MONTREAL PROTOCOL

ON SUBSTANCES THAT DEPLETE

THE OZONE LAYER

UNEP

REPORT OF THE TECHNOLOGY AND ECONOMIC ASSESSMENT PANEL

MAY 2011

VOLUME 1

PROGRESS REPORT

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Montreal Protocol
On Substances that Deplete the Ozone Layer

Report of the UNEP Technology and Economic Assessment Panel

May 2011

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Foreword

The TEAP 2011 Progress Report

The May 2011 TEAP Progress Report consists of two volumes:

Volume 1 TOC Progress Reports, EUN and CUN Reports and several Task Force Reports. This report is the Volume 1 report.

This Volume 1 May 2011 TEAP Progress Report starts with an Introduction, which mentions that this TEAP Progress Report updates previous reports and presents good news on technical innovation in every sector.

It also contains an evaluation of the Essential Use Nominations followed by the Medtical Technical Options Committee Progress Report.

These are followed by the Chemicals Technical Options Committee Progress Report and the Task Force report that responds to the request made by Parties in Decision XXII/10.

Next one will find two more Progress Reports, one of the Halons Technical Options Committee and one of the Methyl Bromide Technical Options Committee; the latter is followed by the CUN evaluation report by the same Technical Options Committee.

In the last part of the Progress Report the report of the Task Force on decision XXII/22 is given. Two short chapters on TEAP operation and TEAP recusal complete this report. As a last piece of information, the TEAP and TOC Membership lists are given as an Annex, status May 2011.

Volume 2 Task Force Report for the Funding Requirement for the Replenishment of the Multilateral Fund for the triennium 2012-2014.

The separate Volume 2 of the TEAP Progress Report contains the report of the Task Force responding to Decision XXII/3 on the funding requirement for the replenishment of the Multilateral Fund for the triennium 2012-2014.

In this Volume 2 report the Executive Summary has been placed upfront, followed by a number of chapters on data, cost effectiveness, methodologies, etc. Chapters 8 and 9 give information on the estimated funding requirement for the triennium 2012-2014 and indicative funding requirement amounts for the two triennia beyond.

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1 Highlights of Technical Success

Stratospheric ozone depletion and climate change are intricately coupled. Ozone absorbs UV radiation and is a greenhouse gas (GHG). Stratospheric ozone influences surface climate and GHGs influence stratospheric ozone. Ozone-depleting substances (ODSs) not only destroy stratospheric ozone but are potent GHGs. Furthermore, hydrofluorocarbons (HFCs) that are chemical substitutes for some ODSs can also be potent GHGs. Hence, ozone layer and climate protection should be considered together in decisions to select new technology.

The Montreal Protocol is working because control measures have created incentives for new technology, because enterprises and organizations have worked hard to implement new technology and because the Multilateral Fund (MLF) has been replenished to finance the agreed incremental costs of the transition for Article 5(1) Parties.

With implementation of each new phase of technology, the Montreal Protocol has succeeded in reducing the production, use, and emissions of ODSs that are also potent greenhouse gases. Through these efforts, the world has avoided significant economic, environmental and health consequences of increases in ultraviolet radiation and climate change.

Under the Montreal Protocol HCFCs were considered low-ODP “transitional substances” to replace high-ODP CFCs in circumstances when environmentally superior alternatives were not available. HFCs were developed as zero ODP alternatives but, in effect, have emerged as “transitional substances” in applications where new technology now offers low- or no-GWP options. A new irony faced by the Montreal Protocol is that HFCs are controlled in the basket of gases of the Kyoto Protocol and are increasingly regulated by many countries including Australia, the European Union, Japan, and the United States. These regulations include import taxes and or deposits on the manufacture or import of HFCs that are used to finance the cost of end-of-life (EoL) due to ODS and GHG destruction, phase-out of HFCs used in vehicle air conditioning, and prohibitions on HFC use. The challenge is to phase out HCFCs while avoiding high-GWP HFCs and while achieving high energy efficiency using technology that is safe and environmentally acceptable. It is called “leapfrogging” when the transition goes directly from HCFCs to low-GWP options.

1.1 Highlights of Technical Success on Protecting Stratospheric Ozone and Climate

This TEAP Progress Report updates previous reports and presents good news on technical innovation in every sector:

Nominations for Essential Use Exemptions (EUEs) for Metered Dose Inhalers (MDIs) are declining rapidly, with nominations from only four countries for a total of about 800 tonnes recommended for 2012; a reduction of about 65 percent from 2010.

Nominations for Critical Use Exemptions (CUEs) for 2013 (submitted in 2011) total only about 750 tonnes from four countries; an approximate 50% reduction in amount of MB requested compared to 2010 round with just 20 nominations.

Nominations for preplant soil use were reduced from 27 to 13 with Israel and Japan no longer seeking CUEs.

Plant nurseries are proving the most difficult area for MB phaseout for preplant soil uses, but only in 3 non-A5 countries (Australia, Canada and USA).

Stocks of MB in the USA have reduced dramatically but still significantly exceed annual MB requests for CUNs of MB.

Process Agent uses allowed by the Montreal Protocol declined from 41 to 14; a net elimination of 27 processes worldwide.

Changes to the applicable Annexes to the Chicago Convention on International Civil Aviation mandating the use of halon alternatives on board newly produced aircraft in the lavatory trash receptacles and handheld extinguishers, and in engine nacelles, and auxiliary power units in new designs are now imminent. A final decision is scheduled for 13 June 2011.

A new purity specification for halon 1211 was approved that increases the level of confidence in relying on recycled halon 1211 in handheld extinguishers onboard aircraft.

Low-GWP options continue to be commercialized for all applications with few uses still depending on HCFCs and high-GWP HFCs.

- Low-GWP refrigerants and foam blowing agents are being rapidly announced and commercialized by companies with operations in both developed and developing countries.
- Motor vehicle manufacturers and suppliers in Europe, Japan and the United States have endorsed HFC-1234yf as the refrigerant-of-choice to replace HFC-134a in mobile air conditioning (MACs).
- HFC-152a and HFC-1234yf are listed under the US EPA (EPA) Significant New Alternatives Program (SNAP) as acceptable replacements in mobile air conditioning and EPA has announced that plans to remove (Un-SNAP) HFC-134a from the list of acceptable replacements.
- New technology is also being commercialized to contain refrigerants and to recover and destroy ODSs and HFCs from banks contained in foam and refrigeration and air conditioning equipment.

MB use for structures and commodities continues to decline in response to very positive results of research, registration, and adoption of alternatives.

- Australia is committed to phasing out MB for its packaged rice by the end of 2014.MBTOC is assisting Australia in determining how to kill the eggs of key rice insect pests with a new review of the published scientific literature, which is included in the 2011 Progress Report.
- Canada did not renew its CUN for pasta facilities, which is evidence that alternatives for that sector have succeeded.
- Israel completed adoption of alternatives for fresh dates and for the first time did not submit a postharvest CUN.
- Japan has committed to the phase out of MB for fresh chestnuts in 2014 using methyl iodide identified an alternative through its research program and is now training its farmers and commercializing methyl iodide.
- The US has very significantly decreased the MB quantities requested in almost all its postharvest CUNs and this year did not send a CUN for food processing facilities.

MBTOC believes that adoption of sulfuryl fluoride alone or heat treatment allowed the US food processing sector to move away from methyl bromide.

1.2 Technology Issues Needing Resolution

1.2.1 Phaseout from CFCs in MDIs

There are two areas of concern remaining in the phase-out of CFCs from MDIs. Unable to phaseout by the 1996 non-Article 5 deadline, the Russian Federation has faced many delays and now projects phase-out by the end of 2013, despite the availability of affordable imported products. China, now the largest consumer of CFCs in MDIs, looks likely to continue until at least 2014, with total phase-out planned for 2016.

Eighty-eight percent of global methyl bromide (MB) controlled uses have been phased out. However, increased use of MB for QPS uses not controlled by the Montreal Protocol is offsetting gains made by reductions in controlled uses for soils, structures and commodities. Some of this increase is due to preplant soil use in propagation nursery sectors. TEAP estimates that currently available alternatives and substitutes could replace approximately 22% to 33% of total QPS consumption.

1.2.2 Use or Destruction of Stockpiles

Stockpiles are the result of 1) ODS manufactured before the scheduled phaseout date and held as an investment or as a hedge against shortage; 2) ODS recovered from use and set aside for future use; 3) ODS inventory at a facility at the time of transition to ODS-free or transitional HCFC technology; 4) ODS granted under a EUE or CUE exemption but not necessary for the essential or critical use; or 5) ODS illegally produced or imported and held for illegal sale. The largest ODS stockpiles are managed by military organizations, private halon banks, and chemical and chemical reprocessing companies for use in applications they consider important or profitable.

Under the Montreal Protocol, unwanted legal stockpiles, including ODS granted under an EUE or CUE, can be used for any domestic purpose and stockpiles granted under and EUE can be exported to another Party to satisfy a new EUE. Domestic regulations sometimes tax or restrict the use of stockpiles or compel collection and destruction, but it has been the experience worldwide that regulations that require the ODS owner to finance destruction frequently result in venting to the atmosphere. When MLF fails to finance the redeployment or destruction of ODS remaining at a facility after transition, there is a temptation to vent when no profitable market can be found and lack of financing can result in stocks leaking away from storage.

It is important during the final stages of the phase-out of CFC MDIs that CFC stockpiles accumulated under essential use provisions are managed properly.

It would be ironic if Parties who demanded excess EUE inventory to avoid shortages in CFC-MDIs were to use those stockpiles for ordinary emissive uses, further depleting the ozone layer, with consequences to human health such as skin cancer, cataracts, and suppression of the human immune system.

It would be consistent with the spirit and letter of the Montreal Protocol if ODS approved for essential use were only used for the purposes approved by Parties or destroyed and that all unwanted or unneeded ODS were collected and destroyed.

2 Essential Uses

2.1 Executive Summary of Essential Use Nominations for Metered Dose Inhalers

MTOC received 4 essential use nominations requesting a total of 877.34 tonnes of CFCs for the manufacture of metered dose inhalers (MDIs) in 2012, and 125 tonnes for 2013: 3 nominations were from Article 5 countries (Bangladesh, China, Pakistan); and 1 was from a non-Article 5 country (Russian Federation).

Table 2-1 summarises the recommendations of the Technology and Economic Assessment Panel (TEAP) and its Medical Technical Options Committee (MTOC) on nominations for essential use production exemptions for chlorofluorocarbons (CFCs) for MDIs. Recommendations are made in accordance with Decision XV/5(3), which requests TEAP and its MTOC to make recommendations on nominations for essential use exemptions for CFCs for MDIs with reference to the active ingredient of the metered-dose inhalers in which the CFCs will be used and the intended market for sale or distribution. Recommendations are for a total of 792.81 tonnes of CFCs for the manufacture of MDIs in 2012.

Table 2-1: Recommendations for essential use nominations

Party	2012	Active Ingredients	Intended Markets
Bangladesh	24.67 tonnes	Ciclesonide, ipratropium, ipratropium/salbutamol, salmeterol and tiotropium	Bangladesh
China	528.14 tonnes	Beclomethasone, beclomethasone/clenbuterol/ipratropium, budesonide, cromoglycate, datura metel extract/clenbuterol, dimethicone; ephedra, gingko, sophora flavescens and radix scutellariae; ipratropium/salbutamol, isoprenaline, isoprenaline/guaifenesin, procaterol, salbutamol, salmeterol	China
	3.9 tonnes	Cromoglycate	Cuba
Pakistan	24.1 tonnes	Beclomethasone, beclomethasone/salbutamol, fluticasone/salmeterol, salbutamol, salmeterol, triamcinolone acetonide	Pakistan
Russian Federation	212 tonnes	Salbutamol	Russian Federation

MTOC thanks the Ozone Secretariat for providing meeting venue sponsorship for the MTOC meeting held in Buenos Aires, Argentina, 20-22 March 2011. MTOC member, Dr Jorge Caneva, and the Ozone Program Office of Argentina (OPROZ) provided a range of organisational assistance.

In 2009, the first year of the essential use process for Article 5 countries, MTOC reviewed nominations from eight Article 5 countries. It is very encouraging to note that two years on, Argentina, Egypt, Iran, India and Syria did not nominate for essential uses of CFCs for MDIs for 2012. There have been significant reductions from about 2,400 tonnes of authorised essential use CFCs in 2010 to about 880 tonnes of CFCs nominated for 2012.

Looking to the future, two major areas of concern remain. The first is Russia, a non-Article 5 country where there have been repeated assurances that phase-out would have been completed by 2008. The use of CFCs in domestically produced MDIs is now projected to be required until 2013, despite the availability of affordable imported products from a number of manufacturers. The second is China, now the largest consumer of CFCs in MDIs, where consumption of greater than 500 tonnes per annum looks likely to continue until at least 2014, with total phase-out planned for 2016.

MTOC accepts the need to protect the patients with limited economic means. With the production of a wide range of generic CFC-free inhalers at very low cost in Bangladesh, India and other Article 5 countries the argument of affordability is no longer valid. Pricing policies, tariffs, import taxes and restrictions have been implemented, which have the effect of protecting local industry, favouring locally made CFC MDIs, and discouraging the use of affordable imported CFC-free alternatives. Parties may wish to consider domestic policies (pricing, import and drug approvals) that will expedite the rapid transition to CFC-free inhalers, with the priority of protecting the health of patients.

MTOC notes that some essential use nominations for 2012 include companies that are seeking small amounts of CFCs, in several cases in China less than 1 tonne. Parties may wish to consider the advantages of consolidating their MDI operations in enterprises that are sufficiently large to cope with the requirements of CFC-free inhaler production, and cease making nominations for manufacturers where there is no intention to continue MDI manufacture in an HFC form. MTOC will consider again next year any essential use nominations submitted to ensure that companies requesting CFCs are diligently undertaking research and development themselves or in collaboration with other companies. In the absence of demonstrated evidence of research and development activity, MTOC is unlikely to recommend the relevant portion of that nomination.

Slow regulatory approval processes (which in China are reported to take up to 4 or more years) and slow funding procurement processes (for the Russian Federation) have been cited as reasons for delays in the introduction of CFC-free alternatives. Parties are strongly encouraged to fast-track administrative processes to speed up the transition to CFC-free alternatives to meet their obligations under the Montreal Protocol.

One nomination (China) included significant CFC quantities to manufacture MDIs intended for export to other Article 5 countries. This nomination did not adequately demonstrate that these CFC MDIs were essential in the intended export markets or demonstrate that importing Parties had provided their prior informed consent for the import of the CFC MDIs in 2012. MTOC does not have the information from importing Parties to substantiate that these uses are essential, except for import of cromoglycate into Cuba where no CFC-free alternative is currently available for use in Cuba. However, MTOC considers that for all countries that import MDIs (except China, Pakistan, and Russia), there is now a complete range of affordable alternatives for salbutamol and beclomethasone. Consequently, MTOC is unable to recommend any of the CFC quantities nominated to manufacture MDIs for beta-agonists and inhaled corticosteroids for intended export markets. Parties may also wish to consider domestic regulations to ban the import or export of any beta-agonist and/or inhaled corticosteroid CFC MDI.

It is technically difficult to formulate anti-cholinergic drugs, such as ipratropium bromide and tiotropium bromide, as HFC MDIs. A limited range of CFC-free inhalers is currently available in this category. MTOC has recommended the nominated quantities for ipratropium and tiotropium and their combinations for Bangladesh and Pakistan for 2012. However, China's own criteria in its transition strategy for anti-cholinergics (category D) appear to have been satisfied with more than one CFC-free alternative available. Consequently, MTOC considers that anti-cholinergics no longer meet the criteria for essential use in China where adequate affordable alternatives appear to be available. Furthermore, MTOC believes that adequate supplies of CFC-free inhalers containing anti-cholinergic drugs will become available worldwide in 2012 and it is unlikely that CFC inhalers for anti-cholinergics or their combinations will be considered essential in future years.

A range of alternative HFC MDI (e.g. Intal and Cromal-5 HFC MDIs) and DPI formulations (e.g. Jing Wei's sodium cromoglycate DPI or Intal Spincaps DPI) to sodium cromoglycate CFC MDI is available. Cuba has requested to import from China a small quantity of sodium cromoglycate CFC MDIs in 2012. MTOC is uncertain whether CFC-free alternatives are approved for use in Cuba. Consequently, MTOC has recommended the quantity of CFC for sodium cromoglycate CFC MDIs intended for export from China for 2012 only. One year will give time for Cuba to complete approvals for import of the globally available CFC-free alternatives. As soon as Cuba achieves the import of CFC-free alternatives, import of sodium cromoglycate CFC MDIs from China should be phased out. The criteria for China's transition strategy appear to have been satisfied for sodium cromoglycate (category C) use within China, although further information is needed by MTOC to confirm its non-essentiality. MTOC requests additional information about CFC-free alternatives to sodium cromoglycate in China and the essentiality of the CFC MDI formulation. In future years, MTOC is likely to recommend that CFCs are not essential for sodium cromoglycate MDIs given the global availability of suitable CFC-free alternatives.

For 2010 and 2011 nominations, MTOC considered the CFCs requested for combination products with anti-cholinergics to be essential for the nominations received from Article 5 countries. MTOC considered this again and has recommended combination products with anti-cholinergics for 2012. However, due to the availability of CFC-free alternatives, combined with the widespread availability of affordable separate inhalers, MTOC has limited the CFC quantity to the same approved for 2011 and is unlikely to consider combination products with anti-cholinergics essential in future years. In the case of Bangladesh, MTOC was unable to recommend as essential the CFC quantities requested for the combination product with fluticasone/salmeterol due to the availability of CFC-free alternatives in 2012.

MTOC has become aware of a new salbutamol CFC MDI product registered in Pakistan in 2007 and launched in late 2010. MTOC also became aware of a new fluticasone/salmeterol CFC MDI that launched in Bangladesh during 2010. In China, it appears that four companies that have requested CFCs for 2012 had no CFC consumption in 2010, and three had CFC consumption only in 2011. In the past, MTOC has been unable to recommend as essential any new CFC MDIs not in the marketplace in 2009. A new product launched in 2010, when alternative CFC and CFC-free inhalers are already available, might not be considered essential under Decision IV/25. Parties may wish to consider domestic regulations to ban the launch or sale of new CFC MDI products in Article 5 countries, even if already approved but not launched.

Of the Parties that provided accounting frameworks for 2010, there were stocks of pharmaceutical-grade CFCs of about 1,930 tonnes at the end of 2010. Sizeable or significant stocks were reported in China, India, and the United States. India also reported a small surplus of non-pharmaceutical grade CFCs resulting from the production of pharmaceutical-grade CFCs. Small or negligible stocks were reported in Argentina, Pakistan and Russia.

Iran reported that it had completely depleted its stockpile. The European Union reported a small stockpile at the end of 2009. Further discussion on stockpiles and stockpile management is elaborated in the following sub-sections of section 3.2 and section 3.3.

2.2 Essential Use Nominations for Metered Dose Inhalers

2.2.1 Criteria for Review of Essential Use Nominations for MDIs

Decision IV/25 of the 4th Meeting and subsequent Decisions V/18, VII/28, VIII/9, VIII/10, XII/2, XIV/5, XV/5, XVI/12, XVIII/16, XX/3, XXI/4 and XXII/4 have set the criteria and the process for the assessment of essential use nominations for MDIs for Parties not operating under paragraph 1 of Article 5 and Parties operating under paragraph 1 of Article 5 of the Protocol. Other essential use decisions relevant to these Parties are Decisions XVII/5, XVIII/7 and XIX/13.

2.2.2 Review of Nominations

The review of essential use nominations by the MTOC was conducted as follows.

Three members of the MTOC independently reviewed each nomination, preparing an assessment. Further information was requested of nominating Parties where necessary. The MTOC considered the assessments, made recommendation decisions and prepared a consensus report at its meeting in Buenos Aires, Argentina, 20-22 March 2011. Members disclosed any potential conflict of interests ahead of the discussion. Where necessary, members were recused from the decision-making process of the nomination relevant to any potential conflict of interest. Annually listed disclosures of members indicate specific interests and any relevant actions taken such as recusal.

Nominations were assessed according to the guidelines for essential use contained within the *Handbook on Essential Use Nominations* (TEAP, 2009) and subsequent Decisions of the Parties. Recommendations are made in accordance with Decision XV/5(3), which requests TEAP and its TOC to make recommendations on nominations for essential use exemptions for CFCs for MDIs with reference to the active ingredient of the metered-dose inhalers in which the CFCs will be used and the intended market for sale or distribution.

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

2.2.3 Observations

MTOC received 4 essential use nominations requesting a total of 877.34 tonnes of CFCs for the manufacture of metered dose inhalers (MDIs) in 2012, and 125 tonnes for 2013: 3 nominations were from Article 5 countries (Bangladesh, China, Pakistan); and 1 was from a non-Article 5 country (Russian Federation). MTOC recommendations are for a total of 792.81 tonnes of CFCs for the manufacture of MDIs in 2012.

In 2009, the first year of the essential use process for Article 5 countries, MTOC reviewed nominations from eight Article 5 countries. It is very encouraging to note that two years on, Argentina, Egypt, Iran, India and Syria did not nominate for essential uses of CFCs for MDIs for 2012. There have been significant reductions from about 2,400 tonnes of authorised essential use CFCs in 2010 to about 880 tonnes of CFCs nominated for 2012. Furthermore, this is the last year of nomination for Bangladesh. All of these Parties are to be commended for their efforts to successfully phase-out CFCs.

Looking to the future, two major areas of concern remain. The first is Russia; a non-Article 5 country where there have been repeated assurances that phase-out would have been completed by 2008. The use of CFCs in domestically produced MDIs is now projected to be required until 2013, despite the availability of affordable imported products from a number of manufacturers. The second is China, now the largest consumer of CFCs in medical products, where consumption of greater than 500 tonnes per annum looks likely to continue until at least 2014, with total phase-out planned for 2016.

There has been substantial progress in the development and registration of affordable CFC-free MDIs, especially those manufactured by Article 5 countries. With economies of scale, and a range of different brands from local manufacturers, HFC MDIs have become more competitively priced compared to CFC MDIs. Despite this, some Parties that locally produce CFC MDIs are asking for more time for their pharmaceutical companies to complete the transition. Some of these Parties are clearly lagging in their transition process, but they still request special treatment for their industries. The main reasons for these requests are the claims that:

- Locally made CFC MDIs are much cheaper than ozone-friendly imported products.
- Research and development and regulatory approval processes take time and significant resources.
- Production of medication to treat asthma/COPD is a sovereignty issue.

2.2.4 Affordability of CFC-free Inhalers

MTOC accepts the need to protect the patients with limited economic means. With the production of a wide range of generic CFC-free inhalers at very low cost in Bangladesh, India and other Article 5 countries the argument of affordability is no longer valid.

MTOC has previously reported that price differences between locally made and imported products can be a result of external variables such as:

- Trade barriers, including higher tariffs, difficult registration procedures, restrictions to market penetration, and government procurement and reimbursement policies;
- Local circumstances such as geographical location;
- Local policies such as pricing of a raw material.

In other cases, national policies like sales price control of the CFC inhalers may prevent the local manufacturer from receiving the revenues required to develop the new CFC free technology.

The conditions mentioned above, even if they exist, do not justify the continued use of CFC MDIs. Furthermore, the continued production of CFC inhalers is counter-productive for the global phase-out of CFC MDIs for the following reasons:

- Creates the false impression that CFC phase-out may not actually occur and discourages change in the Parties where they are still produced.
- Allows for the continued export of CFC MDIs to other Parties, delaying their transition as well.
- Allows the continued production of medical grade CFCs, and, as a consequence of the manufacturing process, also allows production of CFCs that are not medical grade at the beginning and end of each manufacturing run. There are no uses authorised for

this material. Furthermore, there is a risk that these non-medical grade materials may not be disposed of properly.

- Allows some companies to defer research and development activities to facilitate transition, which is a disincentive for those companies that have already transitioned, in some cases entirely at their own expense.

Pricing policies, tariffs, import taxes and restrictions have been implemented, which have the effect of protecting local industry, favouring locally made CFC MDIs, and discouraging the use of affordable imported CFC-free alternatives. Parties may wish to consider domestic policies (pricing, import and drug approvals) that will expedite the rapid transition to CFC-free inhalers, with the priority of protecting the health of patients.

2.2.5 Company Size and Product Demand

The definition of essentiality for purposes of the Montreal Protocol is based in part on the idea that production and consumption of CFCs for essential uses is necessary for the functioning of society.

In those countries where the Multilateral Fund (MLF) is funding phase-out projects for different companies, it is likely that conditions for non-essentiality could be met before all the projects have been completed. Therefore essentiality should not be linked to the completion of all phase-out projects but rather to the satisfaction of essential use criteria.

MTOC notes that some essential use nominations for 2012 include companies that are seeking small amounts of CFCs, in several cases in China[1] less than 1 tonne. These small volume consumptions will result in the production of around 50,000 MDI inhalers per year in each case. It is likely that these small volume operations will have high operating costs, higher losses of material, and few resources for research and development. It is technically and economically difficult for low volume consuming companies to undertake the necessary research and development, especially clinical trials, and investment in new production lines. It is especially challenging to convert low volume products where the investment of funds and technical expertise may not be available or justified.

The manufacture of DPIs and MDIs requires exacting quality control to assure that patients will receive always the proper dose in particles of the right size. Production of CFC-free MDIs is even more demanding than the production of CFC MDIs; the difficulties that delayed the initial introduction of HFC MDIs were the result of different physical properties, compatibility and stability issues, and the need for costly trials. It is possible that small companies with consumptions of a few tonnes of propellant will not have the resources to produce CFC-free MDIs competitively.

In China, rationalisation of production to fewer companies and fewer products is likely to occur. Nonetheless, these companies continue to request CFCs, and China continues to nominate CFCs for these companies. The criteria for including CFC quantities within a nomination require nominating Parties to exclude companies that are not diligently undertaking research and development. China has indicated that it expects some of the companies currently included in its nomination to cease MDI production. Future nominations should not include some of these small factories if they never intend to reformulate their CFC MDIs.

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[1] In China, out of 21 domestic CFC MDI manufacturers, 13 have requested less than 10 tonnes for 2012. Another 7 have requested between 10-80 tonnes, and one company has requested 280 tonnes.

Some companies have been successful in transition, even without MLF-funding of conversion projects. Market leaders in HFC MDIs should not be penalised for fast transition by competing against lower priced CFC MDIs in the same markets. These circumstances also arose in non-Article 5 countries, and this was an important factor in delaying salbutamol CFC MDI transition.

There is the risk that those remaining Parties still nominating essential uses of CFCs, where there are companies with big differences in size, might try to adjust the pace of the transition to that of the smaller enterprises. Such an adjustment would be at the expense of the larger factories that have more resources. The Montreal Protocol has considered the plight of SMEs in many sectors that have used ODPs, but despite attempts to help CFC users regardless of size, the phase-out of CFCs has generally resulted in the adoption of the newer technologies by companies that are the stronger and the more technologically skilled of their sector.

Parties may wish to consider the advantages of consolidating their MDI operations in enterprises that are sufficiently large to cope with the requirements of CFC-free inhaler production, and cease making nominations for manufacturers where there is no intention to continue MDI manufacture in an HFC form.

Furthermore, the concept of therapeutic equivalence (such as within the group of inhaled corticosteroids where one corticosteroid has similar therapeutic benefits to another) implies that not all moieties that were formulated as CFC MDIs need to be reformulated as HFC MDIs to complete the CFC phase-out. The experience with phase-out shows that in some cases, reformulation may not be commercially viable or technically possible, while in other cases, it was possible to reformulate a moiety as a DPI, but not as an MDI.

There are a number of decisions by Parties relating to active research and development by companies seeking production of essential use CFCs to manufacture MDIs.

Decision VIII/10 states:

"*That Parties will request companies applying for MDI essential-use exemptions to demonstrate ongoing research and development of alternatives to CFC MDIs with all due diligence and/or collaborate with other companies in such efforts and, with each future request, to report in confidence to the nominating Party whether and to what extent resources are deployed to this end and progress is being made on such research and development, and what licence applications if any have been submitted to health authorities for non-CFC alternatives*;"

Decisions XVIII/7 (and subsequent modifications made by Decision XX/3) supplements Decision VIII/10 and the requirements for Parties nominating essential-uses by specifying:

"*That Parties will request companies applying for metered-dose inhaler essential use exemptions to demonstrate that they are making efforts, with all due diligence, on research and development with respect to chlorofluorocarbon-free alternatives to their products and are diligently seeking approval of their chlorofluorocarbon-free alternatives in their domestic and export markets aimed at transitioning those markets away from the chlorofluorocarbon products;*"

Decision XIX/13, which further supplements Decision XVIII/7, specifies:

"*That Parties will request each company, consistent with paragraph 1 of decision VIII/10, to notify the relevant authority, for each metered-dose inhaler product for which the production of CFCs is requested, of:*

(a) The company's commitment to the reformulation of the concerned products;

(b) The timetable in which each reformulation process may be completed;

(c) Evidence that the company is diligently seeking approval of any chlorofluorocarbon-free alternative(s) in its domestic and export markets and transitioning those markets away from its chlorofluorocarbon products;"

MTOC will consider again next year any essential use nominations submitted to ensure that companies requesting CFCs are diligently undertaking research and development themselves or in collaboration with other companies. In the absence of demonstrated evidence of research and development activity, MTOC is unlikely to recommend the relevant portion of that nomination.

2.2.7 Slow Processes are Delaying Transition

Different countries have different regulatory approaches to the approval of CFC-free inhalers, resulting in more rapid transition in some countries than in others. Slow regulatory approval processes (which in China are reported to take up to 4 or more years) and slow funding procurement processes (for the Russian Federation) have been cited as reasons for delays in the introduction of CFC-free alternatives. These processes, which are within the control of individual Parties and implementing agencies associated with the Montreal Protocol, appear to be frustrating the transition and stifling companies that have the technology to transition.

China has explained that its *Drug Registration Management Regulation* requires that any company that would like to submit a registration application for HFC MDIs should follow the requirements for a new drug (or a dosage form). Therefore, the process of registering a new HFC MDI product is expected to proceed as follows:

1. After completing pre-clinical studies (including pharmaceutical, pharmacology and safety) for HFC MDIs, the company can submit its application for clinical trial.
2. The Department of Drug registration of SFDA reviews the application dossier and issues a clinical trial licence to the applicants meeting all requirements.
3. MDI manufacturers conduct clinical trials and submit clinical reports and summaries to SFDA.
4. After reviewing the clinical dossier, a manufacturing licence will be issued to the company meeting all requirements.

According to the "*standard time*" required for drug registration in the regulations, China states that it will take at least 3 to 4 years for manufacturers to finish all the steps of drug registration and then launch their products, even if the research and development process goes smoothly and the submitted dossiers meet requirements. China explains this is why two salbutamol HFC MDIs submitted for registration in 2010 will not get to market in China until 2014. This period has already been calculated under the premise of a "*fast track*" registration process. SFDA is now establishing how to implement "*fast track*" approval for HFC MDIs.

In China, two domestic enterprises have salbutamol HFC MDIs currently in the registration process. One of these is the largest MDI producer in China, Jing Wei, which has completed some clinical trials and has production capacity of 36 million cans, more than China's current MDI use. Faster regulatory approval than currently proposed could mean that Jing Wei salbutamol HFC MDIs are on the market sooner. MTOC understands that Jing Wei plans to market the first salbutamol HFC MDI product by 2012, so that at least one locally made salbutamol HFC MDI could be marketed in China within about the next 12 months. MTOC is also aware that Jing Wei already manufactures under contract and exports salbutamol and beclomethasone HFC MDIs at British Pharmaceutical standards.

Parties are strongly encouraged to fast-track administrative processes to speed up the transition to CFC-free alternatives to meet their obligations under the Montreal Protocol.

2.2.8 Exported Products

MTOC has noted the wide availability in Article 5 countries of technically suitable alternatives to CFC MDIs. However, availability by itself has not prompted transition largely due to lack of affordability of these alternatives. CFC-free inhaler products sourced from manufacturers in Article 5 countries are now substantially increasing the range of affordable alternatives.

One nomination (China) included significant CFC quantities to manufacture MDIs intended for export to other Article 5 countries. This nomination did not adequately demonstrate that these CFC MDIs were essential in the intended export markets or demonstrate that importing Parties had provided their prior informed consent for the import of the CFC MDIs in 2012. MTOC does not have the information from importing Parties to substantiate that these uses are essential, except for import of cromoglycate into Cuba where no CFC-free alternative is currently available for use in Cuba. MTOC is also aware that one company, Jing Wei, already manufactures under contract and exports salbutamol and beclomethasone HFC MDIs at British Pharmaceutical standards. It is not clear whether importing Parties are specifically requesting the import of CFC MDIs despite the alternatives available, whether they simply import the cheapest available product even if it contains CFCs, or whether they are unable to switch to alternatives because of a lack of regulatory approval of the alternatives. There is an opportunity for importing Parties to help drive the global phase-out of CFCs through judicious sourcing of CFC-free alternatives and actively declaring non-essentiality.

MTOC considers that in most developing countries there is an adequate range of technically satisfactory and affordable CFC-free alternatives for beta-agonist (in particular, salbutamol) and inhaled corticosteroid (in particular, beclomethasone) CFC MDIs. Furthermore, MTOC considers that for all countries that import MDIs (except China, Pakistan, and Russia), there is now a complete range of affordable alternatives for salbutamol and beclomethasone. Consequently, MTOC is unable to recommend any of the CFC quantities nominated to manufacture MDIs for beta-agonists and inhaled corticosteroids for intended export markets. There are some Parties where beta-agonist and/or inhaled corticosteroid CFC MDIs may still be needed for use in their own countries in 2012: China, Pakistan and the Russian Federation. CFCs for MDIs in these therapeutic categories are recommended for these markets for 2012 while the conversion to CFC-free alternatives is underway and HFC MDI capacity is increasing. However, these Parties should also consider importing the wide range of affordable alternatives that are available now.

MTOC was not provided evidence that salbutamol and/or beclomethasone CFC MDIs are essential in any importing countries in 2012. However, any importing Parties with difficulty in sourcing affordable CFC-free inhalers could potentially access them through the Asthma Drug Facility (an independent non-profit organisation managed by the International Union against Tuberculosis and Lung Disease www.globaladf.org). Parties may also wish to consider domestic regulations to ban the export and import of any beta-agonist and/or inhaled corticosteroid CFC MDI.

2.2.9 Anti-cholinergics

It is technically difficult to formulate anti-cholinergic drugs, such as ipratropium bromide and tiotropium bromide, as HFC MDIs. A limited range of CFC-free inhalers is currently available in this category. New CFC-free inhalers (DPIs and HFC MDIs manufactured in both non-Article 5 and Article 5 countries) for tiotropium and ipratropium (and combinations with other moieties) are beginning to become available. However, in the case of Bangladesh and Pakistan, MTOC remains uncertain that there is an adequate range of affordable CFC-free alternatives to consider the CFC MDIs for these drugs to be non-essential. However, in Bangladesh there is a unit dose DPI formulation of tiotropium. MTOC has recommended the nominated quantities for ipratropium and tiotropium and their combinations for Bangladesh and Pakistan for 2012.

However, China's own criteria in its transition strategy for anti-cholinergics (category D) appear to have been satisfied with more than one CFC-free alternative available. Consequently, MTOC considers that anti-cholinergics no longer meet the criteria for essential use in China where adequate affordable alternatives appear to be available.

MTOC believes that adequate supplies of CFC-free inhalers containing anti-cholinergic drugs will become available worldwide in 2012 and it is unlikely that CFC inhalers for anti-cholinergics or their combinations will be considered essential in future years.

2.2.10 Sodium Cromoglycate

A range of alternative HFC MDI (e.g. Intal and Cromal-5 HFC MDIs) and DPI formulations (e.g. Jing Wei's sodium cromoglycate DPI or Intal Spincaps DPI) to sodium cromoglycate CFC MDI is available. Furthermore, many countries no longer use sodium cromoglycate MDI due to the availability of more effective drug therapies and the technical difficulty in reformulation of the CFC MDI.

Cuba has requested to import from China a small quantity of sodium cromoglycate CFC MDIs in 2012. MTOC is uncertain whether CFC-free alternatives are approved for use in Cuba. Consequently, MTOC has recommended the quantity of CFC for sodium cromoglycate CFC MDIs intended for export from China for 2012 only. One year will give time for Cuba to complete approvals for import of the globally available CFC-free alternatives. As soon as Cuba achieves the import of CFC-free alternatives, import of sodium cromoglycate CFC MDIs from China should be phased out.

The criteria for China's transition strategy appear to have been satisfied for sodium cromoglycate (category C) use within China, although further information is needed by MTOC to confirm its non-essentiality. MTOC requests additional information about CFC-free alternatives to sodium cromoglycate in China and the essentiality of the CFC MDI formulation.

In future years, MTOC is likely to recommend that CFCs are not essential for sodium cromoglycate MDIs given the global availability of suitable CFC-free alternatives.

2.2.11 Combination Products

There are increasing numbers of combination products becoming available in Article 5 country markets. In previous years, MTOC had indicated that it does not consider combination products to be essential where there are the same active ingredients available in the separate CFC-free inhalers. However, subsequently, evidence suggested that the combination of active ingredients in a single inhaler is beneficial, with improved compliance and clinical benefit, sometimes combined with a decrease in cost for patients compared to the drugs delivered in separate inhalers. As a result of this evidence, for 2010 and 2011 nominations, MTOC considered the CFCs requested for combination products with anti-cholinergics to be essential for the nominations received from Article 5 countries. MTOC considered this again and has recommended combination products with anti-cholinergics for 2012. However, due to the availability of CFC-free alternatives, combined with the widespread availability of affordable separate inhalers, MTOC has limited the CFC quantity to the same approved for 2011 and is unlikely to consider combination products with anti-cholinergics essential in future years.

