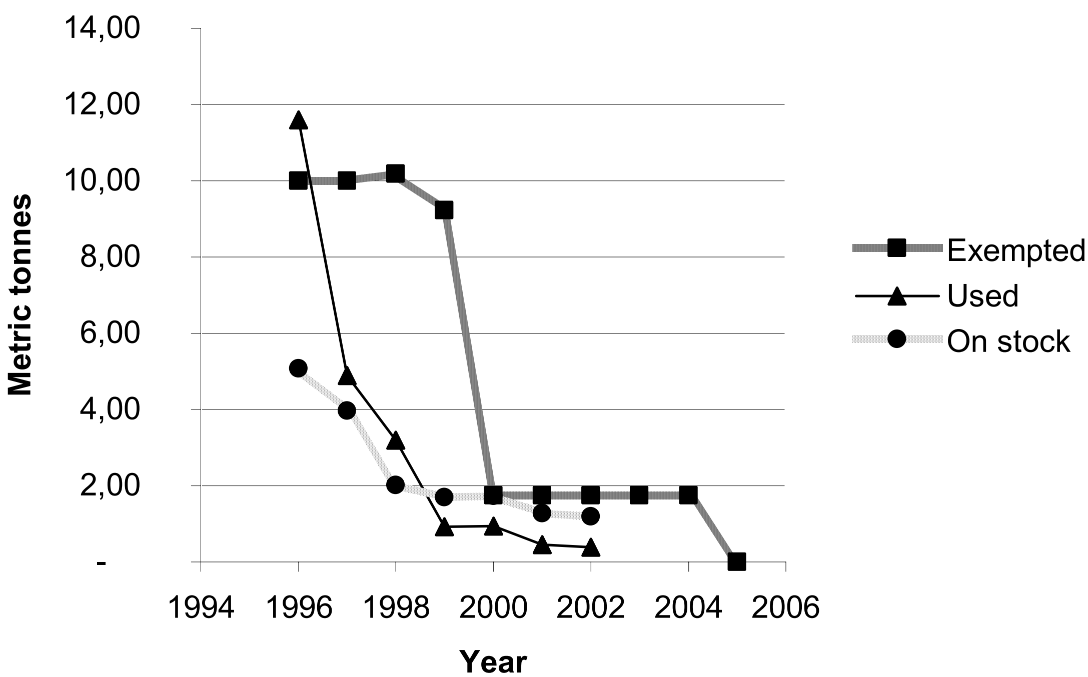


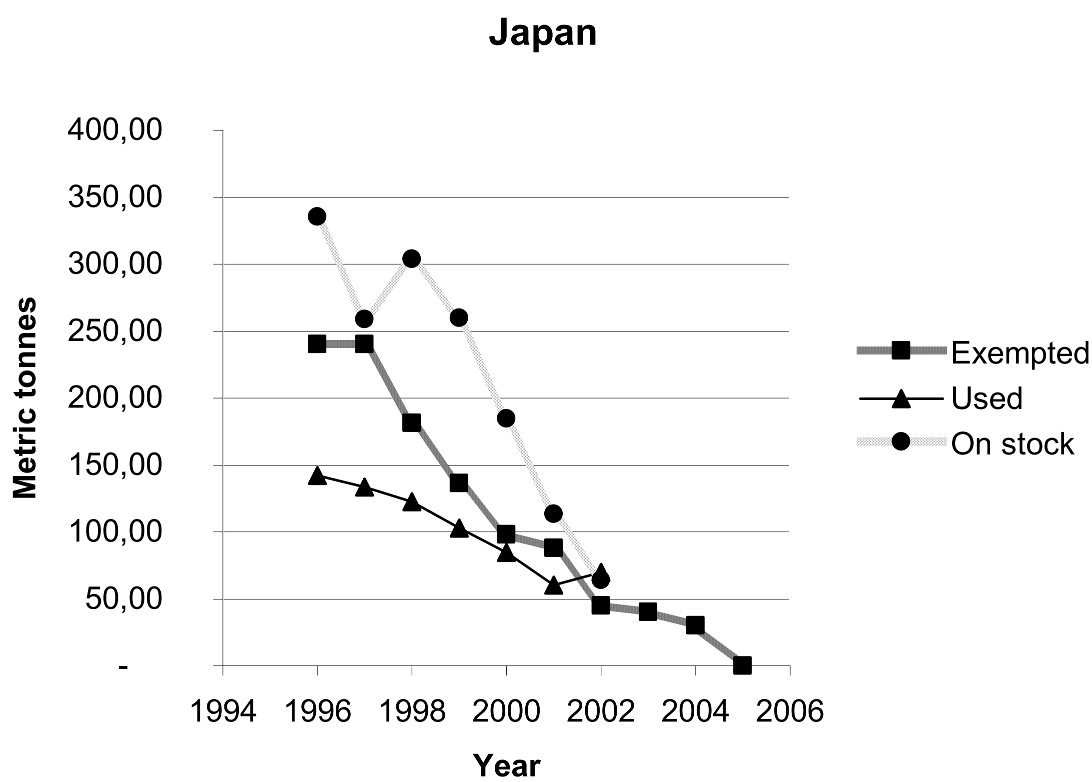


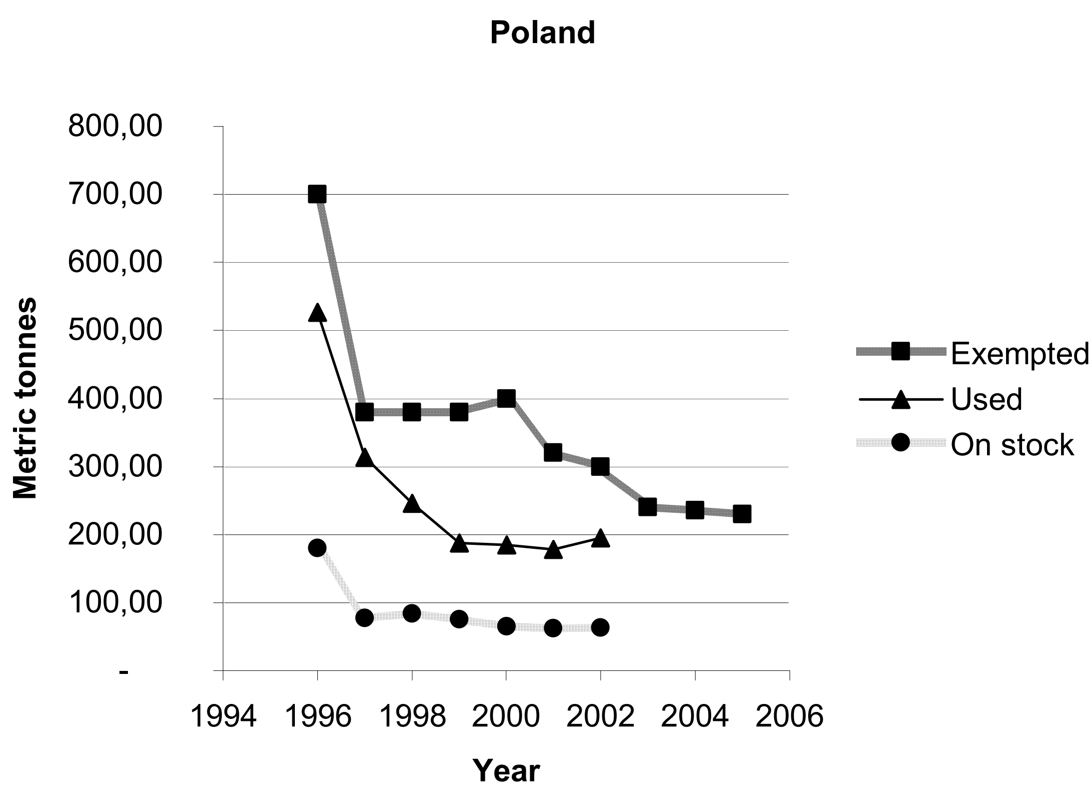
European Union



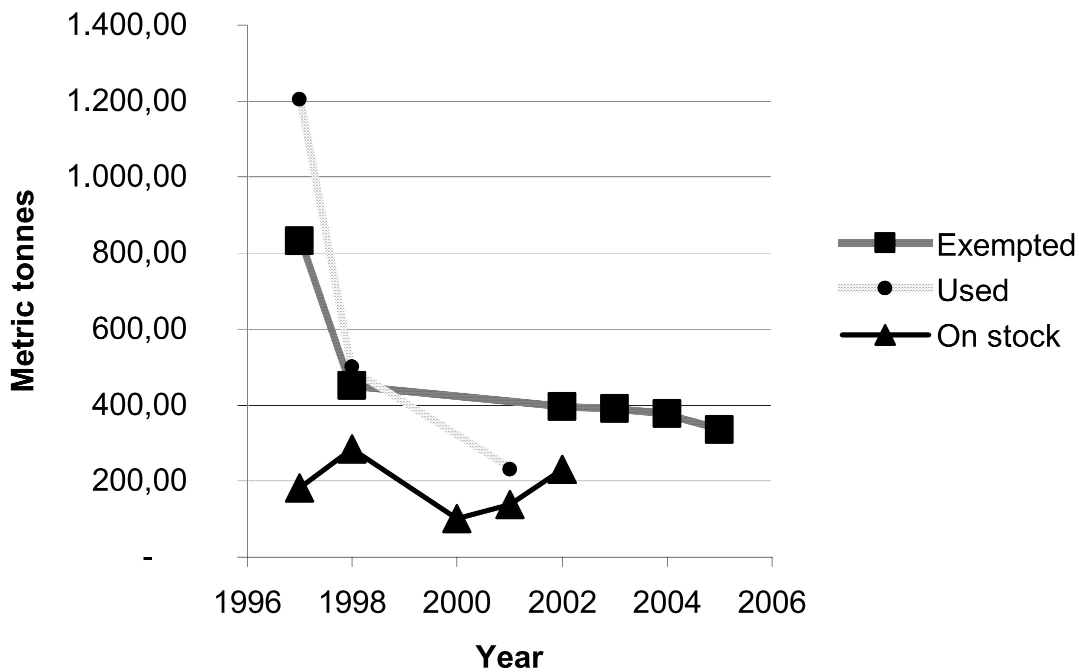
Hungary



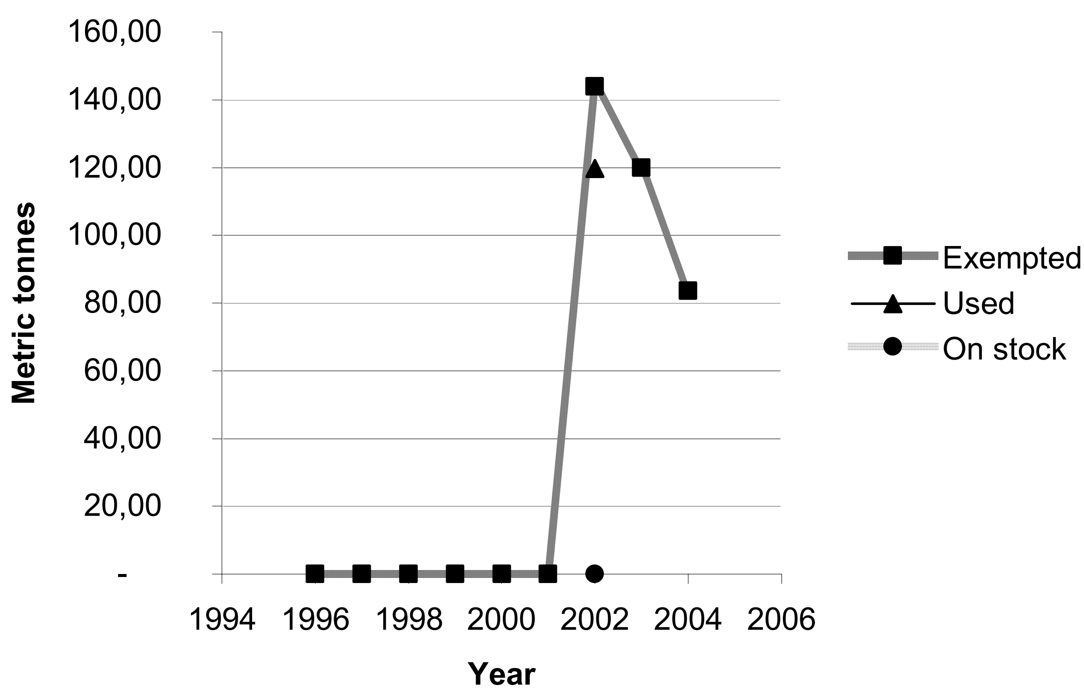

Japan
400,00
350,00
300,00
250,00
200,00
150,00
100,00
50,00
-
Metric tonnes
1994
1996
1998
2000
2002
2004
2006
Year
Exempted
Used
On stock

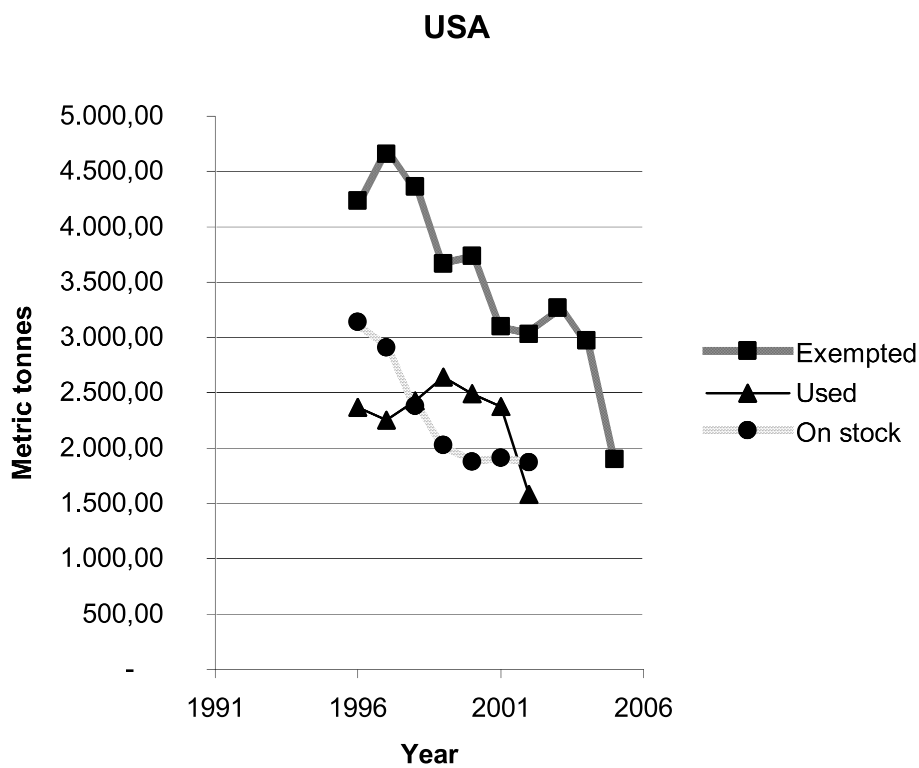

Poland
800,00
700,00
600,00
500,00
400,00
300,00
200,00
100,00
-
Metric tonnes
1994
1996
1998
2000
2002
2004
2006
Year
Exempted
Used
On stock

Russia



Ukraine





Notes to Graphs:

- Exempted amounts are those approved by Parties until 2004 and those recommended by ATOC for 2005. In the case of the Russian Federation and Ukraine. figures for 2004 and 2005 have to be approved by Parties.
- The Russian Federation did not nominate for Essential Uses in the years 1999. 2000 and 2001.Use of CFCs for the Russian Federation in 1999 are not available. Inventories for 1999 and 2000 are not known either.
- The Accounting Framework for 2002 is the only one available for Ukraine.
- The Czech Republic, Israel and Switzerland have presented Accounting Frameworks not listed here.

SECTION 2: PARTIES AND REGIONAL ORGANIZATIONS THAT PROVIDED INFORMATION CONCERNING TREATMENT FOR ASTHMA AND COPD

Australia
Bosnia and Herzegovina
Brazil
Bulgaria
Cambodia
China (Hong Kong)
Croatia
Czech Republic
Eritrea (Non-Party)
EU
Georgia
Israel
Jamaica
Japan
Macedonia
Mauritius
Moldova
New Zealand
Norway
Oman
Panama
Poland
Singapore
Sri Lanka
Tuvalu
Uruguay
USA

7 Update Report on nPB

In Decision XIII/7, Parties requested an annual update on the evolution of use and emissions of n-propyl bromide; this report provides the most recent available data.

7.1 Market factors

Owing to the uncertain toxicity and probable environmental restrictions on the use of nPB and the economic conditions, the market for nPB for solvents use has not developed significantly in most countries, since the publication of the 2002 Update Report (TEAP, 2002). A number of companies have avoided making capital investments for the safe use of nPB, pending the outcome of the geopolitical situation and the consequent economic effects. There may be a significant market expansion in China, although no figures have been reported[28].

There has been an increase reported in the use of nPB as a cold cleaning solvent in Western Europe (Rollet, 2003). This application is emissive.

The price of nPB has dropped and typical bulk prices in Europe and North America are between USD 1.70 and 1.80 per kilogram, probably due to increased global production capacity. This nPB price overlaps the higher end of the chlorinated solvent price range. In countries where the regulatory restrictions on the use of nPB are less onerous than those for chlorinated solvents a significant increase in future use may occur.

7.2 Regulatory Influences

Proposed regulations in the EU and USA would restrict potential use within these jurisdictions and may discourage use elsewhere.

The proposed EU Classification and Labelling Requirements, shown in updated Table 7-1 (mentioned as a proposal in the 2002 Update Report) are now scheduled for voting in mid-2003 and expected to enter into force in mid-2004.

TEAP has identified no major new proposed or promulgated regulations, pending the outcome of scientific toxicological and environmental studies.

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[28] Decision 33/46 of the Executive Committee of the Multilateral Fund calls for nPB reporting and it is thought that the UNDP will make the first report in July 2003 at the 40th meeting of the committee.

The US State of California has proposed regulation according to the Proposition 65 list, by the Developmental and Reproductive Toxicant (DART) Identification Committee of the Office of Environmental Health Hazard Assessment (OEHHA). This was initially proposed of expedited review, which was changed in favour for an ordinary review. This proposal was based only on reproductive toxicity concerns (http://www.oehha.ca.gov/prop65/public_meetings/DART120402.html).

Table 7-1 Proposed EU Classification and Labelling for nPB

Classification	Label #	Warning	Text
	R10		Inflammable
Repr Cat 2:	R60		May impair fertility
Repr Cat 3:	R63		Possible risk of harm to the unborn child
Xn:	R48/20	Harmful:	Danger of serious damage to health by prolonged exposure through inhalation
Xi:	R36	Irritant:	Irritating to eyes
Xi:	R37	Irritant:	Irritating to respiratory system
Xi:	R38	Irritant:	Irritating to skin
	R67		Vapours may cause drowsiness and dizziness
	S2		Keep out of the reach of children
	S9		Keep container in well ventilated place
	S53-45		Avoid exposure – obtain special instructions before use - in case of accident or if you feel unwell, seek medical advice immediately

7.3 New Applications

No new applications have been reported in the past year.

7.4 New Production Facilities

New production facilities have gone on line in China. One facility, (a joint venture of Dead Sea Bromine Group and the Shandong Haihua Shareholding Co. Ltd., a subsidiary of the Shandong Ocean Chemical Group) started operation in late 2001, with reported new bromine production of 50,000 tonnes/year and with new capacity of 6,000 tonnes/year for nPB. The trading arm is Weifang City Sinobrom Economy Trading Co., Ltd (http://www.cnsinobrom.com), with offices in England. According to Internet information, the purity of the nPB offered from this plant meets all Western standards. E-mail publicity, from a different producer in China, claimed a new production capacity of 12,000 tonnes of nPB/year but this has not been substantiated.

Two new distributors and blenders in the USA have been reported. Pacific Fluids (http://www.pacfluids.com/) in Tacoma, WA, have informed clients that they are now supplying nPB-based products. This company has published no information on their products on the Internet. Zep Manufacturing in Atlanta, GA, are providing an nPB-based solvent for wipe and spray applications (http://www.zepmfg.com/PSR/PSR_0555.pdf). The instruction sheet states "…may be used by spraying, immersion or wiping".

Actual production of nPB is estimated at 10,000 – 15,000 tonnes/year, of which about 5,000 tonnes is used by the pharmaceutical, agrochemical and speciality chemical industries (see 1.5 below). Total current production capacity of nPB is higher, conservatively estimated at more than 20,000 tonnes. If the demand exceeded this figure, more capacity could be brought on line.

7.5 Pharmaceutical, agrochemical and speciality chemical industries use of nPB

A considerable quantity of nPB is used as an "intermediate" substance for the manufacture of a wide range of products. If nPB were controlled under the Montreal Protocol, it is possible that most of these processes would fall into the definition of feedstock, but some may also be considered process agents. The direct and indirect emissions of nPB from these processes are unknown.

Pharmaceutical products concerned include: 5-Aminosalicylic acid (5-Amino-2-Hydroxybenzoic acid, 5-ASA, mesalazine, mesalamine); Oxibendazole; Sodium dipropylacetate (Dipropylacetic acid sodium salt, Sodium valproate, Valproic acid sodium salt, Sodium 2-propylvalerate, 2-Propylvaleric acid sodium salt); Albendazole; Probenecid Benemid; Ropivacaine; Propentofylline (3,7dihydro-3-methyl-1(5-oxohexyl)-7-propyl-1H-purine-2,6-dione); Albendazole oxide; Promestriene.

Agrochemicals include: Penconazole; Pirimiphos ethyl; Profenofos; Sulprofos.

Speciality chemicals include: Furfuryl propyl disulfide; 4-[[4-(1-Methylethoxy)phenyl]sulfonyl]phenol (4-(4-Isopropoxy-benzenesulfonyl)-phenol); Dipropylacetic acid (Valproic acid, 2-Propylvaleric acid, 2-Propylpentanoic acid); Prajmaline bitartrate; Dipropylacetamide; Sodium propyl thiosulfate.

The above lists are derived from information published on the Internet (http://www.chembourse.com/).

7.6 Ozone Depletion

At the time of writing, the SAP has not completed its studies. However, this Panel has published data indicating, "… the existing studies for nPB have shown that the ODP for a very short life source gas does vary with location and season of the emissions, by more than a factor of 5 for this particular gas, with the largest values for tropical emission." (UNEP, 2003) Table 2-12 in the same document cites one study giving the estimated ODP range over different large geographical ranges from 0.013 to 0.105, although "…there remain significant uncertainties in the existing studies".

7.7 Toxicity

The US National Institute for Occupational Safety and Health conducted a survey at a plant employing nPB-based adhesives (NIOSH, 2003). Average nPB exposure levels of the workers who were examined were 65.9 ppm. Participants most often reported headaches (48 percent), sleep problems (28 percent), dizziness or feeling "off balance" (25 percent), and blurred vision (24 percent). Blurred vision and dizziness were significantly more common among employees who worked with the adhesive than among employees who worked elsewhere in the plant. The employees experiencing symptoms had higher-than-normal levels of bromine compounds in their urine. NIOSH made recommendations to reduce worker respiratory and dermal exposure.

A useful summary of the known reproductive toxicity was drawn up for the public hearing of the DART Proposition 65 list in California, in 2002. (http://www.oehha.ca.gov/prop65/public_meetings/pdf/bromopropane120402.pdf).

7.8 Exposure Limits Recommended by Companies Marketing nPB

TEAP believes that no vendors of nPB solvents have changed their recommendations since the publication of the 2002 Update Report. There is still a wide range of maximum time-weighted-average operator exposure level from 5 ppm to 100 ppm. Most of the major manufacturers recommend 25 ppm[29], while some of the smaller blenders (who buy their nPB from the same major manufacturers) recommend 100 ppm. A new blender, Zep Manufacturing, recommends 25 ppm in their Material Safety Data Sheet (MSDS).

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[29] The US EPA also recommends 25 ppm, pending a definitive SNAP decision.

7.9 Ground water pollution

Suppliers of nPB claim that their solvents are less likely to cause ground water pollution than solvents like, trichloroethylene, because nPB is more subject to hydrolytic decomposition. However, nPB is more soluble in water (~2.5 g/l), which may contaminate aquifers.

7.10 Conclusions

i. The forecast global expansion of the nPB market has not yet occurred, because of the unclear regulatory situation, the current economic situation and geopolitical tensions.

ii. The bulk price of nPB, both raw and blended, has dropped to a level that is more competitive for general degreasing operations.

iii. The global production capacity of molecular nPB and blended solvents has expanded considerably and can meet foreseeable immediate demands if the regulatory and economic barriers are removed. Bromine production capacity is sufficient that more nPB can be produced at fairly short notice, if needed.

iv. nPB manufacturers and blenders are heavily promoting their products as replacements for non-ozone-depleting chlorinated solvents, exploiting possible regulatory loopholes.

v. The pharmaceutical, agrochemical and speciality chemical industries consume about 5,000 tonnes of nPB annually. The emissions from these are unknown.

vi. There is increased interest in the use of nPB in Article 5(1) countries, notably in the Peoples' Republic of China.

vii. Although there is no new information about the reproductive toxicity and neurotoxicity of nPB, there are grounds for concern arising from the incomplete toxicity or epidemiological information already available.

viii. Recommended safety practices regarding the use of nPB are not always being observed, resulting in excessive emissions and potential over-exposure of operators. In particular, more attention must be paid to the risks of dermal uptake, which may be more rapid in humans than was thought.

ix. In view of the still-unknown toxicology, epidemiology and risk to the ozone layer, the precautionary principle could discourage use of nPB in emissive solvents applications, and could require that every measure be taken to protect the operators from risk of exposure and to minimise emissions.

7.11 References

NIOSH 2003: Health Hazard Evaluation Report 2000-0410-2891, NIOSH Publications Office, Cincinnati, OH, February 2003

Rollet 2003: E-mail (translated from French) sent to Brian Ellis, 18 March 03

TEAP 2002: Report of the Technology and Economic Assessment Panel, April 2002, ISBN 92-807-2227-1, UNEP Ozone Secretariat, Nairobi, Kenya

UNEP 2003: 2002 Assessment Report of the Science Assessment Panel, 2003, UNEP Ozone Secretariat, Nairobi, Kenya

8 Incentives and Impediments to Transition to Non-CFC Chillers Including Availability of Refrigerants for Servicing

8.1 Decision XIV/9 from 14th Meeting of the Parties in Rome 2002

Parties to the Protocol decided:

> *"To request the Technology and Economic Assessment Panel to collect data and assess the portion of the refrigeration service sector made up by chillers and identify incentives and impediments to the transition to non-CFC equipment and prepare a report;*
>
> *To request the Technology and Economic Assessment Panel to submit the report to the 2003 Open-ended Working Group meeting for their consideration;"*

8.2 TEAP Requests More Time for Assessment

The Technology and Economic Assessment Panel (TEAP) is not able to adequately respond to this request for the information in the time available between the November 2002 MOP and the May 2003 meeting of TEAP, and respectfully requests that the report be submitted to the 2004 Open-Ended Working Group (OEWG) for consideration.

8.3 Explanation of Problems Requiring Request for More Time

In early 2003 TEAP members Radhey Agarwal (RTOC Co-Chair), Stephen O. Andersen (TEAP Co-Chair), and Lambert Kuijpers (TEAP Co-Chair and RTOC Co-Chair) collected available data and produced a zero-order draft report. The draft report was circulated to experts from an environmental protection agency, industry NGOs, and experts from companies manufacturing chillers.[30]

TEAP produced a second draft that was subsequently reviewed and edited by TEAP during its 5-8 May 2003 meeting in Manchester UK. Part of that review in Manchester was consideration of new World Bank analysis made available to TEAP just one week earlier.

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[30] TEAP is grateful for the contributions of RTOC member Jim Crawford (Trane), Karim Amrane (Air-Conditioning and Refrigeration Institute—ARI), Doug Bishop (Carrier), Julian deBullet (McQuay), Kevin Fay (Alliance for Responsible Atmospheric Policy), David Godwin (US EPA), John Mandyck (Carrier), Carol Marriott (McQuay), Deborah Miller (ARI), Robert Schmitt (York International), Eugene Smithart (Turbocor), Dave Stirpe (Alliance for Responsible Atmospheric Policy), and Jim Wolf (Trane).

TEAP was unable to reconcile significant differences in the estimates of the global inventory of chillers and unable to develop credible estimates of service emissions in Article 5(1) countries. Service emissions depend on age and condition of equipment and on local practice, environmental regulations, and economic incentives. Furthermore, TEAP was unable to verify whether the incentives and impediments that are known to apply to chiller investment and servicing in non-Article 5(1) countries are substantially different in Article 5(1) countries where investment risk and economic uncertainty may have a stronger controlling influence.

TEAP, its RTOC, and its consulting experts will work to resolve these issues and complete its report to the 2004 OEWG.

9 TEAP Response to Decision XIV/6

Following an instruction issued at the 12th Meeting of the Parties in Ouagadougou in 2000, the Task Force on Destruction Technologies (TFDT) duly submitted its Report to the 20th Open-ended Working Group in Montreal in July 2002.

At that same meeting, a Draft Decision was submitted for consideration by Australia in order to accept the recommendations of the TFDT concerning 'approved technologies'. This was further developed between meetings and tabled for adoption at the fourteenth Meeting of the Parties in Rome (November 2002). However, the inclusion of a table making reference to *'Suggested regulatory standards for destruction facilities'* created difficulties for some Parties.

During a break-out group discussion at the Rome meeting, it emerged that reference to the term *'standards'* was potentially the cause of confusion, bearing in mind that neither the TFDT nor the TEAP is a standards setting body. A distinction was recognised between the technical capability of a process and its measured day-to-day performance, which could be either side of a mean value. Accepting that processes cannot be monitored daily because of the need for specialist equipment to reach the necessary detection limits, the TEAP (through its TFDT) was requested to:

4. *....update the Code of Good Housekeeping to provide guidance on practices and measures that could be used to ensure that during the operation of the approved destruction technologies environmental release of ODS through all media and environmental impact of those technologies is minimised;*

In providing this update, the TEAP was expected to offer some appropriate wording that would maintain the integrity of the screening criteria selected and used by the TFDT in its 2002 Report but, at the same time, allow some flexibility for Governments and other standards setting authorities to select minimum standards that reflected the variations around the mean values associated with technical capability.