In the case of Bangladesh, MTOC was unable to recommend as essential the CFC quantities requested for the combination product with fluticasone/salmeterol due to the availability of CFC-free alternatives in 2012.

2.2.12 New CFC MDI Products being Launched after 2010

MTOC has become aware of a new salbutamol CFC MDI product registered in Pakistan in 2007 and launched in late 2010. In the past, MTOC has been unable to recommend as essential any new CFC MDIs not in the marketplace in 2009. A new product launched in 2010, when alternative CFC and CFC-free inhalers are already available, might not be considered essential under Decision IV/25. Nonetheless, without knowledge of the situation of this new product in Pakistan, MTOC has already considered and recommended CFC quantities for this product in nominations for 2010 and 2011 and Parties have already authorised these quantities based on patient needs. Given the commitment made by Pakistan to phase-out CFC MDIs by the end of 2012, MTOC recommends these CFC quantities for 2012.

MTOC also became aware of a new fluticasone/salmeterol CFC MDI that launched in Bangladesh during 2010, although no CFC quantities were requested for this product for 2012.

In China, it appears that four companies that have requested CFCs for 2012 had no CFC consumption in 2010, and three had CFC consumption only in 2011. This anomalous pattern suggests new CFC MDI product launches or new manufacturing enterprises entering the market after 2010.

Parties may wish to consider domestic regulations to ban the launch or sale of new CFC MDI products in Article 5 countries, even if already approved but not launched.

2.2.13 Stockpiles

Of the Parties that provided accounting frameworks for 2010, there were stocks of pharmaceutical-grade CFCs of about 1,930 tonnes at the end of 2010. Sizeable or significant stocks were reported in China, India, and the United States. India also reported a small surplus of non-pharmaceutical grade CFCs resulting from the production of pharmaceutical-grade CFCs. Small or negligible stocks were reported in Argentina, Pakistan and Russia. Iran reported that it had completely depleted its stockpile. The European Union (EU) reported a small stockpile at the end of 2009. Further discussion on stockpiles and stockpile management is elaborated in the following sub-sections of section 2.2, in section 3.3 and 3.4.

2.2.14 Bangladesh

Year	Quantity nominated
2012	40.35 tonnes

Specific Use: MDIs for asthma and COPD

Nominated quantities, active ingredients and intended markets for which the nomination applies:

Active Ingredient	Intended market	Quantity (Tonnes)
Ciclesonide	Bangladesh	0.48
Fluticasone/Salmeterol	Bangladesh	9.59
Ipratropium	Bangladesh	1.14
Ipratropium/ Salbutamol	Bangladesh	27.41
Salmeterol	Bangladesh	1.10
Tiotropium	Bangladesh	0.63
Total		**40.35**

Recommendation:

Recommend 24.67 tonnes of CFCs for MDIs for use in Bangladesh for active ingredients ciclesonide, ipratropium, ipratropium/salbutamol, salmeterol and tiotropium.

Unable to recommend CFCs for MDIs for active ingredients fluticasone/salmeterol.

Comments

Bangladesh developed an initial National Transition Strategy in 1995. CFC-free MDIs have been introduced starting in late 2006 and it appears their adoption has continued to grow. Currently, three companies manufacture HFC MDIs while two companies manufacture DPI inhalers. In general, the pricing of these alternatives is comparable to their CFC counterparts and this fact should help with continued transition.

In the 2010 update to its Transition Strategy, Bangladesh stated that it would phase out CFC use completely by 2012, four years earlier than was originally proposed in the 2009 nomination. This development has been aided by the MLF-funded plant conversion projects. Good progress has resulted in the availability of multiple HFC products for salbutamol and beclomethasone, together with new CFC-free products for other moieties. Bangladesh has stated that the current nomination for 2012 will be its final nomination for essential uses of CFCs in MDIs. Bangladesh is commended for its proactive and diligent pursuit of transition from CFC MDI products.

For 2012, Bangladesh has nominated a total of 40.35 tonnes of CFC for use in MDIs. The nominated CFCs are for the manufacture of MDIs for domestic consumption only, as Bangladesh does not export CFC MDIs. Transition is actively underway. Accordingly, there is no CFC nomination for manufacture of either salbutamol or beclomethasone MDIs for 2012.

Of the 156.7 tonnes of CFCs authorised for essential uses in Bangladesh in 2010, only 48.0 tonnes were acquired and 44.6 tonnes used, in part due to transition making faster progress than had been anticipated. With an initial stockpile of 4.5 tonnes, this resulted in 7.8 tonnes of CFCs on hand at the end of 2010. MTOC recommended 38.7 tonnes and Parties authorised 57 tonnes CFCs for essential uses for 2011. Given that the 2011 authorised allowance exceeds the 2010 consumption by 13 tonnes, that transition is proceeding for other moieties, and that there are 8 tonnes of stock in hand, it would appear there is more than enough CFCs available for essential uses in 2011. Furthermore, the nomination for 2012 is only 4 tonnes less than consumption in 2010 despite expected transition to CFC-free MDIs for salbutamol and beclomethasone by 2012.

The continued manufacture of CFC MDIs beyond 2010, where multiple HFC or DPI alternatives already exist, competes with the CFC-free alternatives and slows the transition. MTOC learned that a salmeterol/fluticasone CFC MDI product was launched in 2010, although no CFC quantities were requested for this product for 2012.

There are multiple non-CFC alternatives on the market in Bangladesh for budesonide and salmeterol/fluticasone, and single sources of manufacture of salbutamol/ipratropium and salmeterol. There are as yet no CFC-free alternatives for ipratropium (expected later in 2011) and ciclesonide, although there is a unit dose DPI formulation of tiotropium. Most of the CFC-free products are manufactured locally. Consequently, MTOC is unable to recommend the nominated CFC quantity for salmeterol/fluticasone because there are HFC MDI products available from two manufacturers and DPI products available from 3 manufacturers.

HFC MDIs for the manufacture of ipratropium/salbutamol MDIs from one manufacturer have now been on the market for over 12 months without significant issues. However, the quantity of CFCs requested for this combination product by the remaining two manufacturers is 6 tonnes greater for 2012 (27.41 tonnes) than 2011 (21.32 tonnes). Any increase in patients' need can be met from the available HFC MDIs, at a price that is only 10 percent higher than the available CFC MDIs. Therefore MTOC recommends only 21.32 tonnes CFCs for salbutamol/ipratropium, the same quantity as nominated in 2011 by the remaining two manufacturers for these CFC MDI products.

It is very important that Bangladesh continues efforts to educate patients, pharmacists and prescribers on what to expect as transition completes. This will help to ensure that demand for CFC MDIs diminish to a point where it is no longer economically feasible to manufacture and sell them.

In conclusion, MTOC recommends the following quantities for essential use in 2012:

Recommended quantities in accordance with Decision XV/5(3):

Active Ingredient	Intended market	Quantity (Tonnes)
Ciclesonide	Bangladesh	0.48
Fluticasone/Salmeterol	Bangladesh	0.0
Ipratropium	Bangladesh	1.14
Ipratropium/Salbutamol	Bangladesh	21.32
Salmeterol	Bangladesh	1.10
Tiotropium	Bangladesh	0.63
Total		**24.67**

2.2.15 *People's Republic of China*

Year	Quantity nominated
2012	562.89 tonnes

Specific Use: MDIs for asthma and COPD, and acute pulmonary oedema.

Nominated quantities, active ingredients and intended markets for which the nomination applies:

Active Ingredients	China	Export	Total
Beclomethasone	54.77	*5.75	60.52
Beclomethasone/clenbuterol/ipratropium	0.7	0	0.7
Budesonide	11.16	0	11.16
Cromoglycate	6.58	**3.90	10.48
Datura metel extract/clenbuterol	2.0	0	2.0
Dimethicone	0.20	0	0.20
Ephedra, ginkgo, sophora flavescens, radix scutellariae	7.00	0	7.00
Ipratropium	8.50	0	8.50
Ipratropium /salbutamol	0.74	0	0.74
Isoprenaline	45.88	0	45.88
Isoprenaline/guaifenesin	3.96	0	3.96
Procaterol	1.45	0	1.45
Salbutamol	393.68	***16.60	410.28
Salmeterol	0.02	0	0.02
Total	536.64	26.25	562.89

* Intended markets Burma, Cambodia, Nigeria, Sudan, Turkmenistan.

** Intended market Cuba.

*** Intended markets Burma, Cambodia, Chile, Ethiopia, Kenya, Mali, Mozambique, Nigeria, Peru, Sierra Leone, Sudan, Turkmenistan.

Recommendation:

Recommend 532.04 tonnes CFCs for MDIs intended for China for the active ingredients beclomethasone, beclomethasone/clenbuterol/ipratropium, budesonide, cromoglycate, datura metel extract/clenbuterol, dimethicone; ephedra, gingko, sophora flavescens and radix scutellariae; ipratropium/salbutamol, isoprenaline, isoprenaline/guaifenesin, procaterol, salbutamol, salmeterol, and intended for export to Cuba for the active ingredient cromoglycate.

Unable to recommend CFCs for MDIs intended for China for the active ingredient ipratropium.

Unable to recommend CFCs for MDIs intended for export to Burma, Cambodia, Chile, Ethiopia, Kenya, Mali, Mozambique, Nigeria, Peru, Sierra Leone, Sudan, Turkmenistan for the active ingredients beclomethasone and salbutamol.

Comments

China has made a detailed nomination using the 2005 (rather than the 2009) *Handbook on Essential Use Nominations*[2]. The nomination is for 553.69 tonnes of CFCs for MDIs for asthma and COPD, and 200 kg and 9 tonnes, respectively, for dimethicone to treat pulmonary oedema and for Chinese traditional medicines.

Asthma and COPD

The nomination elaborates that there are 20 million patients with asthma and 50 million patients with COPD in China. The nomination is for an identical range of active ingredients compared to 2010, except that the nomination for ciclesonide has been withdrawn. The nominated volume is for a total of 562.89 tonnes of CFCs. Of this, 536.64 tonnes is for domestic use in China, and 26.25 tonnes is for export of CFC MDIs. The volume of CFCs requested for 2012 is more than a threefold increase compared with estimated consumption in 2004. However, requested CFC quantities appear to have peaked in 2011 (809.91 tonnes). The 2012 nomination is markedly lower (562.89 tonnes), due to a lower request both for export markets and for domestic consumption. This appears at odds with the stated increase in treatment rate claimed by China in the nomination.

In 2010, the total amount of domestically produced inhalers (MDIs and DPIs) was about 24 million inhalers, mainly containing salbutamol. In comparison, the amount of imported inhalers (MDIs and DPIs) was 10.3 million. These imported inhalers accounted for 30 percent of total consumption. The imported inhalers included 6.3 million HFC MDI inhalers, of which GSK's Ventolin™ was about 5 million inhalers. In addition, imported DPIs amounted to 4 million inhalers, of which the GSK salmeterol/fluticasone combination comprised 2.8 million inhalers, with the remainder split equally among tiotropium, budesonide and formoterol/budesonide combination.

The China nomination identifies 21 domestic CFC MDI manufacturers. Of these, one (Jing Wei) has requested about half the total requested CFC quantity for China, eight have requested between 10-80 tonnes, and the remaining twelve

[2] http://ozone.unep.org/Assessment_Panels/TEAP/Reports/TEAP_Reports/EUN-Handbook2009.pdf

have requested less than 10 tonnes each. It is unlikely that the large number of small to medium sized manufacturers of MDIs in China will be carrying out active research and development of CFC-free inhalers. In addition, China has indicated itself that the transition of many manufacturers to CFC-free inhalers is not likely to be economically viable. The nomination also suggests that four companies may begin manufacture of CFC MDIs for the first time in 2011 or 2012. However, China has indicated that no product included in the nomination was approved after December 31, 2008, according to Decision XII/2 (*2 bis.*).

MTOC questions whether small to medium sized enterprises (SMEs) that are unlikely to make the transition to CFC-free inhalers should be authorized essential use CFCs. CFC use by these companies may simply continue unnecessarily for years until other manufacturers with greater manufacturing and research capacity successfully complete transition. With adequate notice, larger manufacturers could build market and distribution networks to areas that SMEs currently supply. In future years, MTOC will need much greater justification of whether the requests for CFCs from these numerous low-volume consuming SMEs meet the essential use criteria along with clear, demonstrated evidence of on-going active research and development in order to recommend CFC quantities.

MTOC understands that Jing Wei have four manufacturing lines with a total installed capacity to produce 36 million inhalers per year, more than China's current MDI use. Jing Wei has manufacturing lines capable of producing both salbutamol CFC and HFC MDIs. MTOC is also aware that Jing Wei already manufactures under contract and exports salbutamol and beclomethasone HFC MDIs at British Pharmaceutical standards.

China has a transition strategy based on drug categories, with a plan of action for phase-out of salbutamol that has been submitted to the Ozone Secretariat. The nomination states there will be a complete phase-out of CFC MDIs by December 31, 2016, and that China will cease making nominations by December 31, 2015.

China states that the salbutamol CFC MDI phase-out will be completed by December 31, 2015, but that CFC and HFC MDIs should co-exist during a transition period of one year. The nomination states that some patients "*may not adopt CFC-free MDIs*" and "*a small amount of CFC exemption use may still be required*" after December 31, 2016. For other drug categories, the nomination states that there will be a similar one-year transition period when both CFC and CFC-free MDIs should co-exist, also ending on December 31, 2016.

China has stated that salbutamol CFC MDIs will remain essential until four different CFC-free MDIs from four different domestic enterprises are available in an adequate range of doses. MTOC has considered these criteria carefully:

- *Regulatory approval* – The nomination states that, as yet, no suitable CFC-free MDIs are available in China from domestic manufacturers. Two applications for salbutamol HFC MDIs have been submitted for registration to the SFDA in 2010 and are anticipated to be on the market in 2014. China has explained that its registration process may take up to 4 years. Due to this long regulatory period, MTOC is concerned that only two domestic manufacturers of salbutamol may be able to achieve transition by the specified phase-out date. Thus China may not be able to achieve its own criteria for phase-out of salbutamol CFC MDIs, requiring four separate domestic enterprises.

- *Research and development* – Research and development is progressing for 2 salbutamol HFC formulations by 2 separate companies. However, it is highly unlikely that all of the remaining 19 MDI manufacturers are conducting active research and development on reformulation.
- *Affordability* – The Chinese Essential Drugs Lists (NEDL and EDL) determine the maximum price of salbutamol MDIs in China. An EDL, published in August 2009 as a cross-Ministry agreement, gives more people access to basic medicines at reduced prices (by 28-60 percent). MTOC understands that the price cap for the only imported salbutamol HFC MDI is comparable to that for CFC MDIs. Domestic products are marketed at lower prices than imported products, but the price gap has narrowed. Nevertheless, sales of the imported salbutamol HFC MDI (21 percent of all inhalers) have been accelerating since its inclusion under the EDL.
- *Dry powder inhalers* – A number of imported DPIs are currently available in China. In addition, the nomination indicates that there is a small supply of domestically produced salbutamol DPIs. Neither a list of domestic manufacturers nor production volumes are specified. The nomination also indicates the availability of domestically produced beclomethasone DPIs, but no manufacturer details or production volumes are provided. The nomination states that domestic manufacturers are undertaking research and development on DPI formulations for procaterol, salmeterol and tiotropium.

Patients with asthma and COPD require a range of affordable salbutamol CFC-free inhalers for safe phase-out of CFC MDIs. China has proposed that four domestically produced salbutamol HFC MDIs should be available prior to phase-out. To reach the total of four enterprises with salbutamol HFC MDIs for phase-out of salbutamol CFC MDIs may take a further five years (4 years for regulatory approval and one year of co-marketing). As of March 2011, there are only two enterprises that have submitted regulatory packages to the SFDA. The phase-out criteria for salbutamol CFC MDIs may not be achievable by China's own phase-out date of December 31, 2015.

While the current status of product registration applications from domestic manufacturers is unclear, MTOC believes that a range of affordable salbutamol CFC-free inhalers may be available sooner, through a combination of domestic manufacturing and affordable imports. MTOC believes that China's transition strategy criteria for salbutamol CFC MDI phase-out need not be limited to 4 *domestic* producers. Instead, the criteria should simply be for 4 affordable inhalers from any source (including imports). DPIs could also provide a suitable alternative for many patients.

In China, two domestic enterprises have salbutamol HFC MDIs currently in the registration process. One of these is the largest MDI producer in China, Jing Wei, which has completed some clinical trials and has production capacity of 36 million cans, more than China's current MDI use. Faster regulatory approval than currently proposed could mean that Jing Wei salbutamol HFC MDIs are on the market sooner. At MTOC's 2010 meeting, Jing Wei and another company Nuokang indicated that they might be able to phase out salbutamol CFC MDIs earlier than scheduled in China's national strategy provided there was a favourable fast-track regulatory approval process. MTOC understands that Jing Wei plans to market the first salbutamol HFC MDI product by 2012, so that at least one locally made salbutamol HFC MDI could be marketed in China within about the next 12 months. In addition, one imported salbutamol HFC MDI already has significant market share (about 20 percent) and its price is capped at the same maximum price as domestic salbutamol CFC MDIs. DPIs may be available and could provide a suitable alternative for patients[3]. MTOC believes that these developments (two domestic and one imported salbutamol HFC MDI, and possible DPI alternatives) would provide an adequate range of affordable alternatives for early and safe phase-out of salbutamol CFC MDIs in China.

In addition to salbutamol, China has requested CFCs for MDIs in 2012 for another nine moieties for asthma and COPD (excluding Traditional Chinese Medicines that are addressed further below). These include CFCs for MDIs containing inhaled corticosteroids (beclomethasone and budesonide; 67 tonnes), beta-agonists (isoprenaline and procaterol; 51 tonnes), and anti-cholinergics (ipratropium; 8 tonnes) and their combinations. Under the China transition strategy, all of the CFC MDIs for these moieties will become non-essential when one alternative CFC-free MDI becomes available, except for beclomethasone that requires two CFC-free alternatives.

The China phase-out strategy is also determined by category. In category A (beta-agonists), phase-out is proposed when five CFC-free MDIs become available (4 salbutamol and one other). For Category B (inhaled corticosteroids), phase-out is proposed when two beclomethasone CFC-free MDIs become available along with two other moieties. For categories C, D and E, a single CFC-free inhaler in an adequate range of doses will trigger phase-out for the category. In category F (combinations), phase-out can occur once the separate moieties are available on the market in CFC-free inhalers.

There is already a substantial range of imported CFC-free inhalers in all of these categories, which may provide suitable and affordable alternatives.

For category B, two HFC MDIs are available for fluticasone (one in combination with salmeterol) and four DPIs are available containing an inhaled corticosteroid (fluticasone alone, and in combination with salmeterol; and budesonide alone, and in combination with formoterol). These are significantly more expensive than locally produced CFC MDIs containing inhaled corticosteroids. To date, one locally made budesonide HFC MDI has been submitted for registration to the SFDA in 2010. There have been no registration applications for beclomethasone HFC MDIs as yet, although a locally made beclomethasone DPI is available.

For category C, China states that a locally made DPI alternative for sodium cromoglycate is available.

For category D, an imported ipratropium bromide HFC MDI is dominant in the market (about 1 million inhalers). Ipratropium bromide CFC MDIs are also made in small numbers by two local enterprises (about 20,000 inhalers). These products are sold at the same price as the imported HFC MDI (IMS[4] data;

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[3] Shanghai Sine Tianping Pharmaceutical Co.Ltd produces a salbutamol DPI. It can produce 60 million capsules (single dose) per year, but only produces 6 million capsules per year due to its limited market. Jing Wei also produces a salbutamol DPI (200mcg dose), although its capacity and production are unknown.

[4] IMS Health is an international company that supplies the pharmaceutical industry with sales data.

47 RMB). An imported DPI for tiotropium (and possibly also a locally made DPI) is also available.

MTOC concludes that phase-out of CFC MDIs for inhaled corticosteroids is still in its early stages, and the relative role of imports is unclear, in particular in terms of affordability. In contrast, MTOC considers that anti-cholinergics (category D) no longer meet the criteria for essential use in China. The criteria for China's transition strategy for category D appear to have been satisfied. Consequently, MTOC is unable to recommend the CFC quantities requested for ipratropium. Non-essentiality appears also to apply to sodium cromoglycate (category C) although further information is needed. MTOC requests additional information about CFC-free alternatives to sodium cromoglycate in China and the essentiality of the CFC MDI formulation. In future years, MTOC is unlikely to recommend CFCs for sodium cromoglycate MDIs given the global availability of CFC-free alternatives.

Exports

The China nomination provides a detailed analysis of its proposed export markets for 2012. The requested CFCs for MDI exports constitute about 5 percent of China's total nominated quantity for 2012. The nomination states it will not export to countries that have declared non-essentiality. It provides an intended list of 13 Article 5 countries for exports in 2012 (Burma, Cambodia, Chile, Cuba, Ethiopia, Kenya, Mali, Mozambique, Nigeria, Peru, Sierra Leone, Sudan, Turkmenistan). MTOC understands that the one manufacturer, Jing Wei, makes 90 percent of China's CFC MDI exports.

Cuba has requested to import a small quantity of sodium cromoglycate CFC MDIs from China in 2012. Many countries no longer use cromoglycate MDI due to the availability of more effective therapies and the technical difficulty in reformulation of the CFC MDI. MTOC notes that alternative sodium cromoglycate HFC MDI (e.g. Intal and Cromal-5 HFC MDIs) and DPI formulations (e.g. Jing Wei's sodium cromoglycate DPI or Intal Spincaps DPI) may be available for import to Cuba. However, MTOC is uncertain whether these or other CFC-free alternatives are currently approved for use in Cuba. Consequently, MTOC has recommended the quantity of CFC for sodium cromoglycate CFC MDIs intended for export from China for 2012 only. One year will give time for Cuba to complete approvals for import of the globally available CFC-free alternatives. As soon as Cuba achieves the import of CFC-free alternatives, import of sodium cromoglycate CFC MDIs from China should be phased out.

Except for cromoglycate CFC MDIs intended for export to Cuba, MTOC does not believe that the remaining nominated volumes for export meet the criteria for essentiality, and is unable to recommend these quantities for export. MTOC believes that there is a complete range of affordable CFC-free alternatives available worldwide for all importing countries. MTOC considers that there is probably no essential requirement for export of CFC MDIs from China for 2012 and beyond and that continued export of CFC MDIs is detrimental to the transition to CFC-free inhalers in all importing countries. MTOC was not provided evidence in the China nomination that importing countries still consider CFC MDIs essential in 2012.

Stockpiles

The nomination describes in detail the CFC inventory management process in 2010. At end of 2010, the total stockpile held by MDI manufacturers in China was 65.24 tonnes. Furthermore, the only bulk CFC manufacturer in China held inventory of 865.49 tonnes of pharmaceutical-grade CFCs. Thus, the total 2010 year-end stockpile in China was 930.73 tonnes. This corresponds to about 18 months of actual use. The nomination states that China will not issue a CFC production quota to the CFC manufacturer for 2011 unless the inventory is inadequate. MTOC commends China for plans to manage its stockpile down to no more than 12 months of actual use through licensing of bulk CFC manufacture.

Dimethicone and Traditional Chinese Medications

The nomination includes a request for 200 kg CFCs for dimethicone, which is an anti-foaming agent used in pulmonary oedema in China. MTOC is unaware that dimethicone is used elsewhere for this indication. China has mentioned the technical difficulty of reformulation and substitution of dimethicone CFC MDI due to its chemical properties and those of HFCs compared with CFCs. China has determined to make the use of this product non-essential in 2016.

The nomination also includes a request for 9 tonnes CFCs for Chinese Traditional Medicines (TCM). China has mentioned the technical difficulty of reformulation and substitution of TCM CFC MDIs, and has stated that substitution is unlikely to be completed. China has decided that the date for non-essential use of TCM CFC MDIs is currently determined to be 2016.

In previous years, MTOC has requested published scientific information and outcomes of the Chinese re-evaluation of the therapeutic benefits of these medications. MTOC understands from the nomination that this re-evaluation is still in process. MTOC anticipates this information would be provided in any future nomination to assess the on-going essentiality of these medications. MTOC may be unable to recommend future CFC quantities for dimethicone and Chinese Traditional Medicines without adequate additional information on essentiality.

The nominated quantities of CFCs for essential uses in domestic and export markets for the nominated active ingredients in 2011 (metric tonnes) are:

Recommended Quantities in Accordance with Decision XV/5(3):

Active Ingredients	China	Export	Total
Beclomethasone	54.77	0	54.77
Beclomethasone/clenbuterol/ipratropium	0.7	0	0.7
Budesonide	11.16	0	11.16
Cromoglycate	6.58	3.9	10.48
Datura metel extract/clenbuterol	2.0	0	2.0
Dimethicone	0.20	0	0.20
Ephedra, ginkgo, sophora flavescens, radix scutellariae	7.00	0	7.00
Ipratropium	0	0	0.00
Ipratropium/salbutamol	0.74	0	0.74
Isoprenaline	45.88	0	45.88
Isoprenaline/guaifenesin	3.96	0	3.96
Procaterol	1.45	0	1.45
Salbutamol	393.68	0	393.68
Salmeterol	0.02	0	0.02
Total	528.14	3.90	532.04

2.2.16 Pakistan

Year	Quantity nominated
2012	24.1 tonnes

Specific Use: MDIs for asthma and COPD

Nominated quantities, active ingredients and intended markets for which the nomination applies:

Active Ingredient	Intended Market	Quantity (Tonnes)
Beclomethasone	Pakistan	1.0
Beclomethasone/Salbutamol	Pakistan	14.1
Fluticasone/Salmeterol	Pakistan	1.0
Salbutamol	Pakistan	7.5
Salmeterol	Pakistan	0.2
Triamcinolone Acetonide	Pakistan	0.3
Total		24.1

Recommendation: Recommend 24.1 tonnes CFCs for MDIs for intended use in Pakistan for the active ingredients beclomethasone, beclomethasone/salbutamol, fluticasone/salmeterol, salbutamol, salmeterol, triamcinolone acetonide.

Comments

This nomination should be the final request for essential use CFCs by Pakistan, according to the country´s phase-out strategy. For 2012, Pakistan has nominated 24.1 tonnes CFCs, which is a reduction of about 40 percent from 39.6 tonnes CFCs authorised for 2011. There is an expected reduction in consumption of CFCs for all moieties and combination products, except triamcinolone acetonide. CFCs for ipratropium MDIs are no longer included.

Of the three local producers, GlaxoSmithKline, which historically was the largest local CFC MDI manufacturer, has been importing HFC MDIs, and is expected to start local production of salbutamol HFC MDIs in the second quarter of 2012. The second largest MDI manufacturer, Macter International Ltd., has requested 20 tonnes for 2012, which is a reduction of 16 tonnes from its request for 2011. This company will have to fund its own conversion to CFC-free inhalers because it did not qualify for funding from the Multilateral Fund. The third producer, Zafa Pharmaceutical Laboratories Ltd., has increased its nomination from 3.6 tonnes to 4.1 tonnes. In Decision 56/49, the Executive Committee of the Multilateral Fund approved an investment project for Zafa.

The production of MDIs in Pakistan is solely for domestic consumption. The nomination does not mention the phase-out date of 2012, which according to the National Strategy is the phase-out date. However, the company without MLF funding, Macter, has indicated to MTOC that it is on track for conversion by December 2012.

Introduction of locally made salbutamol CFC-free inhalers could be hindered by imports of inexpensive CFC MDIs from China, for instance CFC MDIs manufactured by Jewim Pharmaceuticals (Shandong) Co Ltd. (otherwise known as Jing Wei) are currently imported into Pakistan. CFC-free inhalers are also imported into Pakistan. MTOC has received information that the following moieties are available in Pakistan either as DPIs or as CFC-free MDIs: beclomethasone, budesonide, fluticasone, formoterol, ipratropium, salbutamol, and salmeterol; and the combination products: salbutamol/beclomethasone, budesonide/formoterol, ipratropium/salbutamol, fluticasone/salmeterol, tiotropium/formoterol. According to the nomination these products are more expensive than the CFC MDI products made locally. However, MTOC is aware that dry powder inhaler capsules for use with two devices (Revolizer and Rotahaler) are now available in a range of locally made medications, including for salbutamol. Dry powder inhaler sales in Pakistan showed an appreciable growth rate of 307 percent in 2010. According to IMS data, about 46,000 patients were shifted to dry powder inhalers during 2010. These devices are reportedly providing the advantage of increased compliance by and cost effectiveness for patients in Pakistan. These locally made CFC-free inhalers provide an expanding alternative to CFC MDIs.

The salbutamol CFC MDI produced by Macter was registered and briefly launched in February 2007 to complete regulatory obligations. However it was not launched commercially until 2010. Essential use requests for this product were made within nominations for the years 2010, 2011 and now for 2012. Its introduction in the market has taken place while GSK has been substituting its salbutamol CFC-free MDI (currently imported but soon to be locally made) for its salbutamol CFC MDI.

A press report (The Express Tribune, 11 February 2011) on the shortage of inhalers and nebulizers for asthma in Pakistan came to the attention of MTOC. While the report highlights the shortage of inhalers in general, it also quotes pharmacy retailers and some patients being aware of both the earlier (CFC-based) brands as well as the newer (CFC-free based) brands. The report also indicates that many patients are psychologically attached to the brands with which they are familiar.

On consulting with the implementing agencies for the Pakistan MDI project (UNDP and UNEP), MTOC was assured that such issues and challenges had been foreseen and were to be expected during the transition period, not only in Pakistan but also other countries. The agencies indicated they were working closely with government, industry and other stakeholders to find ways to minimize the impacts of such challenges on cost-effective availability of inhalers during the transition period. MTOC also learned that local companies are conducting extensive education campaigns.

The accounting framework of Pakistan for the year 2010 indicates that Macter and Zafa together used slightly less (34.6 tonnes) than the amount of CFCs authorised by the Parties (34.9 tonnes). No CFCs were acquired in 2010, with only stock held at the start of 2010 used for the manufacture of MDIs. A small stockpile of 2.5 tonnes remained at the end of 2010.

2.2.17 Russian Federation

Year	Quantity nominated
2012	250.0 tonnes
2013	125.0 tonnes

Specific Use: MDIs for asthma and COPD

Nominated quantities, active ingredients and intended markets for which the nomination applies:

Year	Active Ingredient	Intended market	Quantity (Tonnes)
2012	Salbutamol	Russian Federation	250.0
2013	Salbutamol	Russian Federation	125.0

Recommendation:

Recommend 212 tonnes CFCs for MDIs for intended use in the Russian Federation for the active ingredient salbutamol for 2012.

Unable to recommend CFCs for MDIs requested for 2013.

Comments

The Russian Federation nomination requests 250 tonnes CFCs for the manufacture of salbutamol CFC MDIs for domestic use only, which is 2 tonnes more than the 248 tonnes nominated for 2011, and an 18 percent increase over the 212 tonnes nominated for 2010 and authorised by Parties for 2010 and 2011. The majority of patients continue to use locally produced CFC MDIs owing to their wider availability, low cost and popularity. The combined production volume for locally made salbutamol CFC MDIs increased from 4.1 to 7.6 million units between 2008 and 2010.

CFCs are requested for two Russian pharmaceutical companies, which together with UNIDO took initiatives in 2009-10 to develop a GEF-funded project to complete the phase out of CFCs in MDIs. The Russian Federation stated in 2010 that the phase-out could be achieved by the end of 2012 if GEF funds became available on time. Although the two companies have submitted documents for registration of salbutamol CFC-free MDIs, the implementation of the conversion project, specifically the appropriation of funding for equipment and provision of technology assistance, has been further delayed. This has led them to adjust the timeline to mid-2013.

Negotiations between UNIDO and GEF about a grant for preparation of the UNIDO/GEF Project, "Phase-out of CFC consumption in the Manufacture of Aerosol Metered Dose Inhalers (MDIs) in the Russian Federation", has been completed successfully and on the 15th of March, 2011, UNIDO received notification from GEF about appropriation of those funds. In June 2011 it is envisaged that preparation of the project proposals for submission to the GEF Secretariat will be completed. It is planned that the UNIDO/GEF Project would be approved during the autumn meeting of the GEF Council, and the UNIDO/GEF Project started at the beginning of 2012 and finished in the second part of 2013.

Despite the recent successful appropriation of funds, there has otherwise been little demonstrated progress in manufacturing transition in the last 12 months. At present, Russian companies are carrying out testing of the technological parameters of production of CFC-free products on laboratory equipment for subsequent use in process lines, which they plan to acquire during the UNIDO/GEF Project. Parties authorised an essential use exemption for 212 tonnes for the Russian Federation for each of the years 2010 and 2011. Considering the patient perspective, MTOC is recommending the same quantity (212 tonnes) for 2012, instead of the nominated 250 tonnes. The increased demand for salbutamol MDIs could be fulfilled by the currently available imported CFC-free MDIs, which are similarly priced at equipotent dose.

A bilateral Russia/United States Government workshop on Exchange of Experience in Implementation of Transition to CFC-free MDI Production was held in Moscow in late September 2010. Options for future cooperation were discussed for the Russian conversion of production of MDIs to the use of HFCs. After signing a contract for the supply of equipment and obtaining a list of technical specifications and parameters, the two Russian companies plan to communicate with relevant members of the US working group on specific issues relating to commissioning. This will be aimed at minimising errors and optimising time in starting new production of HFC MDIs. Given the equipment and technology used by US companies are not fundamentally different from those to be introduced by Russian enterprises, such assistance is expected to be extremely useful.

MTOC is unable to recommend the nomination for 2013. The phase-out date for the Russian Federation was initially established as 2008. In recent years the argument of lack of finance has been repeatedly offered to justify new nominations. A delayed funding process with UNIDO and the GEF has more recently frustrated timely transition in the Russian Federation. There is a clear opportunity for the Russian Federation Government and the two companies to take the initiative to accelerate the phase-out process and thereby fulfil their environmental commitments under the Montreal Protocol**.** If conversion is not achieved within 2012, MTOC believes that the Russian Federation should broaden the importation and distribution of affordable, imported salbutamol CFC-free inhalers to meet the demand of Russian patients with asthma and COPD.

2.3 Reporting Accounting Frameworks for Essential Use Exemptions and Issues for Countries in the Final Stages of Transition

The following section describes information provided in reporting accounting frameworks by Parties with authorised essential use exemptions for 2010 that are not nominating essential uses for 2012. It also elaborates some remaining issues for these countries in the final stages of transition. The reporting accounting frameworks of Parties nominating essential uses for 2012, and associated issues, are summarised in the preceding sections.

2.3.1 Argentina

Parties authorised 178 tonnes of essential use CFCs for the manufacture of MDIs in Argentina for 2010. Argentina's accounting framework for 2010 was received on 25th January 2011. Argentina reports that no CFCs were acquired during 2010 for essential uses. With a stockpile of 90 tonnes entering the year, Argentina has used its stockpile to manufacture MDIs in 2010. Final data from MDI manufacturers on usage and the remaining stockpile at the end of 2010 were not available at the time of submission. Apparently there were some CFC supply issues for Argentinian MDI manufacturers that would ordinarily import CFCs.

Argentina has an authorised essential use exemption of 107.2 tonnes for 2011. During its March 2011 meeting held in Buenos Aires, Argentina, MTOC met with a small selection (Atlas, Denver, Pablo Cassara, and 3M Argentina) of local MDI manufacturers and representatives of the Secretaria de Ambiente y Desarrollo Sustentable. Argentina is pleased to report there has been significant progress in the transition from CFC MDIs to CFC-free inhalers. There is now significant HFC MDI production capacity, with a range of alternative CFC-free inhalers available in the market and also in the pipeline. Atlas has developed HFC inhalers, without any previous manufacture of CFC MDIs, with its salbutamol HFC MDI approved during 2010. Denver Farma ceased production of CFC MDIs at the end of 2010, with its salbutamol HFC MDI launched in July 2010. 3M Argentina has developed a range of HFC formulations: it is ready to license generic HFC inhalers (salbutamol, salbutamol/beclomethasone, fluticasone, fluticasone/salmeterol, budesonide) to developing markets.

Pablo Cassara manufactures a number of HFC MDI products in a range of active ingredients. Pablo Cassara continues to develop isobutane-propelled salbutamol MDIs as a climate and ozone friendly alternative to CFC MDIs. It is hoping to submit its formulation for approval to regulatory authorities by the 2nd half of 2012. Pablo Cassara is not anticipating the need for any long-term clinical studies. However, MTOC members are of the opinion that toxicology and clinical studies (in combination with each active ingredient) will be needed, at least outside Argentina, because no full human toxicological studies have ever been performed on isobutane. Pablo Cassara has also developed a formulation for salbutamol HFC MDIs.

Given the scarcity of CFC supply in Argentina, and commendable progress in the manufacture of CFC-free inhalers, it is unlikely that there will be significant continued essential use requirements in Argentina.

2.3.2 Egypt

Parties authorised 227.4 tonnes of essential use CFCs for the manufacture of MDIs in Egypt for 2010. However, no accounting framework has been reported for authorised essential uses in 2010.

2.3.3 European Union

Parties authorised 22 tonnes of essential use CFCs for the manufacture of MDIs in the European Union for 2009. The European Union's accounting framework for 2009 was received on 22nd February 2011. The European Union has also updated the accounting framework for 2008, and outlined plans for the remaining surplus.

For 2009, the European Union reports that about 14 tonnes of pharmaceutical-grade CFCs were acquired in 2009 under its essential use exemption. With about 115 tonnes of stockpile entering 2009, the European Union reports that about 79.5 tonnes were used to manufacture MDIs, of which 74.4 tonnes were contained in exported products. With about 3 tonnes destroyed in 2009, a stockpile of about 46.4 tonnes remained at the end of 2009.