A sub-group of the TFDT met in Washington on Thursday 25th April 2003 to review the Code of Good Housekeeping (as originally adopted by the Parties in Decision IV/11,1992) and develop an updated text for this.

At the outset of the meeting, it was agreed as essential for this update to also include a review of:

- The list of 'Approved destruction processes' (contained in Annex VI of the report of the Fourth Meeting of the Parties as subsequently amended)

- The table of suggested regulatory standards in Annex VII of the report of Fourth Meeting of the Parties, which needed to have its title altered to address specific concerns about the word ‘standard’ voiced in Rome.

In discussion, it emerged that the compromise Decision (XIV/6) finally adopted in Rome did not fully reflect the Technology List recommended for approval by the TFDT. In particular, it was noted that necessary distinctions between CFC, HCFC and Halon destruction capabilities had not been honoured. It was therefore decided to include the original table contained in the TFDT Report in a revision of the ‘Destruction Procedures’[31] text in order to avoid any further misunderstanding.

In the light of the above, Parties may wish to consider adopting a Decision at the 15th Meeting of the Parties to approve the revised ‘Destruction Procedures’ section and, by doing so, to adopt the revised Approved Destruction Processes as tabulated, which corrects the previous error in Decision XIV/6.

The revised ‘Destruction Procedures’ text is included at the end of this section.

9.1 Other issues arising

Other trends in the field of Destruction Technologies are also believed to warrant some comment by TEAP at this juncture. These relate to the treatment of ‘Dilute Sources’ and the definition of ‘Production’ and quantities destroyed under the Protocol.

9.1.1 Treatment of Dilute Sources

The definition of a Destruction Process, as set out in Decision I/12F of Protocol, is as follows:

> “a destruction process is one which, when applied to controlled substances, results in the permanent transformation, or decomposition of all *or a significant proportion* of such substances” *(Italics added)*

It is clear that this definition was always intended to cover processes with the technical capability of destroying less than 100% of controlled substances and that such limitations should not be a barrier to approval, provided that the justification for such lower level of destruction efficiency is sound. Since the prime reason for significantly lower destruction efficiencies is usually the

[31] ‘Destruction Procedures’ is the title under which these items are consolidated within the Montreal Protocol Handbook

dilution of the source (such as occurs for CFCs in foams or methyl bromide diluted by air), these technologies have been described in terms of 'Dilute Sources'. However, in making this classification, it should be noted that this is only for convenience and that there may be other legitimate reasons why only 'a significant proportion' of the ODS can be destroyed. The Protocol itself makes no provision to exclude such technologies subject to their acceptance by the Task Force on Destruction Technologies. However, the imposition of a lower limit for the destruction efficiency of a given substance is not precluded and the maintenance of a strict criterion for traditional concentrated sources is envisaged.

It is also important to distinguish between losses occurring during collection, recovery and storage processes and those occurring during the destruction step. In terms of the approval of technologies, only the destruction step is considered.

These considerations are becoming increasingly important as the focus on recovery of ODS from their use phase becomes more prevalent and the opportunities for destruction expand. The wider consideration of foams in the last TFDT Report and the increasing interest in the recovery and destruction of methyl bromide are evidence of this fact. In response to this trend, the Parties need to consider requesting the TFDT to meet more regularly to review emerging technologies (particularly in the area of methyl bromide) and also to ensure that expanding expertise is engaged to deal with these newer, non-concentrated sources.

9.1.2 Definition of Production and Quantities Destroyed

The relevant part of the definition of 'Production' in Article 1 (5) of the Protocol is as follows: *Production" means the amount of controlled substances produced, minus the amount destroyed by technologies (to be) approved by the Parties and .....*

Since technologies based on both concentrated and dilute sources are now approved, there is a potential need for a provision to define how the amount of destroyed material is reflected in the subtraction from the production figure. Historically, this has not been a particular challenge to the Protocol since most destruction has been conducted using concentrated sources achieving a high level of destruction (>99.9% typically). Moreover, the provision has rarely, if ever, been used.

With scenarios now emerging in the methyl bromide sector that may require consideration of such destruction credits, the Parties need to consider a systematic method of appraisal. Bearing in mind that the TFDT will have had to approve the destruction technology in any event, the TEAP believes that this can be defined quite easily as follows:

Credit for ODS destroyed = (Amount of ODS processed) x (DRE of screening criterion applied)

Therefore a foam containing 1 kg of blowing agent processed through a Municipal Solid Waste Incinerator will be deemed to have destroyed 950g of the blowing agent (95% efficiency) whatever the actual efficiency of the process happens to be. It will be the responsibility of individual Parties to confirm the on-going performance of these facilities (for instance, by the adoption of a certified QA procedure) in line with the revised Code of Good Housekeeping as and when this is adopted by the Parties.

For the avoidance of doubt, such credits would only be available where the identity and quantity of ODS can be clearly established. This may not be possible for all dilute sources.

When formulating a Decision to deal with the various issues raised by Decision XIV/x, Parties may wish to consider clarifying the treatment of ODS destroyed from Dilute Sources as outlined above.

Appendix – Proposal for revised 'Destruction Procedures'

Approved destruction processes

The following table provides an overview of the status of technology approvals as recommended by the TEAP to the 14th Meeting of the Parties [and approved by the 15th Meeting of the Parties]:

	Applicability		
Technology	CFCs & HCFCs	Halon	Foam.
Cement Kilns	Approved		
Liquid Injection Incineration	Approved	Approved	
Gaseous/Fume Oxidation	Approved	Approved	
Municipal Solid Waste Incineration			Approved
Reactor Cracking	Approved		
Rotary Kiln Incineration	Approved	Approved	Approved
Argon Plasma Arc	Approved	Approved	
Inductively Coupled Radio Frequency Plasma	Approved	Approved	
Microwave Plasma	Approved		
Nitrogen Plasma Arc	Approved		
Gas Phase Catalytic Dehalogenation	Approved		
Superheated Steam Reactor	Approved		

The table below presents technology capability (DRE) and guidelines for maximum emissions from destruction facilities as also recommended by the TEAP

Suggested criteria for destruction technologies

Criterion	Units	Diluted Sources (Foams)	Concentrated Sources (CFCs, HCFCs &
DRE	%	95	99.99
PCDDs/PCDFs	ng-ITEQ/Nm3	0.5	0.2
HCl/Cl2	mg/Nm3	100	100
HF	mg/Nm3	5	5
HBr/Br2	mg/Nm3	5	5
Particulates (TSP)	mg/Nm3	50	50
CO	mg/Nm3	100	100

All concentrations of pollutants in stack gases and stack gas flow rates are expressed on the basis of dry gas at normal conditions of 0 C and 101.3 kPa, and with the stack gas corrected to 11% O2

Code of good housekeeping[32]

To provide additional guidance to facility operators, the Technical Advisory Committee (TAC) prepared a “Code of Good Housekeeping” as a brief outline of what should be considered to ensure that environmental releases of Ozone Depleting Substances (ODS) through all media are minimised. This Code is also intended to provide a framework of practices and measures that should normally be adopted at facilities undertaking the destruction of ODS.

Not all measures will be appropriate to all situations and circumstances, and as with any Code, nothing specified should be regarded as a barrier to the adoption of better or more effective measures if these can be identified.

Predelivery

This refers to measures that may be appropriate prior to any delivery of ODS to a facility.

The Facility Operator should generate written guidelines on ODS packaging/containment criteria, together with labelling and transportation requirements. These guidelines should be provided to all suppliers/senders of ODS prior to agreement to accept such substances.

The Facility Operator should seek to visit and inspect the proposed sender’s stocks and arrangements prior to movement of the first consignment. This is to ensure awareness on the part of the sender of proper practices, and compliance with standards.

Arrival at Facility

This refers to measures that should be taken at the time ODS are received at the facility gate.

These include an immediate check of documentation prior to admittance to facility site, coupled with preliminary inspection of the general condition of the consignment.

Where necessary, special or “Fast-track” processing/repackaging facilities may be needed to mitigate risk of leakage/loss of ODS.

Arrangements should exist to measure gross weight of consignment at the time of delivery.

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[32] Source: extract from the report of the ad-hoc technical advisory committee on ODS destruction technologies and subsequent updates

Unloading from Delivery Vehicle

This refers to measures to be taken at the facility in connection with the unloading of ODS.

It is generally assumed that ODS will normally be delivered in some form of container, drum, or other vessel that is removed from the delivery vehicle in total. Such containers may be returnable.

All unloading activities should be carried out in properly designated areas, to which restricted personnel access applies.

Areas should be free of extraneous activities likely to lead to, or increase the risk of, collision, accidental dropping, spillage, etc.

Materials should be placed in designated quarantine areas for subsequent detailed checking and evaluation.

Testing and Verification

This refers to the arrangements made for detailed checking of the ODS consignments prior to destruction.

Detailed checking of delivery documentation should be carried out, along with a complete inventory, to establish that delivery is as advised and appears to comply with expectations.

Detailed checks of containers should be made both in respect of accuracy of identification labels, etc, and of physical condition and integrity. Arrangements must be in place to permit repackaging or "fast-track" processing of anything identified as defective.

Sampling and analysis of representative quantities of ODS consignments should be carried out to verify material type and characteristics. All sampling and analysis should be conducted using approved procedures and techniques.

Storage and Stock Control

This refers to matters concerning the storage and stock control of ODS.

ODS materials should be stored in specially designated areas, subject to the regulations of the relevant local authorities.

Locations of stock items should be identified through a system of control that should also provide a continuous update of quantities and locations as stock is destroyed, and new stock delivered.

Measuring Quantities Destroyed

It is important to be aware of the quantities of ODS processed through the destruction equipment. Where possible, flow meters or continuously recording weighing equipment for individual containers should be employed. As a minimum, containers should be weighed “full” and “empty” to establish quantities by difference.

Residual quantities of ODS in containers that can be sealed, and are intended to be returned for further use, may be allowed. Otherwise, containers should be purged of residues and/or destroyed as part of the process.

Facility Design

This refers to basic features and requirements of plant, equipment, and services deployed in the facility.

In general, any destruction facility should be properly designed and constructed in accordance with the best standards of engineering and technology and with particular regard to the need to minimise, if not eliminate, fugitive losses.

Particular care should be taken when designing plants to deal with dilute sources such as foams. These may be contained in refrigeration cabinets or may be part of a more general demolition waste. The area in which foam is first separated from other substrates should be fully enclosed wherever possible and any significant emissions at that stage captured.

Pumps: Magnetic drive, sealers, or double mechanical seal pumps should be installed to eliminate environmental releases resulting from seal leakage.

Valves: Valves with reduced leakage potential should be used. These include quarter-turn valves or valves with extended packing glands.

Tank Vents (including Loading Vents): Filling and breathing discharges from tank/vessels should be recovered or vented to a destruction process.

Piping Joints: Screwed connections should not be used, and the number of flanged joints should be kept to the minimum that is consistent with safety and the ability to dismantle for maintenance and repair.

Drainage systems: Areas of the facility where ODS are stored or handled should be provided with sloped concrete paving and a properly designed collection system. Water that is collected should, if contaminated, be treated prior to authorised discharge.

Maintenance

In general, all maintenance work should be performed according to properly planned programmes, and should be executed within the framework of a permit system to ensure proper consideration of all aspects of the work.

ODS should be purged from all vessels, mechanical units, and pipework prior to the opening of these items to the atmosphere. The contaminated purge should be routed to the destruction process, or treated to recover the ODS.

All flanges, seals, gaskets and other sources of minor losses should be checked routinely to identify developing problems before containment is lost. Leaks should be repaired as soon as possible.

Consumable or short-life items, such as flexible hoses and couplings must be monitored closely, and replaced at a frequency that renders the risk of rupture negligible.

Quality Control and Quality Assurance

All sampling and analytical work connected with ODS, the process, and the monitoring of its overall performance should be subject to quality assessment and quality control measures in line with current recognised practices. This should include at least occasional independent verification and confirmation of data produced by the facility operators.

Consideration should also be given to the adoption of quality management systems and environment quality practices covering the entire facility.

Training

All personnel concerned with the operation of the facility (with "operation" being interpreted in its widest sense) should have training appropriate to their task.

Of particular relevance to the ODS destruction objectives is training in the consequences of unnecessary losses and training in the use, handling, and maintenance of all equipment in the facility.

All training should be carried out by suitably qualified and experienced personnel, and the details of such training should be maintained in written records. "Refresher" training should be conducted at appropriate intervals.

Code of Transportation

In the interest of protecting the stratospheric ozone layer, it is essential that used ODS and products containing ODS be collected and moved efficiently to facilities practising approved destruction technologies. For transportation purposes, used ODS should receive the same hazard classification as the original substances or products. In practice, this may introduce restrictions on hazardous waste shipment under the Basle Convention and this should be consulted separately. In the absence of such specific restrictions, the following proposed code of transportation for ODS from customer to destruction facilities is provided as a guide to help minimise damage caused to the ozone layer as a result of ODS transfers.

It is important to supervise and control all shipments of used ODS, and products containing ODS, and products containing ODS, according to national and international requirements to protect the environment and human health. To ensure that ODS and products containing ODS do not constitute an unnecessary risk, they must be properly packaged and labelled. Instructions to be followed in the event of danger or accident must accompany each shipment to protect human beings and the environment from any danger that might arise during the operation.

Notification of the following information should be provided at any intermediate stage of the shipment from the place of dispatch until its final destination. When making notification, the notifier should supply the information requested on the consignment note, with particular regard to:

(1) The source and composition of the ODS, and products containing ODS, including the customer's identity;

(2) Arrangements for routing and for insurance against damage to third parties;

(3) Measures to be taken to ensure safe transport and, in particular, compliance by the carrier with the conditions laid down for transport by the member states concerned;

(4) The identity of the consignee, who should possess an authorised centre with adequate technical capacity for the destruction;

and

(5) The existence of a contractual agreement with the consignee concerning the destruction of ODS and products containing ODS.

This code of transportation does not necessarily apply to the disposal of ODS-containing rigid insulation foams. The most appropriate way to dispose of such products may be by direct incineration in municipal waste incinerators or rotary kiln incinerators.

Monitoring

The objectives of monitoring should be to provide assurance that input materials are being destroyed with an acceptable efficiency generally consistent with the Destruction and Removal Efficiency (DRE) recommendations listed in the preceding table of Suggested Criteria for Destruction Technologies, and that the byproducts of destruction yield environmentally acceptable emission levels generally consistent with the other suggested criteria detailed in that table.

As there are as yet no ISO standards applicable for the sampling and analysis of ODS or the majority of the other pollutants listed in the table of Suggested Criteria for Destruction Technologies, where national standards exist they should be employed. Further, where national standards exist they may used in lieu of ISO standards provided that they have been the subject of a verification or validation process addressing their accuracy and representativeness.

As ISO develops international standards for pollutants listed in the table of Suggested Criteria for Destruction Technologies, the technical bodies charged with developing such standards should take note of the existing national standards including those identified in Appendix F to the Report of the Task Force on Destruction Technologies and strive to ensure consistency between any new ISO standards and the existing standard test methods, provided that there is no finding that those existing methods are inaccurate or unrepresentative.

Where national standards do not exist, the TAC recommends adoption of the following guidelines for monitoring of destruction processes operating using an approved technology.

Recognizing that the Unites States Environmental Protection Agency's (US EPA) methods have been the subject of verification procedures to ensure that they are reasonably accurate and representative, that they cover all of the pollutants of interest (although not all ODS compounds have been the specific subject of verification activities), that they provide a comprehensive level of detail which should lead to reproducibility of the methods by trained personnel in other jurisdictions, and that they are readily available for reference and download from the Internet without the charge of a fee, applicable US EPA methods as described in Appendix F may be employed.

In the interest of ensuring a common international basis of comparison, for those pollutants or parameters where ISO standards exist (currently particulates, carbon monoxide, carbon dioxide and oxygen), use of those standards is encouraged and jurisdictions are encouraged to adopt them as national standards or acceptable alternatives to existing national standards.

However, the use of US EPA or other national standards described in Appendix F is also considered acceptable. The precedence given to the US EPA methods here is based on the relative comprehensiveness of the methods available (both in scope and content), and the relative ease of access to those methods.

Measurement of ODS

Operators of destruction facilities should take all necessary precautions concerning the storage and inventory control ODS containing material received for destruction. Prior to feeding the ODS to the approved destruction process, the following procedures are recommended.

(1) The mass of the ODS containing material should be determined, where practicable.

(2) Representative samples should be taken where appropriate to verify that the concentration of ODS matches the description given on the delivery documentation.

(3) Samples should be analysed by an approved method. If no approved methods are available, the adoption of USEPA methods 5030 and 8240 is recommended.

(4) All records from these mass and ODS concentration measurements should be documented and kept in accordance with ISO 9000 or equivalent.

Control Systems

Operators should ensure that destruction processes are operated efficiently to ensure complete destruction of ODS to the extent that it is technically feasible for the approved process. This will normally include the use of appropriate measurement devices and sampling techniques to monitor the operating parameters, burn conditions, and mass concentrations of the pollutants that are generated by the process.

Gaseous emissions from the process need to be monitored and analysed using appropriate instrumentation. This should be supplemented by regular spot checks using manual stack-sampling methods. Other environmental releases, such as liquid effluents and solid residues, require laboratory analysis on a regular basis.

The continuous monitoring recommended for on-going process control, including off-gas cleaning systems, is as follows:

(a) Measurement of appropriate reaction and process temperatures.

(b) Measurement of flue gas temperatures before and after the gas cleaning system.

(c) Measurement of flue gas concentrations for oxygen and carbon monoxide.

Any additional continuous monitoring requirements are subject to the national regulatory authority that has jurisdiction. The performance of on-line monitors and instrumentation systems must be periodically checked and validated. When measuring detection limits, error values at the 95% confidence level should not exceed 20%.

Approved Processes must be equipped with automatic cut-off control systems on the ODS feed system, or be able to go into standby mode whenever:

(i) The temperature in the reaction chamber falls below the minimum temperature required to achieve destruction.

(ii) Other minimum destruction conditions stated in the performance specifications cannot be maintained.

Performance Measurements

The approval of technologies recommended by TEAP is based on the destruction capability of the technology in question. It is recognised that the parameters may fluctuate during day-to-day operation from this generic capability. However, in practice, it is not possible to measure against performance criteria on a daily basis. This is particularly the case for situations where ODS only represents a small fraction of the substances being destroyed, thereby requiring specialist equipment to achieve detection of the very low concentrations present in the stack gas. It is therefore not uncommon for validation processes to take place annually at a given facility.

With this in mind, TEAP is aware that the measured performance of a facility may not always meet the criteria established for the technology. Nonetheless, TEAP sees no justification for reducing the minimum recommendations for a given technology. Regulators, however, may need to take these practical variations into account when setting minimum standards.

The ODS destruction and removal efficiency[33] (DRE) for a facility operating an approved technology should be validated at least once every three years.

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[33] Destruction and Removal Efficiency (DRE) has traditionally been determined by subtracting from the mass of a chemical fed into a destruction system during a specific period of time the mass of that chemical alone that is released in stack gases, and expressing that difference as a percentage of the mass of that chemical fed into the system.

The validation process should also include an assessment over other relevant stack gas concentrations (see table).

This procedure should also be followed when commissioning a new or rebuilt facility to ensure that all facility characteristics are completely documented and assessed against the approved technology criteria.

Tests shall be done with known feed rates of a given ODS-compound or with well-known ODS mixtures. In cases where a destruction process incinerates halogen containing wastes together with ODS, the total halogen load is calculated and controlled. The number and duration of test runs should be carefully selected to reflect the characteristics of the technology.

In summary, the DRE recommended for concentrated sources means that less than 0.1 g of total ODS should normally enter the environment from stack gas emissions when 1000 g ODS are fed into the process. A detailed analysis of stack test results should be made available to verify emissions of halogen acids and PCDD/PCDF. In addition, a site-specific test protocol should be prepared and made available for inspection by the appropriate regulatory authorities. The sampling protocol shall report the following data from each test:

- ODS feed rate,
- Total halogen load in the waste stream,
- Residence time for ODS in the reaction zone,
- Oxygen content in flue gas,
- Gas temperature in the reaction zone,
- Flue gas flow rate,
- Carbon monoxide in flue gas,
- ODS content in flue gas,
- Effluent volumes and quantities of solid residues discharged,
- ODS concentrations in the effluent and solid residues,
- Concentration of PCDD/PCDF, particulates, HCl, HF, and HBr in the flue gases.

10 TEAP Member Biographies

10.1 TEAP Operation – New TOC proposed

In 2003, TEAP will continue to recruit experts on the topics of greatest importance to Parties and will continue its reorganisation to focus on sectors where technologies are still rapidly evolving.

The Methyl Bromide Technical Options Committee will be strengthened further for consideration of nominations for Critical Use Exemptions with particular emphasis on assessing the development, demonstration, registration and deployment of technical options and the economics of implementation.

The Foams and Refrigeration/AC Technical Options Committees will be strengthened in preparation for the rapid introduction of alternatives to HCFCs.

The Halons Technical Options Committee will continue operating with TEAP experts maintaining a network of fire protection professionals. Walter Brunner will be resigning from TEAP by the end of 2003. To maintain the necessary expertise on TEAP as well, TEAP is looking for qualified nominations.

The Aerosols TOC will be refocused on medical uses including MDIs and sterilization.

In place of the current Solvents TOC, TEAP proposes to begin building a new "Chemical Uses and Processes TOC" to integrate topics including process agents and feedstocks, destruction, laboratory and analytical uses, solvents, and CTC.

10.2 TEAP Members

The following contains the background information for all TEAP members as at May 2003.

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Radhey S. Agarwal, Co-chair of the Refrigeration, Air-conditioning, and Heat Pumps Technical Options Committee, is the Deputy Director (Faculty) and Professor of Mechanical Engineering at the Indian Institute of Technology (IIT Delhi), Delhi, India. IIT Delhi makes in-kind contribution for wages. Costs of travel, communication, and other expenses related to participation in the TEAP and its Refrigeration TOC are paid by UNEP's Ozone Secretariat.

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Paul Ashford, Co-chair of the Rigid and Flexible Foams Technical Options Committee is the principal consultant of Caleb Management Services. He has over 20 years direct experience of foam related technical issues and is active in several studies concerning future policy for the foam sector. His funding for TEAP activities, which includes professional fees, is provided under contract by the Department of Trade and Industry in the UK. Other related non-TEAP work is covered under separate contracts from relevant commissioning organisations including international agencies (e.g. UNEP DTIE), governments and trade associations.

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Jonathan Banks, Co-chair of the Methyl Bromide Technical Options Committee, is a private consultant. He serves on some national committees concerned with ODS and their control. He is an honorary fellow with the CSIRO Stored Grain Research Laboratory, a government/industry funded research laboratory engaged in finding improved ways of protecting stored grain, including developing and commercialising alternatives to methyl bromide. His funding for TEAP and MBTOC activities is through a grant from Environment Australia.

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Walter Brunner, Co-chair of the Halon Technical Options Committee, is a partner in the consulting firm envico, Zurich, Switzerland. He operates the halon registry and the halon clearinghouse under contract from the Swiss Government. The Government of Switzerland funds his participation in the Halons Technical Options Committee (HTOC) and TEAP.

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Ahmad Gaber, Co-chair of Solvents, Coatings and Adhesives Technical Options Committee, is Professor of Chemical Engineering, Cairo University. He is also the President of Chemonics Egypt, an Egyptian environmental management consulting firm. The UNEP Ozone Secretariat pays travel, communications and other expenses.

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Lambert Kuijpers, Co-chair of the Technology and Economic Assessment Panel and Co-chair of the Refrigeration, Air-conditioning and Heat Pumps Technical Options Committee, is based in Eindhoven, The Netherlands. He is supported (through the UNEP Ozone Secretariat) by the European Commission and this has been continued for the year 2002/2003. This applies to his activities related to the TEAP and the TOC Refrigeration, which includes in-kind contributions for wages and travel expenses. UNEP also funds administrative costs on an annual budget basis. In addition to activities at the Department "Technology for Sustainable Development" at the Technical University Eindhoven, other activities include consultancy to governmental and non-governmental organisations, such as the World Bank, UNEP DTIE and the French Armines Institute. Dr. Kuijpers is also an advisor to the Re/ ele Company, Netherlands (R&D of components and equipment for refrigeration, air-conditioning and heating).

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Tamas Lotz, Senior Expert Member, is a consultant on air pollution abatement in the Institute for Environmental Management in Budapest, Hungary. He was one of the authors of the Hungarian Country Programme for the phase-out of ODS. Travel and per diem costs are covered by UNEP, and communication costs are an in-kind contribution by the Institute for Environmental Management.

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Nahum Marban-Mendoza, Co-chair of the Methyl Bromide Technical Options Committee, is a full-time professor of Integrated Pest Management and Plant Nematology at the Universidad Autonoma Chapingo in the graduate programme of crop protection. He has over 25 years experience in the research and development of non-chemical alternatives to control plant parasitic nematodes associated with different crops in Central America and Mexico. Prof. Marban-Mendoza has been funded by both private and government funds; occasionally he receives funds for wages and travel. The communication costs related to MBTOC activities and the costs of travel and other expenses related to participation in TEAP and TOC meetings are paid by the UNEP Ozone Secretariat.

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Appendix A Evaluation of Critical Use Nominations – Soils

Party	CUN Number	(a)	Industry	Reported past use (unofficial)	Quantity nominated		Recom-mendation for 2005	Comment
					t/year	Years	Tonnes	
Australia	CUN2003/001		Cut Flowers - field	120 t (1998), 60t (2001)	40t w/o VIF or 25t with VIF	6	10t	MBTOC recommends that a reduced CUE of 10t be approved to allow for commercial scale up of alternatives. An alternative, 1,3-D/Pic, has been registered since Sept 2001 in Australia, but has only just been made available in northern Australia. The CUN states that 1,3-D cannot be applied within 1.5m of cropped soils. MBTOC recommends that the Party consider a further reduction of the amount requested as MB/Pic (50:50) is technically suitable as a transition strategy until 1,3-D/Pic is available and rates of application can be reduced from 62.5 g/m2 to 30g/m2 by use of VIF films and this will substantially reduce emissions.
Australia	CUN2003/002		Cut flowers - protected	120t (1998), 60t (2001)	60t w/o VIF or 40t with VIF	6	20t	MBTOC recommends that a reduced allocation of 20t be approved. MBTOC has suggested a reduced allocation of MB in consideration of adoption of emission reduction strategies where the maximum amount of MB considered effective could be reduced by use of VIF to 60g/m2 for 100% MB or use of MB/Pic mixtures (50:50) with VIF at 30g/m2 (i.e. adoption of VIF and formulation change). Substrates and steam are considered suitable technical alternatives, though MBTOC recognises that steam may be expensive and that not all flower species can be successfully grown in substrates. Owing to reported phytotoxicity and the need for short plant back times, available chemical fumigant alternatives are at present considered inappropriate in the circumstances of the nomination.
Australia	CUN2003/003		Cut flowers, bulbs - protected	17.6t (1998)	7	2	7t	MBTOC recommends that a reduced CUE of 7t be approved for the basis of the statement that no alternatives exist for cropping on steeply sloping ground, (ie.>10o). MBTOC suggests that the Party substantiate the proportion of crops that can be grown in substrates and identify whether the steam plate application or similar methods are appropriate alternatives. MBTOC recognises that steam may be expensive and that not all crops can be successfully grown in substrates. Owing to the need for short plant back times, no chemical fumigant alternatives are presently considered suitable under the specific circumstances of the nomination. The applicant appears to have accounted for emission reduction strategies when calculating the amount and has restricted the maximum amount of MB used to 60g/m2 when hot gas formulations of MB are used with VIF films.
Australia	CUN2003/005		Strawberry fruit - field	330t? (1998)	90t then 59t (2006) and 58t (2007)	3	24t	MBTOC recommends that a reduced CUE of 24t of MB be approved. An alternative, 1,3-D/Pic, has been available since Sept 2001 in Australia, but time is requested to allow for commercial scale up throughout States received the product in the latter part of 2002. The CUN states that 1,3-D/Pic is phytotoxic, but MBTOC is not aware of any study supporting phytotoxicity in fruiting fields. MBTOC recommends that the Party consider a reduction of 67% of the amount requested as MB/Pic (50:50) is considered technically suitable as a transition strategy until 1,3-D/Pic is available and rates of application can be reduced from 50 g/m2 to 30g/m2 by use of VIF films, thereby substantially reducing emissions.
Australia	CUN2003/006		Strawberry runners	33.6 (1998), 29.8 t (2001)	35,75	3	35.75t	MBTOC recommends that 35.75t be approved The CUN states that MB is required to meet certification standards. The CUN did not provide comparative data to show whether or not available alternatives provide the same disease tolerance threshold as MB. The CUN notes plug plants grown in hydroponics a possible alternative, but time and cost was preventing the adoption of this technology. MBTOC considers plug plant technology a technical alternative to methyl bromide, but understands that further development is required before complete adoption is possible. The applicant has shown that the most promising alternative for open field production of nursery plants, 1,3-D/Pic, has been phytotoxic and that attempts to use VIF films have failed because glues do not work in cold temperatures. The Party may wish to reduce the request for a CUE quantity to account for adoption of plug plant systems. The industry already uses 25g/m2 of MB and is encouraged to try to further reduce amounts by adopting VIF films and better glues which allow a reduction in emissions.
Belgium	CUN2003/007			221.12 (1995); 127.5 t (1998)	100	(b)	(c)	MBTOC is unable to recommend this nomination in entirity because of insufficient information to allow full evaluation relating to specific crops within this CUN. An extensive list of references were provided for research in Belgium, almost no comparative results on pathogen control and yields with alternatives were provided for specific situations for specific crops.Information in needed on registration status of key alternatives and their applicability in open fields or protected crops in Belgium. Although MBTOC acknowledges that fumigant mixtures are more difficult to use in protected environments when other crops are grown in the vicinity of the treatment there was no data given to support the 5 week plant back period for chloropicrin or lack of effect when temperatures are below 20oC. MBTOC is also unclear for what proportion of crops steam and substrates were considered technical alternatives.
Belgium	CUN2003/007	-a,b	Lettuce and endive - open field	65.02 t (1998)	42,25	(b)	0t	MBTOC is unable to recommend this nomination. The CUN is a contingent application based on the justification that all uses that can be accomplished with other methods have already switched and that the remaining use (which has been assumed will expand dramatically) is critical. Lettuce and endive are not typically grown with the aid of MB and no justification is made for this unusual nomination. The CUN correctly states that steam and soilless culture are feasible alternatives and that fumigant alternatives are less effective at lower temperatures, but does not provide efficacy data to support this statement. MBTOC is unclear as to what proportion of these crops can be grown in substrates (as occurs at present in neighbouring countries) and why the proportion of crops requiring methyl bromide in 2005 has increased substantially. The applicant should be encouraged to fully evaluate other chemical and non chemical alternatives. Economic analysis of the data submitted with the CUN indicates that some alternatives are economically feasible.