The European Union has completed transition and has not had any authorised essential use exemptions since 2009. In a letter dated February 2011, the European Union has indicated the likely fate of the surplus: some are to be destroyed; some "*will be used for the production of MDIs and parts thereof*"; some were sold for a non-MDI use of which nothing is known of the intended use except that the purchaser is a known user of CFC for process agent uses; no information is available for some; and some was unaccounted for on stock inventory.

Further discussion on CFCs stockpiles and the deployment of surplus is presented in section 3.3.

2.3.4 India

Parties authorised 343.6 tonnes of essential use CFCs for the manufacture of MDIs in India for 2010. India's accounting framework for 2010 was received on 25th March 2011. India reports that about 293 tonnes of pharmaceutical-grade CFCs were manufactured in 2010 under its essential use exemption, along with about 24.4 tonnes of non-pharmaceutical grade CFCs manufactured during the start-up of the production run. Of the 293 tonnes, India reports that 2.24 tonnes of bulk CFCs were exported to Iran under its essential use exemption. MTOC notes that this quantity also appears in the accounting framework for Iran.

Of the 290.7 tonnes of CFCs produced for domestic requirements, only 94.9 tonnes were used for MDI manufacture in India. India reports that none of these CFCs were used to manufacture MDIs intended for exports. No CFCs were destroyed in 2010. With a small stockpile of about 6 tonnes entering the year, by the end of 2010 India had a stockpile of about 201.9 tonnes of pharmaceutical-grade CFCs, plus 24.4 tonnes of non-pharmaceutical grade CFCs.

India's nomination for 2011 was withdrawn and transition has been completed, meaning that a stockpile remains that is surplus to requirements in India. Further discussion on CFCs stockpiles and the deployment of surplus is presented in section 3.3.

2.3.5 Iran

Parties authorised 105 tonnes of essential use CFCs for the manufacture of MDIs in Iran for 2010. The Iran accounting framework for 2010 was received on 16th March 2011. Iran reports that 2.24 tonnes of pharmaceutical-grade CFCs were imported from India under Iran's essential use exemption for 2010. Iran reports that a license for the import of about 18.7 tonnes of CFCs was issued in 2009 under the pre-essential use quota system, and delivered in January 2010. This provided stock of 18.7 tonnes at the start of 2010. Iran used the entire 20.96 tonnes of available pharmaceutical-grade CFCs for the manufacture of MDIs in 2010, with no stockpile remaining. No CFCs were destroyed in 2010.

2.3.6 Syria

Parties authorised 44.68 tonnes of essential use CFCs for the manufacture of MDIs in Syria for 2010. However, no accounting framework has been reported for authorised essential uses in 2010.

2.3.7 United States

Parties authorised 92 tonnes of essential use CFCs for the manufacture of MDIs in the United States for 2010. The United States does not have any authorised essential uses for 2011. The United States' accounting framework for 2010 was received on 19th March 2011. Of the 92 tonnes of CFCs authorised as essential uses by the Parties, the United States allocated 30 tonnes to MDI manufacturers for CFC production under its internal legal processes, all of which was acquired. With a reported stockpile of 525 tonnes entering the year, the United States had 555 tonnes available for use in 2010. The United States reported that 358 tonnes of CFCs were used for the manufacture of MDIs in 2010 and 28 tonnes were destroyed, with remaining stockpile of 169 tonnes at the end of 2010 reported in its accounting framework. Some of the surplus reported in the accounting framework was manufactured pre-1996. In addition, the United States has reported separately under Decision XXII/4(4) that stockpiles of 624.637 tonnes of pharmaceutical-grade CFCs are potentially available for export to Parties with essential-use exemptions in 2011. The United States has advised that this stockpile quantity, held by Honeywell, is separate to the stockpile reported in its accounting framework, held by individual MDI manufacturing companies. Therefore, the United States has a total stockpile of about 793.6 tonnes of CFCs. Further discussion on CFCs stockpiles and the deployment of surplus is presented in section 3.3.

3 Medical Technical Options Committee Progress Report

3.1 Executive Summary

The Medical Technical Options Committee (MTOC) thanks the Ozone Secretariat for providing meeting venue sponsorship for the MTOC meeting held in Buenos Aires, 20-22 March 2011. MTOC member, Dr Jorge Caneva, and the Ozone Program Office of Argentina (OPROZ) provided a range of organisational assistance.

The global use of CFCs to manufacture MDIs in 2010 is estimated to be less than 1,600 tonnes. Article 5 countries that provided accounting frameworks used about 768 tonnes, and the Russian Federation and the United States used about 570 tonnes, of CFCs for the manufacture of MDIs in 2010. Parties reported about 1,931 tonnes of pharmaceutical-grade CFCs in stockpiles at the end of 2010. The United States reported that about 625 tonnes of pharmaceutical-grade CFCs are available for export under commercial agreement with holders of those stocks. In addition, the United States also reported 169 tonnes of CFCs held by individual MDI manufacturing companies in its accounting framework. India reported stockpile of about 202 tonnes of pharmaceutical-grade CFCs, and about 24 tonnes of non-pharmaceutical grade CFCs at the end of 2010.

Production of pharmaceutical-grade CFCs is now limited to a few sources. It is likely that, other than for China and the Russian Federation, all other essential use CFCs will need to be acquired from available stockpile for 2011. Furthermore, CFCs can potentially be supplied from stockpile for the total remaining essential use requirements (190 tonnes) for countries excluding China and the Russian Federation. This depends on, *inter alia*, Parties' decisions regarding essential use exemptions for 2012, whether stockpile is acquired under commercial arrangements, and also whether the CFC mix and specifications of the stockpile meets the needs of the MDI manufacturers. However, it should be possible to complete the phase-out of CFC MDIs in countries without access to CFC production sources with careful management of existing global CFC stockpiles.

Remaining CFC surplus should also be considered for some of the remaining essential use requirements in China and the Russian Federation to avoid the need for unnecessary new production and costly destruction of surplus. Any new source of supply of CFCs will require that CFC MDI producers validate the suitability of the newly sourced propellant in each specific MDI product. Parties may wish to encourage the transfer of stockpiles and to avoid future production of CFCs that is surplus to actual needs. A cautious approach to CFC production is advisable since transition is moving quickly.

TEAP and its MTOC believes that it is important during the final stages of the phase-out of CFC MDIs that stockpiles of CFCs are utilised only in uses authorised through an essential use exemption, in preference to newly produced CFCs, and appropriately destroyed if not utilised in uses authorised under an essential use exemption. Parties may wish to clarify in a decision that CFCs produced under Decision IV/25, or remaining pre-1996 or -2010 phase-out CFCs that were not utilised for essential uses in subsequent years in preference to production of new CFCs, are only authorised for uses specified in essential use exemptions and otherwise, if not utilised, need to be destroyed. Such a decision might clarify obligations for Parties with surplus CFCs.

Technically satisfactory alternatives to CFC MDIs to treat asthma and COPD are available in almost all countries worldwide. MTOC has noted previously the wide availability in Article 5 countries of technically suitable CFC-free alternatives to CFC MDIs manufactured by multinational companies in developed countries. CFC-free inhalers manufactured in developing countries are now substantially increasing the range of affordable alternatives.

3.2 Global Use of CFCs for MDIs

The global use of CFCs to manufacture MDIs in 2010 was about 1,340 tonnes, excluding Egypt and Syria, for which accounting frameworks were not received. Taking potential consumption in these countries into account, global consumption in 2010 is estimated to be less than 1,600 tonnes.

Figure 3-1 and Table 3-1 show the use of chlorofluorocarbons (CFCs) for the manufacture of MDIs for asthma and COPD in Article 5 and non-Article 5 countries for essential uses.

Article 5 countries that provided accounting frameworks used about 768 tonnes of CFCs for the manufacture of MDIs in 2010, a remarkable reduction of 55 percent from 1,700 tonnes in 2009. Most countries reduced consumption significantly between 2009 and 2010, except China for which consumption remained about the same.

The Russian Federation and the United States used about 570 tonnes of CFCs for the manufacture of MDIs in 2010, a reduction of only 2 percent from 2009. The United States increased its production of CFC MDIs in 2010 by 6 percent.

Despite the 2010 trends in China, Russia and the United States, there has otherwise been significant global progress in the transition of CFC MDIs to CFC-free inhalers in 2010. Substantial capacity to manufacture CFC-free inhalers is expected by 2011-2012.

Figure 3-1: Quantities of CFCs for MDI manufacture in Article 5 and non-Article 5 countries

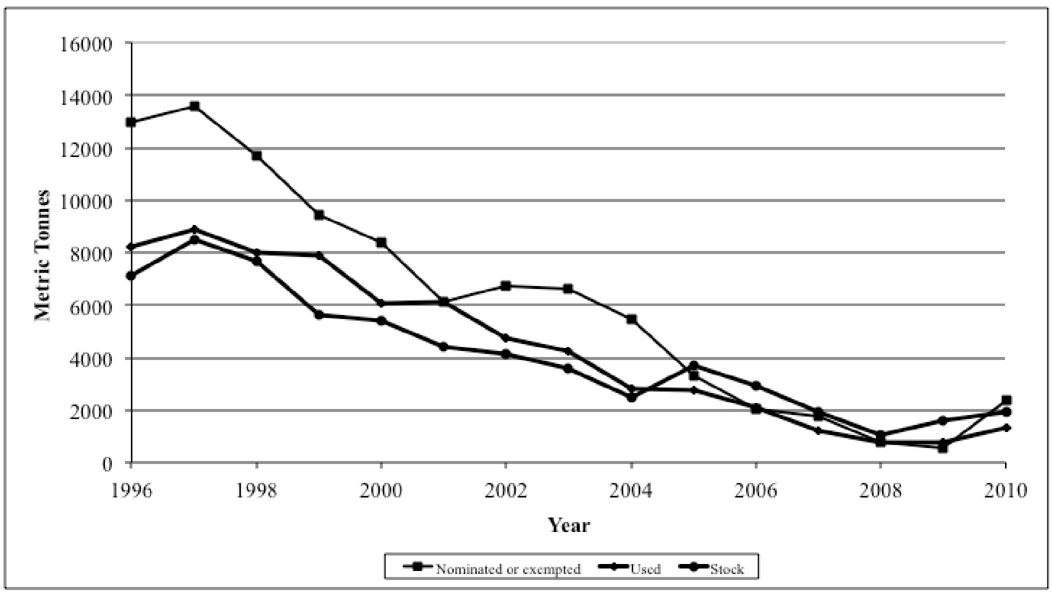

Table 3-1: Quantities (in tonnes) of CFCs for MDI manufacture in Article 5 and non-Article 5 countries

Year of Essential Use	Amount Exempted/ Nominated for year of Essential Use	Used for Essential Use	On Hand End of Year
1996	12,987.20	8,241.13	7,129.59
1997	13,548.00	8,904.99	8,515.24
1998	11,720.18	8,013.60	7,656.63
1999	9,442.13	7,906.35	5,653.95
2000	8,364.95	6,062.75	5,433.32
2001	6,126.53	6,121.62	4,402.59
2002	6,714.75	4,751.92	4,133.71
2003	6,641.55	4,261.91	3,570.27
2004	5,443.12	2,840.82	2,460.10
2005	3,321.10	2,735.40	3,671.01
2006	2,039.00	2,107.10	2,916.08
2007	1,778.00	1,220.90	1,946.68
2008	797.00	796.10	1,022.18
2009	552.00	772.54	**1,590.16
*2010	2,399.78	1,338.29	**1,930.56
2011	1,099.95	-	-

* In the year 2010, Article 5 countries with essential use authorisations are newly included, which explains in part the sudden jump in quantities for all three categories, amount exempted, used and stockpiled. Use and stockpile are not reflected for Egypt or Syria because no accounting frameworks were received for these countries.

** For the years 2009 and 2010, separately reported stockpile (1,017.148 tonnes and 624.637 tonnes respectively) held by Honeywell in the United States is included, in addition to stocks held by individual MDI companies reported in the accounting frameworks.

3.3 CFC Stockpiles

Table 3-1 presents historical stockpiles reported by Parties with essential use exemptions under accounting frameworks. Of the Parties that provided accounting frameworks for 2010, there were stocks of pharmaceutical-grade CFCs of about 1,930 tonnes at the end of 2010.

Decision XXI/4 and XXII/4 encouraged Parties with stockpiles of pharmaceutical-grade CFCs potentially available for export to notify the Ozone Secretariat by 31st December 2009 and 2010 respectively. As a result, at the end of 2009 Parties reported that there were about 1,017 tonnes of pharmaceutical-grade CFCs (about 225 tonnes CFC-11, 425 tonnes CFC-12, 367 tonnes CFC-114) available in stockpiles in the United States and 301 tonnes of pharmaceutical-grade CFC-12 available in Venezuela. At the end of 2010, no further information is available on stockpiles in Venezuela, and the United States reported stockpiles of 624.637 tonnes (about 155 tonnes CFC-11, 349 tonnes CFC-12, 121 tonnes CFC-114). These stockpiles are available for export under commercial agreement with holders of those stocks. Regulatory processes for exporting CFCs from the United States' stockpiles for essential uses are not complicated. The United States has advised that this stockpile quantity, held by Honeywell, is separate to the stockpile of 169 tonnes reported in its accounting framework held by individual MDI manufacturing companies.

Any remaining essential use stockpiles in the European Union are not available for export due to regulations prohibiting the production and export of CFCs from 1st January 2010. The European Union has reported in its accounting framework stockpile of about 46 tonnes at the end of 2009. The European Union has completed transition and has not had any authorised essential use exemptions for MDIs since 2009. In a letter dated February 2011, the European Union has indicated the likely fate of the surplus: some are to be destroyed; some "*will be used for the production of MDIs and parts thereof*"; some were sold for a non-MDI use of which nothing is known of the intended use except that the purchaser is a known user of CFC for process agent uses; no information is available for some; and some was unaccounted for on stock inventory.

India has also reported in its accounting framework stockpile of about 202 tonnes of pharmaceutical-grade CFCs, and 24.402 tonnes of non-pharmaceutical grade CFCs, available at the end of 2010.

The European Union, India and the United States do not have any authorised essential use exemptions for 2011 or later. At the end of 2010, total CFC stockpiles in these Parties was about 1,020 tonnes.

TEAP and its TOCs has reported previously that there may be two remaining[1] options to resolve post-1996 and post-2010 surplus accumulated under the essential use provisions of the Montreal Protocol:

1. Transfer the surplus CFCs to an essential use authorised by Parties; and/or
2. Destruction of the surplus CFCs in processes approved by the Montreal Protocol.

TEAP and its MTOC have also reported previously on the status of pre- and post-1996 stockpiles in non-Article 5 countries[2]. TEAP and its MTOC concluded that it might not be significant that CFCs were produced prior to the 1996 phase-out because of the way these stockpiles have been maintained under the essential use process. Under essential use requirements, it is assumed that any company that had received an essential use allowance would have been required to use existing pre-1996 stock first. TEAP and its MTOC believes that if a company used an essential use quantity while in possession of pre-1996 material, then any pre-1996 surplus remaining at the end of a company's production of MDIs under essential use exemption should be treated as having been produced post-1996. Under this interpretation, the deployment of the pre-1996 surplus would also need to abide by the provisions of the Montreal Protocol that might apply to post-1996 surplus (as outlined above). The same interpretation is relevant for pre- and post-2010 stockpiles in Article 5 countries.

The letter from the European Union raises the issue of whether or not CFCs accumulated under the essential use provisions can or cannot be used for process agent or feedstock uses.

Article 2 of the Montreal Protocol mandates the phase-out of production and "consumption" of substances that deplete the ozone layer. "Consumption" is defined as production plus imports minus exports. Article 2 also authorises the Parties by decision to permit such

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[1] In its 2005 Progress Report, TEAP also reported a third option of transfer to an Article 5 country for basic domestic needs (with prior consent and accounting), which is no longer available as an option. UNEP *May 2005 Report of the Technology and Economic Assessment Panel*, pg. 35, http://ozone.unep.org/Assessment_Panels/TEAP/Reports/TEAP_Reports/teap_progress_report_May2005.pdf.

[2] UNEP *May 2005 Report of the Technology and Economic Assessment Panel*, pg. 35, http://ozone.unep.org/Assessment_Panels/TEAP/Reports/TEAP_Reports/teap_progress_report_May2005.pdf.

production and "consumption" as may be necessary for those uses decided by the Parties to satisfy the essential use criteria.

Under Decision IV/25, production and consumption for essential uses after the Protocol's production phase-out is very specific. It is only permitted against an authorisation granted by the Parties to an individual Party, which is then passed on to an individual company by a national mechanism/regulation. This has applied to MDIs, solvents and halons, since only these uses have been specified as essential uses for the purposes of production and consumption in decisions of the Parties. There is also the global exemption for laboratory and analytical uses.

CFC production and consumption for feedstock and process agents is treated differently to CFC production and consumption for essential uses under the Protocol. In Decision VII/30, Parties decided that quantities of controlled substances being produced and imported/exported for use as feedstock in the manufacture of other chemicals would not be taken into account in the calculation of production or consumption of controlled substances. In Decision X/14, Parties decided that quantities of controlled substances being produced and imported for use as process agents would also not be taken into account in the calculation of production and consumption of controlled substances. They are not essential uses, but have been deemed to be non-emissive uses or uses where emissions are insignificant.

Taken together, TEAP and its MTOC might interpret these decisions to mean that Parties did not intend that CFCs produced under the essential use provisions were authorised for any uses other than those for which the exemption was given, and were not authorised for use as feedstock or process agents. Furthermore, TEAP and its MTOC has operated under the assumption that Parties intended CFCs authorised under essential use exemptions to be used in the uses for which the exemption was given, and has made every effort to estimate accurately CFC requirements for MDIs subject to essential use nominations for any particular year.

Alternatively, there are some environmental and economic advantages to deployment of CFCs, produced under an essential use exemption authorised for MDI manufacture but surplus to requirements, being used in process agent or feedstock applications. This could avoid unnecessary new CFC production, feasibly lowering impacts on the ozone layer and the costs of CFC acquisition for feedstock or process agent uses. On the other hand, opening this as an avenue for deployment of surplus CFCs, produced under an authorised essential use exemption for MDIs, might create a perverse incentive for over-estimation and production of CFCs under the essential use provisions. Technical assessment of nominations under the essential use process might be expected to avoid this outcome. There may be only a few process agent or feedstock uses for CFC-11 and -12, but possibly more uses for CFC-114.

Nonetheless, TEAP and its MTOC believes that it is important during the final stages of the phase-out of CFC MDIs that stockpiles of CFCs are utilised only in uses authorised through an essential use exemption, and otherwise appropriately destroyed. Parties may wish to clarify in a decision that CFCs produced under Decision IV/25, or remaining pre-1996 or -2010 phase-out CFCs that were not utilised for essential uses in subsequent years in preference to production of new CFCs, are only authorised for uses specified in essential use exemptions or otherwise destroyed, rather than diverted to process agent or feedstock use. Such a decision might clarify obligations for Parties with surplus CFCs.

Parties may also wish to recall that Decision VIII/9 (9) states: "…*to request each of the Parties that have had essential-use exemptions granted for previous years, to submit their report in the approved format by 31 January of each year*", meaning that Parties are required to report stockpile management *annually*. This allows Parties to track the deployment of stockpiles of essential use CFCs through transfer, use, or destruction until depleted to zero.

This should include reporting of quantities of non-pharmaceutical-grade CFCs manufactured as a result of production of pharmaceutical-grade CFCs.

3.4 CFC Production

Production of pharmaceutical-grade CFCs is now limited to a few sources. Honeywell, in the United States, has a swing plant producing HCFC-22 that can also produce CFCs. However, regulatory processes to allow export of newly produced CFCs would likely take more than a year to complete. China and India both have production facilities capable of manufacturing pharmaceutical-grade CFCs but they are subject to MLF production phase-out agreements. Under its existing CFC production phase-out agreement, China is allowed to manufacture pharmaceutical-grade CFCs for authorised essential uses for itself and for export to the Russian Federation only. Decision XXI/4 requested the Executive Committee to consider reviewing both of the CFC production phase-out agreements with China and India with a view to allowing production of pharmaceutical-grade CFCs to meet authorised levels of CFC production for essential uses. The 60th Executive Committee Meeting, April 12-15, 2010, decided to modify the production sector agreements for China and India to allow the production for export of pharmaceutical-grade CFCs for 2010, with an annual review, for the purposes of meeting essential use requirements of other countries provided that the exporting countries had specified reporting and verification systems in place. No request has been made to review these agreements for 2011. Therefore it is likely that, other than for China and the Russian Federation, all other essential use CFCs will need to be acquired from available stockpile for 2011.

Any new source of supply of CFCs will require that CFC MDI producers validate the suitability of the newly sourced propellant in each specific MDI product. Validation takes time to complete, and in some cases would require the approval of health authorities. Total time to register a new source can take up to 6 months.

3.5 Estimated Future CFC Usage for MDIs

Table 3-2 and Figure 3-2 show estimated future global CFC usage for MDI manufacture. CFC usage for 2010 is based mainly on quantities reported by Parties in accounting frameworks. MTOC estimates that less than 1,100 tonnes of pharmaceutical-grade CFCs might be required in 2011 to supply CFCs for essential MDI uses, although not all of this quantity is likely to be needed. Excluding China and the Russian Federation, less than 140 tonnes of pharmaceutical-grade CFCs is likely to be required to supply CFCs for essential MDI uses in Parties without access to CFC production sources (Argentina, Bangladesh, Pakistan) in 2011. If Parties approve MTOC's recommendations for essential use quantities of CFCs at the 23nd Meeting of the Parties, less than 50 tonnes of pharmaceutical-grade CFCs might be required in 2012 to supply CFCs for essential MDI uses in countries excluding China and the Russian Federation. For 2013 onwards, the estimated CFC consumption for essential MDI uses in countries other than China and the Russian Federation might be zero tonnes.

For the total remaining essential use requirements (190 tonnes) for countries other than China and the Russian Federation, CFCs can potentially be supplied from stockpile quantities. This depends on, *inter alia*, Parties' decisions regarding essential use exemptions for 2012, whether stockpile is acquired under commercial arrangements, and also whether the CFC mix and specifications of the stockpile meets the needs of the MDI manufacturers. However, it should be possible to complete the phase-out of CFC MDIs in countries without access to CFC production sources with careful management of existing global CFC stockpiles.

Table 3-2: Estimated CFC usage for MDI manufacture by Parties, 2010- 2014+[3]

Country	2010	2011	2012	2013	2014 +	Total
Algeria	11	8	0	0	0	19
Argentina	90	45	0	0	0	135
Bangladesh	45	57	25	0	0	142
China	528	741	528	400	345	2,577
Colombia	-	-	-	-	-	0
Cuba	-	-	-	-	-	0
Egypt	227	0	0	0	0	227
India	95	0	0	0	0	95
Indonesia	-	-	-	-	-	0
Iran	21	0	0	0	0	21
Mexico	-	-	-	-	-	0
Pakistan	35	40	24	0	0	98
Russia	212	212	212	0	0	636
Syria	45	0	0	0	0	45
United States	358	0	0	0	0	358
Uruguay	-	-	-	-	-	0
Venezuela	-	-	-	-	-	0
Total	1,666	1,103	789	400	345	4,353

Remaining CFC stockpiles should also be considered for some of the remaining essential use requirements in China and the Russian Federation to avoid the need for unnecessary new production and costly destruction of surplus.

Parties may wish to encourage the transfer of stockpiles to avoid future production of CFCs that are surplus to actual needs. A cautious approach to CFC production is advisable since transition is moving quickly.

Some changes to the accounting framework were considered by MTOC to help track production and/or import of newly produced CFC, existing stockpile, and other production and stockpile issues. New columns in the accounting framework were considered to report the export of bulk CFCs, whether the exported CFCs were newly produced or from stockpile, and the country to which they were exported. However, TEAP and its MTOC have not elaborated a changed framework given the advanced stage of the phase-out process for MDIs.

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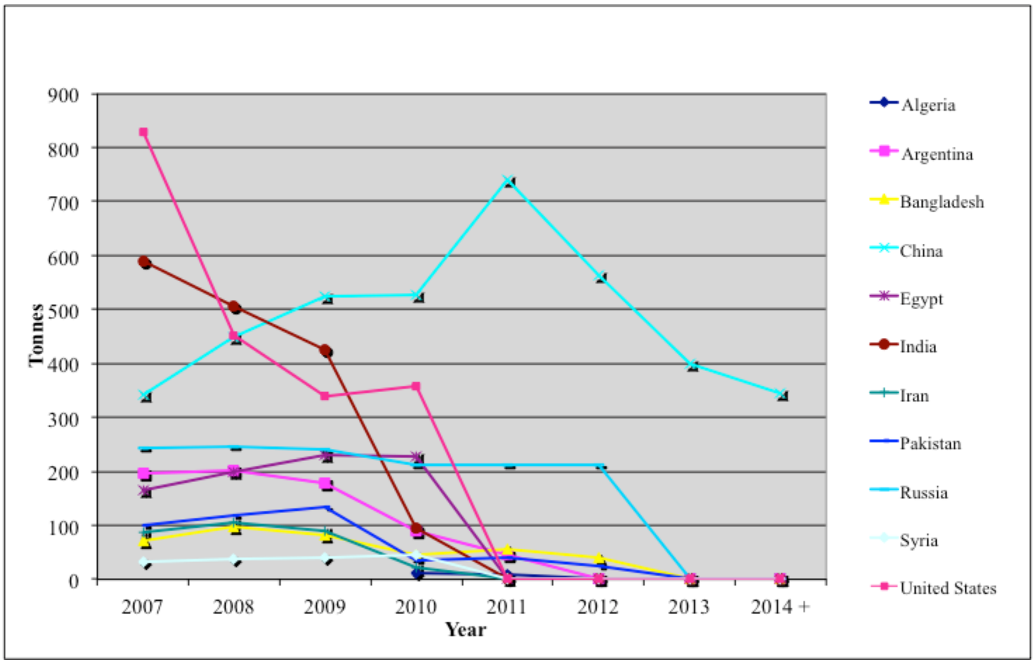
[3] Black font is actual use reported by Parties; red font is essential use quantity authorized by Parties; blue font is an estimate made by MTOC. For 2010, usage data are based on exempted quantities, actual consumption reported in accounting frameworks or estimates provided by countries in 2011 essential use nominations. For 2011, usage data are based on exempted quantities or estimations made by MTOC. For 2012, MTOC estimates are based on essential use quantities recommended by MTOC and does not pre-judge decisions taken by Parties. For 2013 onwards, estimated usage does not take into account whether use meets the essential use criteria.

Figure 3-2: Estimated CFC usage[4] for MDIs for Parties, 2010-2014+



3.6 Transition Away from the Use of CFC MDIs

Technically satisfactory alternatives to CFC MDIs to treat asthma and COPD are available in almost all countries worldwide. For a number of years, MTOC has noted the wide availability in Article 5 countries of technically suitable CFC-free inhalers manufactured by multinational companies in developed countries. CFC-free inhalers manufactured in developing countries are now substantially increasing the range of affordable alternatives.

Further information about the range of alternatives available worldwide are contained in the *2010 MTOC Assessment Report*[5].

3.6.1 Transition Strategies

In response to Decision XII/2, transition strategies developed by seven Parties are listed on the Ozone Secretariat's web site. Pursuant to Decision XV/5(4), plans of action regarding the phase-out of the domestic use of salbutamol CFC MDIs from the European Community, the Russian Federation and the United States are also listed on the Ozone Secretariat's web site[6].

For Article 5 countries, Decisions IX/19(5*bis*) and XV/5(4*bis*) set out requirements for the development of national transition strategies and preliminary plans of action for the phase-out of salbutamol CFC MDIs respectively.

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[4] For 2010, usage data are based on exempted quantities, actual consumption reported in accounting frameworks or estimates provided by countries in 2011 essential use nominations. For 2011, usage data are based on exempted quantities or estimations made by MTOC. For 2012, MTOC estimates are based on essential use quantities recommended by MTOC and does not pre-judge decisions taken by Parties. For 2013 onwards, estimated usage does not take into account whether use meets the essential use criteria.

[5] http://ozone.unep.org/Assessment_Panels/TEAP/Reports/MTOC/MTOC-Assessment-Report-2010.pdf

[6] http://ozone.unep.org/Exemption_Information/Essential_Use_Nominations/index.shtml

Decision IX/19(5*bis*) states:

> "*To require Parties operating under paragraph 1 of Article 5 submitting essential-use nominations for chlorofluorocarbons for metered-dose inhalers for the treatment of asthma and chronic obstructive pulmonary disease to present to the Ozone Secretariat an initial national or regional transition strategy by 31 January 2010 for circulation to all Parties. Where possible, Parties operating under paragraph 1 of Article 5 are encouraged to develop and submit to the Secretariat an initial transition strategy by 31 January 2009. In preparing a transition strategy, Parties operating under paragraph 1 of Article 5 should take into consideration the availability and price of treatments for asthma and chronic obstructive pulmonary disease in countries currently importing chlorofluorocarbon-containing metered-dose inhalers;*"

Decision XV/5(4*bis*) states:

> "*That no quantity of chlorofluorocarbons for essential uses shall be authorized after the commencement of the Twenty-First Meeting of the Parties if the nominating Party operating under paragraph 1 of Article 5 has not submitted to the Ozone Secretariat, in time for consideration by the Parties at the twenty-ninth meeting of the Open-ended Working Group, a preliminary plan of action regarding the phase-out of the domestic use of chlorofluorocarbon containing metered-dose inhalers where the sole active ingredient is salbutamol;*"

Furthermore, Decision XVII/5(3*bis*) requests nominating Article 5 countries to submit a date to the Ozone Secretariat prior to the Twenty-Second Meeting of the Parties, by which time a regulation or regulations to determine the non-essentiality of the vast majority of chlorofluorocarbons for metered-dose inhalers where the active ingredient is not solely salbutamol will have been proposed. Decision XV/5(6) requests Parties to submit to the Ozone Secretariat specific dates by which time they will cease making nominations for essential use nominations for CFCs for MDI where the active ingredient is not solely salbutamol.

This report provides an overview of the national strategies submitted to the MTOC for its review at its 2011 meeting. MTOC has noted, from its experience reviewing Essential Use Nominations, that Parties engaged in transition from CFC MDI to CFC-free alternatives encounter challenges and struggles of various kinds that could result in changes to dates, alteration in project timelines, and product availability. Despite this, MTOC believes that a well-articulated national transition strategy can provide the necessary road map for a country to accomplish the transition.

In 2011, an update to China's transition strategy was submitted to the Ozone Secretariat, which, among other things, elaborates the date by which the non-essentiality of the vast majority of non-salbutamol CFC MDIs will be proposed and specific dates by which time they will cease making essential use nominations. This updated strategy is summarised in Chapter 2 on Essential Use Nominations.

Argentina has not yet submitted its national transition strategy. However, Argentina is demonstrating significant commendable progress in phasing out CFC MDIs, and it is unlikely that there will be significant continued essential use requirements in Argentina. Section 3 of Chapter 2 provides a summary of Argentina's progress.

Further recent information on transition strategies is contained in the *2010 MTOC Assessment Report*[7].

3.6.2 Progress Reports on Transition Strategies under Decision XII/2

Under Decision XII/2, Parties are required to report to the Secretariat by 31 January each year on progress made in transition to CFC-free MDIs. In 2011, progress reports about progress made with implementation of national transition strategies were received within essential use nominations.

Article 5 countries that develop their own national transition strategy should provide it to the Secretariat, to be posted on its website, and then report each year on progress in transition, in accordance with Decisions XX/3 and XII/2.

3.7 Global Database in Response to Decision XIV/5

Under Decision XIV/5, all Parties are requested to submit information on CFC and CFC-free alternatives to the Secretariat by 28 February each year. In 2011, a report was received from Canada[8]. Canada reported that it imported about 5.57 million DPIs, 2,500 CFC MDIs and 9.2 million HFC MDIs in 2010 from either the United Kingdom or the United States. The source of the small number of imported CFC MDIs is not clear from the information provided but might indicate minor cross-border movement of redundant technology.

Twenty-two Article 5 countries have submitted data pursuant to Decision XIV/5 since its inception, but much of the data is up to 10 years old and no longer relevant to today's markets. These Parties are Argentina, Belize, Bosnia and Herzegovina, Brazil, China, Costa Rica, Croatia, Cuba, Eritrea, Georgia, Guyana, India, Indonesia, Jamaica, Malaysia, Mauritius, Namibia, Oman, Singapore, South Africa, Sri Lanka, and Uruguay. The Ozone Secretariat agreed to send a letter in 2010 to remind Parties of their obligation to report annually under Decision XIV/5. However, other than Canada, no other Party provided its annual update.

It is important that Article 5 countries collect their own data on CFC and CFC-free inhaler use annually and provide it to the Secretariat by 28 February each year, to be posted on its website, in accordance with Decision XIV/5. Decision XII/2(3) also requests Parties, including Article 5 countries, to notify the Ozone Secretariat of any MDI products determined to be non-essential, and for nominating Parties to take this information into consideration. The Ozone Secretariat website only has information for the European Community. Collection of such data would aid in the development and implementation of effective transition plans within each country and in the determination of any essential use nominations for Article 5 countries.

Parties may wish to recall Decision XII/2(3) to notify the Ozone Secretariat of any MDI products determined to be non-essential.

[7] http://ozone.unep.org/Assessment_Panels/TEAP/Reports/MTOC/MTOC-Assessment-Report-2010.pdf

[8] http://ozone.unep.org/Exemption_Information/Essential_Use_Nominations/index.shtml

3.8 Export Manufacturing Transition Plans in Response to Decision XVIII/16

Decision XVIII/16(7) requests:

> "…*each Party receiving essential-use exemptions for the production or import of chlorofluorocarbons to manufacture metered-dose inhalers for export to Parties operating under paragraph 1 of Article 5 to submit to each importing Party a detailed export manufacturing transition plan for each manufacturer where the exports of an active ingredient to that Party exceed 10 metric tonnes, specifying the actions that each manufacturer is taking and will take to transition its exports to chlorofluorocarbon-free metered-dose inhalers as expeditiously as possible in a manner that does not put patients at risk;*"

Paragraph 10 of that Decision requests each Party to submit a report summarising the export manufacturing transition plans as part of the Party's essential use nomination, and paragraph 11 requests the TEAP to consider such reports in its assessments of essential use nominations.

No export manufacturing transition plan has been submitted under this Decision because the threshold has not been exceeded (10 metric tonnes of CFCs for an active ingredient for exports to a Party).

4 Chemicals Technical Options Committee (CTOC) Progress Report

4.1 Executive Summary

The CTOC met on March 1-3, 2011 in Bangkok, Thailand. The agenda of the meeting covered issues requested by the Parties, including process agents, laboratory and analytical uses, CTC issues and destruction technologies, in addition to two essential uses nominations; one from the Russian Federation on CFC-113 for aerospace industries and the other from Jordan on bromochloromethane (BCM) for polymeric flame retardants.

Process Agents

The Table A in decision XXII/8 contains 41 ODS uses registered as process agents. Based on information provided by the Parties through the Ozone Secretariat, and the report of the status on process agent applications in Article 5 Parties submitted by the Executive Committee under decision XXI/3(5), the CTOC recommends removing 27 process agent uses from the Table A, which are no longer operational. (See Table 4-1) Table 4-1 also involves a list of parties operating process agent uses according to the request under decision XXII/8(4).

Table 4-2 summarises the status of ODS emissions from process agent uses in Table B of decision X/14 based on the information submitted from EC, USA, Switzerland, Israel and China to the Ozone Secretariat under decision X/14(4). Ninety three parties so far confirmed that they do not have process agent uses.

Information about process agent uses was derived from the report of the MLF ExCom in response to Decision XXI/3.

Laboratory and Analytical Uses

Decision XXI/6 requested the TEAP/CTOC to complete the report as requested under decision XIX/18 and to provide it for the OEWG-30, by following the preliminary report prepared in 2010 and substantial information provided in 2009.

The 2009 CTOC Progress Report provided an extensive list of laboratory and analytical procedures for which it believes that alternatives to the use of ODS are available, and the list is still effective and was included in the prologue of Decision XXI/6.

It was noted in the 2010 Progress report that there were biomedical procedures in which small quantities of CTC had long been used as a toxicant, and also noted that biomedical research material is routinely destroyed by incineration and so CTC used in such procedures was unlikely to be emitted. However, Macedonia was advised about CTC use in analytical procedures to remove lipids that might interfere with the assay from other laboratories that alternative (non-ODS) solvents could be used and that commercial analytical kits that avoided the use of CTC were available. As is often the case with other uses of CTC in analytical work, the use of an alternative requires parallel investigations to ensure comparability, and (in the case of the kits) adoption of more expensive methods.

With the assistance of the Ozone Secretariat, the CTOC has made contact with two major standard-setting bodies, ASTM International and the European Standards organisation (CEN), with a view to stimulating the preparation of standard methods not involving ODS. CTOC noted that ASTM International has the matter of non-ODS alternatives under investigation and is providing copies of standard methods to a CTOC co-chair so that alternative methods can be considered. The CTOC continues to work with the organizations with a view to developing a list of procedures for which agreement could be reached that some new standards were necessary.

If preparation of a handbook on laboratory and analytical uses were to be commissioned it would assist countries to make appropriate choices and so prove to be of great value. Parties may wish to allocate funding for the preparation of such a handbook. Meanwhile, Parties may wish to require reporting of the quantities of any ODSs so used in Article 5 Parties, as suggested above, so that assistance can be provided to those with the greatest need.

The reasons that non-ODS methods are not adopted in Article 5 Parties are: (a) adherence to standard methods for which there are no non-ODS alternatives, and (b) the cost of implementing new methods, including training. Only in the few cases where an international standard exists and there is no non-ODS alternative should it be necessary to persist with the use of ODS. The CTOC also advises that costs of transition should be sustainable, although the cost of alternative substances may be higher than those of the ODS they replace.