Party	CUN Number	(a)	Industry	Reported past use (unofficial)	Quantity nominated		Recom-mendation for 2005	Comment
					t/year	Years	Tonnes	
Belgium	CUN2003/007	-c	Tomatoes - protected	29.42 t(1998)	17,17	(b)	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The application is a contingent application based on the justification that all uses that can be accomplished with other methods have already switched and that the remaining use (which has been assumed will expand dramaticlaly) is critical. Substrates have been adopted for 75-80% of tomato production in Belgium. The applicant correctly states that steam and soilless culture is a feasible alternative and that fumigant alternatives are less effective at lower temperatures but fails to provide comparative efficacy data. MBTOC is also unclear as to what proportion of these remaining MB-using crops can be grown in substrates (as occurs at present in neighbouring countries) and why the proportion of crops requiring methyl bromide in 2005 has increased substantially.
Belgium	CUN2003/007	-d	Pepper, eggplant - protected	13.77 t (1998)	5,27	(b)	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The application is a contingent application based on the justification that all uses that can be accomplished with other methods have already switched and that the remaining use (which has been assumed will expand dramatically) is critical. The applicant correctly states that steam and soilless culture is a feasible but costly alternative and that fumigant alternatives are less effective at lower temperatures but fails to provide suitable efficacy data. MBTOC is also unclear as to what proportion of these crops can be grown in substrates (as occurs at present in neighbouring countries) and why the proportion of crops requiring methyl bromide in 2005 has increased substantially.The applicant should be encouraged to fully evaluate 1,3-D/Pic and other chemical and non chemical alternatives. Acreage has been significantly reduced by using substrates (75-80% of tomato and up to 100% of cucumber and sweet peppers). Reasons for not using substrates for remaining production are not given.
Belgium	CUN2003/007	-e	Cucurbits	5.48 t (1998)	0,61	(b)	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. No information. is supplied in the CUN on area to be treated in 2005. The CUN states that there are technical problems associated with the use of substrates, but these have not been specifically validated for curcubits and they are in use in neighbouring countries for the same crop. In view of the case presented, MBTOC is unable to support a recommendation although it is recognised that some potential alternatives are not registered.
Belgium	CUN2003/007	-f	Beans	0 t (1998)	0,23	(b)	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The application is a contingent application based on the justification that all uses that can be accomplished with other methods have already switched and that the remaining use (which has been assumed will expand dramaticlaly) is critical. The applicant states that fumigant alternatives are less effective at lower temperatures but does not provide comparative efficacy data. MBTOC is also unclear as to what proportion of these crops can be grown in substrates and why the proportion of crops requiring methyl bromide in 2005 has increased substantially. MBTOC has noted that applicant reports using 0t of MB for this crop in 2001and presented no justification for renewing use. The applicant should be encouraged to fully evaluate 1,3-D/Pic and other chemical and non chemical alternatives.
Belgium	CUN2003/007	-g	Radish	No data	0,14	(b)	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The application is a contingent application based on the justification that all uses that can be accomplished with other methods have already switched and that the remaining use (which has been assumed will expand dramaticlaly) is critical. No historical use of MB has been provided and the crop is not typically grown elsewhere with the aid of MB. The applicant states that fumigant alternatives are less effective at lower temperatures but does not provide comparative efficacy data. MBTOC is also unclear as to why the proportion of crops requiring methyl bromide in 2005 has increased substantially. Applicant should be encouraged to fully evaluate- chemical and non chemical alternatives.
Belgium	CUN2003/007	-h	Asparagus	No data	0,63	(b)	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. No amount of MB has been used (specified) historically. If the Party considers this application should be supported they would need to provide specific data for use of alternatives on asparagus as MBTOC has no other data to reference in support of the use of fumigation on this crop.
Belgium	CUN2003/007	-I	Strawberry fruit	4.05 t (1998)	3,4	(b)	3.4t	MBTOC recommends that up to 3.4t be approved for CUE contingent on the Party providing an update on the registration status of 1,3-D/Pic and provide evidience that substrates are not a technical alternative for production of strawberries under the specific circumstances of the nomination. Whilst significant data and information is lacking from the submission, MBTOC recognises that adequate technical alternatives may not be available for production of strawberries in the circumstances of the nomination but notes that substrate production is extensively used in neighbouring countries.
Belgium	CUN2003/007	-j	Orchard - pome fruit & berries	3.86 t (1998)	1,35	(b)	1.35t	MBTOC is unable to recommend a CUE on the basis of the available information, but notes that other Parties have made apparantly similar nominations that were supported by MBTOC. MBTOC thus recommends a CUE of 1.35t. The application is a contingent application based on the justification that all uses that can be accomplished with other methods have already switched and that the remaining use is critical. Applicant also points out that 2001 was an unusually low use year because growers were concerned that high rates of MB beneath VIF films may be phytotoxic. The applicant correctly states that soilless culture is a feasible alternative and that fumigant alternatives are less effective at lower temperatures but does not provide comparative efficacy data. MBTOC is unclear as to what proportion of this nomination is for orchards and fields suffering from Replant Disorder. Although MBTOC has identified Perennial Crop Replant Disorder as a problem for which alternatives to MB may be inadequate, it is not clear whether this is the situation represented by this nomination.

Party	CUN Number	(a)	Industry	Reported past use (unofficial)	Quantity nominated		Recom-mendation for 2005	Comment
					t/year	Years	Tonnes	
Belgium	CUN2003/007	-k	Chicory (Brussels witloof)	0.54 t (1998)	0,6	(b)	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The application is a contingent application based on the justification that all uses that can be accomplished with other methods have already switched and that the remaining use (which has been assumed will expand dramatically) is critical. Amount of MB requested is higher than used in 2001 with no clear justification of why this is necessary. The applicant states that fumigant alternatives are less effective at lower temperatures, but does not provide comparative efficacy data. MBTOC is also unclear as to why the proportion of crops requiring methyl bromide in 2005 has increased substantially. Applicant should be encouraged to fully evaluate chemical and non chemical alternatives.
Belgium	CUN2003/007	-l	Leek, onions	0 t (1998)	1,22	(b)	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. No amount of MB has been used (specified) historically. Fumigation is not used to grow leeks and onions in most regions of the world. If the Party considers this application should be supported they would need to provide specific data for use of MB and alternatives for leeks and onions as MBTOC has no other data to refer to to support the use of fumigation for this crop.
Belgium	CUN2003/007	-m	Celery	No data	0,56	(b)	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. No amount of MB has been used (specified) historically. If the Party considers this application should be supported they would need to provide specific data for use of MB and alternatives on celery as MBTOC has no other data to reference in support of the use of fumigation for this crop.
Belgium	CUN2003/007	-n	Cut flowers excl. roses and chrysanthemum	19.79 t (1998)	6,11	(b)	0t	MBTOC is unable to recommend this CUN. Significant attempts have not been made to reduce consumption of MB. Amount requested is higher than historical use (2001). MBTOC notes the R & D plan to reduce consumption of MB is restricted to biocontrol, but might cover a wider range of alternatives. Methods which avoid the need for MB (substrate production) are considered technically feasible by the applicant, however, industry needs to validate their use for each particular flower species. Reduced efficacy of metham sodium due to low temperatures may be overcome by improved application techniques (e.g. spading). MBTOC considers steam a technically feasible alternative for small scale use for protected crops.
Belgium	CUN2003/007	-o	Cut flowers-roses	4.37 t (1998)	1,64	(b)	0t	MBTOC is unable to recommend this CUN. Significant attempts have not been made to reduce consumption of MB. Amount requested is higher than historical use (2001). MBTOC notes the R & D plan to reduce consumption of MB is restricted to biocontrol, but might cover a wider range of alternatives. Methods which avoid the need for MB (substrate production) are considered technically feasible by the applicant. Reduced efficacy of metham sodium due to low temperatures may be overcome by improved application techniques (e.g. spading). MBTOC considers steam a technically feasible alternative for small scale use for protected crops.
Belgium	CUN2003/007	-p	Cut flowers-chrysanthemum	11.96 t (1998)	1,8	(b)	0t	MBTOC is unable to recommend this CUN. Significant attempts have not been made to reduce consumption of MB. Amount requested is higher than historical use (2001). MBTOC notes the R & D plan to reduce consumption of MB is restricted to biocontrol, but might cover a wider range of alternatives. Methods which avoid the need for MB (substrate production) are considered technically feasible by the applicant. Reduced efficacy of metham sodium due to low temperatures may be overcome by improved application techniques (e.g. spading). MBTOC considers steam a technically feasible alternative for small scale use for protected crops.
Belgium	CUN2003/007	-q	Ornamental plants	11.96 t 1998)	5,66	(b)	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. Significant attempts have not been made to reduce consumption of MB. Amount requested is higher than historical use (2001). MBTOC notes the R & D plan to reduce consumption of MB is restricted to biocontrol, but might cover a wider range of alternatives. Methods which avoid the need for MB (substrate production) are considered technically feasible by the applicant, however, industry needs to validate their use for each particular flower species. Reduced efficacy of metham sodium due to low temperatures may be overcome by improved application techniques (e.g. spading). MBTOC considers steam a technically feasible alternative for small scale use for protected crops in this region.
Belgium	CUN2003/007	-r	Nursery	1.44 t (1998)	not predictable	(b)	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. Applicant has not requested a specific amount of MB nor specified a land area, but has indicated the need as "unpredicatable". The CUN correctly states that soilless culture is a feasible alternative and that fumigant alternatives are less effective at lower temperatures but does not provide comparative efficacy and cost data. MBTOC is also unclear as to what proportion of these crops are for certified nursery production and what regulations apply to certified nurseries.
Belgium	CUN2003/007	-s	Tree nursery	3.86 t (1998)	0,23	(b)	0.23t	MBTOC recommends that 0.23t be approved, on the basis of evaluation of similar applications from other Parties. The amount nominated represents 88% reduction from the amount used in 2001. Although very little information is given in the application, MBTOC recognizes that propagation of healthy plant material is an area where many methyl bromide alternatives may be inadequate. MBTOC recognizes that some alternatives may not be registered and that cool soil temperatures impact efficacy of some alternatives.
Belgium	CUN2003/007	-t	All crops (yellow nutsedge)	No data	not predictable	(b)	(c)	MBTOC unable to recommend this nomination as presented, but requests the Party provides information on the status of herbicides registered to control this weed by crop and comparative data on the effectiveness of alternatives relative to MB to allow further evaluation of the nomination.

Party	CUN Number	(a)	Industry	Reported past use (unofficial)	Quantity nominated		Recom-mendation for 2005	Comment
					t/year	Years	Tonnes	
Canada	CUN2003/009		Strawberry runners	12.839t	7,952	2	8t	MBTOC recommends a CUE for 8t of MB be approved, based partly on evaluation of similar CUNs from other Parties.This nomination lacked comparative data to determine the technical feasibility of many alternatives, including plug plants, and their comparative performance compared to MB. The nomination does not consider the full range of chemical alternatives reported to be effective by MBTOC. The nomination also contains limited research (one private undisclosed study) to support claims and is relying on research in other countries to support the CUE. Whilst certification to acheive disease tolerance is assumed to be the reason for the CUN, the actual reason is not stated. MB is currently applied as 67:33 (MB/Pic) at 30 to 40 g/m2. MBTOC recommends that for open field use of MB after 2005, that emission reduction techniques, e.g. VIF, are used and a maximum rate of 30g/m2 of MB used unless it can be demonstrated a higher rate is needed.
France	CUN2003/010		Carrots - protected and field	7.7 t	10	4	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The CUN does not provide comparative data or references to technically validate that alternatives were ineffective and MBTOC is unable to use data from other Parties to assist evaluation because this was the only CUN involving carrot growing. MBTOC is unclear why the amount requested exceeds historic use.
France	CUN2003/013		Cucurbits - protected and field	206 t (1997)	85	4	(c)	MBTOC is unable to recommend a CUE on the basis of the available information. The industry presently uses MB/Pic (98:2) at rates of 60 g/m2 with VIF tarps. As submitted the CUN does not fully substantiate that no alternatives reported by MBTOC are technically appropriate. The CUN provides no analysed technical comparisons of efficacy of alternatives and avoids discussion of alternatives in combination. The CUN states that dazomet gave satisfactory results, but its efficacy is limited by low soil temperatures in the northern part of France. The CUN also states that chloropicrin and metham sodium give good control of weeds and fungi and that steam is applicable on light soils. MBTOC has further information which does not conform to the case presented. The alternatives, 1,3-D/Pic, chloropicrin, solarisation, biofumigants, grafting and their combinations are technically considered to be effective alternatives for cucurbit production in many climatic regions. Chloropicrin use is banned by local legislation. MBTOC recognises that some technically feasible alternatives are not registered in France and that significant attempts to reduce MB usage have been made through rate reduction and use of VIFs.
France	CUN2003/014		Forest nurseries	20 t (1998)	10		10t	MBTOC recommends a CUE for 10t of MB be approved, based partly on evaluation of similar CUNs from other Parties. This CUN represents 50% reduction of the reported usage of methyl bromide since 1995. A total of 20 hectares are crops that are grown outdoors. The industry presently uses MB/Pic (98:2) at a rate of 50g/m2 under VIF, though historically has used 70 g/m2. As submitted the application partially substantiates that all the possible alternatives reported by MBTOC are technically inappropriate, but insufficient detail on efficacy was given. Containerised plant systems apparantly present a non-MB option. The application states that dazomet gave satisfactory results, but its efficacy is limited by low soil temperatures in the northern part of France. Applicant also states that chloropicrin and metham sodium give good control of weeds and fungi and that steam is applicable on light soils. MBTOC is assuming that these alternatives have been considered in asking for a reduced amount in the nomination.
France	CUN2003/015		Orchard and raspberry nurseries	16 t (1997)	5	4	5t	MBTOC recommends a CUE for 5t of MB be approved, based partly on evaluation of similar CUNs from other Parties. This will allow allow the industry time to substantiate claims for CUE or implement existing or new alternatives which are under evaluation and development. The quantity of MB requested represents 70% reduction of the reported usage of methyl bromide in 1997. The industry presently uses MB/Pic (98:2 or 99.5:0.5) at rates of 50 g/m2 under VIF, but historically has used rates as high as 80 g/m2. MBTOCÕs 2002 Assessment has identified the level of disinfestation required for nursery certification as a problem for which alternatives to methyl bromide are generally inadequate. As submitted the application provides no analysed technical comparisons of efficacy of alternatives specifically for use in certified nurseries. The only trial results presented are from orchard replant trials. Significant attempts have been made to reduce consumption of MB by reducing the land area treated, and reducing the rates of MB application from 800 kg/ha to 500 kg/ha, through use of VIF tarps.
France	CUN2003/016		Cut flowers, bulbs - protected and open field	198 t (1998)	75	4	60t	MBTOC recommends that a reduced CUE of 60t of MB be approved, with the reduction on the basis of progressive adoption of identified alternatives (substrates, steam). MBTOC recognises that several technically feasible alternatives, particularly chloropicrin and chloropicrin mixtures, are not registered in France and that significant attempts to reduce MB usage since 1995 have been made. Conversion to production of crops in substrates was identified as a technically feasible alternative but it was stated that time was required (up to 5 years) to convert some crops. Steam is also a technically feasible alternative which has been made cost effective in similar cropping situations in some countries and it is recommended that the Party determine what proportion of MB could replaced by this treatment. A plan for adoption of MB alternatives might include implementation of substrate production for the different crops (species, cultivar).
France	CUN2003/017		Orchard - replant	53 t (1997)	25	4	25 t	MBTOC recommends that 25t be approved. MBTOC recognizes that perennial crop replant disease is a problem for which alternatives to MB are generally not adequately proven. MBTOC also acknowledges that the applicant has made significant reductions in use of MB since 1995 and that the request is a 55% reduction from the amount used in 2000. Orchard is strip treated at a reduced rate and VIF is applied. The main constraint to the adoption of alternatives is the inability to definitively identify what is causing replant disease.