EUE of CFC-113 for Aerospace Industries by the Russian Federation

The Russian Federation submitted a new request for Essential Use Exemptions of 100 metric tonnes of CFC-113 for manufacturing the missile and space equipments in the year 2012, to the Ozone Secretariat on January 25, 2011.

The required amounts of CFC-113 are 20 metric tonnes higher than the forecasted 80 metric tonnes as was seen in the TEAP May 2010 Progress Report. The CTOC asked the Russian Federation why it is necessary to maintain the consumption of CFC-113 at a level of 100 metric tons for the period 2012 – 2013 in spite of the continuing efforts to reduce the use of CFC-113. The CTOC noted that there are objective reasons to expand the Russian national space program before 2015 in terms of reliability and failure-free performance of the Russian space equipment and hardware. The Russian space industry has authorized the increase of the number of manned missions to ensure safe and reliable operation of the International Space Station (ISS) and to provide support for the Global Navigation Satellite System GLONASS in addition to the unexpected launch failure of satellites. (e.g. http://www.insidegnss.com/node/2464)

The CTOC acknowledged the research development of the Russian Federation to reduce essential use of CFC-113, but the comparison of the research results reported in this nomination with those reported in 2010 shows rather slow progress in developing appropriate alternatives to CFC-113. The CTOC recommends acceleration.

After substantial review and discussion, the CTOC recommends the Essential Use Exemptions for 100 metric tonnes of CFC-113 in 2012 for the Russian Federation.

EUE of Bromochloromethane (BCM) as a Solvent for Polymeric Fire Retardants by Jordan

Jordan has submitted an Essential Use Nomination for the use of bromochloromethane (BCM) as a solvent in the bromination of polystyrene to produce brominated polystyrene which is advantageously used as a polymeric flame retardant. It facilitates recycling and reprocessing of plastics such as high-impact polystyrene and acrylonitrile-butadiene-styrene resins containing this flame retardant. The special efficacy of BCM as a reaction solvent has been claimed in several patent applications. But investigation of any possible solvents is continuing and alternatives could be adopted if found suitable.

The information provided by Jordan covers the essential nature of the use, both as to the desirability of producing brominated polystyrene and need for BCM as a solvent. The details of the process are presented, from which it is clear that much of the BCM is recycled and that emission controls will be in place.

However, in view of the existence of other methods for the production of brominated polystyrene, the CTOC is unable to recommend the Essential Use Exemption by Jordan for the use of bromochloromethane in producing brominated polystyrene.

Solvents and Update of n-PB

The elimination of HCFC and high GWP-HFC solvents still leaves many options available and they have found various levels of acceptance. However, no single option seems well suited to replace HCFCs and HFCs completely. HFEs with low or moderate GWP are expected as one of the options to replace high-GWP HFC solvents, even though HFEs are mostly expensive solvents. Their growth may be high when expressed by percentage, but quantities per chemical and in total are expected to remain relatively small.

Decision XIII/7 has requested the TEAP *to report annually on n-PB use and emissions (para3) together with requests to Parties to inform industry and users about the concerns the use and emissions of n-PB and the potential threat that these might be pose to the ozone layer (para 1) and to urge industry and users to consider limiting the use of n-PB to applications where more economically feasible and environmentally friendly alternatives are not available, and to urge them also to take care to minimize exposure and emissions during use and disposal (para2).* Only limited action has been taken so Parties may wish to reconsider the practicality of the request to the TEAP under Decision XIII/7.

Carbon Tetrachloride (CTC) Emissions and Opportunities for Reduction

The discrepancy between ‘bottom up’ estimates and ‘top down’ estimates has been left unsolved in spite of year-by-year reconsideration of possible emissions from industrial and natural sources of CTC and the revision of its atmospheric lifetime by the Scientific Assessment Panel (SAP).

Some data was added from EC PRTR (Pollution Release and Transfer Release) last year indicating previously unreported emissions of CTC from industrial facilities. The quantities revealed by the EC study cannot explain the current discrepancy, but do suggest that further work in other jurisdictions could reveal sources not reporting to the Ozone Secretariat.

It is likely that chemical manufacture using CTC as a feedstock would also result in accounting for CTC emissions. As noted in Chapter 7 of this report, better information will be needed and Parties may wish to consider requiring more thorough reporting of feedstock uses of CTC and the emissions there from.

The MLF ExCom produced a separate report on CTC emissions as part of its report under decision XXI/3 on process agent uses.

Feedstocks

Common feedstock applications have been updated, but the quantities of emissions from those feedstock remain uncertain, because no reported global uses of ODS feedstock exist.

In order to obtain the level of feedstock uses of ODS, and actual or estimated emissions arising from these uses, Parties may wish to consider requiring the reporting of all feedstock uses of ODS. Disclosure of confidential information can usually be avoided by aggregation at country level.

Destruction Technologies

The CTOC has reviewed proposals for new technologies using information provided by the proponents. In some cases the information was subject to commercial confidentiality. The CTOC prepared a preliminary report which was provided to the XXII/10 TEAP Task Force.

The destruction technologies for methyl bromide in the agricultural field are quite different from those of industrial products such as refrigerants. The CTOC believes that it is necessary to develop new criteria for the destruction technologies for methyl bromide, since the criteria in 1992 were established for ODS in industrial products and not for dispersed uses such as agricultural processes.

There are a number of in-country projects to link recovery of ODS with destruction according to the following information from UNDP, and their progress is summarise din this CTOC report.

4.2 Introduction

The CTOC met on March 1-3, 2011 in the United Nations Conference Centre (UNESCAP) Bangkok, Thailand where the meeting was kindly hosted by Atul Bagai and Charuwan Tintukasiri of UNEP ROAP. Their extraordinary courtesy was highly appreciated. Eleven out of sixteen CTOC members participated in the meeting. Attending members were five from Article 5 Parties (two from China, and one each from India, Kuwait and Tanzania) and six from non-Article 5 Parties (two from Japan, and one each from Australia, the Netherlands, the Russian Federation, and the USA).

The agenda of the meeting covered issues requested by the Parties, including process agents, laboratory and analytical uses, n-PB, CTC issues and destruction technologies. Furthermore, the CTOC reviewed two essential use nominations; one from the Russian Federation on solvent use of CFC-113 for aerospace industries for 2011, and the other from Jordan on solvent use of BCM for polymeric flame retardants. The CTOC also discussed and updated ODS feedstock uses.

4.3 Process Agents

The Parties have requested that TEAP undertake a periodic review of process agent uses in a variety of aspects, including revisions of Table A (a list of process agent uses) and Table B (make up and emissions of ODS as process agent uses) under the following decisions.

- Decision XXII/8 has requested the TEAP *to review progress made reducing process agent uses and to make any additional recommendations to parties on further actions to reduce uses and emissions of process agents starting in 2011 and every other year thereafter.*
- Decision XXI/3(5) has requested the TEAP and the Executive Committee of the Multilateral Fund *to prepare a joint report on progress with phasing out process agent applications.*
- Decision XVII/6(6) has requested the TEAP and the Executive Committee *to report to the Open-ended Working Group starting in 2007 and every other year thereafter on the progress made in reducing emissions of ODS process agent uses*
- Decision XVII/6(7) and XVII/6(8) have requested the TEAP *to review the information submitted by Parties regarding ODS process agent uses and to report and make recommendations to the Parties at MOP-20 in 2008 and every other year thereafter, on process agent use exemptions to revise Table A of decision X/14, and to recommend any reductions to the make-up and maximum emissions with respect to Table B.*

4.3.1 Revision of Table A

Based on information of process agent uses provided by Parties and also provided by the ExCom under the decision XXI/3, 27 process agent uses are no longer operational and can be removed from Table A (see annex 1). In Table 4-1 an overview is given of which Parties are still operating process agent uses according to the request under decision XXII/8(4).

Table 4-1: A revised Table A on process agent uses listing operating Parties

Process Agent Application	**Substance**	**Decision XXII/8 No.**	**Parties**	**Recommend by CTOC removing from Table A**
Elimination of NCl3 in chlor-alkali production	CTC	1	EU, Israel and US	No
Chlorine gas recovery by tail gas absorption in chlor-alkali production	CTC	2	EU and US	No
Production of chlorinated rubber	CTC	3	EU	No
Production of Endosulfan	CTC	4	India	Yes
Production of chlorosulfonated polyolefin (CSM)	CTC	5	China and US	No
Production Aramid polymer (PPTA)	CTC	6	EU	No
Production of synthetic fibre sheet	CFC-11	7	US	No
Production of chlorinated paraffin	CTC	8	EU-	Yes
Photochemical synthesis of perfluoropolyetherpolyperoxide precursors of Z-perfluoropolyethers and difunctional derivatives	CFC-12	9	EU	No
Preparation of perfluoropolyether diols with high functionality	CFC-113	10	EU	No
Production of Cyclodime	CTC	11	EU	No
Production of chlorinated polypropene	CTC	12	China	No
Production of chlorinated ethylene vinyl acetate (CEVA)	CTC	13	China	No
Production of methyl isocyanate derivatives	CTC	14	China	No
Production of 3-phenoxy benzaldehyde	CTC	15	China	Yes
Production of 2-chloro-5-methylpyridine	CTC	16	China	Yes
Production of Imidacloprid	CTC	17	China	Yes
Production of Buprofenzin	CTC	18	China	Yes
Production of Oxadiazon	CTC	19	China	Yes
Production of chloradized N-methylaniline	CTC	20	China	Yes
Production of 1,3- dichlorobenzothiazole	CTC	21	China	Yes
Bromination of a styrenic polymer	BCM	22	US	No
Synthesis of 2,4-dichlorophenoxyacetic acid (2,4-D)	CTC	23	US	Yes
Synthesis of di(-2-ethylhexyl) peroxidedicarbonate (DEHPC)	CTC	24	US	Yes
Production of high modulus polyethylene fibre	CFC-113	25	US	No
Production of vinyl chloride monomer	CTC	26	US	Yes
Production of Sultamicillin	BCM	27	-	Yes
Production of Prallethrin	CTC	28	China	Yes
Production of o-nitrobenzaldehyde	CTC	29	China	Yes
Production of 3-methyl-2-thiophenecarboxaldehyde	CTC	30	China	Yes
Production of 2-thiophenecarboxaldehyde	CTC	31	China	Yes
Production of 2-thiophene ethanol	CTC	32	China	Yes
Production of 3,5-dinitrobenzoyl chloride (3,5-DNBC)	CTC	33	China	Yes
Production of 1,2-benzisothiazol-3-ketone	CTC	34	China	Yes
Production of *m*-nitrobenzaldehyde	CTC	35	China	Yes
Production of Tichlopidine	CTC	36	China	Yes
Production of *p*-nitro benzyl alcohol	CTC	37	China	Yes

Process Agent Application	Substance	Decision XXII/8 No.	Parties	Recommend by CTOC removing from Table A
Production of Tolclofos methyl	CTC	38	China	Yes
Production of polyvinylidene fluoride (PVdF)	CTC	39	China	Yes
Production of tetrafluorobenzoylethyl acetate	CTC	40	China	Yes
Production of 4-bromophenol	CTC	41	China	Yes

In China, 47 production lines that have used CTC as a process agent are no longer in operation. *(UNEP/OzL.Pro/ExCom/62/Inf.2/Rev.1 16 March 2011)* Accordingly, 27 process agent uses can be deleted from Table A, leaving just 14 process agent uses approved by the Parties.

4.3.2 Revision of Table B

To date, information of ODS emissions from process agent uses in Table B has been less than complete. Information of process agent applications from the Russian Federation and Israel are not known but use and emissions are included in Table B. A better standard of reporting of emissions needs to be achieved so that Table B gives a reliable picture of emissions arising from process agent uses. The reported data are summarized in Table 4-2.

As of 1 March 2011, ninety three Parties have confirmed that they do not have process agent uses according to information provided by the Ozone Secretariat.[a)]

Table 4-2: A revised Table B (metric tonnes)

Party	Make up or consumption 2009	Maximum make up or consumption	Emissions 2009	Maximum emissions
European Union	669	1083	1.6	17
United States of America	No data	2300	47.1	181
Russian Federation	No data	800	No data	17
Israel	2.4	3.5	0	0
Brazil	0	2.2[b]	0	2.2[b]
China	313	1103	No data	1103
Total	982	5292	49	1320

a) Afghanistan, Andorra, Argentina, Armenia, Australia, Austria, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belize, Botswana, Bulgaria, Burkina Faso, Cambodia, Canada, Cape Verde, Chad, Comoros, Congo, Costa Rica, Croatia, Cuba, Cyprus, D.R. Congo, Dominican Republic, Egypt, Estonia, Finland, Ghana, Grenada, Guyana, Holy See, Hungary, Iran, Ireland, Italy, Jamaica, Japan, Kenya, Kiribati, Kyrgyz Republic, Lebanon, Lesotho, Liberia, Liechtenstein, Lithuania, Macedonia, Madagascar, Malaysia, Maldives, Malta, Mexico, Moldova, Monaco, Montenegro, Morocco, Myanmar, New Zealand, Niger, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Republic of Korea, Saint Lucia, Sao Tome & Principe, Senegal, Serbia, Singapore, Slovakia, Slovenia, Spain, Sri Lanka, Sri Lanka, St. Vincent & the Grenadines, Sweden, Switzerland, Syria, Tajikistan, Tanzania, Togo, Trinidad & Tobago, Turkey, Turkmenistan, Tuvalu, Uruguay, Uzbekistan, Vietnam and Zimbabwe.

b)In accordance with decision 54/36 of the Executive Committee of the Multilateral Fund, the annual make-up or consumption and maximum emissions for Brazil will be 2.2 metric tonnes up to and including 2013 and zero thereafter

4.3.3 Alternatives to Process Agents

Of the cases reviewed by the CTOC, especially those in which CTC is used as process agent, there are only a few in which the reasons for using CTC rather than an alternative are described in detail. It seems likely that no investigations of alternatives have been made, and that CTC is used because that was the solvent used in laboratory work that led to patents and industrial processes. Owing to the chemical engineering considerations of a plant's design, once a process has begun operation, changing to an alternative solvent can be difficult. Therefore an established plant may well be solvent specific and changing the solvent may be difficult even from an economical point of view.

4.3.4 Information on Pprocess Agents Uses in the European Union

A new decision in the EU came into force on 18 June 2010 that allocated make up quantities for the eight facilities that have permitted process agent uses.

Regarding CTC emissions in the EU, there are 16 facilities that reported CTC emissions (with a threshold of 100 kg) in 2008. A total of 63 metric tonnes was emitted, including the process agent use facilities that emitted CTC in 2008 as part of a total of 1.6 metric tonnes ODS (CTC and CFC-12, EU report on the use of ODS as process agent). (Ref. http://prtr.ec.europa.eu/PollutantReleases.aspx)

4.4 Laboratory and Analytical Uses

This report completes the CTOC response to Decision XXI/6, following the preliminary report prepared in 2010 and substantial information provided in 2009.

4.4.1 Analyses for which there are no Non-ODS Alternatives

Clause 5(a) of Decision XXI/6 requested *a list of laboratory and analytical uses of ODS including those uses where no alternatives exist.* The case studies presented in the 2009 Progress Report showed that most laboratory and analytical uses of ODS in non-Article 5 Parties had ceased. There have been no changes to the extensive list of procedures in the 2009 Progress Report where alternatives were identified by the CTOC for almost all uses and this list was included in the prologue of Decision XXI/6.

There are laboratory uses in both non-Article 5 and Article 5 Parties that are essentially consumptive in nature – in other words, uses in which the ODS takes part in a chemical reaction and is thereby transformed to non-ODS substance. Since no alternatives are available, these uses are likely to continue. There is a parallel with feedstock uses that take place on an industrial scale. The ODS most commonly used in these laboratory procedures are carbon tetrachloride (CTC) and methyl bromide. The CTOC has drawn attention to another laboratory use of CTC as a specialized solvent for reactions involving N-bromosuccinimide, and noted that despite some investigations by researchers, no alternative has been identified.

In the 2010 report, the CTOC requested information from Article 5 Parties where procedures removed from the global exemption by the Parties in earlier decisions might still be in use, but no information was forthcoming. The intention of the request was to enable CTOC members to assist laboratories in such countries to identify and adopt alternatives. Some work of this kind has already been reported to the Parties and it has been found that contact through Ozone Officers is the appropriate way to make the necessary connections.

It was noted in the 2010 Progress Report that there were biomedical procedures in which small quantities of CTC had long been used as a toxicant. Although the procedures are not formally designated as such, their longevity means that they are effectively 'standard methods'. It was also noted that biomedical research material is routinely destroyed by incineration and so CTC used in such procedures was unlikely to be emitted. However, not all biomedical procedures are of this type. Macedonia advised about CTC use in analytical procedures to remove lipids that might interfere with the assay. Advice was received from other laboratories that alternative (non-ODS) solvents could be used and that commercial analytical kits that avoided the use of CTC were available. Quality control is important in laboratories, taking in robustness of analytical methods, confirmation of positive results and avoidance of false positives. As is often the case with other uses of CTC in analytical work, the use of an alternative requires parallel investigations to ensure comparability, and (in the case of the kits) adoption of more expensive methods.

4.4.2 National and International Standards

Clause 5(b) of Decision XXI/6 requested the TEAP/CTOC *to identify the international and national standards that require the use of ODS and to indicate the corresponding alternative standard methods not mandating the use of ODS*. Considerable information about alternative methods has been provided in the last two Progress Reports. Alternative standard methods exist for a number of procedures, as detailed in the 2009 Progress Report. The analysis of oil, grease and petroleum hydrocarbons in water, soils and air by infrared spectroscopy is described in a number of standard methods designated by national and international bodies. The use of the non-ODS solvent S-316 to replace CTC and CFC-113 used in older methods is specified in standard method ASTM D7066-04. As regards the use of butane to replace CTC in measurements of adsorptivity of activated carbon, the standard method ASTM D3467-04 (2009) specifies the use of CTC, but ASTM D5228-92 (2005) uses butane and ASTM D5742-95 (2005) provides a correlation between results obtained with CTC and with butane. ASTM methods are thoroughly tested before release and provide assurance to users that reliable results will be obtained. The correlation standard enables results obtained by the new standard method to be related to those obtained by the old method, so the historical record of results is preserved.

With the assistance of the Ozone Secretariat (see Clause 4 of Decision XXI/6), the CTOC has made contact with two major standard-setting bodies, ASTM International and the European Standards organisation (CEN), with a view to stimulating the preparation of standard methods not involving ODS. In general, requests for the development of new standards come from users, although in the European case requests from the EC can also be received. ASTM International has the matter of non-ODS alternatives under investigation, and is providing copies of Standard Methods to a CTOC co-chair so that the uses of ODS can be appraised and alternatives suggested. The CTOC continues to work with the organizations with a view to developing a list of procedures for which agreement could be reached that some new standards were necessary. For example, as a result of CTOC investigations some alternatives have been shown to work well in analyses and new standard methods could be based on them. Examples are oil, grease and petroleum hydrocarbon determinations by infrared, iodometric titrations, and iodine and bromine index determinations.

Clause 5(c) of Decision XXI/6 requests TEAP/CTOC *to consider the technical and economical availability of those alternatives in Article-5 and non-Article-5 parties as well as to ensure that the alternative methods show similar or better statistical properties (for example accuracy or detection limits)*. Standard methods, often termed ‘norms’, are in place in a number of countries and since these are legislated on a national basis, alternatives can be devised and implemented without the need for international standard-setting bodies to be involved. This was the subject of the request to all Parties in Clause 3 of decision XXI/6, *to urge their national standards-setting organisations to identify and review those standards which mandate the sue of ODS in laboratory and analytical procedures with a view to adopting, where possible, ODS-free laboratory and analytical products and processes.* The task of gathering information globally is beyond the resources of advisory committees, but the TEAP/CTOC would be able to provide better advice to the Parties if Parties had this information. It is noted that Clause 7 of Decision XXI/6 allowed Article 5 Parties to *deviate from the existing laboratory and analytical use bans in individual cases, where a Party considers this justified by 31 December 2010*.

4.4.3 Reporting to the Ozone Secretariat

Clause 9 of Decision XXI/6 requested *Parties to continue to investigate domestically the possibility of replacing ODS in those laboratory and analytical uses listed in the report by the TEAP and to make this information available to the Ozone Secretariat by 30 April 2010*. Only three reports were received - those of the European Commission (EC), Australia and Lithuania.

In 2009 the EC authorised (nationally allocated) the use of 190 ODP tonnes of ODS for laboratory and analytical purposes but only 59 tonnes was actually authorised for use, mostly CTC (35.8 ODP tonnes) and CFCs (23.2 ODP tonnes) (52.8 and 47.1 metric tonnes, respectively). The figures include some ODS that was exported for laboratory and analytical uses and so overstates actual consumption in the European Union. The EC provided information about a number of standard methods and alternatives, and suggested that the CTOC should determine the applicability of the latter. The EC drew attention to the fact that methods formerly used in non-Article 5 Parties may still be in use, or being considered for introduction, in Article 5 Parties, and so should be included in the compilation. The task suggested for the CTOC, amounting to the production of a laboratory and analytical uses handbook, is beyond the capacity of the CTOC. However, if preparation of such a handbook were to be commissioned it would assist countries to make appropriate choices and so prove to be of great value. Parties may wish to allocate funding for the preparation of such a handbook. The EC report was of great value and Parties may therefore wish to consider requiring reports from all Parties, say every few years, that include quantities of ODS used in laboratory and analytical procedures, the ODS procedures that are followed, the alternatives under consideration, and the time to phase-out.

Australia reported that CTC had been imported from Europe in 2008 for use as a specialty solvent in reactions involving N-bromosuccinimide, a use to which the CTOC has previously drawn attention as one for which no alternative has yet been found. Australia reported on-going experiments with alternatives. Bromochloromethane was also imported for a consumptive use, preparation of acetals, which has also been identified in earlier CTOC reports. Trials have been conducted with non-ODS reagents but none has proved satisfactory.

Lithuania provided a very detailed report. Information about laboratory and analytical uses of ODS had been sought from stakeholders, including the national standardisation body. They had also been provided with information from the TEAP. The Lithuanian Ministry of Environment reported that 'the results of the recently undertaken survey poorly reflect the situation in industry. In our opinion, the Lithuanian industry might use ODS to perform some analyses mentioned in the TEAP report, but the industry showed disinterest and lukewarmly participated in the survey'. It was noted that that use of ODS for analysing hydrocarbons (oil and grease) in water has been banned in Lithuania already for several years. This has caused problems for industries where hydrocarbon analysis is required, but alternative methods not involving ODS are required by Lithuanian law. ODS, probably not exceeding a few hundred grams a year in any one case, are still used in a number of other analyses for which the TEAP has identified non-ODS alternatives, as well as some other procedures for which alternatives need to be sought and some such as calibrations and consumptive sues for which no alternatives exist. Lithuanian use of ODS is governed by European Council and Parliament Regulation (EB) 1005/2009, covering a range of ODS.

The CTOC is aware of another questionnaire, sent to countries in the Arabian Gulf Region, which did not elicit information from possible users of ODS. The reasons for the poor response are not known, but could include those identified by Lithuania, namely, no use of ODS or reluctance to move to new methods. Many laboratories have been unwilling to replace standard methods (either international or local standards) with other methods because they are not able to guarantee the accuracy of such analyses without doing some comparisons of old and new methods, which takes time and costs money. This accounts for a good deal of the inertia in the laboratory analytical sector. Even when new standards are developed, nationally or internationally, each user laboratory will want to conduct trials before confirming adoption of the new methods. An additional consideration is that, when only small quantities of ODS are involved, which is often the case, they are subsumed in Basic Domestic Needs and do not receive scrutiny from officers acting at national level.

The CTOC will continue to work with UNEP and the Ozone Officers as instructed by Parties in Decision XXI/6(9), but if Parties wish to accelerate the phase-out of laboratory and analytical uses of ODS they may wish to require reporting of the quantities of any ODSs so used in Article 5 countries, as suggested above, so that assistance can be provided to those with the greatest need.

4.4.4 Possible Exemptions

Clause 6 of Decision XXI/6 requests *TEAP while continuing in its work as described in paragraph 5, to evaluate the availability of alternatives for those uses already banned under the global exemption in Parties operating under Article 5(1), considering technical and economic aspects…* (and) … *present its findings and recommendations whether exemptions would be required for parties operating under Article 5(1) for any of the uses already banned.* It will be evident from the earlier sections of this report that the reasons that non-ODS methods are not adopted in Article 5 countries are: (a) adherence to standard methods for which there are no non-ODS alternatives, and (b) the cost of implementing new methods, including training. As to the first of these, where purely national standards are involved, then it is within the power and capability (since skilled staff exist and methods are available in the scientific literature) of countries to adopt the necessary procedures. Only in the few cases where an international standard exists and there is no non-ODS alternative should it be necessary to persist with the use of ODS. In the second instance, The CTOC advises that costs of transition should be sustainable, although the cost of alternative substances may be higher than those of the ODS they replace. As suggested above, Parties may wish to require reporting of time horizons for the phase-out of ODS in laboratory and analytical procedures.

4.5 Reviews of Essential Use Nominations

4.5.1 Essential Use Nomination of CFC-113 for Aerospace Industries by the Russian Federation

4.5.1.1 Introduction

Decision XXI/5 in MOP-22 approved an essential use exemption of 100 metric tonnes of CFC-113 in 2011 for applications in the missile and aerospace industries in the Russian Federation, taking into consideration the TEAP/CTOC findings that no appropriate alternatives to CFC-113 currently exists for its use in the aerospace industries in the Russian Federation and that the search for its alternatives continues, as confirmed in the TEAP May 2010 Progress Report Vol.2 (p57-59)

On 25 January 2011, The Ministry of National Resources and Environment of the Russian Federation sent a new request for Essential Use Exemptions of 100 metric tonnes of CFC-113 for manufacturing the missile and space equipments in the year 2012 to the Ozone Secretariat.

4.5.1.2 The CTOC Comments on EUE of CFC-113 in 2012 by the Russian Federation

The Russian Federation had been successful in reducing the annual consumption of CFC-113 in the missile and space industry from 241 metric tonnes in 2001 to 100 metric tonnes in 2010 as shown in the Illustration 2 (TEAP May 2010 Progress Report Vol.2, p59). However, the Russian industry has found no solvents comparable to CFC-113 from viewpoints of cleaning efficiency, versatility and compatibility with structural materials.

The new request by the Russian Federation for an Essential Use Exemption for 100 metric tonnes of CFC-113 in the year 2012, which is 20 metric tonnes higher than that forecasted in the TEAP May 2010 Progress Report, describes and explains in detail why this application is urgent for health and safety or vital for society; what efforts have been made to investigate currently available alternatives, and why they are insufficient or unsuitable for the purpose; and also efforts to minimize the emissions of CFC-113. The CTOC asked the Russian Federation why it is necessary to maintain the consumption of CFC-113 at a level of 100 metric tonnes for the period 2012 – 2013 in spite of the continuing efforts to reduce the use of CFC-113. The CTOC noted that there are objective reasons to expand the Russian national space program before 2015 in terms of reliability and failure-free performance of the Russian space equipment and hardware. The Russian space industry has to increase the number of manned missions to ensure safe and reliable operation of the International Space Station (ISS) and to provide support for the Global Navigation Satellite System GLONASS in addition to the unexpected launch failure of satellites. (e.g. http://www.insidegnss.com/node/2464)

Unique physicochemical properties, high processing and operational characteristics of CFC-113 ensure the required cleanliness levels of parts and assembly units, high tightness levels of the missile and space equipment. Faultless and reliable operation in those applications, and consequently, the life and health of spacecraft crews, personnel and communities in the launching area depend on proper selection of the cleaning solvent for those parts and equipment. In particular, failures of gyro instruments of the launch vehicle or space vehicle control system can lead to fatal situations and insufficient liquid-propellant rocket systems, which use liquid oxygen as an oxidizer, can result explosions during launching.

So far, tested candidates of solvents for replacement of CFC-113 have covered ozone-safe organic solvents, chlorocarbons solvents, aqueous detergents, transitional HCFC solvents (HCFC-122, HCFC-122a, HCFC-141b and HCFC-225) and fluorocarbons. However, none of these candidates could meet the requirements for the replacement of CFC-113.

In order to minimize emissions of CFC-113, recirculation and stock accumulation have been attempted, however the recycled and accumulated stock of CFC-113 is not available in sufficient quality for the expected application. Also, due to ultra-high requirements for the content of the main product, the recycled application of CFC-113 is limited.

The Russian new nomination satisfies, in principle, the following criteria to qualify as “Essential” under the decision IV/25.

1. It is necessary for the health, safety or critical for the functioning of the society.
2. There are no available technically and economically feasible alternatives or substitutes that are acceptable from the standpoint of environment and health.
3. An action has been attempted to minimize emission of CFC-113.

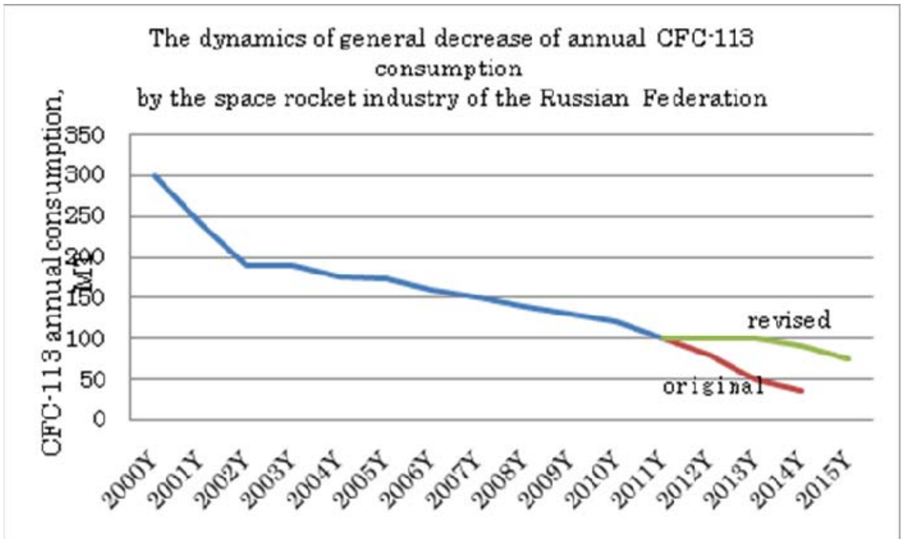
4.5.1.3 Conclusions

The CTOC acknowledged the research development of Russian Federation to reduce essential use of CFC-113, but the comparison of the research results reported in this nomination with those reported in 2010 shows rather slow progress in developing appropriate alternatives to CFC-113. The new proposed schedule of CFC-113 essential usage by the Russian Federation shows a significant delay in reducing CFC-113. The previous future schedule shown in TEAP May 2010 Progress Report Vol.2, page 59 forecasted the usage at 80 metric tonnes in 2012, 50 metric tonnes in 2013 and 35 metric tonnes in 2014 respectively, and the revised future schedule shown in figure 5-1 seems to be delayed by at least 2 years.

The CTOC recommends the acceleration of efforts to introduce appropriate alternatives, to investigate materials incompatible with alternatives, and the adoption of newly designed equipment to complete the phase-out of CFC-113 within an accelerated time schedule. Parties that are partners or customers of Russian space projects may wish to consider the advantage of cooperation in implementing ozone-safe alternatives.

After substantial review and discussion, the CTOC recommends the Essential Use Exemptions for 100 metric tonnes of CFC-113 in 2012 for the Russian Federation.

Figure 4-1: The Phase-out Schedule given by the Russian Federation



4.5.2 Essential Use Nomination of solvent use of BCM for polymeric flame retardants by Jordan

4.5.2.1 Introduction

Jordan has submitted an Essential Use Nomination for the use of bromochloromethane (BCM) as a solvent in the bromination of polystyrene to produce brominated polystyrene which is marketed as a flame retardant. Use by the Jordan Bromine Company Limited, a joint venture between Jordan's Arab Potash Company and Albemarle Holdings Company Limited (USA), is proposed to commence in 2013. BCM has solvent properties that make it especially suitable for this use, and is largely recovered after use, so had the process been started prior to 30 June 1999 then this application would have been made for Process Agent status. Use of BCM for such a chemical reaction in the US has been accorded Process Agent Status (see #22 in Table A of Decision XXII/8).

Jordan provided information in response to the questions in the form provided for submission of Essential Use Nominations.

4.5.2.2 Essentiality

The 'gateway' question is 'why is this use necessary for the health and/or safety or critical for the functioning society?', in response to which the following information was provided. Brominated flame retardants save lives by increasing the fire safety of products and materials. The costs associated with loss of human life and property damage due to fires are staggering. In the United States alone, fires kill more than 3,000 people (52% of them children under the age of 5) each year and injure more than 20,000, with property damage exceeding $11 million annually. In the absence of flame retarded materials, these figures would likely be significantly higher. However, despite the benefits of flame retardants, many types of small-molecule flame retardants have been voluntarily withdrawn or banned (notably under the Stockholm Convention) because of concerns over bioaccumulation and potential harm to human health or the environment. Other current small-molecule flame retardants are under scrutiny and could also be banned. Therefore, replacement molecules that are equally effective at meeting regulatory fire safety requirements, but that lack the human health and environmental concerns are desperately needed. Polymeric flame retardants have these attributes and have been widely accepted by regulatory agencies. The brominated polystyrene prepared by bromination in BCM has superior properties, including low levels of impurities, high bromine content (bromine being the active element in fire suppression) and good thermal stability, which facilitates recycling and reprocessing of plastics such as high-impact polystyrene and acrylonitrile-butadiene-styrene resins containing this flame retardant with less waste and fewer emissions.

4.5.2.3 Alternatives

The claims for special efficacy of BCM as reaction solvent are contained in several US patents held by the Albemarle Company (especially US 5,767,203 and US 5,916,978). Alternative solvents that have been investigated include dichloromethane, dibromomethane, 1,2-dichloroethane, 1,2-dibromoethane and even elemental bromine. None produces brominated polystyrene with properties approaching that formed in BCM. Aromatic, olefinic, protic and basic solvents are unsuitable because they are attacked by bromine, aluminium chloride (catalyst in the bromination reaction) or HBr (by product). Alkanes, ethers and fluorocarbons do not possess sufficient solvent power for this reaction. Investigations into possible solvents are continuing and alternatives could be adopted if found suitable.

4.5.2.4 Minimizing Use and Emissions

Most of the BCM solvent is recovered after the reaction and, after purification, is reused. New material is sourced from the United States. A code of Good Housekeeping (Manufacture) is to be followed, and Jordan provided information on the following aspects: pre-delivery, arrival at facility, unloading, testing and verification, storage and stock control, quantity measurement, facility design, maintenance, quality control and quality assurance, training and control equipment.

4.5.2.5 Quantity

Since this is a new industry, the following annual figures are estimates based on the operation of other facilities working at this scale. In 2013 the usage (= makeup) figure would be 62Mt, but as production of brominated polystyrene grows from 20,000 Mt to 40,000 Mt over five years, this would increase to 132 Mt made up as follows:

Operation	**BCM Mt (tonnes)**
Emissions – point source (8), fugitive (12)	20
Remaining in spent carbon	2
Decomposed (conversion to CH_2Br_2)	30
Solvent in final product	80
Total	**132**

Two entries in the table merit further comment. Air emissions throughout the process are controlled by best-available technology and equipment, including regenerative carbon beds, liquid scrubbers and chilled condensers (note that the boiling point of BCM is 68^{o}C). At end-of-life, when carbon beds need to be replaced, they retain small amounts of BCM which is destroyed when the carbon is incinerated. The second comment concerns an unusual feature of this reaction, the conversion of a small proportion of the solvent, through replacement of chlorine with bromine, to dibromomethane (CH_2Br_2) which is recovered and sold. It is not a controlled substance under the Montreal Protocol.

4.5.2.6 Conclusions

The information provided by Jordan covers the essential nature of the use, both as to the desirability of producing brominated polystyrene and need for BCM as solvent. The details of the process are presented, from which it is clear that much of the BCM is recycled and that emission controls will be in place.

Jordan has given no indication of the time for which this EUE will be necessary but the submission envisages the period 2013-2018.

With the banning of small-molecule brominated flame retardants under the Stockholm Convention, there is increased interest in the use of polymeric flame retardants. A recent announcement from Dow Chemical tells commercial interests in their newly-invented brominated polymer which is not, according to commercial sources, brominated polystyrene.

The case for an Essential Use Exemption for the used of BCM by Jordan rests on the importance of the proposed product, brominated polystyrene, to the fire protection industry. This compound is produced by two other manufacturers, Albemarle (using BCM under a Process Agent exemption) and Israel Chemicals Limited (ICL). The process used by ICL is confidential but the company has notified the CTOC that BCM is not used. Searches of the literature have disclosed methods using chlorinated solvents such as methylene chloride or 1,2-dichloroethane, or excess bromine.

Given the existence of these alternatives, the CTOC is unable to recommend the Essential Use Exemption by Jordan for the use of bromochloromethane in producing brominated polystyrene.

4.6 Solvents and Update of n-PB

4.6.1 Solvent Update

As stated in the 2010 CTOC Assessment Report (Chapter 4. Solvents, pp13-16), most of the ODS solvents had been replaced by not-in-kind technologies and some in-kind alternatives have been introduced advantageously in precision and electronics cleaning.

Among the in-kind alternatives, HCFC-141b has been conveniently used in Article 5 countries and its use in small and medium-size customers will be expected to be replaced by not-in-kind alternatives such as chlorocarbons and hydrocarbons. Sizable amounts of HCFC-225 solvent have been used in niche applications including military and aerospace industries where no other alternatives are available in non-Article 5 Parties. The other in-kind alternatives in solvent applications include some HFC and HFE (hydrofluoroethers), which are expensive and their uses are mostly limited in non-Article 5 Parties.

The elimination of these HCFC and high GWP-HFC solvents still leaves many options available and they have found various levels of acceptance. However, no single option seems well suited to replace HCFCs and HFCs completely. HFEs with low or moderate GWP are expected as one of the options to replace high-GWP HFC solvents, even though HFEs are mostly expensive solvents. Their growth may be high when it is expressed by percentage, but quantities per chemical and in total are expected to remain relatively small.

Some new HFE solvents have been introduced in the non-Article 5 market and are summarised in Table 4-3.

Table 4-3: HFE solvents recently commercialized

Code Number	HFE-64-13S1	HFE-77-12	HFE-347pc-f2
Product Name	Novec 7300	Novec 7600	AE-3000
Chemical Structure	$C_6F_{13}OCH_3$	$C_3HF_6CH(CH_3)OC_3HF_6$	$CF_3CH_2OCF_2CHF_2$
Boiling Point (□)	98	131	56
KB value	5	9.5	13
Flammability	Non-flammable	Non flammable	Non flammable
GWP (100yrs)	210	700	580
Atmospheric Lifetime (yrs)	3.8	9	7.1

Furthermore, unsaturated fluorochemicals with zero ODP and ultra lower GWP are said to be under development for the replacement of high GWP-HFC and low or moderate GWP HFE solvents.

4.6.2 n-Propyl Bromide (n-PB) Update

The CTOC reported repeatedly the difficulties of obtaining complete and accurate data on production and uses of n-PB because n-PB is not classified or registered as a controlled substance nor registered as a hazardous air pollutant. Responding to this issue, one representative commented in the 30-OEWG (UNEP/OzL.Pro.WE1/30/7, para29) that from January 1, 2010 n-PB had to be reported under the new European Union Regulation on ozone-depleting substances. The CTOC noticed a new registration of n-PB for REACH (EC No. 203-45-0), but it has not been successful in obtaining production and consumption data from the REACH Inventory.

On the other hand, the SAP reported nothing new for the behavior of n-PB as a very short-lived substance but a calculation of its lifetime as 41 days instead of formerly reported 34 days (2010 SAP Assessment Report, Table 1-4, pp38).

Decision XIII/7 has requested the TEAP *to report annually on n-PB use and emissions (para3) together with requests to Parties to inform industry and users about the concerns on the use and emissions of n-PB and the potential threat that these might pose to the ozone layer (para1) and to urge industry and users to consider limiting the use of n-PB to applications where more economically feasible and environmentally friendly alternatives are not available, and to urge them also to take care to minimize exposure and emissions during use and disposal (para2).* Action has been taken on the latter part of para2, for example, the approval of n-PB for selected applications as a substitute for CFC-113 and methyl chloroform in metals, electronics and precision cleaning under the SNAP in US EPA as well as its registration under the REACH in EU.

Having considered the current status, Parties may wish to reconsider the practicality of the request to TEAP under Decision XIII/7.

4.7 Carbon Tetrachloride (CTC) Emissions and Opportunities for Reduction

For some years now the CTOC and TEAP members have attempted to reconcile differences between the estimates of emissions of carbon tetrachloride (CTC; CCl_4) provided by consideration of known or estimated usage of this chemical and the associated emissions (‘bottom up’ estimates), and estimates derived from the observed stratospheric concentrations of CTC and the lifetime calculated by the Science Assessment Panel (‘top down’ estimates).

Both estimates were subject to reconsideration. After consideration of bulk uses of CTC, no evidence of substantial sources for release of CTC from natural sources such as oceans and volcanoes, and from pollutant releases from landfills, drinking water disinfection and contaminated groundwater was found. We were left to conclude that, if releases were indeed much greater than our 'bottom up' estimates, then there must be other – and quite substantial – sources of CTC emissions. These could be production and consumption that had not been reported to the Ozone Secretariat, but discussions with Parties suggested that there were no such sources, at least on the scale required to 'balance the books'.

As for the 'top down' estimates, attention was focused on the atmospheric lifetime ascribed to CTC. If this were substantially longer than the accepted figure of about 28 years, and perhaps as long as 44 years as was sometimes suggested, then smaller emissions would suffice to maintain the observed stratospheric concentration and the difference in estimates would be within the limits of error for such estimation techniques. The Science Assessment Panel addressed this issue in their 2010 Assessment Report, noting that 'Although the size of this discrepancy is sensitive to uncertainties in our knowledge of how long CCl_4 persists in the atmosphere (its "lifetime"), the variability cannot be explained by lifetime uncertainties. Errors in reporting, errors in the analysis of reported data, and/or unknown sources are likely responsible for the year-to-year discrepancies'. The SAP (in its 2010 Assessment Report in section 1.2.1.3, Box 1-2 and Fig 1-5) gave consideration to lifetimes in the range 23-33 years and summarised the attempts to reconcile the estimates.

During the last year some data from the EC Pollution Release and Transfer Register, indicating previously unreported emissions of CTC from industrial facilities, has added new information that needs to be taken in to account. In 2008 the releases to air totaled 62.63 tonnes, mostly from industrial scale production of basic organic chemicals in France, Netherlands and UK. Releases to water totaled less than 1 tonne. While the largest emitters were organic chemical producers and urban waste-water treatment plants, there were significant amounts from production of inorganic chemicals, fertilizers and biocides and from disposal of hazardous wastes. Some of these industrial facilities use CTC as a process agent and the emissions from their operations would be accounted for in EC reporting to the Ozone Secretariat. However, other emissions came from facilities in which elemental chlorine was produced or used. CTC as a by-product in production, for example, of chloroform (feedstock for production of HCFC-22) is well understood and the by-product may be recycled or marketed as a valuable industrial chemical. In addition, the fact that chlorine is an extremely powerful chemical reagent is often not appreciated, and any industrial procedure that uses chlorine in association with organic chemicals is likely to produce at least some CTC. An example is the chlorination of carbon monoxide to produce phosgene ($COCl_2$), which is used on a large scale in production of isocyanates, the precursors of polyurethanes.

The quantities revealed by the EC study do not suggest that such emissions are on the scale required to eliminate the current discrepancy but do suggest that further work in other jurisdictions could reveal sources not reporting to the Ozone Secretariat.

Other information from the EC, reported in December 2009, shows that CTC production declined steadily from 18,633 tonnes in 2004 to 15,763 tonnes in 2008, and that in 2008 there was no import or export of this chemical. Sales within the EU amounted to only 862 tonnes, suggesting that most CTC was used as feedstock by the producers. This is also likely to be the case in other countries.

It is likely that chemical manufacture using CTC as feedstock would also result in CTC emissions. As noted in this report, better information is needed and Parties may wish to consider requiring reporting of feedstock uses of CTC and emissions arising from them.

The Executive Committee of the Multilateral Fund responded to Decision XXI/3 by producing a separate report (ExCom/62/Inf.2) concentrating on process agent uses of CTCs including information on CTC emissions from those uses.

4.8 Feedstocks

Carbon tetrachloride (CTC), trichloroethane, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), all ozone depleting substances, serve as chemical building blocks in the preparation of other chemicals. They allow incorporation of fluorine atoms into molecule structures and in all known uses there are no other technologically and economically viable alternative routes at this time. Their use in chemical reactions provides cost-effective manufacture of refrigerants, blowing agents, solvents, polymers, pharmaceuticals, agricultural chemicals, etc. to benefit society. As raw materials, they are converted to other products except for de minimus residues. As a result, their environmental impact is minimal. These could be residual levels in the ultimate product (which are typically miniscule) or by fugitive leaks in the production, storage and/or transport processes.

4.8.1 Montreal Protocol Definitions

The Montreal Protocol defines "Production" as: "the amount of controlled substances produced, minus the amount destroyed by technologies to be approved by the Parties and minus the amount entirely used as feedstock in the manufacture of other chemicals. The amount recycled and reused is not to be considered as Production." Based on this definition, substances controlled by the Montreal Protocol are not subject to phase-out regulations while being used in feedstock applications. Therefore, it is expected that production of some of these controlled substances will continue for the foreseeable future until either the products derived from these feedstocks are no longer needed or when alternative economically attractive synthetic technologies are commercialized.

4.8.2 Where they are Used

CTC, CFCs and HCFCs can be feedstocks by being fed directly into the process as a raw material stream, as production as an intermediate in the synthesis of another product or as a by-product during manufacture of other desired products. Losses can occur during production, storage, transport, if necessary, and transfers. Intermediates are normally stored and used at the same site and so fugitive leaks are somewhat lower in this case.

Common feedstock applications include, but are not limited to the following:

- Conversion of HCFC-21 in the synthesis of HCFC-225 which finds application as a solvent
- Conversion of CFC-113 to chlorotrifluoroethylene. The latter is subsequently polymerized to polychlorotrifluoroethylene, a barrier resin used in moisture-resistant packaging.
- Conversion of CFC-113 and CFC-113a to HFC-134a and HFC-125. As this is the route to much of the HFC volumes, it is a high volume use.
- Conversion of HCFC-22 to tetrafluoroethylene (TFE). TFE forms the building block of many fluoropolymers both by homopolymerization and copolymerization. This is a very high volume use. TFE is also a feedstock for producing HFC-125. Work has been done for decades to identify and develop a commercial direct route to TFE without success.
- Conversion of 1,1,1- trichloroethane as a feedstock in the production of HCFC-141b and HCFC-142b. This can continue until 2040 at high volume for emissive uses of these products and can continue long-term for uses related to conversion to polymers as noted below.
- Conversion of HCFC-142b to vinylidene fluoride which is polymerized to polyvinylidene fluoride or to copolymers. These are specialty elastomers. This feedstock use of HCFC-142b is not subject to phase-out and is likely to continue long term.
- Conversion of carbon tetrachloride (CTC) to CFC-11, CFC-12, etc. This has historically been a very high volume application. However, as the phase-out of CFC production is now limited to only a few essential uses, e.g., limited amounts of propellant production for metered dose inhalers, volume of CTC required for this application has been dramatically reduced.

- Conversion of CTC to chlorocarbons which, in turn, are used as feedstocks in production of HFC-245fa and other fluorochemicals.
- Reaction of CTC with 2-chloropropene to eventually lead to production of HFC-365mfc.
- CTC is used in reaction with vinylidene chloride for preparation of HFC-236fa with production volumes under 1 million pounds annually.
- By-product CTC can be produced in the manufacture of chloroform which is a feedstock used in production of HCFC-22, a long-term high volume operation.
- Conversion of HCFC-123, HFC-123a and HFC-133a in manufacture of pharmaceuticals which is a long term use not subject to phase-out.
- Conversion of HCFC-123 in the production of HFC-125. While this usually occurs as an intermediate, it is possible that this could be done using HCFC-123 as a starting material. We are not aware of using HCFC-123 as a starting material at this time.
- HCFC-124 can be used as a feedstock to prepare HFC-125.
- Halon-1301 in the manufacture of pharmaceuticals and pesticide (Fipronil)
- CTC in the synthesis of synthetic pyrethroids.

4.8.3 Estimated Emissions of ODS

In earlier CTOC reports, efforts were made to estimate emissions likely from use of ODSs as feedstocks. In the 2010 CTOC Assessment Report and also in the Progress Report, this was estimated as total emissions of 4450 metric tonnes representing about 1600 ODP tonnes. Although parties are required under Article 7 of the Montreal Protocol to report ODS production for feedstock uses, reported global uses of ODS feedstocks do not exist and the basis for estimates are anecdotal. This created serious disagreement concerning both the data and sources. Much of the estimated levels were based on proprietary unpublished market information which, by necessity, was aggregated for competitive reasons. Further, until such time as parties are required to report such feedstock volumes by use, estimates of emissions will be uncertain and subject to disagreement.

Further complicating such efforts are how to properly estimate levels of emissions during feedstock use from storage facilities, transfers, transportation, fugitive losses, etc. No commonly accepted guidelines are in place which has resulted in non-productive disagreements.

In order that a better understanding may be gained of the feedstock uses of ODS and actual or estimated emissions arising from these uses, Parties may wish to consider requiring reporting of all feedstock uses of ODS. Disclosure of confidential information can usually be avoided by aggregation at country level. Where possible, annual quantities for each type of use should be given but at minimum there should be reporting of the nature of all feedstock uses.

4.9 Destruction Technologies

The TEAP Task Force on destruction technologies that reported in April 2002 described a number of technologies as being suitable for destruction of ODS in bulk or in foams. It established criteria for destruction and recovery efficiency (DRE) for dilute and concentrated ODS, for dioxin/furan emissions, and a number of other practical matters associated with the operation of destruction facilities. A number of facilities have been installed using these technologies, and subject to local regulations and legislation, but no comprehensive list of these facilities is available.

The Task Force also recommended investigation of technologies that convert ODS into useful compounds via chemical reactions, and these have been slow to appear but the first few are reported below. They begin, of course, with destruction of the ODS but then instead of the end products being fluoride, chloride, or bromide salts, there is recovery of useful hydrogen fluoride or an organic fluorochemical for which there are potential or actual uses.

The CTOC has reviewed proposals for new technologies using information provided by the proponents. Information was be provided to the XXII/10 TEAP Task Force. No cost information was provided in the submissions. Proposals were received from SGL CARBON GmbH, LESNI A/S, ASADA Corporation, Midwest Refrigerants LLC, University of Newcastle (Australia), SRL Plasma, and Nordiko Quarantine Systems Pty Ltd (the last two being concerned with destruction of methyl bromide).

4.9.1 *Necessity of New Criteria of the Destruction Technologies*

The destruction technologies in the agricultural field are quite different from those in the industrial products such as refrigerants. Recently, however, new technologies for the destruction of methyl bromide in the agricultural field have appeared.

The destruction efficiencies of methyl bromide in the above mentioned Nordiko Pty Ltd are lower than the suggested minimum standards of DRE 99.99% for concentrated sources and DRE 99.5% for dilute sources such as ODS in foams which were set in the ad-hoc Technical Committee in 1992. In addition, it took a long period (16 months) for the destruction of methyl bromide on activated carbon.

Despite of these difficulties, new criteria for destruction technologies are necessary since the criteria in 1992 were established for ODS in industrial products and not for the dispersed uses such as agricultural processes. The CTOC recommends re-consideration of the criteria.

4.9.2 *Recent Literature*

A recent publication (R. Xuan, D.J. Ashworth, L. Luo and S.R. Yates, 'Reactive Films for Mitigating Methyl Bromide Emissions from Fumigated Soil', *Environmental Science and Technology*, 2011, electronic version accessible at DOI: 10.1021/es103713k) has described the use of reactive films for preventing or minimizing the emission of methyl bromide from field applications. A layer of the active ingredient, dry ammonium thiosulfate, is sandwiched between a lower, permeable, film and an upper virtually-impermeable film. Methyl bromide is destroyed through reaction with the thiosulfate. No commercial applications of this technology have yet been reported.

4.9.3 *Destruction Projects in Article 5 Parties*

Reverse manufacturing of ODS-containing equipment and material at a number of scales is within the capability of many countries. Difficulties that attend transboundary movements of waste mean that there is no plan (that CTOC is aware of) for a regional destruction facility but there are a number of in-country projects to link recovery of ODS with destruction. Decisions between export and in-country destruction are likely to be influenced by the cost and availability of smaller-scale destruction equipment such as some of the above examples.

Brazil had a relatively advanced commercial hazardous waste management infrastructure, and the MLF approved a project to develop a fully functioning system of 'end of life' (EOL) management including environmentally sound and verifiable ODS destruction capability. After screening of a number of potentially available destruction facilities (7 incineration and 1 plasma arc), UNDP and the Brazil Ministry of Environment are conducting an assessment to evaluate the actual requirements that are in place and the potential adaptations those facilities may require to destroy ODS. At one there was already reverse manufacturing of domestic refrigerators which had resulted in a declared stock of 12 tonnes of CFC-12 through manual and semi-automatic process from the national operator. Two automatic reverse manufacturing facilities were also established in the latter part of 2010, handling refrigeration circuits and foams, and is expected that each one will have destruction capability although information about the destruction technology is not yet available. The projects have received bilateral funding from the Government of Germany and funding from a Swiss Foundation, respectively. Assessments may need to be done to verify if the estimated capacity of the three plants are to exceed the market needs in the short term. Also, verification of the interest of those companies to receive ODS from third parties (e.g. independent refrigerators de-manufacturers through manual processes and EOL chillers containing CFCs) is needed. In the longer term, they also must be consulted on their interest/or availability to destroy HCFCs - the successors to the ODS currently being recovered and destroyed, CFC-11 and CFC-12 from Commercial Refrigeration and AC, since those plants were primarily designed for the management of EOL domestic refrigerators.

UNDP **Ghana** in collaboration with the Environment Protection Agency (EPA), Energy Commission of Ghana, and the center for Rural and Industrial research (CRIR) has developed an overarching strategy to provide climate and ozone benefits through the Integrated Plan for Energy Efficiency, Climate Mitigation and ODS Reductions for the Refrigeration Sector, the last of these three projects having MLF support. Waste ODS would be transported from refrigerator servicing and dismantling centres (to be set up with MLF and GEF funding, respectively) and transported overseas for destruction. The ExCom will give further attention to this at its 63rd meeting (April 2011).

The MLF Executive Committee has approved funding for UNDP for a preparatory study in **India** for demonstration of a sustainable technological, financial and management model for disposal of ODS. The project proposes to maximize cross-convention synergies by including work on e-waste, ship-breaking, energy efficiency, and equipment replacement programmes. Processes for destruction and safe disposal of recovered ODSs from refrigeration and air-conditioning equipment, disposal waste stream, chillers, ship breaking activities etc., are expected to be operationalized through this project.

A destruction project in **Cuba**, funded by the MLF and implemented by UNDP, seeks to develop an efficient and cost-effective logistic framework for the transport, storage and destruction of ODS in a cement kiln in Cuba. Since 2006, the Government of Cuba has expended over US $700 million on decommissioning of 2,757,000 refrigerators and 276,000 air-conditioning units aged between 20 and 60 years. A stockpile of 133 tonnes of waste ODS awaits destruction. At its 62nd meeting, December 2010, the ExCom approved funding of US $525,200 for destruction of 43.5 metric tonnes of ODS waste in the ODS Waste Management Pilot project in Cuba.

The World Bank's 2009-2011 Business Plan for Montreal Protocol operations lists a global study of financing of ODS destruction, and pilot ODS destruction projects in **Mexico** (UNIDO has produced a concept plan), **Indonesia** (a previous project there was funded by Japan) and the **Philippines**.

5 TEAP Task Force Response to Decision XXII/10

5.1 Context and Content of Decision XXII/10

The Montreal Protocol allows remanufacture of ODSs to replace a portion of ODS destroyed under specific conditions (within the same year as destruction, within the same group of substances, etc.). This creates the necessity to determine the portion of ODS delivered to a destruction facility that is actually destroyed in order to know how much can be remanufactured, if the Party were to choose to remanufacture. In practice, however, Parties have typically not remanufactured ODS to offset quantities destroyed, choosing instead to further protect stratospheric ozone and climate with destruction. Thus, the list of Approved Destruction Technologies has been more concerned with destruction efficiency and concerns about safety and atmospheric by-products than with quantification of ODS destroyed.

It is also significant that considerable work on destruction technologies has taken place to support the development of market-based strategies to pay for destruction of greenhouse gases in the Kyoto basket. New protocols similarly incentivize the destruction of ODS that are also greenhouse gases.

The Technology and Economic Assessment Panel, its TOCs and Task Forces have assessed existing and emerging technologies and have made recommendations for technologies to be added to the list of approved destruction technologies, since 1992. The first major assessment on destruction was published in the 2002 TEAP Progress Report as a separate volume. This work screened in 16 technologies before confirming 11 for destruction of concentrated CFC destruction (5 of which were also confirmed suitable for halons) and 1 for the destruction of CFCs in foams. Four more technologies were judged as having ‘high potential’ for both CFCs and halons (these were AC Plasma, CO_2 Plasma, Gas Phase Chemical Reduction and Solvated Electron Decomposition), while 6 of the technologies already confirmed for CFCs were judged to have high potential for halons. Most importantly, 29 technologies were ‘screened out’ as not being appropriate. The next request for an update of the list was in Decision XVI/15 and an update on Destruction Technologies was included as Section 6.9 of the 2005 TEAP Progress Report as a consequence. This decision did not request an update of the Approved Technologies List, therefore the four ‘high potential’ emerging technologies were not addressed for further consideration by the Parties. The current Approved Technologies List, as contained in the 2009 Handbook of the Montreal Protocol, therefore remains unchanged from the list developed in 2002.

Further discussion of destruction technologies was included in Section 4.7 of the 2010 TEAP Progress Report, partially in response to clause 3 in Decision XXI/2, which was worded:

> 3. *To request the Technology and Economic Assessment Panel to review those destruction technologies identified in its 2002 report as having high potential and any other technologies and to report back to the 30th meeting of the Open-ended Working Group on these technologies and their commercial and technical availability.*

This assessment documented the emergence of national regulations to govern the destruction of ODS, often based on the criteria set out in the 2002 TEAP Progress Report. It noted, however, that the breadth of destruction technologies being practiced at that time was already ‘far wider’ than the Approved Technologies List, partially because of the influence of progress in destruction of POPs under the Stockholm Convention and the introduction of Resource Conservation & Recovery Act (RCRA) requirements and Maximum Achievable Control Technology (MACT) standards in the USA. However, the TEAP (through its CTOC) did not explicitly advocate any further additions to the Approved Technologies List. An additional section in the 2010 TEAP Assessment Report highlighted a series of ‘emerging technologies’. These were described in the 2010 Report in Table 4-4, which is reproduced below for ease of reference:

Organisation	*Nation*	*Fluorocarbons Destroyed*	*Evaluation*
Lesni A/S	Denmark	CFCs, HFCs	Destruction of dilute fluorocarbons by catalytic cracking
Midwest Refrigerants, LLC	United States of America	CFCs, HCFCs, HFCs, PFCs, Halons	Transformation of fluorocarbons by pyrolytic conversion
SGL Carbon GmbH	Germany	HCFCs, HFCs, CCl_4	Destruction of concentrated sources by a porous reactor
University of Newcastle	Australia	Halons, CFCs	Transformation of fluorocarbons to fluorinated vinyl monomers
SRL Plasma Pty Ltd	Australia	Methyl bromide	Applicability of present destruction technologies to methyl bromide

Decision XXII/10 now focuses on the review of Destruction and Removal Efficiency (DRE) criteria in general and consideration of the minimum DRE criterion for methyl bromide destruction. In addition, the TEAP has been asked to review the list of 'existing and emerging technologies' in the context of these criteria and provide an evaluation of their performance and commercial/technical availability. DRE is currently viewed as the appropriate metric for measuring the efficiency of ODS destruction. In order to ensure that the emerging technology assessment reviews the most recent developments, a call for new submissions was made – to be received no later than 1st February 2011.

The full operative text of Decision is as follows:

1. *To request the Panel and the relevant technical options committees, in consultation with other relevant experts, for consideration at the thirty-first meeting of the Open-ended Working Group and with a view to possible inclusion in the Montreal Protocol handbook:*

    a. *To evaluate and recommend the appropriate destruction and removal efficiency for methyl bromide and to update the destruction and removal efficiency for any other substance already listed in annex II to the report of the Fifteenth Meeting of the Parties;*

    b. *To review the list of destruction technologies adopted by parties taking into account emerging technologies identified in its 2010 Progress Report and any other developments in this sector, and to provide an evaluation of their performance and commercial and technical availability;*

    c. *To develop criteria that should be used to verify the destruction of ozone-depleting substances at facilities that use approved ozone-depleting-substance destruction technologies, taking into account the recommended destruction and removal efficiencies for the relevant substance;*

2. *To invite submissions to the Ozone Secretariat by 1 February 2011 of data relevant to the tasks set out in paragraph 1 above;*

In response to paragraph 2 of the current decision, the Ozone Secretariat has not only received further inputs from the five emerging technology proponents listed in 2010, but also from the ASADA Corporation in Japan and Nordiko Quarantine Systems PTL Limited in Australia,

5.2 Task Force Composition

The Chemicals Technical Options Committee (CTOC) had taken the lead on the destruction technologies issue since 2005 and had reviewed the subject periodically since then. However, the number of destruction experts on the Committee was limited. Accordingly, the burden of this work had fallen on a relatively small number of individuals and did not include experts in all aspects of destruction.

In view of the specificity of Decision XXII/10, TEAP decided to form a specific Task Force co-chaired by one of the existing CTOC co-chairs (Ian Rae), but also involving some foam expertise in the form of an FTOC co-chair (Paul Ashford), who had previously dealt with the coverage of ODS destruction from dilute sources in both the TEAP Task Force on Destruction Technologies (2002) and the Foams End-of-Life Task Force in 2005. Other Task Force members were selected on a basis of expertise and availability.

The main focus of the decision was on destruction criteria and it was felt necessary to strengthen the expertise in this area by involving Rick Cooke, who has experience from the Stockholm Convention on Persistent Organic Pollutants and the Global Environment Facility as well as Montreal Protocol demonstration projects. In addition, Dr Koichi Mizuno, from the CTOC, provided continuity with earlier assessments and to bring his substantial experience to the Task Force. Finally, it was deemed as valuable to have a member on the Task Force responsible for the oversight of existing destruction facilities in developing countries. Ms Cristina Poli of CETESB in Brazil, which is the agency of the State Government responsible for the control, supervision, monitoring and licensing of pollution generating activities, with the aim of preserving and recovering the quality of air, water and soil, was therefore invited onto the Committee.

The Task Force was further strengthened by the presence of Ms Bella Maranion of the United States Environmental Protection Agency who oversees the regulation of ODS destruction in the United States and who, along with other Task Force members, had been part of the Advisory Workgroup to the Climate Action Reserve in California on the development of its International Protocol.,

Clause 1(c) of the decision addresses the need for criteria for the verification of destruction at facilities that use ODS destruction technologies. This need arises from the fact that the Climate Action Reserve, amongst others, has been nervous about ensuring environmentally-sound destruction outside of the United States of America. In turn, this provided a barrier to the use of local destruction facilities in Article 5 countries. With this in mind, TEAP invited four experts in the field of project verification to join the Task Force: they were Syd Partridge from the Reserve itself, Tim Kidman (SAIC), Kristian Bruning (Climate Wedge) and, representing the management of appliances, Christoph Becker (RAL Standards).

The full membership is summarised in the table below:

Member	***Affiliation***	***Nationality***
Ian Rae (co-chair)	University of Melbourne	Australia
Paul Ashford (co-chair)	Caleb Management Services (consultancy)	UK
Christoph Becker	RAL Standards	Germany
Kristian Bruning	Climate Wedge	Finland
Rick Cooke	Man-West Environmental Group	Canada
Tim Kidman	SAIC	USA
Bella Maranion	US Environmental Protection Agency	USA
Koichi Mizuno	National Institute of Advanced Industrial Science and Technology (AIST)	Japan
Syd Partridge	Climate Action Reserve	USA
Cristina Poli	CETESB	Brazil

Although methyl bromide destruction was an element of the brief to the Task Force, it was considered that the existing destruction expertise on the Task Force would be sufficient to assess specific issues related to the substance. However, it was noted that close liaison with the Methyl Bromide Technical Options Committee (MBTOC) would be an important aspect of this work.

The Task Force did not physically meet to conduct its business, but communicated primarily by e-mail. Bella Maranion, Paul Ashford and Ian Rae took advantage of the opportunity to meet during the TEAP meeting in Geneva in May 2011 in order to discuss the structuring and content of the report. The opportunity was also taken to liaise informally with MBTOC members in the margins of the TEAP meeting on issues of significance to Decision XXII/10.

5.3 Performance Criteria

5.3.1 Destruction and Removal Efficiency (DRE) vs. Destruction Efficiency (DE)

The 2002 TEAP Task Force Report on Destruction Technologies (TFDT) noted that there was a clear distinction between Destruction and Removal Efficiency (DRE) and Destruction Efficiency (DE) with Destruction Efficiency being the more comprehensive measure of the efficiency of destruction in that it not only considers losses in the stack gas, but also losses from other sources such as fly ash, scrubber water and bottom ash. In this respect, it aims at getting closer to a full mass balance.

The decision in the 2002 TFDT Report to stay with DRE as the criterion for deriving the list of Approved Technologies was based mostly on the availability of data. Accordingly, it was viewed as appropriate to remain with this measure in order to cover as many technologies as possible. Since then, Destruction Efficiency has become a more prevalent measure of destruction performance when documenting POPs destruction under the Stockholm and Basel Conventions. A current proposal from the Scientific Technical Advisory Panel of the GEF recommends the use of Destruction Efficiency (DE) before quoting a Destruction and Removal Efficiency (GEF/C.40/Inf. 16).

Inevitably, the DE is lower than the DRE because it encompasses more potential losses. However, the GEF Scientific and Technical Advisory Committee (STAP) highlights that Best Available Technology (BAT) should be able to achieve DRE of 99.9999% and DE of 99.99% and that these should be used as ‘working benchmarks’. This means that the current criterion for destruction within the Montreal Protocol of 99.99% DRE is fairly modest.

Under the Clean Air Act in the United States, the stratospheric ozone regulation (40 CFR Part 82 Subpart A) specifies minimum performance in terms of Destruction Efficiency rather than Destruction and Removal Efficiency and set a minimum performance of 98%. However, the International Protocol developed by the Climate Action Reserve holds to the Montreal Protocol approach of specifying a DRE of 99.99%.

The opportunity therefore exists for the Montreal Protocol to re-visit its specification of destruction criteria and could now consider the possibility of specifying the more comprehensive performance indicator of Destruction Efficiency. However, if this criterion was left at a value of 99.99%, it would effectively be an increase in the requirements for destruction over the current position. An alternative would be to consider a lower threshold, noting that the current US minimum requirement is set at 98%. For gaseous materials such as ODS, the difference between DRE and DE would not be expected to be so substantial. Accordingly, a figure of 99% or 99.5% for DE would seem to be more appropriate. Such proposals could be the basis for wider consultation within the Parties of the Montreal Protocol.

However, counter-arguments to a change include the fact that DE is primarily used to trace losses of hazardous bi-products in water and soil. Since ODSs are volatile and are not generally deemed as hazardous outside of their ozone impacts, the adoption of DE would not provide a particular advantage and would entail additional cost. The improvement in the quantification of ODS destroyed would also be marginal. Conversely, if destruction is extended to methyl bromide, there might be advantage in being able to trace other sources of loss from destruction facilities, in view of its toxic nature (see Section 5.4).

In summary, the Task Force is not proposing a specific change at this time, but believes it important for Parties to keep this wider perspective in mind for future decisions related to destruction.

5.3.2 Destruction and Removal Efficiency in Perspective

As the shift in ODS destruction moves from surplus ODS stockpiled from manufacture to recovery and destruction of ODS at end-of-life (E-o-L), the losses occurring in the collection and recovery stages have become the subject of greater focus. Although these losses can still be relatively low for concentrated sources derstroyed in sophisticated facilities, it is likely that considerable losses (sometimes in excess of 5%) can occur in recovery of some refrigerants and foam blowing agents prior to the destruction step. Section 5 of this report also picks up on the management of dilute sources, where re-concentration can also lead to additional losses.

Under these circumstances, a case can be made to avoid setting criteria for destruction that are dwarfed by losses from other sources. Therefore, there does remain a solid basis for retaining a DRE of 99.99% rather than 99.9999%, for example. Indeed, some argue that a DRE of 99.9% would also provide sufficient margins of safety in view of the fact that these minor emissions are not environmentally significant when compared with losses in collection and recovery.

The STAP also highlights in its recent paper the fact that striving for the highest destruction criteria can have a damaging effect of the cost effectiveness of destruction and notes that this can limit the amount of destruction that occurs to the wider detriment of the environment. In particular, it is viewed that the criteria for developing countries should be no more stringent than those already applied in developed countries.

Applying these principles to the destruction of ODS, the Task Force believes that there is a reasoned case for reducing the DRE to 99.9% but recognises that this would open up the need to review all of the technologies that were 'screened out' in 2002 to see if they would have qualified under the revised criteria. In addition, if there is a decision as a result of the discussion in Section 5.1 to move to the more comprehensive Destruction Efficiency (DE) measure, then it would certainly be counter-productive to have to re-visit the 'screened out' technologies twice. A critical aspect of any decision to adjust criteria is that any changes maintain appropriate levels of environmental prudence while maximizing the opportunity to recover and destroy ODS in the field.

5.3.3 The Case for Moving the Dioxin/Furan Limits for ODS

Apart from the efficiency of destruction considered in the previous two sections, there is a need to ensure that the breakdown products themselves do not cause an increased risk to the environment. The likely components of such a breakdown in the case of ODS are polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/PCDF). The screening criteria in the 2002 TFDT Report were set at 0.2ng ITEQ/Nm^3 (toxicity equivalency factor) for concentrated sources. Since there are 75 types of PCCD and 135 types of PCDF, the purpose of the ITEQ approach is to aggregate individual toxicities and concentrations in such a way as to set an overall limit. Accordingly, a more toxic substance will contribute to reaching the aggregated threshold more quickly than a less toxic substance.

Even in the 2002 Report, there were comments to the effect that 0.2 ng ITEQ Nm^3 was a compromise between more stringent requirements in developed countries (<1 ng ITEQ Nm^3) and possibly higher figures in developing countries. To put this into context, however, it should be noted that the figure put forward by the Technical Advisory Committee in the 1992 report was 5 times higher at 1.0 ng ITEQ Nm^3.

The Task Force is currently of the view that a limit of 0.1 ng ITEQ Nm^3 would be closer to the industry norm, but notes that there may be some existing ‘screened in’ technologies that might not satisfy this criterion. As can be seen in Section 4, there is one technology that has been operational in Denmark, Sweden and the UK for several years and operates to a limit of 0.2 ng ITEQ Nm^3.

In conclusion, the Task Force recommends a move to 0.1 ng ITEQ Nm^3 and suggests that this should be done via a consultation process through the regulatory authorities of the Parties in order to determine the impact prior to a definitive decision.

5.3.4 Destruction and Removal Efficiency for Methyl Bromide

Since the primary use of methyl bromide is as a toxic fumigant, it clearly has a human health hazard profile that needs to be managed. However, this has been achieved successfully in the diverse world of agriculture and is therefore not seen to provide any insurmountable handling challenges to the chemical destruction sector. The main hazard characteristics of methyl bromide can be summarised as:

- Toxic and Corrosive through ingestion, inhalation and skin contact
- Strong irritant
- Potential mutagen

Methyl bromide has been reported historically to be the most difficult ODS to destroy by incineration[1], having a Class 1 Thermal Stability Index (Ranking 31-33). Nonetheless, significant quantities of methyl bromide have been destroyed historically. The 2010 Progress Report highlighted a table that indicated the destruction of over 13,000 tonnes of methyl bromide in the United States alone between 1991 and 2003. Further investigation has revealed that a number of destruction technologies were used during that period, but the major ones were rotary kiln incineration, conventional thermal incineration (called a fume/vapour system by some facilities) and catalytic oxidisers. Little information is available on the levels of destruction achieved.

Having reviewed the limited data available, the Task Force sees no reason why the Destruction and Removal Efficiency (DRE) should be set at an initial figure that differs from that used for other ODS (99.99%). However, as with ODS, the opportunity exists to round this down in due course to a DRE of 99.9% or switch across to a more comprehensive DE measure. Since this decision will not be made immediately, there is an opportunity to solicit more information from the destruction sector on methyl bromide destruction experiences. However, with the on-going refinement of destruction technologies, there is unlikely to be any insurmountable to the achievement of DREs in excess of 99.99%.

5.3.5 Specific Concerns about Brominated Dioxins/Furans

A more significant issue for methyl bromide destruction is the avoidance of hazardous bi-products as part of the destruction step. In the case of methyl bromide, these will be primarily polybrominated dibenzo-*p*-dioxins and polybrominated dibenzofurans (PBDD/PBDF). In 1998, an expert group recommended the use of the aggregated TEF approach for these compounds and further recommended the adoption of the same limits as for PCDDs and PCDFs[2]. However, these recommendations have not yet been fully adopted into the TEF scheme.

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[1] B. Dellinger and P.H. Taylor, “Handbook: Guidance on setting permit conditions and reporting trial burn results, Appendix D” US EPA/625/6-89/019, (1989)

[2] http://www.inchem.org/documents/ehc/ehc/ehc205.htm

In the light of this background, the Task Force recommends a limit of 0.1ng TEQ Nm^3 in order to align with the likely eventual adoption within the TEF scheme.

5.3.6 Conclusions on Performance Criteria

The review conducted by the Task Force has uncovered a number of aspects that would drive towards a change in the current performance criteria. However, the predicting the full consequences of such changes to existing, high potential and emerging technologies will need further consultation with the destruction industry. The Task Force would therefore propose an on-going consultation, possibly via the Parties to their national agencies, to seek feedback on the following:

- A change from a performance criterion set on the basis of DRE to one based on DE
- A setting of the DRE at 99.9% or DE at 99% or 99.5%
- The decrease of PCDD/PCDF limits to 0.1 ng ITEQ Nm^3
- The value of PBDD/PBDF limits to be set at 0.1 ng TEQ Nm^3
- The DRE for methyl bromide to be set initially at 99.99% but to mirror on-going changes proposed for other ODS.

5.4 Evaluation of Emerging Technologies

5.4.1 Generic Technologies vs. Specific (proprietary) Technologies

One of the challenges associated with the assessment of destruction technologies for approval under the Montreal Protocol is deciding what constitutes a technology. The 2002 TFDT Report identified 45 distinct technologies and only 'screened in' 16 of these. 12 were approved by Parties at that point and four were characterised by TEAP as having 'high potential'. The remainder were 'screened out'. As noted in Section 3, any changes in performance criteria will require re-appraisal of the whole set of 45 technologies previously screened in and out.