Party	CUN Number	(a)	Industry	Reported past use (unofficial)	Quantity nominated		Recom-mendation for 2005	Comment
					t/year	Years	Tonnes	
France	CUN2003/018		Eggplant, pepper, tomato	452 t (1997)	150 (all solanaceous crops)	4	150 t	MBTOC recommends that 150t be approved, contingent on the use of emission reduction technologies e.g. VIF film and reduced dosage rates. MBTOC recognises that applicant has identified technically feasible alternatives such as 1,3-D/Pic and metham sodium by drip, but these are not registered. Significant attempts to reduce MB usage have been made by the Party. Applicant needs to provide a clearer phaseout plan for MB and specific CUE amounts required for each individual crop, including justification of why substrates and other non-MB technologies could not be used to grow at least part of the crop.
France	CUN2003/019		Strawberry - runners	100 t (1997)	40	4	40t	MBTOC recommends that 40t be approved. The CUN states that MB seems necessary to meet certification standards for plant hygiene. MBTOC acknowledges that France has a reduce range of alternatives available in practice, because products containing chloropicrin are not registered. The nomination did not provide comparative data that other alternatives do or do not provide the same disease tolerance threshold as MB. MBTOC is also unclear about the status of herbicides to control weeds. The applicant does not discuss the potential for plug plants produced in substrates and hydroponics to replace MB. MBTOC considers plug plants a possible alternative and Parties may wish to reduce the CUE quantity to take into account progressive adoption of this non-MB technology. MBTOC understands that further development is required before complete adoption is possible. The applicant has shown that MB amounts can be reduced by use of VIF, but indicates that they are difficult to use on a broad acre basis. MBTOC recognises the reduction in MB of over 50% since 1997 and encourages the applicant to consider further reductions in amounts by adopting better VIF films which substantially reduce emissions.
France	CUN2003/020		Strawberry fruit - protected and open field	200 (1997)	90	4	90t	MBTOC recommends that 90t be approved, on the basis that products containing chloropicrin do not become available before 2005. MBTOC acknowledges that France is in a difficult situation, because it can not use any products containing chloropicrin because they are not registered. France has accepted that 1,3-D/Pic is a feasible alternative and CUE should only be granted on the basis that France continue to seek registration of this product. This registration would also halve the amount of methyl bromide required for future CUN's. In spite of granting a CUE, the applicant fails to discuss the potential for substrates and hydroponics to replace MB. MBTOC understands that further development of substrates may be required before complete adoption is possible.
Greece	CUN2003/021			980 t (1997) All crops	300-350t (all crops)			MBTOC is unable to assess CUNs from this Party on the basis of the information provided. The specific quantity of MB needed for particular crops was not provided. Specific consideration of alternatives by crop is needed, preferably including comparative trials with alternatives. There are a number of clear alternatives to MB, including substrate production and metham sodium, with improved application techniques that are apparantly alternatives to the MB uses nominated.
Greece	CUN2003/021	-a	Beans - protected				(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The Party is requested to provide CUNs for individual crops. The CUN did not specify the quantity of MB requested for each crop. Specific consideration of alternatives is needed, preferably including comparative trials with alternatives. Production of beans (green or dried) is not typically carried out elsewhere with the aid of methyl bromide (but see CUNs 2003/007 and 2003/031).There are a number of clear alternatives to MB, including substrate production and metham sodium, with improved application techniques that are apparently alternatives to the MB uses nominated. The Party notes the availability of several alternatives.
Greece	CUN2003/021	-b	Cucurbits - protected				(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The CUN did not specify the quantity of MB requested for the crop. Specific consideration of alternatives is needed, preferably including comparative trials with alternatives. Production of curcubits in protected cultivation is carried out elsewhere without the aid of methyl bromide.There are a number of clear alternatives to MB, including substrate production and metham sodium, with improved application techniques that are apparently alternatives to the MB uses nominated. The Party notes the availability of several alternatives.
Greece	CUN2003/021	-c	Eggplant - protected				(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The CUN did not specify the quantity of MB requested for the crop. Specific consideration of alternatives is needed, preferably including comparative trials with alternatives. Production of curcubits in protected cultivation is carried out elsewhere without the aid of methyl bromide.There are a number of clear alternatives to MB, including substrate production and metham sodium, with improved application techniques that are apparently alternatives to the MB uses nominated. The Party notes the availability of several alternatives.
Greece	CUN2003/021	-d	Peppers - protected				0t	MBTOC is unable to recommend this CUN, on the basis partly of evaluation of similar CUNs by other Parties. The Party did not state the requested MB tonnage for peppers. At a national level MB reductions have been made by the introduction of VIF and reduced doses (25-30 g/m2). The applicant identified, Meloidogyne incognita, as the only target pest relevant to pepper. Combinations of registered products in Greece would appear feasible. According to the applicant, registered products include 1,3-D (including EC formulation), oxamyl, cadusafos, fosthiazate, fenamiphos, dazomet, sodium tetrathiocarbonate and these should be sufficient to control Meloidogyne in the absence of methyl bromide. Substrates are technically effective for protected crops in Mediterranean regions, although investment costs may present a barrier.

Party	CUN Number	(a)	Industry	Reported past use (unofficial)	Quantity nominated		Recom-mendation for 2005	Comment
					t/year	Years	Tonnes	
Greece	CUN2003/021	-e	Strawberry - protected				(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The CUN did not specify the quantity of MB requested for the crop. Specific consideration of alternatives in relation to this crop is needed, preferably including comparative trials with alternatives. There are a number of clear alternatives to MB, including substrate production and metham sodium, with improved application techniques, that are apparantly alternatives to the MB uses nominated. The Party reports very good results with several chemical alternatives, but does not indicate why these cannot be used. A 1-3D/Pic mixture has been recently registered but no validation trials with this alternative are presented.
Greece	CUN2003/021	-f	Tomato - protected			?	(c)	MBTOC is unable to recommend a CUE on the basis of the available information. The CUN did not specify the quantity of MB requested for the crop. Specific consideration of alternatives in relation to this crop is needed, preferably including comparative trials with alternatives. There are a number of clear alternatives to MB, including substrate production and metham sodium, with improved application techniques that are apparantly alternatives to the MB uses nominated. The Party reports very good results with several chemical alternatives that are registered in Greece (e.g. 1,3-D, metham sodium, dazomet, oxamyl, cadusafos, fosthiazate, femaniphos, sodium tetrathiocarbonate), but does not indicate why these cannot be used. The Party's research on protected tomato production concluded that 1,3-D, metam (injected) and dazoment combined with other treatments (eg.cadusafos or oxamyl) provided good control of nematode populations including root knot nematode. At a national level MB reductions have been made by the introduction of VIF and reduced doses (25-30 g/m2).
Israel	CUN2003/022							MBTOC is unable to recommend a CUE for any nominations from this Party, as insufficient information was available for full evaluation. No comparative data or references are available to validate the performance of alternatives against MB. Although MBTOC recognises that local restrictions on the use of major alternatives to MB, chloropicrin (large buffer zones) and 1,3-D/Pic (groundwater restrictions), mean that some MB may be justified, information is insufficient to determine this amount. For most of the crops in this nomination, only a limited number of alternatives are considered.
Israel	CUN2003/022	-a	Cut flowers - protected	700 t	175	4	(c)	MBTOC is unable to recommend a CUE on the basis of the available information, but notes that similar CUNs by other Parties hve been suported at reduced allocations or not recommended on the basis of availability of alternatives. In spite of significant data and information gaps, MBTOC recognises that the Party faces registration and regulatory constraints with typical chemical alternatives used elsewhere, e.g. 1,3-D is not registered and chloropicrin use is prohibited in populated areas. Attempts to reduce consumption of MB by changing formulations, rates, etc. are not described, although total consumption has apparently decreased and significant effort have been made to reduce emissions through mandatory adoption of VIF tarps. Further replicated research trials (e.g. with substrates, steam, as appropriate) should be conducted to generate data to substantiate/refute claims and support/deny resubmission for further rounds of CUNÕs. Specific crops (flower types) and problems should be identified and amounts of MB needed for each case indicated.
Israel	CUN2003/022	-b	Melon -protected & field	700 t	315	4	(c)	MBTOC is unable to recommend a CUE on the basis of the available information. In spite of significant data and information gaps, MBTOC recognises that the Party faces registration and regulatory constraints with typical chemical alternatives, e.g. 1,3-D is not registered and chloropicrin use is prohibited in populated areas. MBTOC acknowledges that specific diseases in open fields in Israel form the basis of the CUN (e.g. control of *Monosporascus cannonballus* and *Fusarium oxysporum*). However, insufficient discussion on alternatives, especially the use of resisitant varieties, has been given. No discussion is given on the suitability of substrates for melon production. Attempts to reduce consumption of MB by changing formulations, rates, etc. are not described, although total consumption has apparently decreased and significant effort have been made to reduce emissions through mandatory adoption of VIF tarps. Further information on alternatives is required to generate data to substantiate/refute claims and support/deny resubmission for further rounds of CUNs.
Israel	CUN2003/022	-c	Potato	600 t	385		(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. Although not stated it was assumed that the request was for potato seed. It is not possible to determine to what extent crop losses are incurred on a given hectare and how much this represents of the total crop grown. Where insufficient information. was provided MBTOC attempted to use information. from other CUNs but this was a unique CUN and therefore a recommendation could not be made. The Party is requested to further justify why the CUN is for a unique situation requiring use of MB as potatoes are grown elsewhere without the use of MB .
Israel	CUN2003/022	-d	Propagation material	120 t	85	10	(c)	MBTOC is unable to recomment a CUE on the basis of the available information. The CUN represents a 42% reduction of the reported historical usage of methyl bromide. As submitted the application does not define what is meant by propagation materials, what type of propagation materials are involved nor if these are certified nursery materials. No information is given on the cropping system (open field, protected, etc.), on the alternatives evaluated, or data on results of these evaluations. The CUN has stated that all alternatives tested are inferior to methyl bromide in cool soil conditions and that phytotoxicity due to short plant-back times are a concern. No discussion was given as to suitability of substrate production as an MB alternative. MBTOC notes that significant attempts have been made to reduce consumption of MB by reducing rate of application to 50 g/m2 and to reduce emissions by use of VIF tarps.