In the 2010 Progress Report, the CTOC had highlighted a list of 5 emerging technologies. A further two technologies related to methyl bromide have also been added since that time and are assessed in this report. These are primarily proprietary technologies put forward by individual legal entities. Intellectually, this creates the challenge of deciding whether these specific technologies are sub-sets of technologies previously reviewed, whether 'screened in' or 'screened out'. Without this wider analysis, there is a risk that a specific 'emerging' technology could be 'screened in' or 'approved' while the wider generic technology could have been previously 'screened out'. The Task Force considered that each application for approval should be treated on its own merits, and that decisions should not be swayed by previous evaluations. This avoids the risk of misappropriation of the technology. It may be a separate (future) step in the management of the Approved Technology List to go back through and identify duplications and over-laps. Parties are invited to consider and comment on this approach.

5.4.2 Status of Previous 'High Potential' Technologies

The 2002 Report of the TFDT identified four technologies that were of 'high potential'. These were:

- AC Plasma
- CO_2 Plasma
- Gas Phase Chemical Reduction
- Solvated Electron Decomposition

The Task Force has reviewed AC Plasma and CO_2 Plasma technologies and has concluded that they remain suited to low vapour pressure liquid and gaseous streams and therefore of high potential for

ODS destruction. However, the published literature is limited on their actual use for ODS (particularly for CO_2 Plasma), so it is not yet clear whether they can be added to the Approved Technology List. Parties may wish to consider a call for further information via the Ozone Secretariat.

In the case of Gas Phase Chemical Reduction and Solvated Electron Decomposition, however, these technologies are less suited to ODS unless a level of pre-treatment takes place. This could make assessment of destruction efficiencies more challenging. There is also some question mark about the widespread commercial adoption of these technologies, placing some further doubt on the earlier optimism. Nevertheless, it is viewed as premature to 'screen out' these processes until more experience is gained.

5.4.3 Assessment of Each Technology

The following table summarises the information received on the seven emerging technologies reviewed by the Task Force:

Proponent	Technology	Feed rate of ODS	Against criteria 99.99% DRE Dioxins < 0.1 ng ITEQ m^{-3}	Comment
SGL Carbon GmbH	Refrigerant gas, air and fuel in porous reactor at high temp for short time.	2 -10 kg/h for HCFC-22 and HFC-134a; 60 kg/h for CCl_4	99.99% DRE (but 95% for dilute sources); dioxins < 0.1 ng m^{-3}	Already operated at Frankfurt Main by Akzo; pilot plant at TU Bergakademie, Freiberg.
Lesni A/S	Catalytic destruction of fluorocarbons and hydrocarbons vapour from foams at modest temperatures.	60 kg/h for CFC-11, CFC-12, HFC-134a and pentane	>99.9% DRE; dioxins 0.2 ng Nm^{-3} (0.5 ng Nm^{-3} for dilute gases).	Operated for 7 years in Sweden, Denmark, and UK.
ASADA Corporation	Plasma destruction, small scale	Typically, 2 kg/h for HCFC-22, HFC-134a, 1 kg/h for CFC-12	DRE >99.99%; dioxins < 0.000002 ng-ITEQ m^{-3}	Operated at Matsuzaka-city, Mie prefecture and at Giacomino, Argentina.
Midwest Refrigerants LLC	Thermal conversion of ODS with hydrogen and carbon dioxide.	In a pilot plant, 5.4 – 7.3 kg/h (12 – 16 lbs/h) for CFC-12	DRE >99.99% reported; 2,3,7,8-PCDD 0.0095 ng m^{-3} reported	Halogens recovered as salable hydrogen halides or halide salts. Further process definition provided since 2010
Newcastle, Australia	Thermal conversion of fluorocarbons to vinylidene chloride (described in two US patents).	Feed rate achieved for both halons and CFCs was 1.5 kg/hr	Conversion of reactant halons and CFCs was 99.99% at 1173 K (900 degree C)	Catalytic reactions of fluorocarbons with hydrocarbons (natural gas) in a semi-scale reactor;
SRL Plasma	Plasma destruction of methyl bromide	31 kg over 100 minutes	DRE >99.5% claimed but 2-3% of MB recovered; may meet dioxin criterion if bromo-dioxins have ITEQ similar to chlorinated.	Trial processed
Nordiko Quarantine Systems Pty Ltd	Adsorption of methyl bromide on activated carbon and subsequent destruction by chemical, biological or thermal means.	Not quantitative amount of methyl bromide reported	DRE of 96.02%. claimed for methyl bromide adsorbed on activated carbon in an ambient conditions for 16 months	

The technical adequacy of the initial submissions received varied significantly and much of the data contained in this table was accumulated through a number of bilateral communications between Task Force members and the technology proponents. This was not always a very efficient process and some technology holders struggled to provide the information required.

One conclusion from this is that there may be a case for developing a specific *'pro forma'* for information submissions in future. This could be made available on the Ozone Secretariat website for ease of access, with periodic 'calls' for submission.

5.4.3.1 SGL Carbon

The technology application submitted by SGL Carbon GmbH has been described as a process by which ODS, air and fuel are combined for a short period in a porous reactor. Generically, this is understood to be a thermal oxidation reactor which would broadly qualify under the 'screened in' incineration technologies already Approved. However, there may be proprietary nuances to the technology which take it slightly outside of the current definitional boundaries.

A pilot plant operates at Frankfurt Main and has a feed rate which is above the minimum required for eligibility. The performance achieved is as listed in the table and meets the current criteria specified. Therefore the Task Force recommends adding this technology to the list of Approved Technologies immediately, although it may be subsumed in an existing category as and when the review referred to in Section 5.1 is undertaken. **(Recommended for Approval)**

5.4.3.2 Lesni A/S

This technology is described as the catalytic destruction of fluorocarbons from foams at modest temperatures. As such, it may fall under the wider category of 'Gas phase catalytic dehalogenation' but, as with the SGL technology, this can be resolved in a subsequent review. The DRE claimed for the technology is 99.9% which, under current criteria does not qualify. Additionally, the Dioxins performance of 0.2 ng ITEQ Nm^3 is now considered below the international norm form for ODS destruction processes. However, the Task Force notes that this technology has been operated for 7 years under the purview of the Swedish, Danish and UK authorities.

The Task Force would wish Parties to consider the treatment of such cases within a fluid situation for performance criteria (see Section 5.3). However, the Task Force does not feel empowered to approve the technology under the current circumstances, although it accepts its high potential. **(High Potential)**

5.4.3.3 ASADA

The ASADA portable plasma destruction plant has the advantage of being transportable to the place of need. Issues surrounding the requirements for continuity of power supply have been raised and addressed, leading to a general conclusion that the plant is operable in most circumstances. Plants are already reported to be operating in Japan and Argentina.

The capacity of these plants can be as low as 1 kg/hour for some ODS (e.g. CFC-12). However, this is equivalent to the minimum feed rate defined by the TFDT in 2002 as a 'screen in' criterion. Whilst this low throughput might have an impact on the economics, the Task Force does not view this as a basis for exclusion of the technology.

The destruction performance is consistent with other approved plasma technologies and the Task Force recommends it for Approved Technologies List **(Recommended for Approval)**

5.4.3.4 Midwest Refrigerants

This technology provides a novel approach to the destruction of ODS and involves the thermal reaction of ODS with hydrogen and carbon dioxide. The process results in an irreversible transformation and the performance criteria currently in place for ODS destruction are met, although there was initially some concern within the Task Force concerning the process flow adopted and the level of analytical verification. However, this has subsequently been resolved. Since the process is targeted to create hydrogen halides and/or halide salts as saleable bi-products of the destruction process, the normal screening criterion related to maximum HCl or HF levels in the stack gases do not really apply.

The Task Force believes that this represents a significant additional technology option and, although it is still in its semi-commercial stage, recommends its inclusion in the Approved Technologies List. **(Recommended for Approval)**

5.4.3.5 University of Newcastle

As with Midwest Refrigerants, this technology is strictly a transformation process. However, the Task Force points out that all destruction processes are, in fact, transformation processes, with the only difference being whether there is a specific use for product (in this case vinylidene fluoride) into which the ODS has been transformed. The critical aspect of any transformation process from a Task Force perspective is whether the transformation is irreversible or not. Clearly, it would not be appropriate to sanction technologies in which the permanence of the transformation was not assured.

Being a transformative process, however, does not mean that it should be subject to lower performance thresholds than other destruction technologies. In this instance, a conversion factor of 99.99% has been reported for both CFCs and halon. Whether this is viewed strictly as a DE or a DRE, the level of conversion is sufficient to meet the criteria set for inclusion as an Approved Technology, and accordingly is recommended for approval. **(Recommended for Approval)**

5.4.3.6 SRL Plasma

This is the first of two technologies submitted specifically to address the destruction of methyl bromide. In principle, the Task Force sees no reason why plasma technology of the type operated by SRL Plasma would not be suitable for methyl bromide destruction. However, although the DRE is quoted as 99.5%, there seems to be a contradiction in the fact that 2-3% is recovered from the waste stream. The Task Force suspects that the flow rate used for the trials may have been too high (31 kg over 100 minutes) to achieve full destruction and that slower rates might be more effective. This is equally borne out by the observation in Section 5.4 that methyl bromide is more thermally stable than other ODS.

The Task Force has concluded that there is insufficient information on SRL Plasma to recommend approval, but notes the high potential that it represents. **(High Potential)**

5.4.3.7 Nordiko

The technology is described as the adsorption of methyl bromide on activated carbon and subsequent destruction by chemical, biological or thermal means. Since the technology is not linked with any <u>specific</u> destruction technology, the Task Force does not believe that this current submission can be considered within the scope of an assessment of destruction technologies. The technology, as described, relates more to a collection and recovery methodology which clearly performs well in achieving a recovery rate of 96.02% over an extended period (16 months). Currently, there is no approved performance criterion for collection and recovery of methyl bromide. The closest parameter under consideration is the Recovery and Destruction Efficiency (RDE) used as a benchmark for recovering ODS from foams, either in dilute form or by re-concentrating. With these points in mind, the Task Force is ‘unable to assess’ this submission based on the data available. **(Unable to Assess)**

5.5 Development of Verification Criteria

5.5.1 Maximising Destruction or Quantifying Destruction?

In the early years of the Montreal Protocol, the primary purpose of Approved Destruction Technologies was to act as a vehicle for destroying ozone depleting substances in order to omit these materials from declared national consumption, where consumption is defined as follows:

Consumption = Production + Imports – Exports – Quantity Destroyed

The provision allowed for the remanufacture of ODS to offset that destroyed in a facility approved by the Parties, if accomplished in the same year and if the ODS remanufactured were in the same ODS group. As noted earlier however, Parties have typically not remanufactured ODS to offset quantities destroyed, choosing instead to further protect stratospheric ozone and climate with destruction.

Implicit in this mechanism was an underlying assumption that Parties would be destroying unwanted stockpiles rather than gathering ozone depleting at end of life for destruction to prevent emissions. It was largely assumed that any ODS collected from the field was more likely to be reclaimed or recycled than destroyed at a time when these substances also had a market value of their own.

Since most stockpiles already existed, there was no significant collection step and certainly not one that would be likely to result in substantial emissions prior to destruction. There was also no particular challenge in quantification of materials destroyed. The focus was therefore on the destruction technology used and the efficiency of that process – both in terms of level of destruction (at least 99.99%) achieved and levels of trace pollutants that might result.

In the 2002 TEAP Task Force Report on Collection, Recovery & Storage (TFCRS), the discussion had already begun to move towards consideration of the 'banks' of ozone depleting substances in use (i.e. 'already consumed' in Montreal Protocol language) and ways in which emissions could be avoided or, at least, minimised at the point at which equipment and products were being decommissioned in order to maximise destruction. This necessarily required consideration of the losses that might be incurred during the collection, recovery and storage stages prior to destruction, unless the recovery and destruction would lead to new production.

For refrigerants and halons, it was noted that the ODS were generally contained and, with the use of appropriate equipment and/or practices, could be aggregated into significant quantities for destruction. This was not the case for blowing agents in foams, where the blowing agent was distributed in discrete pockets throughout the foam and, in some instances, might even be partially dissolved in the polymer matrix itself. Recognising this reality, it was concluded that the destruction of ODS in foams could be addressed either by extracting the blowing agent to the extent possible prior to re-concentrating it for destruction by Approved Destruction Technologies or, could be destroyed along with the foam itself through an appropriate incineration process. This led to the inclusion of Municipal Solid Waste Incinerators (MSWI) in the list of Approved Technologies for diffuse sources (intact foams) following positive reports of destruction efficiencies from work conducted by the foam industry in Europe during the 1990s (e.g. the Tamara Project). Later Rotary Kiln Incineration was added to the List following positive evidence in support of this technology from Japan and elsewhere.

The destruction of ODS directly within foams typically results in lower destruction efficiencies because of the non-homogeneous nature of the substrate and its distribution through the product. Accordingly, a Destruction and Removal Efficiency (DRE) of 95% was deemed reasonable for such direct incineration processes. Where blowing agent was extracted from foams prior to destruction, it was recognised that there would be losses in the physical handling of foams through the process. In addition, there would be residual level of blowing agent remaining in the polymer matrix after extraction. These various points of loss would lead to lower recovery yields even if the final Approved Destruction Technology resulted in a 99.99% DRE. In addition, for both categories of destruction there would be some losses in foam decommissioning and collection. The TEAP Task Force on Foam End-of-Life Issues provided further insight into these issues and concluded that it was necessary to introduce an additional parameter called Recovery and Destruction Efficiency (RDE), which accounted for all losses from the point of product decommissioning to the final destruction of the blowing agent. Therefore RDE was defined as:

$$RDE\ (\%) = \left\{ \frac{\text{Blowing Agent in foam Immediately prior to Decommissioning} - \text{[Losses in Segregation and/or Mechanical, Recovery and/or Incineration]}}{\text{Blowing Agent in foam immediately prior to decommissioning}} \right\}$$

This was the first step towards the assessment of losses in ODS destruction from foams as summarised in the following:

Product Type	*Recovery Method*	*Losses in segregation*	*Losses in other pre-incineration steps*	*Losses in incineration*	*Recovery & Destruction Efficiency (RDE)*
General Building Foam	Mechanical Recovery	2-8%	0.5%	<0.1%	>90%
General Building Foam	Direct Foam Incineration	2-8%	Not Applicable	<0.1%	>90%
Sandwich Panels	Mechanical Recovery	Not Applicable	<5%	<0.1%	>94%
Sandwich Panels	Direct Foam Incineration	Not Applicable	Not Applicable	<0.1%	>99%
Appliance Foam	Mechanical Recovery	Not Applicable	<5%	<0.1%	>94%
Appliance Foam	Direct Foam Incineration	Manual (no ODS capture) 5-25%	Not Applicable	<0.1%	<95%
Appliance Foam	Direct Foam Incineration	Manual (with ODS capture) 0.5-4%	Not Applicable	<0.1%	>95%

The initial inference, as recorded in the Foams End-of-Life Task Force Report (2005), was that an RDE of 85% or 90% could be set as a minimum recovery and destruction level. The updated table above would indicate that a decision to opt for a minimum RDE of 90% could rule out some manual separation practices with appliances in non-enclosed facilities. This may be a desired outcome in regions where better alternatives can be afforded, but may not be appropriate in all regions and circumstances.

However, whichever route is chosen it should be noted that all of these approaches are targeted at maximising destruction rather than measuring destroyed amounts. In particular, the direct incineration of foams would not provide a quantitative assessment of ODS destroyed, since there would be no input flow measure of the type required for the determination of DRE when concentrated ODS are destroyed.

The lack of quantification was of little consequence in the end-of-life scenario until it became clear that destroyed ODS could become a source of co-funding as a result of the carbon equivalent value in protecting the climate. This was particularly significant because of the high global warming potentials of most CFCs, HCFCs and other ODSs. As carbon projects began to be considered in earnest for ODS recovery and destruction, there was a need to consider the protocols for quantification. Organisations such as the Voluntary Carbon Standard (VCS) and the Climate Action Reserve (CAR) either have developed, or are in the process of developing such protocols, with CAR taking this through to a full methodology[3] although only for the recovery of blowing agents/refrigerants prior to incineration. CAR concluded that the challenges associated with the quantification of blowing agent in in-tact foam were too great at this stage to extend the methodology to this aspect. In order to quantify emissions savings achieved by the projects in question, these protocols also needed to take due account of the baseline emissions that would otherwise occurred in the waste stream. Any quantitative or qualitative adjustments to minimum emission thresholds or monitoring procedures adopted by the Parties will

[3] *Climate Action Reserve*: Article 5 Ozone Depleting Substances Project Protocol, Version 1 (February 2010)

likely have a direct impact on the requirements set by these methodologies. In particular, ambitious RDE minimum thresholds can have a significant impact on monitoring costs.

For CAR, in particular, there was some concern that the ability to apply its methodology internationally would depend, first and foremost, on the level of confidence in the performance of the destruction facilities themselves (i.e. the reliability of the certificate of destruction). As a secondary point, it would also be necessary to have confidence in the availability of data on the baseline emissions and procedures practiced in collection and recovery, as well as confidence in data on external energy consumed by the destruction project. However, these would ultimately be factors influencing the quantity of credits available, with conservative assumptions being taken in the absence of information.

In the short term, CAR's concern on the verification of performance of destruction facilities led to the decision to restrict the destruction step to operations in the United States of America or its territories, so that the management of destruction could be covered under the US Clean Air Act (US EPA rule 40 CFR 82). In order to extend the application of the CAR Protocol beyond the boundaries of the USA, there would be a need to assure verification against criteria set out in Section 5.3 of this report. This therefore focused attention on the Code of Good Housekeeping that had been previously developed under the Montreal Protocol and included in the Montreal Protocol Handbook.

Finally, it should be highlighted that recovery and destruction of ODS under carbon schemes by nature increases incentives to maximizing RDE as losses reduce the amount of material available for destruction. Beyond given RDE and DRE thresholds, an ODS carbon project only generates credits against measured destruction. A focus on Code of Good Housekeeping as a measure to maximize or verify RDE and DRE would create an indirect project eligibility criteria. Further work would be required to assess any impact on supply of projects.

5.5.2 Status of Code of Good Housekeeping

The Code of Good Housekeeping was first prepared by the *Ad-hoc* Technical Advisory Committee in May 1992 and was incorporated into the Montreal Protocol provisions via Decision IV/11 at the Fourth Meeting of the Parties later in the same year. The primary purpose of the Code was explicitly described 'to ensure that environmental releases of ozone depleting substances through all media are minimised'. However, in seeking to achieve this, it advocated important quantification measures.

Following the preparation of the 2002 TEAP Task Force Report on Destruction Technologies, the Code of Good Housekeeping was updated in the 2003 TEAP Progress Report to include the new list of Approved Technologies and also to provide a broader coverage of the handling of issues surrounding the management of dilute sources (foams). In the process of this update, a level of concern developed amongst Parties over the use of the word 'standards' in the draft text. It was recognised that a distinction needed to be drawn between the 'technical capability' of a process and its measured day-to-day performance, which could be either side of a mean value. The primary rationale for this change was that the TEAP, TOCs and Task Forces are not standards setting bodies and there is a need to 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. For this reason the text of the Code is non-prescriptive in its entirety. Whilst this serves to provide Governments with the comfort needed, it acts against the idea of using the Code of Good Housekeeping itself as a verification tool.

As noted earlier, the Code also straddles the dual challenges of both minimising emissions and quantifying destruction. The following table highlights the main activities covered in the current Code and their impact on both maximising and quantifying destruction:

Procedure	*Minimise Emissions*	*Quantify Destruction*
1. Pre-delivery	Yes*	No
2. Arrival at the facility	Yes	Yes
3. Unloading from delivery vehicle	Yes	No
4. Testing and verification	Yes	Yes
5. Storage and stock control	Yes	Yes
6. Measuring quantities destroyed	No	Yes
7. Facility design	Yes	No
8. Maintenance	Yes	No
9. Quality control and Quality Assurance	Yes	Yes
10. Training	Yes	Yes
11. Code of transportation	Yes	No**
12. Monitoring	Yes	Yes
13. Measurement of ODS	No	Yes
14. Control Systems	Yes	Yes
15. Performance measurements	Yes	Yes
16. Suggested substances for declaration	Yes	No

* by establishing detailed 'chain of custody' and appropriate practices
**unless a quantitative declaration is required from the customer

5.5.3 Further Verification Needs for Quantifying Destruction

The basic quantification of the ODS destroyed is, of course, achieved at the destruction facility. Many would argue that 'some destruction is better than no destruction' and there is a case for this line of argument based on the alternative of 'no destruction'. However, for a reputable organisation such as CAR or VCS, it would be important not to be associated with projects that were poor in their chains of custody, since this would cast doubt on both the validity of any baseline calculations and the duty of care exercised in minimising emissions in the supply chain to the destruction facility.

This said, the means of satisfying any project verifier of chain of custody issues is likely to remain qualitative rather than quantitative unless a decision is taken to introduce minimum Recovery and Destruction Efficiencies or something similar.

In conclusion, the focus of concern for those developing project protocols and methodologies is to be sure that destruction occurs appropriately and that quantities of destroyed ODS are known by product type either on their own, in blends or in products. These are all items that can be achieved by applying the Good Housekeeping practices described in the Code, but the ability to verify that those practices have been observed requires something stronger. Effectively, if verification is to be achieved, there needs to be the opportunity to audit the paper trail retrospectively and/or carry out spot checks on physical deliveries. In order to fulfil normal verification procedures, these audits would typically be carried out by third party auditors or verifiers. A possible text for such requirements is set out in the draft Voluntary Annex attached to this section.

5.5.4 Use of a Voluntary Annex for Verification Purposes

The purpose of a Voluntary Annex to the Code is to provide a separation between the Code of Good Housekeeping statements on 'technical capability' and the verification procedures necessary to ensure minimum standards of verified destruction are achieved. The rationale for making the Annex voluntary is to allow for destruction facilities anywhere in the world to actively participate in destruction projects under the Climate Action Reserve (CAR), Voluntary Carbon Standard (VCS) and other relevant destruction protocols that either already exist or may emerge in the future. The criteria in either instance are no different from those contained in the Code of Good Housekeeping. The purpose of such a Voluntary Annex is simply to strengthen the verification procedures by shifting the burden of proof to the destruction facilities and project proponents themselves.

It should be stressed that Section 5.6 that follows is only an outline of how such a Voluntary Annex might look and is not intended as a formal proposal from TEAP or its Task Force. This is made available for possible discussion by Parties at the thirty first Open Ended Working Group Meeting and any further inter-sessional work deemed appropriate ahead of the twenty second Meeting of the Parties.

5.6 Possible Text for a Voluntary Annex to the Code

Compliance with this Voluntary Annex offers destruction and other reversible transformation facilities around the world a route to pre-qualify for participation in ODS destruction projects that are eligible under selected ODS protocols. These include, but are not limited to, the protocols of the Climate Action Reserve and the Voluntary Carbon Standard.

The Code of Good Housekeeping contains a list of Approved Destruction Technologies which qualify according to their respective technical capabilities. However, in order not to limit the autonomy of Parties to set their own national minimum performance criteria, no minimum standard is prescribed. To comply with this Annex, the destruction facility needs to positively demonstrate performance and practices that ensure that the technical capabilities of the technology are consistently achieved. The requirements are listed under the following five headings:

<u>Chain of Custody</u>

The destruction facility shall put measures in place to ensure that verifiable, written declarations of quantified ODS content are provided by customers on all shipments arriving at the facility, where the ODS is in a pure form, in blends (including contaminated sources) or in products containing ODS. To determine the actual weight of the ODS content, the following information shall be recorded: gross weight of each container, tare weight of the container, weight of the contents, type of scale used (including calibration history and scaling error) and the date of weighing. Information on the mode of transport and distances shipped should also be made available.

Because recovered ODS may contain a wide range of contaminants such as oil, water, other substances, the destruction facility shall address any up-front preparation of material for destruction that may be necessary because of these unknowns

The destruction facility shall be capable of handling the likely variation in container sizes and be able to introduce the ODS contents into the feed stream of the destruction facility. NOTE: Some cylinders do not have dual port valves: if liquid product is to be removed in lieu of vapour, the cylinder must be inverted.

Analysis of the contents of each shipment shall be available for retrospective inspection or audit and records shall be kept available for a minimum of [5] years following the processing of the said shipment.

Access shall be given to provide for the conduct of ‘spot checks’ on shipments as received by the destruction facility. A spot check shall take place at least once in every six months.

Customers shall be encouraged to assist project developers in establishing the baseline emissions scenario for the waste stream in question, although the project developer shall retain ultimate responsibility for the presentation of the baseline scenario within a project preparation document (PPD).

Estimates of emissions in the chain of custody shall be made for each shipment based on best practice at the time and shall be documented by the project developer.

Where shipments have crossed national borders, the project developer shall be responsible documenting compliance with all cross-border regulations (e.g. the Basel Convention, where relevant) and this shall be open to verification by the project verifier.

The destruction facility shall provide a means of removing any waste/bi-product created during the destruction process, including the transfer of the waste/bi-product to a licensed disposal site and disposal of empty non-reusable containers.

<u>Destruction Criteria</u>

The destruction facility shall ensure that its plants meet the performance criteria set out in the Approved Technologies List or the national minimum standard, whichever is the more stringent, and shall organise third party independent verification of this at least once in every [three] years. These criteria will include both relevant DRE values and maximum International Toxic Equivalency Quotient (ITEQs) of relevant classes of pollutants. The outputs shall be reviewed by the project verifier.

Where a rigorous national minimum standard for destruction facilities may not exist or where compliance and enforcement of such a standard is poor or questionable, the destruction facility may conduct a destruction trial analysis: a specified quantity of the received ODS contents shall be processed into the destruction system over a sufficient duration period for destruction/conversion to take place and to evaluate the feasibility of using the technology; process streams are sampled before, during, and after processing and analysed to demonstrate the destruction of ODS; the fate of fluorine and chlorine in the system is determined; and confirmation is made that no reformation of chlorinated and fluorinated Volatile Organic Compounds (VOCs) occurred. An independent laboratory will oversee the trial destruction process to ensure collection of relevant process data, will review all data output during the process, and may collect samples for off-site laboratory analysis.

The destruction facility shall also permit the conduct of ‘spot checks’ on these criteria by a competent authority or Third Party Auditor in their jurisdiction within [one] week of notification.

The means of demonstrating compliance shall be through the development and implementation of a suitable Monitoring and Operations Plan, as currently defined in the CAR protocol.

Detailed records of energy use within the destruction facility shall be maintained for a minimum of [3] years and provide information on quantity, fuel type and calorific value (e.g. from fuel purchase receipts, electricity bills etc.)

The minimum DRE shall be commensurate with the form of ODS being processed (concentrated versus dilute) and shall be confirmed by the project verifier.

Avoidance of Fugitive Emissions

The Destruction Efficiency (DE) for concentrated sources shall be no less than [98%]

For dilute sources such as foams, the Recovery and Destruction Efficiency RDE shall be no less than [85%]

As appropriate, the destruction facility shall ensure that the DE and/or RDE is assessed at least once in every [three] years for routine shipments.

For shipments arriving from new sources or containing new products, the first shipment shall have an assessment of the relevant criterion. This shall be repeated at least [one] further time within the first [ten] such shipments.

Destruction facilities will take all reasonable care to minimise on-site emissions in accordance with the principles set out in the Code of Good Housekeeping and the measures so taken shall be overseen by the project verifier.

Measurement and Recording of Quantities

Estimates of emissions in the chain of custody shall be made for each shipment based on best practice at the time. Actual measurements or justification for use of an overall emissions factor may be provided to meet this requirement. Likely point sources of emissions in the chain of custody include at recovery, decanting (if needed), consolidation / transfer to storage tank, transport, handling, and storage.

From the assessment of the chain of custody information, the fugitive losses on site and the relevant destruction and removal efficiencies, the destruction facility shall derive its estimate of destroyed ODS for each shipment. This will be supported by physical measurements at the two points highlighted in the Code of Good Housekeeping.

The quantities of destroyed ODS shall be recorded by type and, as appropriate, provided to the project verifier in order that they can then be weighted by their global warming potentials (SAR?) to determine the carbon equivalent emissions avoided.

Records shall be kept for a period [five] years or for the period stated in the relevant project documents, whichever is the greater.

Qualifications for Project Verifiers and other Third Party Auditors

All Project Verifiers operating under this Annex shall be companies or individuals with at least [two] years' experience in the verification of carbon projects and the project leaders shall carry appropriate professional qualifications.

All Third Party Auditors covering the technical performance of destruction facilities under this Annex shall have at least [five] years' experience in auditing similar destruction facilities and the project leaders shall carry appropriate professional qualifications.

In keeping with the concept of pre-qualification, nothing in this Annex guarantees the acceptance of a destruction facility for a specific project. Protocol developers will be fully within their rights to set more stringent criteria as circumstances dictate and may also require specific demonstrations on the particular ODS to be destroyed.

6 HTOC Progress Report

The Halons Technical Options Committee (HTOC) does not plan to meet in 2011 unless issues are raised at the 31st meeting of the Open Ended Working Group that would necessitate a meeting. The Committee's next meeting will most likely be in the first quarter of 2012. The following is the update for 2011.

6.1 Alternative Agents

Testing of the new alternative agents/technologies mentioned in the 2010 HTOC Assessment report continues.

Water mist technologies continue to evolve. Recently commercialised innovations include: new atomisation technology using two-fluid system (air and water) to create ultrafine mist with spray features that are adjustable by changing the flow ratio of water to air, and water mist combined with nitrogen to gain extinguishing benefits of both inert gas and water mist.

Development continues on the use of pyrotechnic products to generate nitrogen or mixtures of nitrogen and water vapour, with little particulate content, for use in total flooding fire extinguishing applications.

One chemical manufacturer is developing unsaturated HFC compounds for various uses including as total flooding fire extinguishing agents. The molecules of these chemicals have short atmospheric lifetimes and, therefore, low values of GWP.

The development and testing of the unsaturated hydrobromofluorocarbon (HBFC) 3,3,3-trifluoro-2-bromo-prop-1-ene for use as a halon 1211 replacement in the aviation industry continues.

A second fluoroketone is under development aimed at replacing halon 1211 (and possibly halon 2402) in streaming applications.

Phosphorous tribromide, PBr_3, is an effective fire extinguishant in part due to its bromine content but it poses little risk to stratospheric ozone. The agent decomposes rapidly in the atmosphere and it has been commercialised for use as a fire extinguishant in one small aircraft engine application.

A novel non-corrosive and low toxicity water-based agent that employs multiple salts to achieve a very low freezing point (-70°C) without the use of glycols has been introduced. It goes under the trade name of Aquagreen XT, and has excellent fire extinguishing effectiveness that includes film-forming capability. Initial commercial applications are as fixed local application systems in industrial vehicles such as mining and forestry, but it could have military applications as well.

6.2 Halon 1301 Use as a Feedstock

Halon 1301 (CF3Br) continues to be produced in China and France for use as a feedstock in the manufacture of the pesticide Fipronil. The total halon production quantities in these countries are unknown to the Committee but have been increasing annually in China since 2005.

6.3 Halon Recovery and Recycling in Article 5 Countries

In India, currently the military and offshore oil platforms have the major demand for halons, although a small quantity of halons (about 1 MT) is in use for the servicing of civil aircraft. However, the major airlines are sourcing halon and having equipment serviced abroad. The main sources of halon 1301 within India come from shipbreaking and industry decommissioning. In the past year, shipbreaking has yielded approximately 25 MT of halon 1301 and 10 MT of halon 2402. The decommissioning of industrial systems, e.g., from the power sector, is picking up, but the lack of suitable recycling facilities and testing laboratories is hampering progress. Of concern is the fact that halon 1301 is recovered by private fire industry companies who are then selling the halon to end users without proper purification and testing. Halon 1211 is now in short supply, similar to the previously reported situation with halon 2402.

In China, halons recovered from decommissioned equipment are now classified as a hazardous waste. Recovery and recycling therefore require a hazardous waste management license. The companies who were supposed to collect and recycle the halons do not have such a license and appear to have limited interest in handling hazardous wastes. This has hampered efforts to export the halon to other Parties.

6.4 Contaminated Recycled Halons

Over the past year, the HTOC has been working closely with ASTM International (formerly known as the American Society for Testing and Materials) to fast track a halon 1211 Standard for use by recyclers and testing laboratories. This Standard, D7673, is now available and the HTOC recommends strict adherence to this and other international halon specifications/standards to avoid the potential risks from reduced fire extinguishing performance or increased agent toxicity from contaminated recycled halons.

6.5 Update on the Response to Decision XXI/7

The HTOC continues to work with the International Civil Aviation Organization (ICAO) on requiring the phase-out of the use of halons on new aircraft. On 16 November 2010, the ICAO Air Navigation Commission (ANC) considered proposals that were supported by the HTOC to amend their Chicago convention Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*, Part II — *International General Aviation — Aeroplanes* and Part III — *International Operations — Helicopters* and Annex 8 — *Airworthiness of Aircraft* to establish requirements and timeframes for the replacement of halon fire extinguishing agents. The proposal included language supporting the use of alternatives that cause the least amount of impact to the environment while performing the specific fire protection applications for which the equipment was designed.

The ANC agreed that the proposals should be transmitted to ICAO Member States and appropriate international organizations for comment. State letter AN 3/25.1-10/75, dated

17 December 2010 was sent with a due date for replies of 1 March 2011.

By 1 March 2011, 45 replies had been received from 42 States (including eight Council Member States), and three international organizations. By 1 May 2011, 57 replies had been received from 54 States (including 16 Council Member States), and three international organizations.

The vast majority of replies indicated broad support for the proposed amendment. However, China and the Russian Federation provided Disagreement with Comments, known as “DC” in the ICAO process.

The comments from the Russian Federation in their DC indicate that they have concerns that requiring the mandatory introduction of halon alternatives in new aircraft within the specified timeframes would have a large financial impact on the industry and that considerable time would be needed to implement the requirements. They proposed reducing the requirement from a mandate to a recommended practice only. In previous meetings and discussions at ICAO in which the Russian Federation representative was present, the Stakeholders group, which includes ICAO Member States, HTOC, Industry and Industry Association representatives came to the conclusion that the recommended practice approach was not the best approach and that the financial burden and timeframes recommended were manageable.

On 2 May 2011, the HTOC co-chair met with the ICAO Secretariat and the ANC member from the Russian Federation to assist in resolving their concerns. The HTOC has offered its co-chair from the

Russian Federation to provide assistance within the Russian Federation to explain the HTOC position and provide additional information as needed. The HTOC has also informed the ANC member from China, through the ICAO Secretariat, that they have a member of HTOC from their Civil Aviation Authority who would be a good internal resource to assist them with information and coordination of any future questions.

The ANC met on 3 May 2011 to take up the comments and decide upon the final path forward. An HTOC co-chair was invited by the ICAO Secretary General staff and participated in the meeting. The ICAO Secretariat concurred with moving forward as originally proposed. The DCs from the Russian Federation and China were not found to be persuasive and the ANC agreed as follows.

- the proposed amendments to Annex 6, Parts I, II and III as contained in Appendix B to State letter AN 3/25.1-10/75 and as modified by action taken to resolve comments received to date will go forward to the Council for approval;

- the proposed amendments to Annex 8 as contained in Appendix C to State letter AN 3/25.1-10/75 and as modified by action to resolve the comments received to date will go forward to the Council for approval;

- the proposed amendments to Annex 6, Parts I, II and III should become applicable on 15 December 2011;

- the proposed amendment to Annex 8 should become applicable on [date of adoption + 3 years]; and instruct the Secretary regarding the preparation of the draft report to Council.

Agreement by the Council is the final step in mandating the replacement of halons in civil aviation. The Council is scheduled to meet the week of 13 June 2011. An HTOC co-chair has been invited by the ICAO Secretary General staff and will attend the meeting to participate in the discussions to support moving forward on the resolution as proposed. Final results of the Council meeting and overall ICAO progress will be included in the TEAP / HTOC update during the Open-ended Working Group in August 2011.

7 MBTOC Progress Report

Since MBTOC recently published its 2010 Assessment Report, this report focuses only on those areas where there are new developments, and areas where further analysis is relevant at this time.

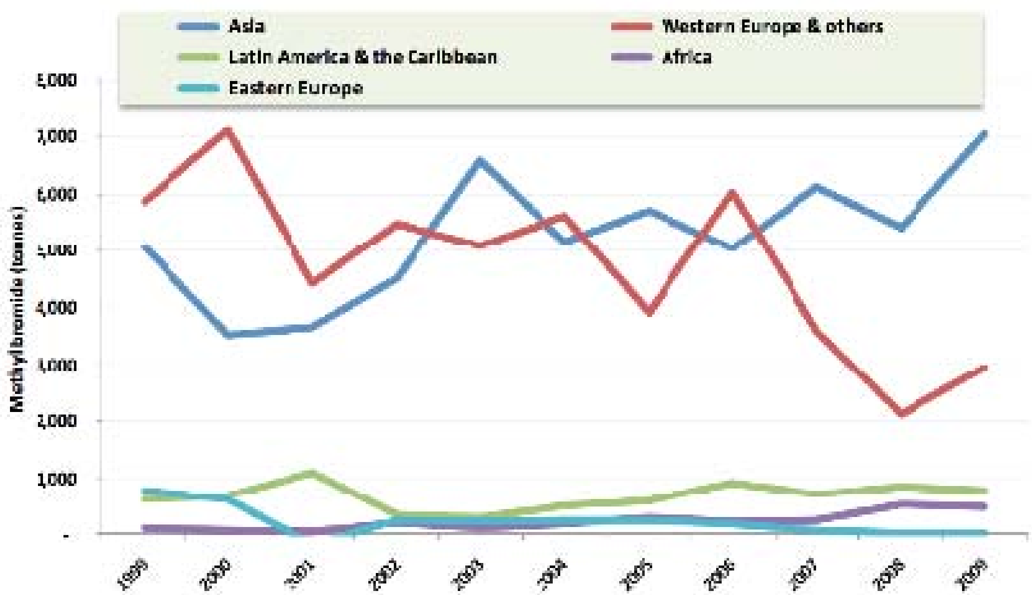
7.1 Quarantine and Pre-shipment (QPS)

This section provides and update on consumption of methyl bromide for QPS, information on recent developments in the International Plant Protection Convention (IPPC) on phytosanitary activities relevant to the methyl bromide phase out, examples of recent legislative changes and clarifications, examples of alternatives to methyl bromide being used and a summary of R&D to find alternatives to methyl bromide for key uses.