Party	CUN Number	(a)	Industry	Reported past use (unofficial)	Quantity nominated		Recom-mendation for 2005	Comment
					t/year	Years	Tonnes	
Israel	CUN2003/022	-e	Strawberries - runners & fruit, protected and open field	250 t	140	3	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The CUN is a combined submission for both open fields and greenhouses and covers both nursery and fruit production without providing specific information. about individual industries and situations. No characteristics about nursery productiuon are provided and no detailed technical information. about alternatives are given. MBTOC notes that CUNs applying to apparantly similar applications have been submitted by other Parties.
Italy	CUN2003/023		Eggplant - protected	582 t (1995) 300 t (2001)	280t	4	137.2t	MBTOC recommends that a reduced CUE of 137.5t of MB be approved, to allow time for recently registered alternatives to be deployed. MBTOC is unclear if 1,3-D/Pic is registered or being registered for this CUN. CUE is recommended and calculated on the basis that the industry uses VIF films to minimise emissions and does not exceed 30g/m2 for MB/Pic formulations and 60g/m2 for hot gas MB. MBTOC considers that further dosage reductions may be possible by the adoption of MB/Pic formulations with lower doses of MB (eg. 70:30, 67:33 and 50:50). MBTOC noted the Party's efforts in reducing MB usage and emissions.
Italy	CUN2003/024		Melon - protected	498 t (1995) 257 t (2001)	180	4	88.2t	MBTOC recommends that a reduced CUE of 88.2t of MB be approved, to allow time for recently registered alternatives to be deployed. CUE is recommended and calculated on the basis that the industry uses VIF films to minimise emissions and does not exceed 30g/m2 for MB/Pic formulations and 60g/m2 for hot gas MB. Clarification of the registration status of chloropicrin and 1,3-D/Pic for this CUN is sought. MBTOC considers that further dose reductions may be possible by the adoption of MB/Pic formulations with lower doses of MB (eg. 70:30, 67:33 and 50:50). MBTOC noted the Party's efforts in reducing MB usage and emissions.
Italy	CUN2003/025		Cut flowers, bulbs - protected	594 t (1995) 302 t (2001)	250	1	105t	MBTOC recommends that a reduced CUE of 105t of MB be approved, to allow time for recently registered alternatives to be deployed. CUE is recommended and calculated on the basis that the industry uses VIF films to minimise emissions and does not exceed 30g/m2 for MB/Pic formulations and 60g/m2 for hot gas MB. MBTOC notes that substrate culture is widely used for cut flower production. MBTOC considers that further dose reductions are possible by the adoption of MB/Pic formulations with lower doses of MB (eg. 70:30, 67:33 and 50:50). Clarification of the registration status of chloropicrin and 1,3-D/Pic as alternatives is sought. MBTOC noted the Party's efforts in reducing MB usage and emissions. Party should specify amounts needed for each flower species or group. The Party is requested to clearly identify why substrates, steam and resistant varieties (particularly in the case of fusarium wilt) are not technically suitable, especially when used within an IPM approach.
Italy	CUN2003/026		Pepper - protected	781 t (1995) 290 t (2001)	220	1	0t	MBTOC is unable to recommend this CUN. MBTOC notes MB use has been reduced using VIF and 2 year intervals between applications (doses are 50 g/m2, MB/Pic 98:02). Several alternatives/combinations appear to be are available in Italy for controlling the target pests (Meloidogyne spp. and fungal pathogens) in protected peppers. The CUN notes that chloropicrin and 1,3-D are registered separately, and 1,3-D/Pic is registered for greenhouses and being adopted by commercial fumigators. MBTOC notes that Italy has pepper varieties resistant to Meloidogyne (some at high soil temperature). Italian authors have noted the efficacy of metam or dazomet + 2-3 week solarisation, and that nematicides provide effective control of nematodes in Italy . Substrates are technically feasible in Mediterranean regions.
Italy	CUN2003/027	-a	Strawberry- runners	100 t (2001)	100	1	50t	MBTOC recommends a reduced quantity of 50 t of MB be approved, to allow time for recently registered alternatives to be deployed. The reduction has been calculated on the basis that emission reduction strategies are adopted, with associated dosage reduction, use of fumigant mixtures with a reduced concentration of MB and progressive adoption of alternatives. In some protected environments, where hot gas MB/Pic 98:2 may be the only option available, a maximum rate of 60g/m2 has been used to calculate recommended CUE amounts. CUN2003/026 notes that chloropicrin and 1,3-D are registered separately, and 1,3-D/Pic is registered for greenhouses and being adopted by commercial fumigators.. MBTOC recognises efforts made by Party to reduce MB use and emissions. Substrates and hydroponic production are technically feasible alternatives in similar climatic regions to this CUN.
Italy	CUN2003/027	-b	Strawberry - fruit	1502 t (1995) 603 t (2001)	510	1	255t	MBTOC recommends a reduced quantity of 255 t of MB be approved as a CUE. The reduction has been calculated on the basis that emission reduction strategies are adopted, with associated dosage reduction and use of fumigant mixtures with a reduced concentration of MB and progessive adoption of alternatives. In some protected environments, where hot gas MB/Pic 98:2 may be the only option available, a maximum rate of 60g/m2 has been used to calculate recommended CUE amounts. Clarification of the registration status of chloropicrin and 1,3-D/Pic is sought. MBTOC recognises efforts made by the Party to reduce MB use and emissions. Substrates and hydroponic production are technically feasible alternatives in other similar climatic regions.

Party	CUN Number	(a)	Industry	Reported past use (unofficial)	Quantity nominated		Recom-mendation for 2005	Comment
					t/year	Years	Tonnes	
Italy	CUN2003/028		Tomato - protected	1500 t (2001)	1300	1	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. MBTOC is unable to verify the specific circumstances for which MB is requested, because regions are aggregated in this nomination. MBTOC notes that dosage rates of methyl bromide have increased from former rates. A reduction in the area cropped to tomatoes has not been reflected by a reduction in MB use. The CUN notes that chloropicrin and 1,3-D are registered separately, and 1,3-D/Pic is registered for greenhouses and being adopted by commercial fumigators. Substrates, hydroponic production, grafted plants and alternative fumigant(s) are technically feasible alternatives for this crop in similar climatic regions to that for this CUN, though this CUN notes water supply may limit substrate use.
Japan	CUN2003/029	-a	Melon	188 t (1998)	94,5	3	47.3t	MBTOC recommends a reduced quantity of 47.3t of MB be approved as a CUE, to take into account a maximum rate of 30 g/m2, the use of VIF and the use of mixtures of MB/Pic (67:33). The quantity of MB nominated is 75% of current use. Resistant varieties have inferior yield qualities. MBTOC considers that MB/Pic mixtures (67:33, 50:50) may be technically suitable. MBTOC notes that there is no use of soilless culture, an MB alternative typically adopted elsewhere. A number of viruses occur in single, double and triple cropped cucurbit varieties in Japan. Control is dependent on rapid penetration of MB through soil, often treatment is in cool conditions, and no alternatives are reportedly effective.
Japan	CUN2003/029	-b	Watermelon	92 t (1998)	71,4	3	35.7t	MBTOC recommends a reduced quantity of 35.7t of MB be approved as a CUE, to take into account a maximum rate of 30 g/m2, the use of VIF and the use of mixtures of MB/Pic (67:33). The quantity of MB nominated is 75% of current use. Resistant varieties have inferior yield qualities. MBTOC considers that MB/Pic mixtures (67:33, 50:50) may be technically suitable. MBTOC notes that there is no use of soilless culture, an MB alternative typically adopted elsewhere. A number of viruses occur in single, double and triple cropped cucurbit varieties in Japan. Control is dependent on rapid penetration of MB through soil, often treatment is in cool conditions, and no alternatives are reportedly effective.
Japan	CUN2003/029	-c	Peppers - protected	112 t (1998)	74,1	3	37.0t	MBTOC recommends a reduced quantity of 37.0t of MB be approved as a CUE, to take into account a maximum rate of 30 g/m2, the use of VIF and the use of mixtures of MB/Pic (67:33). The quantity of MB nominated is 75% of current use. Resistant varieties have inferior yield qualities. MBTOC considers that MB/Pic mixtures (67:33, 50:50) may be technically suitable. MBTOC notes that there is no use of soilless culture, an MB alternative typically adopted elsewhere. The CUN does not consider steam (known to be effective for some viruses) and substrates as potential alternatives to MB. The CUN noted that dry heat treatment of seed gave good but not perfect results, but does not provide comparative data with MB. Japanese research has identified two sweet pepper cultivars resistant to PMMoV.
Japan	CUN2003/029	-d	Cucumber	42.4 t (1998)	39,4	3	19.7t	MBTOC recommends a reduced quantity of 19.7t of MB be approved as a CUE, to take into account a maximum rate of MB application, the use of VIF and the use of mixtures of MB/Pic (67:33). The quantity of MB nominated is 75% of current use. Resistant varieties have inferior yield qualities. MBTOC considers that MB/Pic mixtures (67:33, 50:50) may be technically suitable. MBTOC notes that there is no use of soilless culture, an MB alternative typically adopted elsewhere. A number of viruses occur in single, double and triple cropped cucurbit varieties in Japan. Control is dependent on rapid penetration of MB through soil, often treatment is in cool conditions, and no alternatives are reportedly effective.
Portugal	CUN2003/031							MBTOC is unable to assess CUNs from this Party in its entirity on the basis of the available information. Specific consideration of alternatives by crop is needed, preferably including comparative trials with alternatives. There are a number of clear alternatives to MB, including substrate production and metham sodium, with improved application techniques that are apparantly alternatives to at least some of the MB uses nominated.
Portugal	CUN2003/031	-a	Strawberry - protected and open field		30	4	15t	MBTOC recommends this CUN on the basis of similar CUNs by other Parties, with a reduced allocation of 15t on the basis of use of reduced dosages of MB (30 g/m2) in conjunction with VIF films. The industry presently uses MB/Pic (98:2) at high rates in the range from 65 g/m2 to 80 g/m2. Application method is not stated.
Portugal	CUN2003/031	-b	Cut flowers - protected and open field		130	4	50t	MBTOC recommends this CUN on the basis of similar CUNs by other Parties, with a reduced allocation of 50t on the basis of use of reduced dosages of MB in conjunction with VIF films. The industry presently uses MB/Pic (98:2) with VIF but at a very high rate (80 g/m2). Application method is not stated.The application states that particularly the flower market is growing due to increasing national and international interest and investments in this sector, motivated by a most favourable combination of both climatic and environmental conditions. About 14% of growing area is MB treated, but the CUN does not indicate what proportion of this area is suitable for recognised alternatives such as substrate culture.
Portugal	CUN2003/031	-c	Tomato- protected and open field		20	4	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The industry presently uses MB/PIC (98:2) at high rates of 70 g/m2. Application method is not clear. From other CUNs and MBTOC information. there appear to be a number of alternatives for this crop and situation, together with scope for substantial reduction in MB use when combined with emission control technologies or formulation changes.

Party	CUN Number	(a)	Industry	Reported past use (unofficial)	Quantity nominated		Recom-mendation for 2005	Comment
					t/year	Years	Tonnes	
Portugal	CUN2003/031	-d	Peppers - protected and field		5	4	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The industry presently uses MB/PIC (98:2) at high rates of 70 g/m2. Application method is not clear. From other CUNs and MBTOC information. there appear to be a number of alternatives for this crop and situation, together with scope for substantial reduction in MB use when combined with emission control technologies or formulation changes. The CUN does not provide technical comparisons of efficacy of alternatives. The CUN notes that an alternative, 1,3-D/metham sodium, is cheaper than MB. Substrates are technically effective for protected crops including peppers in Mediterranean regions. Portugese experts notes that steam is technically effective but the investment cost may be a barrier.
Portugal	CUN2003/031	-e	Watermelon - protected and open field		4	4	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The industry presently uses MB/PIC (98:2) at high rates of 70 g/m2. Application method is not clear. From other CUNs and MBTOC information. there appear to be a number of alternatives for this crop and situation, together with scope for substantial reduction in MB use when combined with emission control technologies or formulation changes.
Portugal	CUN2003/031	-f	Melon - protected		5	4	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The industry presently uses MB/PIC (98:2) at high rates of 70 g/m2. Application method is not clear. From other CUNs and MBTOC information. there appear to be a number of alternatives for this crop and situation, together with scope for substantial reduction in MB use when combined with emission control technologies or formulation changes.
Portugal	CUN2003/031	-g	Green bean - protected and open field		3	4	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The basis for the CUE is not clear - the CUN is for the control of aerial diseases (Alternaria, Cladosporium, Botrytis) that are not normally controlled with MB or other soil fumigants.
Portugal	CUN2003/031	-h	Cucumber - open field		3	4	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The stated basis for the CUN, control of foliar diseases, are not normally a target for MB and can be controlled by other means. Feasibility of alternatives has not been validated, although the CUN states that two (unidentified) alternatives may be available. The rates of MB used with VIFappear excessive.
Spain	CUN2003/032		Strawberry runners	406 t (1998)	230	2+	230 t	MBTOC recommends that 230t of MB be approved. The CUN states that MB is required to meet EU certification standards and local regulations, but does not provide data that other alternatives do not provide adequate disease control to meet the standard. The CUN has presented results which show a number of alternatives are technically feasible for pathogen control, but most generally fail to give adequate weed control. MBTOC is unclear about the status of herbicides to control weeds. MBTOC considers plug plants grown in hydroponics a possible alternative, but time and cost appears to be preventing the adoption of this technology. MBTOC understands that further development is required before complete adoption is possible. The CUN indicates that the most promising alternative for open field production of nursery plants, a 1,3-D/Pic mixture, has been quite successfully used in combination with VIF films. The CUn states VIF films are difficult to use on a broad acre basis. The industry is to be commended on already reducing amounts by adoption of 50:50 mixtures, the use of 20-40g/m2 of MB and is encouraged to further reduce amounts by adopting improved emission control technology.
Spain	CUN2003/033		Cut flowers (Cadiz & Seville) - protected	est. 2150 t (1998)	53	ndefinite	53 t	MBTOC recommends that 53t of MB be approved. The CUN provided data and references which show that a number of alternatives which MBTOC considers are technically suitable have failed to give consistent results.The Party is requested to show why substrate production and use of resistant varieties are also technically suitable, particularly when used within an IPM approach. MBTOC recognises the very substantial reduction of MB use from high historical levels and also of emissions by adoption of MB/Pic mixtures (67:33), low rates (10g/m2 MB) and VIF films.
Spain	CUN2003/034		Cut flowers (Catalonia) - carnation, protected and open field	23 - 47t	20	ndefinite	20t	MBTOC recommends that 20t of MB be approved. MBTOC recognises the very substantial reduction of MB use from high historical levels and also of emissions by adoption of MB/Pic mixtures (e.g. 67:33), low rates (10g/m2 MB) and VIF films.The CUN does not give evidence that the alternatives for this use are inappropriate in the circumstances of this nomination. In particular, MBTOC notes substrates are used in other major carnation production regions around the world, metham sodium, steam and resistant varieties have also been found technically suitable, particularly when used within an IPM approach.
Spain	CUN2003/035		Strawberry fruit - open field	1846 t (1998)	556	1?	556 t	MBTOC recommends a CUE of 556t, contingent on the non-availability of alternatives, notably 1,3-D/Pic. The Party may wish to reduce its nomination to account for phasing in of alternatives prior to 2005. MBTOC notes that there are several technical feasible alternatives for this use, but they may require time to introduce into the industry. Since 1998, the industry has also made major reductions in the use and emissions of MB by adoption of MB/Pic mixtures (50:50%), VIF films and low rates (10.6 g /m2 MB).

Party	CUN Number	(a)	Industry	Reported past use (unofficial)	Quantity nominated		Recom-mendation for 2005	Comment
					t/year	Years	Tonnes	
Spain	CUN2003/036		Peppers - protected	574 t (1998)	300 t (98:2) or 200 t (67:33)	1?	150 t	MBTOC recommends a CUE of 150t, contingent on the non-availability of alternatives, notably 1,3-D/Pic. The Party may wish to reduce its nomination to account for phasing in of alternatives prior to 2005. The CUN states that a particular formulation of 1,3-D/Pic may also be as effective as MB and has been adopted at commercial level in Spain for peppers. 1,3-D/Pic + grafted plants give good results similar to MB. MBTOC acknowledges that the industry has also made major reductions in the use and emissions of MB by adoption of MB/Pic mixtures (50:50), VIF films and low rates (10.6 g/m2 MB). Several alternatives are available for peppers in Spain. Substrates are used for 10% of production of peppers, usually with greater yield than MB.
UK	CUN2003/039		Ornamental tree nurseries	20 t (1998)	12	1	6t	MBTOC recommends that a reduced allocation of 6t be approved, with the reduction on the basis of use of VIF with lowered rates of MB, possibly in conjunction with chloropicrin. MBTOC has determined that the propagation of healthy plant propagation material is an area where methyl bromide alternatives may not be fuly effective and thus supports this CUN. The industry presently uses MB/Pic (formulation not stated) at rates of 75-100 g/m2. Significant attempts have been made to reduce emissions by adoption of VIF tarps and deep injection.The higher than normal rates may be necessary because of the depth of soil treatment involved. Containerised plant systems would appear to be technically feasible alternatives for this CUN. As submitted, the CUN partially substantiates that most of the possible alternatives reported by MBTOC are technically inappropriate, but does not discuss substrates and steaming.
UK	CUN2003/040		Strawberries & raspberrries - fruit	185 t (1998)	80	2	68t	MBTOC recommends that a reduced allocation of 68t be approved for this CUE, on the basis of reduced dosage rates being used. The CUN states that dazomet, metham sodium, and 1,3-D can give good control, but approval would need to be sought for use in combinations as presently mixtures are not registered in the UK. Applicant states that substrates have been tried commercially but they are considered uneconomic.The CUN relies heavily on overseas studies for its conclusions. Significant attempts have been made to reduce emissions by adoption of VIF tarps, treatment of beds rather than broadacre treatments and deep injection.
USA	CUN2003/049		Cucurbits - field	1267 t (1998)	1187,8	3	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. This nomination did not give comparative data, except some yields, to determine the technical feasibility of many alternatives and their comparative performance compared to MB under the circumstances of the nomination. The nomination states that metham sodium is a technical alternative for southern US States with low to moderate nutgrass pressure and requests MB be given a CUE for 25% of production of the total US crop. The nomination does not discuss key alternatives reported by MBTOC, e.g. 1,3-D/Pic and grafting, and does not explain why herbicides cannot be used for control of nutgrass, the main reason for use of MB in southeastern USA (representing 98% of that requested). Although there has been a change from 98% to 67% MB in formulations to date, no further plan has been presented to reduce emissions.
USA	CUN2003/050		Eggplant - field	191 t (1998)	73,6	1	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. This nomination did not give comparative data, except some yields, to determine the technical feasibility of many alternatives and their comparative performance compared to MB under the circumstances of the nomination. The nomination does not discuss key alternatives reported by MBTOC. MBTOC notes that control of nutgrass is difficult where herbicides or other measures cannot be used and there are areas where alternatives are not available through local restrictions (e.g. township caps). Although there has been a change from 98% to 67% MB in formulations to date, no further plan has been presented to reduce emissions. MBTOC has recommended that MB for a CUE be applied with VIF films or other emission reduction technology, combined with reduced rates of MB..
USA	CUN2003/052		Forest nursery seedlings	545.5 t (1998)	192,515	1	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. This nomination did not give comparative data to determine the technical feasibility of many alternatives and their comparative performance compared to MB under the circumstances of the nomination. The CUN finds that two chemical alternatives are considered technically feasible, but does not discuss the feasibility of utilising substrates and containerised plants for forest seedling production. Containerised plant systems are quite widely in use.
USA	CUN2003/053		Ginger production - field	44 t (1998)	9,2	1*	9.2t	MBTOC recommends a CUE be approved for 9.2t of MB. This crop is grown under unusual terrain and can be considered a minor crop where research is lagging. Time is needed to technically evaluate application methods for alternative fumigants and other alternatives. CUE is recommended on the basis that the industry uses systems to minimise emissions and does not exceed 30g/m2 of MB (present use 42g/m2).
USA	CUN2003/055		Fruit tree nurseries	230 t (1998)	45,789	1*	45.8t	MBTOC recommends a CUE for 45.8t of MB be approved, based partly on evaluation of similar CUNs from other Parties.The CUN notes that use of a particular alternative be restricted because of local regulations and technical efficacy on heavy textured soils. The CUN contained no references to support lack of efficacy of alternatives compared to methyl bromide. The nomination also states that MB is required to treat substrates in the citrus industry, but does not explain why steaming and soilless substrates (containerisation) have not been considered a technical option for seedling production and tree production outdoors. Although there has been a change from 98% to 67% MB in formulations to date, no further plan has been presented to reduce emissions. MBTOC has recommended that MB for a CUE be applied with VIF films or other emission reduction technology, combined with reduced rates of MB.

Party	CUN Number	(a)	Industry	Reported past use (unofficial)	Quantity nominated		Recom-mendation for 2005	Comment
					t/year	Years	Tonnes	
USA	CUN2003/056		Orchard replant	1691 t (1998)	706,176	1*	706.2t	MBTOC recommends that 706.2t be approved for this CUN . Whilst it was difficult to make a recommendation based on the lack of technical data provided or references for the specifc crops in the nomination, MBTOC noted that the industry is aware of the technically available alternatives and appears to be making an effort to adopt these alternatives. Three alternatives,1,3-D alone or 1,3-D combined with chloropicrin or metham sodium were considered to be technical alternatives in the CUN for treatment in light soils. The nomination appears to take this into account when calculating the nominated quantity of MB.
USA	CUN2003/057		Chrysanthemum cuttings - rose plants (nursery)	246 t (1998)	29,412	2	14.7t	MBTOC recommends that a reduced allocation of 14.7t be approved for this CUN, on the basis that feasible alternatives are available for chrysanthemum cuttings (e.g. substrates) and adoption of reduced dosages with emission control strategies. MBTOC noted that the industry is aware of the technically available alternatives and appears to be making an effort to adopt these alternatives. From the case presented MBTOC is unable to recommend a CUE for chrysanthemums as steaming and production in substrates are technically and economically feasible. Roses are successfully grown in substrates worldwide. The Party may wish to recalculate the nomination on the basis of use of reduced MB dosages combined with emission control technologies, and availability of alternatives.
USA	CUN2003/058		Peppers - field	1943 t (1998)	1085,3	1*	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. MBTOC notes that a number of alternatives are in commercial use for this crop and seeks further information. on the applicability of these alternatives, noting that the availability may be restricted by local regulations.
USA	CUN2003/059		Strawberry fruit - field	2757 t (1998)	2468,87	1*	(c)	MBTOC is unable to recommend a CUE on the basis of the available information, but notes that control of nutgrass is difficult where herbicides or other measures cannot be used and there are areas where alternatives are not available through local restrictions (e.g. township caps). As confirmed by the CUN, MBTOC suggests that 1,3-D combined with either chloropicrin or metham sodium are feasible alternatives to MB in the circumstances of the nomination. To date over 10% of the industry has already converted to the use of formulations of 1,3-D/Pic in some regions. MBTOC recognises that application issues, plant back times and reliability restrict adoption of other fumigant alternatives by the industry.
USA	CUN2003/060		Strawberry runners	313 t (1998)	54,988	1*	55t	MBTOC recommends that 55t be approved. MBTOC notes that the applicant has not technically verified that any alternatives are feasible. The CUN states that MB is required to meet certification standards, but does not provide data that other alternatives do not provide the same disease tolerance threshold to satisfy these standards. The CUN also does not consider plug plants grown in hydroponics a possible alternative, but MBTOC considers this technology a technically feasible alternative, but understands that further development is required before complete adoption is possible. The Party may wish to reduce the CUN to account for plug plant development as an alternative. The industry already uses low dosage rates of MB and is encouraged to try to further reduce amounts by adopting further emission control technology and MB formulations with lower rates of MB (e.g. MB/Pic 50:50).
USA	CUN2003/061		Sweet potato - field	246 t (1998)	224,528	1*	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The CUE is based on a contingency of double the land use requiring fumigation with MB. Where insufficient information. was given by a country for a specific crop in this round of CUE, MBTOC attempted to fill in the missing data on alternatives or lack of them wherever possible using MBTOC's technical knowledge or if considered relevant data provided by other applicants from other countries. However, this is the only CUE submitted for MB use on sweet potatoes. The CUN has provided information. suggesting that alternatives may be available for 2005 cropping season.
USA	CUN2003/062		Tomato - field	4,495 t (1998)	2865	2	(c)	MBTOC is unable to recommend a CUE on the basis of the available information, but notes that control of nutgrass is difficult where herbicides or other measures cannot be used and there are areas where alternatives are not available through local restrictions (e.g. township caps). It is also requested that the Party calculate the revised amount consistent with the use of low dosages of methyl bromide in formulations such as MB/Pic (67:33 or 50:50). The nomination noted that a range of alternatives were considered technically feasible for areas of low inoculum levels of pathogens and weeds (e.g. 1,3-D/Pic and metham sodium). Formulations of metham sodium are proving effective at least in some regions.
USA	CUN2003/063		Turfgrass	600 t turf growing (1998), 102 t golf courses (1998)	352,194	1*	(c)	MBTOC is unable to complete its evaluation of this CUN on the basis of available information. The nomination covers several uses of MB, including the establishment and maintenance of golf courses, and production of turfgrass sod. Some or all of the sod may be certified, although no supporting documentation was provided about the certifcation tolerance requirements. An unspecified quantity of MB is reported to be used as a quarantine treatment for red fire ants in sod. Insufficient information. was provided to enable MBTOC to judge whether this might be a QPS treatment. It is requested that these differing uses of MB be disaggregated and the amounts presented as separate CUNs. In the case of golf course maintenance, some technically feasible alternatives have been reported. The nominated quantity may be revised in consideration of adoption of emission reduction strategies.

Footnotes:

(a) CUN index after disaggregation.

(b) not stated or indefinite

(c) evaluation not completed, pending further clarification sought from the nominating Party

Appendix B: Evaluation of Critical Use Nominations – Post Harvest & Structures

Party	CUN Number	Industry	Type	Quantity nominated		Recommen-dation for 2005	MBTOC recommendation* for the critical uses of methyl bromide for the specific circumstances described by the applicant
				t/year	Years	Tonnes	
Australia	CUN2003/004	Rice	Commodity	12,3	3	12,3	MBTOC recommends that 12.3 tonnes be approved. MBTOC noted that there were no technically feasible alternatives for the specific circumstances of this nomination. The Party is requested to clarify details of reduced dosages to be used, and reduced quantities of commodity to be fumigated
Canada	CUN2003/008	Pasta and Flour Mills	Structures	47,2	2	47,2	MBTOC recommends that 47.2 tonnes be approved. MBTOC noted more than 50% of the Canadian mills were reported not to use MB and that there were technically feasible alternatives apparantly available. The one alternative, regarded as promising by industry, is not yet registered. The Party is requested to ensure that the CUE is restricted to those premises unable to use the alternatives.
France	CUN2003/012	Old buildings and artefacts	Structures and objects	8	4	0	MBTOC was unable to recommend this CUN. Alternatives are available for this use.
France	CUN2003/012	Mills and Processors	Structures	55	4	55	MBTOC recommends that 55 tonnes be approved, conditional on confirmation that the use will be resrticted to those structures unable to be treated with available alternatives.
France	CUN2003/012	Chestnuts	Commodity	2,0	4	2,0	MBTOC recommends that 2.0 tonnes be approved. MBTOC noted that there were no technically feasible alternatives for this use.
France	CUN2003/011	Commodities other than rice	Commodity	8,0	4	(a)	MBTOC was unable to complete its evaluation of this CUN on the basis of available information. MBTOC considered that technically feasible alternatives are available for most commodities in the application but that there may be some commodities in some situations that do not have alternatives.
France	CUN2003/012	Rice	Commodity	2,0	4	2,0	MBTOC recommends that 2.0 tonnes be approved. MBTOC noted that there were no technically feasible alternatives for the specific circumstances of this nomination.
Japan	CUN2003/029	Chestnuts	Commodity	4,6	1	4,6	MBTOC recommends that 4.6 tonnes be approved. MBTOC noted that there were no technically feasible alternatives for this use.
Netherlands	CUN2003/030	Cut flowers (postharvest)	Commodity	1,2	1	0	MBTOC is unable to recommendthis nomination for a CUE, as it is likely that some or all of the quantity requested is likely to be exempt from control under the QPS exemption. Additional information is sought to clarify the status of the MB use. No alternatives were considered.
United Kingdom	CUN2003/037	Food storage (dry goods)	Structures	1,1	2	1,1	MBTOC recommends that 1.1 tonnes be approved. MBTOC recommended 1100 kg of methyl bromide for 2005. MBTOC noted that there were technically feasible alternatives but the one regarded as most promising by industry was not yet registered.
United Kingdom	CUN2003/038	Mills and Processors	Structures	30,752	2	30,8	MBTOC recommends that 30.8 tonnes be approved. MBTOC recommended 35,000 kg of methyl bromide for 2005. MBTOC noted that there were technically feasible alternatives but the one regarded as most promising by industry was not yet registered.
United Kingdom	CUN2003/041	Food storage (spices)	Structures	1,728	2	1,728	MBTOC recommends that 1.728 tonnes be approved. MBTOC recommended 1,728 kg of methyl bromide for 2005. MBTOC noted that there were technically feasible alternatives but the one regarded as most promising by industry was not yet registered.
United Kingdom	CUN2003/044	Mills and Processors	Structures	16,38	2	16,38	MBTOC recommends that 16.38 tonnes be approved MBTOC recommended 16,380 kg of methyl bromide for 2005. MBTOC noted that there were technically feasible alternatives but the one regarded as most promising by industry was not yet registered.

Party	CUN Number	Industry	Type	Quantity nominated		Recommen-dation for 2005	MBTOC recommendation* for the critical uses of methyl bromide for the specific circumstances described by the applicant
				t/year	Years	Tonnes	
United Kingdom	CUN2003/045	Rice	Commodity	1,0	2	0	MBTOC was unable to recommend this CUN. MBTOC noted that there were technically feasible alternatives for this use. Furthermore, the nominated use appears to be potentially a QPS MB treatment against *Trogoderma granarium,* and thus exempt from control.
United Kingdom	CUN2003/037	Whitworth	Commodity	2,4	2	2,4	MBTOC recommends that 2.4 tonnes be approved. MBTOC noted that there were a number of apparantly feasible alternatives that may be suitable for some of this nomination but the one regarded as most promising by industry was not yet registered.
United Kingdom	CUN2003/046	Cheese stores (traditional)	Commodity	0,140	2	0,140	MBTOC recommends that 140 kg be approved. MBTOC noted that there were no technically feasible alternatives for this use.
United Kingdom	CUN2003/047	Cheese stores (traditional)	Commodity	1,50	2	1,50	MBTOC recommends that 1.5 tonnes be approved. MBTOC noted that there were no technically feasible alternatives for this use.
United Kingdom	CUN2003/042	Stored spices	Commodity	0,030	2	0,030	MBTOC recommends that 30 kg be approved. MBTOC noted that there were no technically feasible alternatives registered in the UK for this nomination.
United Kingdom	CUN2003/043	Tobacco (stored)	Commodity	0,523	2	0	MBTOC was unable to recommend this CUN. MBTOC noted that there were technically feasible alternatives for this use in the United Kingdom and other countries.
United States	CUN2003/051	Mills and Processors	Structures	536,328	1	536,328	MBTOC recommends that 536 tonnes be approved, conditional on there being no registered alternatives available in 2005. MBTOC noted that at the time of evaluation in March 2003 there were no technically feasible alternatives for this use.
United States	CUN2003/048	Smokehouse Ham	Commodity	0,907	1	0,907	MBTOC recommends that 0.907 tonnes be approved. MBTOC noted that there were no technically feasible alternatives for this use.
United States	CUN2003/048	Dried fruit, beans & nuts	Commodity	86,753	1	86,753	MBTOC recommends that 87 tonnes be approved, conditional on there being no registered alternatives available in 2005. MBTOC noted that at the time of evaluation in March 2003 there were no technically feasible alternatives for this use.
United States	CUN2003/054	Nursery trays for tobacco	Object	1,323	1	0	MBTOC was unable to recommend this CUN. MBTOC noted that alternatives are in common use in similar circumstances in several countries. These alternatives include chlorine, irradiation, fungicides, steam and quaternary ammonium compounds.

Footnote:
(a) Evaluation not completed, pending further clarification sought from the nominating Party