7.1.1 Consumption of Methyl Bromide for QPS

The consumption of methyl bromide for QPS showed increased consumption reported by Parties from "Asia" and "Western Europe and Others" groupings (Fig. 7-1).

Figure 7-1: Consumption of methyl bromide for QPS from 1999 to 2009 according to regional groupings



The "Western Europe and Others" Group comprises 29 entities including 16 States in the European Union, 9 Parties (Australia, New Zealand, European Union, Holy See, Iceland, Norway, Switzerland, USA) and 4 principalities. The trend downwards from 2006 to 2008 in this Group was reversed in 2009 mainly by the USA that reported a 73% increase in methyl bromide consumed for QPS.

The "Asia" Group comprises 56 Parties including China, Republic of Korea and Israel. In 2009 compared to the consumption reported in 2008, the Republic of Korea doubled its consumption and Israel increased its consumption 15-fold, which were the main reasons for the reversal of the downward trend from 2007 to 2008. China's continued export trade during the global crisis in 2009 did not result in an increase in methyl bromide for QPS as China reported a decrease in 2009 compared to 2008.

The overall trend in QPS consumption for non-Article 5 and Article 5 Parties that reported methyl bromide consumption for QPS is shown in Figure 7-2. The global trend shows a general increase over the past 10 years in MB consumed for QPS in Article 5 Parties (blue line), and a general decrease over the same period in non-Article 5 Parties (red line). The consumption of MB for QPS in 2009 was about the same in Article 5 Parties and non-Article 5 Parties (blue and red lines).

The global consumption (green line) showed an increase in methyl bromide consumed for QPS in 2009 compared to 2008, due to an increased consumption in non-Article 5 Parties. There were 27 non-A5 Parties that reported QPS consumption between 1999 and 2008. Of these, 16 Parties (59%) have reported every year and 6 (22%) 6-10 times in this period. The frequency of reporting by the majority of the non-A5 Parties that consume methyl bromide for QPS provided confidence in the trend lines shown in Figure 7-2.

Figure 7-2: Consumption of methyl bromide for QPS from 1999 to 2009 in Article 5 (blue), non-Article 5 (red) and for all Parties (green)

7.1.2 International Plant Protection Convention

The IPPC is an international agreement that aims to protect cultivated and wild plants by preventing the introduction and spread of pests mainly during trade of commodities. The IPPC supports the development of International Standards for Phytosanitary Measures (ISPMs), which are the standards, guidelines and recommendations recognized as the basis for phytosanitary measures. Some of these standards include procedures that can replace or avoid the use of MB for use in quarantine.

The Commission on Phytosanitary Measures (CPM) governs the implementation of the IPPC. The CPM meets annually and provides a forum for the discussion of international plant protection issues and sets the annual programme of work for the IPPC. The sixth session of the CPM (CPM-6) was held in Rome 14-16 March 2011. There were three documents on the CPM agenda that aimed to reduce or eliminate the consumption of methyl bromide[1], which were therefore also relevant to the Montreal Protocol:

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[1] Documents for the meeting are stored on https://www.ippc.int/index.php?id=13330&L=0

- Report of the CPM Informal Working Group on Strategic Planning
- IPPC Standard setting, topics and priorities
- IPPC Strategic Framework 2012-2019

7.1.3 Report of the CPM Informal Working Group on Strategic Planning

Despite staff and financial resource constraints, the IPPC set as a high priority the establishment of standards for *"…plants for planting, new ISPM 15 treatments that are alternatives to methyl bromide, international movement of wood, soil and growing media…"2.* These are also topics that are relevant to the Parties to the Montreal Protocol. Standards for these activities that contain options to not use methyl bromide will increase the possibility of using alternatives and reduce the consumption of methyl bromide.

7.1.4 IPPC Standard Setting, Topics and Priorities

Standards are established according to formal procedures that involve work undertaken by Technical Panels and Expert Working Groups. The IPPC follows five steps to adopt a new or a revised standard, which is summarised in Figure 7-1. It typically takes 4-5 years from "start to adoption" of a standard.

The outcome of their work is considered in formal consultations with relevant organisations and the CPM. So far these procedures have resulted in 34 ISPMs that have been adopted.

Figure 7-3: Steps to revise or develop a standard

7.1.5 Technical Panels and Expert Working Groups

Five Technical Panels and one Joint Panel are undertaking work that aims to provide information that can lead to new or revised ISPMs:

- Technical Panel on Phytosanitary Treatments (TPPT)
- Fruit fly treatments (20) based on heat and cold treatments
- Irradiation treatments (3 species) and one generic dose for all insects except lepidopteran species in the host
- Treatments for soil and growing media in association with plants
- Technical Panel on forest quarantine (TPFQ, 7 topics)
- Joint Panel on treatments for wood packaging material (TPPT / TPFQ, 5 treatments)
- Technical Panel on the Glossary of Phytosanitary Terms (TPG, 35 terms under consideration)
- Technical Panel on pest free areas and systems approaches for fruit flies (TPFF, 5 topics)

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[2] CPM 2011/INF/7: Summary Report of the 12th Meeting of the CPM Informal Working Group on Strategic Planning and Technical Assistance.

- Technical Panel that develops Diagnostic Protocols for specific pests (TPDP, 31 topics divided into Bacteria, Fungi, Insects and mites, Nematodes, and Plants)

In addition to the Panels, there are 25 Expert Working Groups that specialise in the development of documents to address a wide range of pest control measures and practices. Altogether there are 146 specifications under development by the Panels and Expert Working Groups that could lead to new or revised standards[3] (see Table 7-1 below for examples of five specifications under development).

Standards adopted by the CPM may result in a decrease in the use of methyl bromide if the standards that result from this work include MB-free options and if they are adopted for post-harvest pest control by countries. The standards are voluntary and can be useful guidance for Parties wishing to establish a phytosanitary agreement for new trade, or for establishing the appropriate protocols for existing trade. The level of risk mitigation varies according to the requirements of the importing country, and may be less than the level recommended in the standard. The activities toward development of the standard specifications undertaken by the Technical Panels and the Expert Working Groups that are most relevant to Montreal Protocol are summarised below.

Technical Panels on Forest Quarantine / Phytosanitary Treatments

The TPPT/TPFQ has examined additional treatments for ISPM-15, which is the Standard describing phytosanitary measures that reduce the risk of introduction and spread of quarantine pests associated with the movement in international trade of wood packaging material. The TPPT/TPFQ:

Submitted a draft ISPM to the Standards Committee in November 2010 for the separate use of microwave irradiation and sulfuryl fluoride for disinfesting wood packaging material;

Submitted a revised version of ISPM-15 for Country Consultation in June 2010, which is projected for adoption by the CPM in 2012. This contains revised and expanded guidelines for heat treatment, a correction of an inconsistency between the text on methyl bromide and the Annex in ISPM-15, and provision for sulfuryl fluoride and microwave irradiation treatments as alternatives to heat and methyl bromide-based treatments. Annex 1 is projected for adoption by the CPM in 2013; and

Requested further information on the following proposed treatments for wood packaging material: methyl isothiocyanate and sulfuryl fluoride (Ecotwin mixture); Hydrogen cyanide; and methyl iodide.

All of these treatments have been given "*high priority*" because of the need to add other treatments to ISPM-15. ISPM-15 specifies the use of debarked wood heated to a minimum temperature of 56°C continuously for at least 30 minutes. Alternatively, methyl bromide can be used according to the treatment schedule provided in ISPM-15. However, National Plant Protection Organisations (NPPOs) are required by the IPPC to take into account a previous CPM Recommendation "*Replacement or reduction of the use of methyl bromide as a phytosanitary measure (2008)*", which encourages NPPOs to promote the use of heat rather than use methyl bromide for WPM. The work of the joint TPPT/TPFQ panels on alternatives to methyl bromide and heat for wood packaging material is summarised in Table 7-1

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[3] CPM 2011/6: IPPC Standard setting topics and priorities

Table 7-1: Work being undertaken by the joint TPPT/TPFQ Panels

Process	Priority	Wood packaging material treatment	Body	Added to work pgm	Status
Special	High	Microwave irradiation of wood packaging material (WPM)	TPPT (TPFQ)	SC 1-5 November 2010	Draft ISPM to SC for Member Consultation
Special	High	Sulfuryl fluoride fumigation of WPM	TPPT (TPFQ)	SC 1-5 November 2010	Draft ISPM to SC for Member Consultation
Special	High	MITC and SF (Ecotwin mixture) fumigation for Bursaphelenchus xylophilus, Coleoptera: Cerambycidae, and Coleoptera: Scolytinae of WPM	TPPT (TPFQ)	SC 1-5 November 2010	Additional data requested from submitter
Special	High	HCN treatment of WPM	TPPT (TPFQ)	SC 1-5 November 2010	Additional data requested from submitter
Special	High	MI fumigation for Bursaphelenchus xylophilus and Coleoptera: Cerambycidae of WPM	TPPT (TPFQ)	SC 1-5 November 2010	Additional data requested from submitter

Source: IPPC 2011.

Despite the widespread implementation of heat treatment facilities in Article 5 and non-Article 5 countries, some of them have not installed heat treatment facilities1 and they do not have access to non-wood packaging material2. Therefore, alternatives to heat and methyl bromide in ISPM-15 are needed in a revised ISPM-15 standard as soon as possible.

Additionally, alternative treatments to methyl bromide are needed for treating wood packing material in shipping containers that are already loaded with goods, and that have been stamped with the ISPM-15 compliance mark in anticipation of a successful heat treatment. Stamping before treatment is allowable under some interpretations of the ISPM-15 standard.

Technical Panel Working on the "Glossary of Phytosanitary Terms"

The Technical Panel that is working on the Glossary of Phytosanitary Terms (TPG) is considering revisions to 34 phytosanitary terms e.g., host susceptibility, pest freedom. One of TPG's areas of work is particularly relevant to the Montreal Protocol, as it concerns an examination of the *"Terminology of the Montreal Protocol in relation to the Glossary of Phytosanitary Terms"*. The TPG has compared the definitions used in the Montreal Protocol with those used in the Glossary of Phytosanitary Terms by the Parties to the IPPC. The TPG reported on the degree of overlap between the Montreal Protocol and the Glossary terms, and noted definitions that had insufficient or no overlap in the terminology used by the IPPC and the Montreal Protocol e.g. pre-shipment. The work undertaken by the TPG on Terminology of the Montreal Protocol is under consideration as an Annex to ISPM-5 *"Glossary of Phytosanitary Terms"*. A draft was circulated to the Standards Committee for Member Consultation. The Ozone Secretariat, with input from the MBTOC, reviewed the draft and provided comments. Member consultation on the draft terms is expected to begin in June 2011. During that consultation, the Parties to the Montreal Protocol will be able to provide comments at the national level through their Convention contact points. The Ozone Secretariat will keep the Parties

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[1] TEAP. 2009. QPS Task Force Report. A5 facilities Pp 84 ; Non-A5 Pp 52. See also page 99 of TEAP 2010 Progress Report; There are more than 6,000 certified heat treatment facilities deployed globally (Dec XXI/10 2009)

[2] TEAP. 2009. QPS Task Force Report. Pp 75-76.

informed of the process3.. A revised ISPM-5 is projected for adoption by the CPM in 2013. The implications of this work on the definitions of QPS used in the Montreal Protocol, and any actions that the Parties to the Montreal Protocol may wish to consider as a result of the work, were not discussed in the reports circulated by the IPPC for Country Consultations.

Technical Panel on Phytosanitary Treatments

The TPPT is considering twenty treatments to control fruit flies using heat (vapour, high temperature forced air) and cold storage conditions. All of them have been given high priority for development. However, additional data have been requested for nineteen of them and only one has been completed as a draft ISPM that has been sent to the Standards Committee. Fruit flies are not typically controlled with methyl bromide and therefore ISPM treatments for fruit fly control will generally have little impact.

Other treatments under development include irradiation treatments. These have progressed further than the heat and cold treatments, as two have been recommended for adoption by the CPM in 2011, and one has been transmitted for Country Consultation and for adoption in 2012. The ISPM under development as a generic irradiation dose for all insects except lepidopteran species in the host requires additional data before it can be submitted for the consideration of the Standards Committee. All of the work on these irradiation treatments has been given high priority for development. In some instances, irradiation treatments may be an alternative to QPS MB treatments.

The TPPT is considering the development of an ISPM for "treatments for soil and growing media in association with plants". In the Montreal Protocol, treatments to control soil pests associated with soil on nursery plants to meet certification standards accounted for about 25% of the total QPS consumption reported by non-Article 5 Parties4. Because the high consumption of methyl bromide for QPS for soil and growing media in association with plants, the Parties to the Montreal Protocol may wish to invite the IPPC to consider raising the priority to from 'normal' to 'high' for this aspect of the work of the TPPT.

Expert Working Group Examining Actions to Minimise the Risk of Quarantine Pests in Stored Products

An Expert Working Group is examining actions that can be taken to minimise the risk of quarantine pests associated with stored products in international trade. Their work is expected to contribute toward an ISPM on this topic. Specifications with comments have been submitted to the Standards Committee. The projected adoption date for the ISPM entitled "*International Movement of Grain*" has not been determined. In 2009, there was substantial global consumption of methyl bromide for grain disinfestation of about 12% (1300 tonnes) annually[5].

7.1.6 IPPC Strategic Framework 2012-2019

Parties at the CPM were invited to discuss and tentatively agree the 8-year IPPC Strategic Framework 2012-2019, and to provide guidance on 4-year Medium Term Plan and 2-year Programme of Work and Budget that are included in the IPPC Strategic Framework.[6] The IPPC Strategic Framework replaces the current Business Plan, which expires in 2011. As the IPPC Strategic Framework contains information relevant to the use of methyl bromide used for pest control, the main parts of the Framework relevant to the Montreal Protocol are summarised. The IPPC's strategic objectives for 2012–2019 are to:

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3 UNEP/OzL.Pro.WG.31/2; paragraphs 34 and 35.

4 MBTOC. 2010. Assessment Report, Section 6.13.2: Treatment of soil with methyl bromide to control pests in propagated plants. Page 257.

5 TEAP. 2009. QPS Task Force Report, Table 4-6, page 40.

6 IPPC. 2011. IPPC: Strategic Framework 2012-2019. Agenda Item 13.5 of the Provisional Agenda for CPM-6. CPM 2011/18.

- Protect sustainable agriculture and enhance global food security through the prevention of pest spread
- Protect the environment, forests and biodiversity against plant pests
- Create economic and trade development opportunities through the promotion of harmonised, scientifically-based phytosanitary measures
- Develop phytosanitary capacity for members to accomplish A, B & C.

A vast range of plant pests and diseases threaten global food production (including animal feed), the culture of forests and the wild flora of the natural environment. If pests can be prevented from establishing in an area, the resources used in prevention are invariably significantly lower than those needed for long-term control, containment, eradication (if possible) after introduction. The regulatory policy challenges to prevent pest establishment are shaped by global trade; environment and natural resources (including climate change); demographic trends; and food security. The IPPC:

Acknowledged a reduction in international trade in the past few years due to the global financial crisis, but predicted that countries would emerge from the global downturn and exports would increase as governments seek a broader economic growth strategy;

Noted that "*…the ozone damaging effects of methyl bromide are now well known and documented, and alternative phytosanitary measures are encouraged (see IPPC Recommendation[7])…*";

Predicted that population growth of middle class consumers in developing countries would generally be greater than those in developed countries, which would lead to more import and export of goods and increased risk to the environment from potential pest incursions;

Considered that the availability of, and access to, adequate food supplies is a food security issue for many countries. Food security was affected by climate change, plant pests (including invasive species), trade, food aid, new production technologies and rural development;

Noted that developing countries aimed to reduce dependence on food aid by increasing exports of locally produced food, which may require capacity development, technical assistance and trade promotion to reduce the risk of pests being accidentally shipped with the exports.

Many of these challenges might be met by methyl bromide in the short term. The IPPC saw a role for NPPOs to address these policy challenges by concentrating their efforts on reviewing existing policies to meet the changing environment and risks. The IPPC cited the measures in place for methyl bromide in the Montreal Protocol, which required NPPOs to use combinations of alternative pest management measures and systems approaches for pest control. These approaches were being used more widely to "*…counter increasing public opposition to traditional pesticide-based means of dealing with pest outbreaks and to allow countries to meet their obligations under the Montreal Protocol. These have increased the costs faced by governments in ensuring an equivalent level of phytosanitary protection provided by traditional, but environmentally damaging, treatments*".

NPPOs safeguard agriculture, environment and natural resources from the negative impacts of pests, and thereby contribute to enhanced food security and open up trade opportunities for countries. The ISPMs provide the framework for the effective operation of an NPPO e.g. the establishment and operation of an import regulatory system, how to conduct pest risk analysis, and guidelines for surveillance, pest status and pest eradication.

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[7] "Replacement or reduction of the Use of Methyl Bromide as a Phytosanitary Measure" adopted as a Recommendation for the Implementation of the IPPC at CPM-3. UNEP/OzL.Pro.WG.1/28/INF/4

Quarantine use is currently exempted from any control measures. However, TEAP periodically provides information to the Parties that may result in their re-evaluation of the exemption. Thus, the quarantine exemption could be modified or even eliminated in the future[8]. The work of the IPPC would be an important factor in any decision taken by the Parties on QPS. The Parties to the Montreal Protocol can be kept abreast of the ongoing work of the IPPC according to previous Decisions[9] of the Parties that requested the Ozone Secretariat to strengthen cooperation and coordination with the IPPC Secretariat.

7.1.7 Legislative Updates and Clarifications

Brazil

The Government of Brazil has confirmed their intention of ceasing all uses of MB for QPS purposes by 31 December 2015[10]. (Controlled uses have been phased out entirely as of 2007). Brazil has achieved significant reductions in MB used for pre-shipment, and presently, over 70% of wood packaging materials (ISPM 15) are being treated with heat. Some quarantine uses still pose challenges for replacement with alternatives but research is underway in this respect. Brazil is also undertaking a more detailed analysis of amounts of MB used at present for QPS.

Canada

The government of Canada has declared that none of the nominations submitted to the Montreal Protocol in 2011 for strawberry runner production constitutes QPS in Canada, either for domestic or for export purposes[11]. The fumigation of strawberry plantlets does not fall under the definition of pre-shipment application because the soil is fumigated more than 21 days from shipment. Therefore, the treatment neither qualifies with the definition of pre-shipment as defined in the Montreal Protocol that requires shipment in less than 21 days after fumigation with methyl bromide, nor with Canada's *Ozone-depleting Substances Regulations (1998)*. The pests that are targeted by the fumigation are not pests identified by Canada as quarantine pests.

The soil is fumigated in the context of normal agricultural practice to meet provincial phytosanitary requirements and industry-sponsored certification programmes which are quality assurance driven. The runner plants are produced under a quality management programme as the plants are intended to be used for berry crop production. The methyl bromide is used to aid production of healthy plants, as free as practicable from the endemic pest complement. Presently, these pests are not targeted for quarantine management or eradication programmes in Canada. For these reasons, Canada believes the nominations are consistent with the criteria governing critical use nominations and not QPS.

European Union

The European Union prohibits all uses of methyl bromide including those used for QPS from 19 March 2010, in accordance with Regulation (EC) No 1005/2009 on ozone depleting substances which came into force[12] on 1 January 2010. The prohibition in that Regulation was consistent with two earlier legislative measures in the EU that prohibited the use of methyl bromide as a biocide from 1 September 2006, and Decision 2008/753/EC which prohibited the use of methyl bromide as a plant protection product under 91/414/EEC from 18 March 2010. Only substances that are listed in Annex 1 of 91/414/EEC can be used in the EU, and since methyl bromide was not included it could not be used. Methyl bromide was prohibited because of its harmful effects on human health and in particular its effects on bystanders and on consumers.

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8 Ragsdale and Vick. 2001. Pesticide Outlook, December 2001, p.248

9 Decisions XVII/15 (2005), XVIII/14 (2006) and Decision XX/6 (2008).

10 Oficio e nota técnica MAPA Protocolo de Montreal. Ministério da Agricultura, pécuaria é Abastecimento, Brasilia, Brasil, Nov 2010.

11 Canada. 2011. Nomination for methyl bromide CDN01_CUN13_Soil_Strawberry_Runners_PEI.doc

12 Article 12(1) in Regulation (EC) No 1005/2009 on Substances that Deplete the Ozone Layer.

The prohibition on the use of methyl bromide was re-confirmed in February 2011 when the European Union decided to not accept a proposal to amend Annex I of Directive 91/414/EEC to allow the use methyl bromide for the treatment of wood packaging material in sea containers. The proposal was not accepted because the applicant did not address all of the concerns with its use, especially those related to the harmful effects on human health and in particular its effects on bystanders and on consumers[13].

Regulation (EC) No 1005/2009 allows the Commission to authorise the temporary production, placing on the market and emergency use of methyl bromide where unexpected outbreaks of particular pests or diseases[14]. The placing on the market and use of methyl bromide must also be exempted under Directive 91/414/EEC and Directive 98/8/EC. The Commission has not authorised any emergency uses of methyl bromide for QPS since methyl bromide was prohibited for all uses in March 2010.

Japan

The Japanese plant protection authority has published a revised plant quarantine regulation that establishes a new quarantine pest list and appropriate quarantine measures based on the pest risk analysis[15]. The risk of new quarantine pests is considered to be higher as a result of increased imports of plant products, trade partner and rapid international distribution. In addition, quarantine measures with scientific pest risk analysis are internationally required. The revised plant quarantine regulation:

Lists 724 species quarantine pests. Interim quarantine pests that are undergoing pest risk analysis constitute 238 families of harmful animals and 362 genera and 2 taxa of harmful plants; non-quarantine pests are 194 kinds of animals and plants, including new 17 species. Most of these new species are scale insects, aphids and others that are normally fumigated with HCN and not methyl bromide.

Excludes from the list pests that are widely distributed in Japan and considered not harmful.

Requires enforcement of the regulation by the introduction of thorough quarantine measures, such as re-examination of imports from prohibited areas that might include banned plants, and/or requiring quarantine measures before export for quarantine pests that are difficult to detect on import e.g., inspection at cultivation area, heat treatment and precise identification.

Generally, the increase in the number of non-quarantine pests as a result of the new regulation is expected to reduce the need for methyl bromide for QPS compared to the previous regulation. The revised plant quarantine regulation will come into force in September 2011.

New Zealand

Following a two year re-assessment of the controls on the use of methyl bromide for QPS, New Zealand's Environmental Risk Management Authority (ERMA) decided in late 2010 to continue to permit the use of methyl bromide for the QPS treatment of imports and exports[16]. ERMA considered that a ban on methyl bromide was inappropriate because of a lack of alternatives for specific uses on imports and exports. Exports of unprocessed logs from New Zealand were expected to triple in the next 5 years[17], which could increase the use of methyl bromide used for QPS.

Continued use of methyl bromide in New Zealand was made conditional on putting in place practices to manage the indirect effects of methyl bromide on human health and the environment, including the requirement to install recapture equipment on fumigation facilities by 2020; setting non-occupational by-stander Tolerable Exposure Limits to methyl bromide for 24h (0.333 ppm) and 1h (1 ppm)

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13 Commission Decision 2011/120/EU of 21 February 2011.
14 Article 12(3) of Regulation (EC) No 1005/2009 on Substances that Deplete the Ozone Layer
15 MAFF-Japan. Nov 2010. http://www.maff.go.jp/j/syouan/keneki/kikaku/minaoshi-an.html In Japanese.
16 ERMA. 2010. Methyl bromide reassessment. HRC08002 Decision 28 October 2010.
17 OzoNews 2 November 2010. Article No. 6.

exposures; requiring reports of the concentration of methyl bromide in the air close to fumigation facilities; and imposing minimum buffer zones of 10-100 meters, depending on the quantity of methyl bromide being applied.

ERMA strongly recommended further research on both methyl bromide recapture technology and alternatives to methyl bromide. Following ERMA's recommendation, New Zealand committed to expenditure of US$1.85 million from government and industry sources from 2011 to 2016 on research that aims to meet phytosanitary requirements by either capturing methyl bromide or developing a replacement. "New Zealand hopes to significantly reduce the environmental harm from the use of methyl bromide by 2015"[18]. In the meantime methyl bromide was needed to meet the phytosanitary requirements of importing countries for New Zealand timber exports worth $2.2 billion a year.

7.1.8 Procedures to Find Alternatives

MBTOC has reported uses in the past where Parties have reported that alternatives to methyl bromide for QPS were not yet available[19]. Research and developed was reported to be underway to identify alternatives to replace methyl bromide for specific uses e.g., HCN for wood packaging material; or to develop practical treatments for those that had been identified e.g. sulfuryl fluoride treatment of food facilities; or to put in place a not-in-kind alternative e.g. non-wood pallets that cannot be infested by pests[20].

The availability of non-MB treatments for specific QPS uses may not be immediately apparent. A systematic search may be needed to find an alternative treatment that involves examination of alternatives in use, such as those located in the USDA-APHIS-PPQ Treatment Manual, Biosecurity Australia, Biosecurity New Zealand, Japan MAFF, European Plant Protection Organisation (EPPO), TEAP and MBTOC reports, proceedings of conferences, publications, unpublished studies and industry reports. Local pesticide registration databases may need to be examined to see if the treatment is authorised for use in the country where the treatment is to be carried out.

As the procedures for finding an alternative may be generally useful to Parties, MBTOC has chosen to illustrate them using three examples. A summary of the search steps and the databases involved are provided in Table 7-4.

Rice Seed

Many countries require the seeds for rice for planting to be free of the nematode *Aphelenchoides besseyi*. It can exist in a dormant state in the seed. When the seed is planted, the nematodes become active and move to the growing points of leaves and stems where they feed externally. *A. besseyi* is present in Asia, America, Africa, Italy and others (MBTOC, 2002), and is classed as a quarantine pest by many quarantine authorities around the world. Contradictory information has been published on whether or not the pest is present in a particular country. Treatment of seed against seed-borne nematodes has been identified in the past as a use of methyl bromide without alternatives[19].

If *A. besseyi* is confirmed to not be present in the importing country, the first option is to obtain seed that has been certified as nematode free. Certified seed is normally available commercially from a range of suppliers. Some quarantine authorities prohibit the import of rice seed unless it is certified as free from *A. besseyi*. Importation of seed that is not certified free could result in the competent authority rejecting the consignment on entry, which means that it could be returned to the sender or destroyed.

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18 NZ News UK. 1 February 2011. Methyl bromide research funding welcomed. NZ Env. Minister Dr Nick Smith.
19 TEAP. QPS Task Force Report. Uses of methyl bromide where alternatives are not available, pp 76-79
20 TEAP. QPS Task Force Report. Section 6.2.5.3 Not-in-kind alternatives for WPM, pp 75

Alternatively, imported non-certified seed could be disinfested with an alternative to methyl bromide. Methyl bromide is to be avoided as it is both ozone-depleting and can damage the germination of rice seeds at the required rates. A disinfestation treatment should be carefully selected that controls the pest with the least impact on germination.

As a result of this search, a range of hot water treatments were found effective for controlling *A. besseyi:* Hot water immersion at 132.8°F (56°C) for 15 minutes is an approved quarantine treatment in the US[21]; Soaking in cold water for 24h, followed by immersion in hot water at 51-53°C for 15 minutes[22]; Soaking in cold water for 3h, followed by hot water immersion at 52-57°C for 15 minutes, then dried to 14% moisture content[23]; Immersed at 40°C for 15-30 minutes, followed by 57°C for 10-15 minutes[24]. The temperature and exposure times need to be precisely controlled to kill the nematode with minimal impact on rice seed germination. The level of risk mitigation may vary between treatments and be more or less acceptable to the importing country, according to the importance that the importing county attaches to rice production.

Apart from heat treatments, soaking the seed in the fungicide Thiabendazole was also reported to control *A. besseyi*[25]. This treatment was not approved by competent authorities or rice organisations, and some countries may not authorise the use of a fungicide to control a nematode.

This example illustrates the importance of avoiding the need for any treatment by importing seed that is certified to be free of the pathogen. Seed certified free of nematodes, as well as heat treatment and possibly Thiabendazole, are alternatives to methyl bromide.

Military Vehicles

Military vehicles are sometimes moved from one country to another for warfare or local security. When imported back to the country of origin following a tour of duty, disinfestation may be required to prevent quarantine pests being accidentally imported along with the vehicles. Detecting pests on military equipment can be challenging as the equipment contains many places where pests can hide.

Spiders are particularly problematic pests because they can be quarantine pest that may also pose a risk to human health. Military vehicles imported into some countries can be infested with spiders of the genus *Latrodectus*, called widow spiders. The injection of neurotoxic venom from the female widow spider is particularly harmful to humans because of its unusually large venom glands. Different species of widow spiders can be found on every continent of the world except Antarctica. They are classified as a quarantine pest when a species of *Latrodectus* is accidentally imported to a country where it is not normally found.

In this case, new military vehicles used for troop transport were imported into a country. On inspection they were found to be infested with widow spiders that were classified as a quarantine pest. Treatment with methyl bromide was not a preferred option for several reasons: methyl bromide is an ODS; spiders are tolerant of methyl bromide and require significantly more methyl bromide than most lepidopteran pests; and methyl bromide damages natural rubber-based materials which was an important component of the vehicles.

Non-MB treatment options were considered, including the application of 1% SO_2 / 6% CO_2 mixture at > 16°C for 30 minutes. This is an approved treatment on grapes imported by New Zealand from the

21 USDA-APHIS Treatment Manual 2011, Section 5-6-18, Treatment T559-2
22 IRRI 1988, p.110. IRRI is the International Rice Research Institute
23 CGIAR 2010, p.2. CGIAR is an international agricultural research organisation
24 EMBRAPA, the national agricultural research organisation of Brazil , based on Tenente *et al* 2006,p.241-242
25 Vuong & Rodriguez 1970 cited in Fortuner & Williams 1975, p.12

USA[26]. However, it was not an approved treatment for military vehicles infested with spiders, and therefore it was not immediately available for use.

SF was also considered as another option as the lethal accumulated dose had been determined experimentally for the black widow spider *L. hesperus*[27]. However, this treatment was not recognised as an approved treatment in the importing country for military vehicles.

Heat treatment can be an acceptable disinfestation treatment since the military vehicles are usually constructed to operate in adverse climatic conditions where the temperatures can exceed 55°C, which is the minimum temperature required for the rapid heat treatment. However, heat treatment facilities were not considered suitable as they were not large enough to treat the number of vehicles in the time available.

Thirty candidate pesticides were screened for their potential to control the widow spider, their registration status, ease of use, environmental and human safety, and suitability for use on the vehicles. From this list, alpha-cypermethrin met these criteria and was selected for the treatment of the widow spiders in military vehicles. It also has a record of being used for the spot treatment of pests in stores, warehouses, industrial buildings, houses, apartment buildings, greenhouses and laboratories; on ships, railcars, buses, trucks and aircraft; and in non-food areas such as schools, nursing homes, hospitals, restaurants, hotels and in food processing plants[28].

This example illustrates that the use of methyl bromide was not necessary as a suitable pesticide was registered and available to control a spider pest on new military vehicles.

Cotton Exports

The cotton boll weevil (*Anthonomus grandis*) is recognized as a quarantine pest of cotton internationally. In many countries *A. grandis* is on the list of harmful organisms, such as EPPO's "A1 List" of pests where it is recommended for regulation as a quarantine pest. Certain plants or plant products that are associated with the cotton boll weevil are restricted, which aims to prevent the introduction into, and whose spread within, protected areas or zones.

A country that wanted to import raw cotton requested the exporting country to apply a methyl bromide treatment, in compliance with the importing country's regulation or policy, prior to exporting the cotton. The exporting country, however, showed the results of an EPPO survey conducted in 2006 that showed *A. grandis* was not present.

Typically, procedures acceptable to the importing country must be in place and carried out annually to demonstrate freedom from a pest. Although such procedures were not in place, and on the basis of the results of the survey carried out several years previously, the exporting country questioned the need for the treatment since the target of the restriction (*A. grandis)* did not appear to be present. Even if the pest was absent, the importing country still required the treatment with methyl bromide as this was a phytosanitary measure that governed the import of cotton. However, the exporting country was not able to use methyl bromide because it had been banned due to concerns with its harmful effects on human health.

Normally, under these circumstances both countries would need to negotiate the terms and conditions for market access. The time needed to reach a successful agreement, and the conditions of any

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[26] NZ Biosecurity. 2008. Import Health Standard. Procedures for the Management of Regulated Spiders Associated with the Importation of California Table Grapes (*Vitis vinifera*).

[27] Thoms, E.M., and R.H. Scheffrahn. 1994. Control of pests by fumigation with Vikane gas fumigant (sulfuryl fluoride). Down to Earth, 49 (2): 23-30.

[28] US-EPA. 1989. Pesticide Fact Sheet Number 199: Cypermethrin. US EPA, Office of Pesticide Programs, Registration Div., Washington, DC

agreement, were unlikely to be determined in the short term. In the meantime, the cotton was treated with phosphine and exported to other countries in order to avoid financial hardship for the cotton exporters and growers. Phosphine had been approved or recommended as a quarantine treatment for *A. grandis* in bulk cotton by the EPPO, the FAO and USDA-APHIS. EPPO had approved phosphine at a dosage of 1.3 gm^{-3} at >10°C for 72h[29]. FAO recommended methyl bromide or phosphine fumigation for raw cotton from countries where *A. grandis* occurs[30]. USDA-APHIS had approved the use of phosphine at 1.27 gm^{-3} at 50°F for 72h as a quarantine treatment for *A. grandis*[31]. Approved treatments that did not use methyl bromide have been available for more than 8 years.

This example shows that the conditions for exports based on area freedom from a quarantine pest requires an agreement on the protocol to demonstrate ongoing area freedom, such as surveys, reporting and records[32]. The time to agree the protocol and to change the importing phytosanitary requirement from methyl bromide to an alternative can take several years. Annual surveys to demonstrate area freedom can be an additional cost that the government or the industry are not willing to meet, and therefore a fumigation or other treatment at the port of exit can be more cost effective. In the meantime, an approved phosphine treatment was used to allow trade in cotton with other countries.

Summary of Suggested Search Procedures

The procedures that could be used to search for suitable alternatives require a search for them globally, in the region and in the relevant country. Various legislative checks would be made to "filter out" alternatives that were not applicable. The steps involved in the search are summarised in Table 7-2, with hyperlinks to the relevant documents.

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29 EPPO (1998) Phytosanitary procedure. Fumigation of cotton and cotton products to control **Anthonomus grandis.** PM 3/47 (1), amendment of 1998. European Plant Protection Organisation, Paris. 3pp. Available as a current EPPO Standard PM 3/47 (1), http://archives.eppo.org/EPPOStandards/procedures.htm

30 FAO 1983 cited in EPPO 1997, p.4

31 APHIS (2009) PPQ Treatment Manual, Plant Protection and Quarantine, Animal and Plant Health Inspection Service, United States Department of Agriculture. Treatment No. T301-d-1-2

32 IPPC. 2007. ISPM No. 29: Recognition of pest free areas and areas of low pest prevalence

Table 7-2: Suggested steps to find alternatives to methyl bromide

1) Search for existing alternatives by commodity / pest species on:
    a. The USDA-APHIS-PPQ Treatment Manual
    b. Treatments in other country databases e.g. Australia, New Zealand, Japan
    c. EPPO standards
    d. IPPC International Standards
    e. TEAP Reports, MBTOC-QPS subcommittee reports
    f. CABI Crop Protection Compendium (global module) for pest distribution, if relevant
    g. Conferences on alternatives in the US
    h. Publications, unpublished studies, and industry data
2) Check to see if the treatment is authorised for use in the country where the treatment is being carried out
3) Compile summary workbook of relevant information from above, including the sources of the information and date
4) Determine the relevant category of pest or action of the treatment:

DE – Desiccant

HB – Herbicide

OT - Other treatment

AC - Acaricide

IN – Insecticide

RO – Rodenticide

BA - Bactericide

MO – Molluscicide

ST - Soil treatment

FU - Fungicide

NE – Nematicide

SY – Synergist

5) Determine conditions of use for a proposed treatment according to:
    a. Treatment schedule (see (1) above)
    b. Technology (see (1) above)
    c. Manufacturer specifications e.g. Degesch, Dow Agro Sciences, Bayer
    d. Researcher files e.g. USDA-ARS
    e. Conference references e.g. EU conferences on alternatives to methyl bromide; US conferences (MBAO) and stored product conferences (e.g. CAF)
    f. From published and unpublished literature
    g. From pest control companies
6) Determine plant or human health impacts of the leading treatments:
    h. Identify treatments that have the least impact on the environment and human health
    i. Hyperlink and / or download any PowerPoint documents or information that could be helpful for end users such as technical bulletins, brochures, farm-notes, seminars etc

7.2 Soils

7.2.1 Scope of the Report

The MBTOC 2010 Assessment Report has been recently published and is accessible at the Ozone Secretariat website http://ozone.unep.org/Assessment_Panels/TEAP/Reports/MBTOC/MBTOC-Assesment-Report-2010.pdf. This report focuses mainly on assessment of alternatives to methyl bromide, (MB) for the remaining Critical Uses and those alternatives adopted through Multi Lateral Fund (MLF) projects to achieve reductions of MB and/or phase out in A5 Parties. The acceptance of new alternatives continues to increase as new products, such as methyl iodide or iodomethane (IM) and dimethyl disulphide (DMDS) expand registration and growers become more used to others practices, i.e. the 3 way system in the USA.

Since the last report, several Parties, Israel and Japan, no longer submit Critical Use Nominations. The US has not submitted a nomination for sweet potatoes or forest nurseries.

The recently 2010 Assessment Report contains a full analysis of the technical and economic feasibility of alternatives to replace MB. It also contains sections on the commercial adoption of alternatives and potential alternative treatments to MB as a soil fumigant. It shows trends in MB production and consumption in both Article 5 and non-Article 5 Parties; estimated levels of emissions of MB to the atmosphere, and strategies to reduce those emissions. In addition, the report gives a review of economic issues relating to MB phase-out. In light of the above, this progress report will describe briefly the remaining challenges and will give a short update of chemical and non chemical alternatives technically and economically feasible at a large scale

7.2.2 Chemical Alternatives for Soil Fumigation

Chloropicrin (Pic), is a key alternative which is being used alone or in combination with other fumigants to effectively control soilborne fungi and some insects. It has limited activity against weeds (Ajwa et al. 2003). Recent results with new virtually or totally impermeable films (VIF, TIF) are proving an effective strategy to reduce dosage rates and avoid off gassing issues (Chow 2009).

The increased use of Pic and other alternatives, eg 1,3-Dichloropropene has proved successful in many countries to sustainably control diseases in the absence of methyl bromide. In the US, Israel and Spain, some increases in infestation with *Macrophomina phaseolina* and *Fusarium oxysporum* have been observed. Further studies are required to determine if this is due to the ineffectiveness of the fumigants or related to changes to strip treatment and drip fumigation. Regulatory constraints continue to limit Pic use in some countries that already phased out MB.

1,3-Dichloropropene (1,3-D) is used as a nematicide and also provides effective control of insects and suppresses some weeds and pathogenic fungi (Ajwa et al 2003). 1,3-D as a single application is not very effective in controlling fungi or bacteria. However when combined with Pic it has been a key alternative to MB in almost all countries. As with Pic, 1,3-D can be combined virtually or totally impermeable films (VIF, TIF) to help reduce dosage rates and improve efficacy (Chow 2009).

Fumigants that are based on the generation of methyl isothiocyanate (MITC), e.g. dazomet, metam sodium and metam potassium, are generally only fully effective against a wide range of arthropods, soilborne fungi, and weeds, when combined with other methods but are less effective against bacteria and root-knot nematodes. The use and knowledge of their application is continually improving.

Methyl iodide (MI) has been recently tested on a wide range of crops by drip and shank-injected and found to be highly effective at controlling a wide range of soilborne pathogenic fungi, nematodes, and weeds (Browne et al. 2006, Fennimore et al. 2008, Schneider et al. 2008, 2009, Yakabe et al. 2010). . MI is now registered in all the United States except Washington and New York for 27 crops including ornamentals, peppers, strawberries, tomatoes, stone fruits, nut crops, vine crops (including table and wine grapes), turf, conifer trees and nursery crops. MI is a key alternative with efficacy similar to MB and is only limited for uptake for the remaining uses of MB because of lack of registration and regulations on dosage rates, buffer zones and economics. Present regulations in California on dosage rates and buffer zones may limit the areas where methyl iodide can presently be adopted. In spite of this the US has accepted MI as a key alternative for the remaining critical uses. Australia is hopeful of achieving registration for use in strawberry runners to offset the use of MB for the last remaining critical use in soils and Canada has been urged to consider evaluation of the product also for the remaining strawberry runner use.

Dimethyl disulfide (DMDS), which has been registered in some countries, including the US, appears to be highly efficient against various nematodes, including Meloidogyne spp.(Santos et al 2009), especially when combined with Pic. DMDS efficacy can be enhanced when combined with VIF or TIF films (Chow 2009).

In the EU, all alternative fumigants (Pic, 1,3 D, metham K and metham Na, dazomet) were revised after MB ban according the regulation 91/414/CE. Only dazomet is now included in the 91/414/CE annex I list of registered pesticides. 1,3 D is not included and its use is questionable, being subjected to specific authorizations country by country for emergency uses. Metham Na and K are also not included and their use is possible until December 2014 only for specific essential uses in each country. Inclusion of Pic in annex I list is still pending, and the final decision is expected in late 2011. Contrary to the MB phase out process, the revision of EU uses of MB alternative fumigants has been undertaken without considering the possible technical substitution with alternative solutions.

7.2.3 Non Chemical Alternatives in the Soil Sector

Resistant Cultivars

The use of resistant cultivars to control soilborne pathogens is considered as the best alternative to MB for some specific crops e.g. tomato, pepper, eggplant. Cultivars with resistance to diseases, root-knot nematodes, bacteria, viruses and *Orobanche* spp. have been developed (Devran and Sogut, 2010, Quesada-Ocampo and Hausbeck, 2010, Dor *et al*. 2009, Wu *et al*. 2009) .The major limitations to use of resistant varieties include the appearance of new pests and disease, new races of known diseases that overcome resistance genes, presence of a diverse range of nematodes and pathogens in the same field, presence of high population levels of pathogens that can override resistance, and environmental conditions, which may limit the level of resistance (Besri 1993; Takken and Rep 2010; Tanyolaç and Akkale 2010).

Grafting

Grafting has been used with great success to control a wide spectrum of vegetable diseases (Bausher, 2009; Louws, 2009). In addition to reductions in disease severity grafting also provides yield increases, improved fruit quality, growth promotion, extended production periods and crop longevity, more efficient fertilizer use, reductions in the number of plants required per hectare, tolerances to soil salinity, low temperature and flooding (Bausher *et al*., 2007; Davis *et al*., 2008;; Maršić and Jakše 2010). In the USA, grafting is still mostly limited to greenhouses and organic producers, but many research projects are underway to establish the technology on a wider scale, particularly in the open fields (Bausher 2008, 2009, Kubota *et al*., 2008 a,b; Rivard *et al.* 2009; Freeman *et al.* 2009; Louws 2009). The best performance seen with grafted plants has been obtained when they are used as a component of an IPM program combining non chemical and chemical alternatives (Besri 2008; Davis *et al.*, 2008; Kokalis-Burelle *et al*., 2008; Lin *et al*., 2008; Rivard *et al.*, 2009). In this regard, pre-plant soil fumigation with specific nematicides (1,3 D) combined with grafting is widely used to control root knot nematodes and soilborne diseases. Presently the major concern with respect to grafting is the enhanced risk of spreading diseases throughout grafting handling procedure.

Substrates

Substrates are widely employed for growing healthy and high-quality plants, particularly in protected agriculture (Kazaz and Yilmaz, 2009). Although initial investment is generally high, increased productivity and yield due to higher planting densities and often better quality of produce, offsets any extra costs (Savas and Passam, 2002; Caballero and De Miguel 2002;). A number of countries have now developed substrate systems that are cost effective because they employ materials that are locally available. The use of substrates has less potential to replace MB for large-scale open field operations because of limited availability of suitable local materials. Constraints on soilless culture may include lack of identification of suitable local substrates, and the vulnerability of the system to pathogen attack, the need for large amounts of water in open systems and the complexity of closed and semi-closed systems needing recirculation of nutrient solutions.

Steaming

Use of steam has continued to increase as an alternative to MB in intensive, protected, high-value cropping systems such as flowers and vegetables (Runia 2000; O'Neill and Green 2009). Steam has replaced the use of MB for sterilization of substrates in a number of areas (Barel 2005). Cost and energy souces are the main limiting factors for this technique.

Hot water

New more effective hot water treatments have gained acceptance for use in Japan. Hot water is applied for the cultivation of tomato, melon, strawberry, spinach, sweet pea and carnation (Nishi 2000, 2002, Uematsu *et al*., 2003). This technology however, is not expanded to countries other than Japan.

Solarization

The effectiveness of soil solarization in controlling many diseases in a variety of annual crops has been shown under a variety of conditions, soils and agricultural systems in many countries (Katan 1981, Stapleton 2000). Control of certain soil pathogens in solarized soil was improved by combining this method with reduced dosages of fumigants e.g. MB, metam sodium, formalin (Stapleton 2000, Chellimi and Miruso 2006).

Biofumigation

Spain switched a significant area to biofumigation and biosolarization as the main non-chemical alternative to MB (Bello et al 2007). The combination of biofumigation and soil solarisation (biosolarisation) has been found to be synergistic in improving the efficacy of both procedures and thereby reducing the time required for solarization and the rates of amendment needed for biofumigation (Bello et al 2007).

7.2.4 Remaining Challenges

The key alternatives, Pic, 1,3-D and MI all have regulations, which have potential to affect their uptake for the remaining uses of MB. MBTOC continues to urge Parties to consider review of these regulations to ensure they serve the best interests of the Montreal Protocol and human safety.

Use of methods which avoid the need for MB (substrates, soilless culture, grafting, resistant varieties) continue to expand worldwide to grow crops once produced with MB and these technologies get more cost effective every year. Continual review of these technologies is required to support evaluation of Critical Use nominations.

Nursery uses are the most significant remaining use for methyl bromide worldwide and more studies are required to determine the risk imposed by use of alternatives in these industries. Until these are conducted growers are apprehensive about switching to alternatives.

MB continues to be classified differently for nursery applications by several Parties despite the target pests and crops being similar in several countries. Canada supplied a useful summary of their interpretation of this use which has been included in the QPS report. MBTOC continues to urge Parties to review the status of these uses.

Emergence of new or re-emergence of previously controlled pathogens in fields that have used MB alternatives for a few years. Examples include *Macrophomina* on strawberry and morning glory and nutgrass in nurseries, *Orobanche* species in greenhouse tomato and pepper crops in Israel. Furthermore, root knot nematodes have emerged after the phase-out of MB in regions in Israel of which this pathogen did not exist.

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7.3 Economic Issues Relating to MB Phase-out

During CUN evaluations, MBTOC assesses the economic feasibility of alternatives available to the Party (Decision IX/6), because an alternative may be considered technically feasible, but may not be economically feasible. In its assessment report MBTOC provided a detailed summary of this information, but a further summary is provided here to assist Parties with future assessment of the economic feasibility of alternatives to methyl bromide.

Measurement of the economic implications of the use of methyl bromide or an alternative can in most cases be done satisfactorily by means of a partial budget analysis, which is a practical quantitative decision tool used to compare alternative production practices. It is partial because the analysis considers only a part of a larger enterprise.

More than one alternative can be analyzed with partial budgeting. The key information for the analysis is the impact on output and the changes in variable costs (see below). Physical output is not deterministic, especially in primary agriculture where yields are affected by exogenous factors such as the weather and soil fertility. Furthermore, soil pest pressure is dynamic and the efficacy of disinfestations is variable. Partial budgeting analysis can address biological factors in a reduced form manner by conducting sensitivity analysis by varying the assumed yield differences. The analyses can also examine the sensitivity of results to different prices for variable inputs like labour. The stochastic output prices need not be modelled unless the alternatives affect the quality of the crop or the timing of the harvest and thus the realized price.

Other circumstances that need special attention include:

Where there is a single treatment followed by a multi-year stream of marketable output, which necessitates economic discounting, and hence the careful selection of the discount rate, which should be based on the producer's time preference and opportunity cost of funds.

Disinfestation in multiple-output production or processing systems, where the economic analysis has to account for the beneficial effect of the disinfestation on the other outputs.

7.3.1 Components of an Assessment of Financial Feasibility

In assessing financial feasibility, the calculation of each of the following key components is done for: (i) the firm operating with methyl bromide and (ii) the firm operating with each of the next best technically feasible alternatives for each use:

Gross revenue measures the earnings of the firm; broadly the quantity of the product sold times the average selling price per unit. Where gross revenue is not expected to change as a result of the adoption of an alternative it is not necessary to consider it.

Variable costs are those costs of production that vary with the amount produced, e.g. fumigation costs; broadly the quantity of the input used times the cost per unit of input. Borrowing costs for capital equipment and remuneration to the owner are excluded.

Fixed costs are those costs that do not vary with the amount produced, e.g. property taxes and insurance premiums. Fixed costs may be difficult to deal with in situations where firms produce more than one product, as they then have to be allocated to different products produced by the firm.

Capital costs are classified as fixed costs; e.g. investment in new machinery. Capital includes a time element as it generates revenues over more than one production cycle and its costs are spread over time through interest on borrowing. Where transition to an alternative involves investment in capital equipment, the costs of such equipment should be spread over the economic life of the asset.

The gross margin is what remains from gross revenue after subtracting certain variable costs. The process of calculating the gross margin is conventionally referred to as partial budgeting because it does not include fixed and capital costs.

It is sometimes necessary to measure a margin above specified costs, for example where certain capital costs or even fixed costs change as a result of the adoption of an alternative.

Net Revenue (or Net Returns) is what remains from gross revenue after subtracting variable, fixed and capital costs.

7.3.2 Estimating the Components for Assessing Financial Feasibility

A responsible financial assessment requires sufficient data to construct a partial budget for the current use (in this case production with methyl bromide) as well as for the next best technically feasible alternative.

However, enterprise budgets in agriculture are difficult to construct because of:

- The diversity of firms in terms of size, age and geographic location, etc.;

- The diversity of conditions that can affect input use as well as gross revenue;

Changes introduced as a result of the adoption of the next best alternative, such as increased risk of loss in production, increased variability in yields or efficacy, missed market windows, the creation of new markets (e.g. organics), etc.;

Because of this diversity, it is important that the presentation of the budgets be accompanied by explicit statements of the way in which each figure was calculated. Examples of well constructed enterprise budgets can be found at the UC-Davis Department of Agricultural and Resource Economics[33].

In all these cases, it is not always possible to provide proprietary information on individual firms. Hence, data should be provided for either a ‘typical’ or an average enterprise, i.e. one that shares similar physical, economic, etc. characteristics as the firm(s) in question.

The information regarding financial feasibility must be assessed for internal consistency, completeness, and reasonableness. Because there are virtually no published sources on the financial feasibility of the adoption of methyl bromide alternatives, MBTOC is largely dependent on the Parties to provide objective sources. To this end, the work of MBTOC will be made easier if the data that is provided has been verified by a third party, e.g. via banks that serve the clients in question, government agencies such as extension services, and farmer study groups, etc.

In terms of financial feasibility, the following considerations apply:

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[33] http://coststudies.ucdavis.edu/current.php

Alternatives that result in significant negative gross margins are not financially feasible.

In the event that the gross revenues are higher and costs are lower (a situation which is unlikely as initial profit gains are generally short term and likely to be offset by increased supply over time), the alternative is financially feasible.

In the unlikely event that changes in costs and revenues are absolutely equal, the alternative is financially feasible because of the environmental benefits accruing.

When costs and revenues increase or decrease simultaneously, the result is ambiguous, and there is a need to define default values.

All other effects on the economics of the business are assumed to remain unchanged (e.g. high fuel prices, changes in the commodity price), unless explicitly stated otherwise in the analysis.

7.3.3 Default Values

Financial feasibility criteria are needed for those cases where gross margin declines but remains positive. Thus, Parties asserting that methyl bromide alternatives are not financially feasible should explain why projected impacts are of sufficient magnitude to support their claim.

MBTOC has adopted the default assumption that alternatives leading to decreases in gross margins (or in a margin above specified costs where appropriate) of more than around 15 to 20 percent or more are not financially feasible.

7.3.4 References

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7.4 Structures and Commodities

The 2011 MBTOC Assessment Report includes a chapter on use of alternatives to methyl bromide in control of pests in structures and commodities . In that chapter Parties will find new writing and analysis of the research on pest control in food processing structures and commodities. Almost all the 200 references that were cited have been published since 2006..

This section of the TEAP May 2011 Progress Report, contributed by the MBTOC Structures and Commodities subgroup (MBTOC SC) includes two sections:

A regulatory news update and;

A special review on achieving control of pest eggs by sulfuryl fluoride.

Parties, MBTOC, CUN applicants and researchers continue to note inconsistencies in observed efficacy of sulfuryl fluoride (SF) in practice. This is of concern as fumigation with SF is one of the pest control adopted by some parties as the principal alternative to methyl bromide in some major postharvest and structural uses. The lack of full effectiveness of SF against eggs of pests is mentioned in several critical use nominations. To assist in understanding, and hopefully resolving, this problem, MBTOC SC prepared a Special Review, given below (Section 7.4.2) of reported laboratory studies on SF in controlling eggs of stored product insect pests. This review provided a basis for analysis of the lack of full control of pests by SF in some commercial fumigations .

As a result of its review, MBTOC concludes that:

-- the target dosage rate of SF, typically a ct-product of 1500 g h m-3 over 24h at 26C, is insufficient to fully control eggs of some common species of stored product insect pest

-- many common pests will be fully controlled (all developmental stages including eggs) to commercial levels under these conditions.

It is important to achieve a high degree of kill of infestations, including the egg stage, under situations where resistance development may be a risk.

MBTOC noted that the actual ct-product experienced by pests, including their eggs, may be less than the free space ct-product under conditions where there are significant barriers to gas distribution, such as packaging materials.

The review and analysis reported here merits further examination and testing by researchers and refinement by pest control fumigators, but at this point, we believe the information could act as a guide to improving the efficacy of SF fumigations as methyl bromide replacements.

7.4.1 Regulatory News

Since the last Progress Report there have been few changes in registration and other regulatory news of interest to Parties. Neither Australia nor Canada have expanded their registrations for sulfuryl fluoride (SF), which applicants are reported to be awaiting.

MBTOC notes the uncertainty caused by the recent US EPA proposed regulation on sulfuryl fluoride, which has been brought about as part of a range of actions to reduce the incidence of fluoride in the diet of some sub-sectors of the US population, particularly children.

The lengthy US proposed regulation discusses both the health assessment of the residues resulting from the use of SF in structures and commodities, as well as the legal basis and issues which resulted in the proposal to phase out its use. Excerpting short sections of this lengthy regulation can lead misunderstandings so Parties may want to review the entire regulation at: EPA. 2011. Sulfuryl Fluoride; Proposed Order Granting Objections to Tolerances and Denying Request for a Stay. Federal Register Vol. 76 No 12 Page 3444.

Fluoride presence in the diet is largely regional, the result of naturally occurring fluoride (from soils impacting water), from fluoride additions to drinking water, and to a much lesser extent from fluoride residues resulting from the use of SF as a fumigant. Australia then addressed this issue and re-assured its public that fluoride presence was not a problem in Australian diets and therefore its approval of SF for control of structural and commodity pests would not change as a result of the US proposed regulation. MBTOC notes that Canada has not established a tolerance for SF contact with foods in Canada.

In further regulatory news, as explained in the text box for Japanese fresh chestnuts, Japan is progressing in the necessary logistical and training requirements following its registration of methyl iodide for control of chestnut pests. As part of their CUN of 2011, Japan presented a full phase out plan for the use of MB in chestnuts by 2015.

7.4.2 Special Review on Achieving Control of Pest Eggs by Sulfuryl Fluoride - Key Messages Resulting From the Review of SF Efficacy against Pest Eggs

Fumigations which target only 95% efficacy in killing pest eggs can quickly result in severe re-emergence of infestation and can, eventually after repeated fumigations, result in pest resistance to the fumigant. Therefore, MBTOC is of the opinion that, where there is risk of resistance development (e.g. with repeated treatments of infested premises) fumigations should be conducted to achieve a very high level of kill (>99%) of all pest life stages, including eggs.

Because of varied mortality responses (including by the tolerant egg stage) to SF, , identification of the pests of concern before the fumigation is required to select treatment parameters necessary to achieve full efficacy.

Knowledge gained from the pest identification, when coupled with the data shown in the review tables in the Appendix, can be used to determine the treatment parameters necessary for egg mortality.

Crucial factors for limiting egg tolerance are temperature and length of exposure, and level of concentration, which operate differently on different species. Other important factors affecting response to SF include the developmental period of the embryo, the structure of the egg shell and other compounds of the egg.

Achieving an effective treatment may require a combination of concentration and time and elevated temperature, which is not currently found elsewhere.

The dosage/mortality values determined in laboratory studies may be used as a basis of commercial dosage recommendations, with allowance for the various inefficiencies and deviations from ideal systems that occur in practice. Reichmuth (2010b) proposed a factor of three times for conversion of laboratory-derived values to commercial applications.

7.4.2.1. Reasons Why MBTOC SC Conducted this Special Review Project

As noted in the Australia rice CUN text box, in the Canada Mills CUN and in MBTOC's 2010 Assessment Report review of the effectiveness of SF as a methyl bromide replacement, some researchers and food processing companies have reported inadequate control of pest eggs with SF and difficulties understanding the research in that field. In many situations, pest control methods, used as a single control measure, are not considered to be adequately effective if they do not control the eggs as the facility or commodity will become noticeably infested again from survivors within very few weeks.

Some commercial recommendations for the use of SF in food processing structures and commodities target a 95% kill of pests. It is the opinion of MBTOC members that fumigations with less than 99% efficacy of killing pest eggs are undesirable because of selection for resistance under situations where the SF fumigant is the sole control measure used and repeated exposures are likely.

The reason for this is that survivors of such repeated unsuccessful fumigations will eventually become resistant to the fumigant -- and the fumigant will not longer be useful, including as a methyl bromide replacement. On the other hand, if other subsequent, additional control measures including IPM processes (e.g. a second fumigation, cooling, heating or further processing) were to be used in addition to the SF fumigation, and if a resulting additive kill-effect could be validated to 99%, then a 95% kill of all stages, with 'complete' kill of adults, may be sufficient both technically and commercially. Additionally we note that increasing the temperature and/or duration of the fumigation for a particular dosage will also help to increase effectiveness of the fumigation.

MBTOC notes, however, that in the absence of MB, it is likely that SF will be used repeatedly as a postharvest fumigant in many applications without achieving full control, thus setting the conditions for pest resistance (i.e., if the treatment(s) are not effective to >99%). Since eggs tend to be much more tolerant than other developmental stages to SF, it is critical that the conditions leading to >99% mortality of eggs is understood if control to >99% efficacy is to be achieved.

Australia's rice CUN applicant and North American flour millers have said they have been unable to show efficacy of SF to control eggs under their treatment conditions. Australia has indicated its intention to phase out MB use for rice in 2015, largely by switching to phosphine, but since the use of SF would require fewer logistical changes, they have also been examining it.

MBTOC wishes assist Parties in correct use of SF and at the same time we were concerned about ongoing inconsistency in reports of efficacy of SF fumigations in controlling pest eggs. We believed that much research had been done that might be helpful to Parties whose applicants continue to struggle to find efficacious fumigations.

7.4.2.2. Method Used for MBTOC's Special Review of Efficacy of SF against Eggs

Given the problems outlined above, , several MBTOC members, led by Dr. Christoph Reichmuth (Germany) collated all available data on the fumigation of eggs of stored product insects and especially those occurring in rice and flour mills, the situations of particular concern where SF is a potential or actual methyl bromide replacement

From an extensive data set from published laboratory studies on SF effects on insect pests, MBTOC decided to include in its review only those data points which showed efficacy of at least 99%. Quarantine treatments may require effectiveness much greater than 99% mortality, and so were excluded from this analysis.

Additionally, to ensure MBTOC-SC had the most up to date research and to ensure the Committee's analysis correctly reflected current knowledge, MBTOC-SC also sought data from a scientist whose work focuses on pest control in food processing structures and commodities (Dr. Spencer Walse of USDA's Parlier Research Lab.). MBTOC appreciates the unpublished data submitted by Dr. Walse.

The data collected for this special review and forming the basis for the conclusions are given in the four tables below (Tables 7-3 to 7-6).

Table 7-3 summarises published mortality data and lethal responses of eggs of 28 economically important insects and mites following fumigation with sulfuryl fluoride. Additional information on the pests can be obtained from Reichmuth et al., (2007) and in the cited references. This table provides Parties access to research data on specific pest species where control of pest eggs was >99%.

Table 7-4 presents a bar graph of the reported minimum and maximum ct-products required for 99% efficacy of control of eggs by various pest species.

Table 7-5 presents unpublished data from US Department of Agriculture's Parlier Laboratory in California, including information on pests associated with Pre-shipment treatments at the comparatively low temperature of 15.6°C. They confirm the range of other data in the main table and the very high dosages that are required to control the eggs of the dried fruit beetle, Carpophilus hemipterus. MBTOC notes that Dr. Walse's work is focused on pests of dried fruit and dates, that may be of interest to Parties considering treatment of these commodities with SF as a methyl bromide alternative.

Table 7-6 sorts pest species into groups that are probably, possibly or unlikely to be controlled at 1,500 g h m-3 at at 26.7°C (80°F) and 24 h exposure. This ct-product is maximum rate that is allowed under the registration of SF as a pesticide ('label' rate) for control of all developmental stages of stored product pest, such as specified in the 'Fumiguide', a proprietary guide to the use of SF as a postharvest and structural fumigant. This rate is targeted at 95% mortality.

7.4.2.3 Assessment of the Data Available

In assessing the data revealed in the tables, MBTOC has prepared some summary comments.

(1) The ct-products given in Table 1 were sufficient to kill >99% of the eggs in the test. Where available, the mortality rate corresponding to the ct-value is given. In some studies, the steps of concentration increase between tests were large, so that the actual value for achieving 99% mortality is not well defined, but lies between two limiting values. The higher value is used in the table, but may be an overestimate of the true value for 99% mortality.

Some authors calculated LD95 and spoke of "complete control", whereas others presented CTPs that were lethal to all eggs in the test (no survivors or no development to adults). The costs that were often included in the papers but not included in this table, showed that in most cases much higher CTPs will be needed to avoid even one surviving egg that may lead to claims in the food chain.

7.4.2.4. Historical Background to the Use of SF and to Its Efficacy on Eggs

Sulfuryl fluoride (SF) was registered for stored product protection in 2004 as ProFume® by the DowAgroscience company (Buckley and Drinkall, 2010). This company undertook a large effort to investigate the necessary CTPs and dosages for control of many pest insects and mites that can infest stored food products and other material. SF has also been registered for control of termites (Miekle et al., 1963) and wood pest insects(Williams and Sprenkel, 1990) under the name Vikane®.. SF has been used for termite control for about 50 years (Kenaga, 1975). SF has been independently developed in China as a grain fumigant and methyl bromide alternative.

From the very first introduction of this compound for pest control in the US it was obvious that eggs of arthropods were the most tolerant developmental stage and that they could not be killed for many species at dosage rates that eliminated the adult stage. Also a strong dependency of the lethal dosages on temperature became soon very evident. This can clearly also be seen from Table 1 when comparing the CTPs for eggs of one species at different given temperatures with higher temperatures leading to lower CTPs for control. Explanations for these dependencies have been suggested by Meikle et al. (1963) and Outram (1967a; 1967b). Uptake of SF by eggs compared to other developing stages and adults is much less pronounced and seems to be linked to the properties of the egg shell membranes. On the other hand, the lethal effect seems to be linked to physiological processes that are reduced at lower temperatures.

The registration of SF for fumigating food processing structures and commodities by DowAgroscience was accompanied by the introduction of a proprietary computer program (Fumiguide®) to optimise SF fumigation efficiency under particular situations. Inputs to the Fumiguide include many scientific and technical factors that describe an effective fumigation, including species, stage, temperature, exposure period, loss rate of SF due to expected leaks on the base of a gas tightness test, wind speed, and commodity to be treated. All this information has to be introduced by the fumigator to obtain the necessary amount of SF that should be applied in a particular fumigation. In certain cases the guide even gives the top up quantity of additional gas required to achieve the set ct-product, based on gas concentration measurements and identified losses of gas during the treatment. In some countries the Fumiguide is not publicly available, but linked to licencing of SF use by the registrant.

During many fumigations after 2004 in the US, it was found by practitioners and scientists that mostly all the pests were controlled, provided the recommendations of the Fumiguide were followed. The temperature range of the current Fumiguide is limited to temperatures above 20°C and below 40°C.

7.4.2.6. Discussion of Results of MBTOC Review

As with other fumigants, there is a wide range of sensitivity to SF fumigant with different pest species and developmental stage with some insect species tolerating much higher exposures than others.. The eggs themselves develop through different stages that differ markedly in uptake of gas and ct-products that can give high mortality. (see Table 7-3 where response of eggs with different age are summarised). The different stages have been prepared in the laboratory by waiting various hours after egg laying before introducing them into a test fumigation. The development of the embryo differs in these eggs of different ages and also the structure of the egg shell and other components of the egg. The kinetics of these processes are strongly dependent on temperature.

Crucial factors for limiting egg tolerance are temperature and length of exposure, which operate obviously differently on different species. For example ct-products (CTPs) of about 800, 600 and 300 g h m-3 killed 95% of eggs of *Rhyzopertha dominica* at 20°C, 25°C and 30oC, respectively. At 30oC, the CTP required for complete kill of eggs fell steadily from 300 g h/m3 as the exposure time was lengthened from 20h, only 155 g h m-3 being required over a 120 h exposure. The table also shows that even for tolerant species such as *Ahasverus advena* at 20oC, length of exposure is the key to reducing the dosage levels required for control to the practically feasible level of 1500 g h m-3. In other words, with this species, the CTP depends strongly on exposure time and not so strongly on concentration of SF during the treatment.

For *Acanthoscelides obtectu*s the effect of a longer exposure can be seen at all temperatures, together with the effect of temperature itself (Table 7-3). For other species, however, e.g. *Sitophilus granarius* and *Ephestia kuehniella* , concentration may appear more important than the time component of the ct-product at a temperature of 25oC, but below 15 g m-3 exposure times longer than two or three days are needed to give the necessary ct-product for control.

As with phosphine, there appears to be a strong dependence on exposure period related to the time taken for eggs to develop from a tolerant to susceptible stage. Thus for *R. dominica* where eggs can take 11 days to hatch at 25oC, increasing exposure times from one to five days have little effect on reducing the ct-product for control. At 30oC, the eggs develop quickly enough to become susceptible in 5 days. For *A. obtectus* and *A. advena* with eggs starting to hatch a week after oviposition at 20oC, increasing the exposure to four or seven days greatly affects tolerance at this temperature. The length of the phase of high tolerance in the egg stage (varying between species so some are more tolerant than others) is a fixed proportion of the total egg development time and so is temperature dependent. Development continues during exposure to SF until a susceptible stage is reached. If gas is still present, the egg succumbs.

For use of SF in control of insects that occur in rice storage in Australia, e.g. *Tribolium castaneum* and *Sitophilus oryzae*, necessary basic information for the dosage can be derived from Table 7-3. Unfortunately, *T. castaneum* belongs to the very few species that eggs are pronouncedly more tolerant than eggs of most other species. The maximum ct-product that is recommended by the Fumiguide® (1500 g h m- 3) does not guarantee the complete control of all eggs present, at least not at 20°C.

Reichmuth (2007, 2010a, 2010b) has tried to demonstrate the limitations of not killing all the present eggs of a pest species in the context of the speed of rebound time of infestation after a fumigation. The speed of rebound depends on temperature. Typically common stored product pests lay 40 to 200 eggs per female. With a 99% kill of adult females, the remaining female can lay eggs that can then develop into the same level of infestation as before the treatment. Generation times can be a few weeks or months depending on species and temperature. A goal of, for instance, control of only 95% is totally insufficient within the food industry where zero tolerance of insects in food is the rule. It is a weak argument to say that new infestation will occur the very moment after the mill or other object of fumigation has been aerated and reopened. The client and government inspectors regulating the mill or food-processing facility will expect that there will be actually or nearly no surviving pest insects and stages following a SF fumigation.

Also Schaub (2010) dealt with the financial and economic aspects of fumigation in stored product protection. It is known that in practice, gas leaks, temperature sinks of 10°C, residual flour of 10 cm thick layers may occur. The avoidance of all these factors that can jeopardize the success of a fumigation is nearly impossible.

A fumigation plan which targets or results in less that 99 % control is bad fumigation practice and may result in survivors that are more tolerant than the regular field strains. Campbell et al. (2010) dealt with the question of rebound of pest populations, considering field conditions. Harzer et al. (2010b) presented more detailed information on the field fumigations, which led to the results in Harzer et al. (2010a), quoted in Table 7-3. Ciesla and Ducom (2009), quoted in Table 7-3, also subsequently gave also more detailed information (Ciesla and Ducom, 2010).

Reichmuth and Klementz 2010b) compared the selection of the appropriate dosage for practical fumigation for methyl bromide and sulfuryl fluoride treatments. It was accepted as a reasonable, conservative approach to multiply the lethal dosage determined in the laboratory with a factor of about three to obtain the practical dosage. With MB, for example, 20 g m-3 is an accepted concentration for space fumigations, even though in the lab a concentration of only 5 g m-3 results in complete control for most species and stages over the same exposure time. However, with SF, as shown in Table 7-3, the theoretical values from the laboratory were converted into the recommended commercial dosing in the field mostly without giving some tolerance practical imperfections typically encountered, as previously discussed (Section 7.4.2.5). Reichmuth (2010b) proposed a factor of three for this conversion.

Another possibility to overcome the increased tolerance of the egg stage in using SF for insect pest control is the combination with other fumigants. Xiaoping et al. (2008), Ling et al. (2008), Guogang et al. (2008) proposed the combination with carbon dioxide (see also Table 7-3), whereas Reichmuth and Klementz (2010b) showed data on the very effective combination of SF with hydrogen cyanide (HCN). Of course, the combined use of heat or elevated temperature and SF offer an opportunity to economise on use of SF and still kill all eggs and other stages present. The use of supplemental heat to achieve sufficient egg kill in SF fumigations has been recommended by MBTOC since its 2008 Progress Report. This technique may also be applicable with packed food.

Dr. Spencer Walse, USDA, (personal communication) confirmed the range of the necessary ct-products to control egg stages (especially the one day old eggs) of the dried fruit beetle with about 4500 ghm-3 being necessary even at 25°C. According to his unpublished experimental results, the ct-products for LD50 he observed are slightly higher than those described by Flingelli et al. (2011) especially at the highest experimental temperature.

Additional Comments on Interrelationship of Packaging and SF Efficacy, of Particular Relevance to the Australia Rice CUN

Some infestable stored foodstuffs are typically fumigated after packaging. There is an interrelationship between the permeability of the packaging and the efficacy of SF fumigation.

In particular, the Australian rice CUN for 2012, and previously, arises, in part, because the applicant wishes to fumigate its product after packaging, at a point where the packed material leaves its premises, as part of their quality assurance programto ensure retailers and consumers do not receive infested rice. The rice packaging used in Australia is punctured with holes. This packaging method prevents the package from ‘ballooning’ with air during filling and prevents bursting during subsequent handling. From the perspective of disinfestation, the use of punctured packages is a two-edged sword. Insects may be able to re-infest fumigated packages through the holes if they are larger than 0.1 mm in diameter. But on the other hand, packages without holes may be fairly gas tight and insects inside sealed packages may be protected from exposure to the fumigant to some extent.

The Australian rice industry should ensure the correct identification of the pests and developmental stages of concern to their product; evaluate the SF efficacy such as using data from the tables 1 and 4 below and the information on the permeability of plastic packaging to determine dosages that may be suitable to ensure complete control of all egg stages that might be present in the rice.

Some authors (Osbrink et al., 1988; Scheffrahn et al., 1990) described the permeation of SF through different plastic membranes. Scheffrahn et al., (1990) describes most of what is needed to know on pack permeability to SF and its low rate of permeation compared with methyl bromide through plastic films. On the basis of data from Scheffrahn et al., (1990), a 24 hour exposure to SF is unlikely to give lethal (ovicidal) concentrations within an intact laminate bag of rice. This conclusion is based on the likely diffusion and permeation of SF through plastic laminates that are used to package possibly infested processed rice in Australia. The influence of the pinholes is undefined and probably quite variable.

It may be useful for the Australian applicant to consider the quoted references.

Furthermore, it should now be possible to determine the likely SF and fluorine ion (F-) residues that may be formed in the course of an effective fumigation with SF.

7.4.3 References

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Table 7-3: ct-products for sulfuryl fluoride giving >99% mortality of eggs of various stored product pests, given in published laboratory and field test results at different temperatures and exposure periods.

Species and strain Laboratory tests	**Egg age (days)**	**Temperature (°C)**	**Ct-product for>99% mortality (g h m-3)**	**Exposure period (days). in days**	**SF concentration (g m-³)**	**Ref.**
Ahasverus advena	All	20	4656	1.67		Bell (2006)
Ahasverus advena	All	20	3072	4		Bell (2006)
Ahasverus advena	All	20	1966	7		Bell (2006)
Acanthoscelides obtectus	All	20	1070	1		Bell (2006)
Acanthoscelides obtectus	All	20	605	4		Bell (2006)
Acanthoscelides obtectus	All	25	763	1		Bell (2006)
Acanthoscelides obtectus	All	25	379	2		Bell (2006)
Acanthoscelides obtectus	All	30	480	1		Bell (2006)
Acanthoscelides obtectus	All	30	259	2		Bell (2006)
Attagenus piceus	2	26.7	1216	0.66	76	Kenaga (1957)
Acarus siro	All	25	>669			Bell at al. (2003)
Corcyra cephalonica	3	27	377	3	5.24	Barakat et al. (2009)
Corcyra cephalonica	All	27	503	5	4.19	Barakat et al. (2009)
Corcyra cephalonica	All	27	503	4	5.24	Barakat et al. (2009)
Corcyra cephalonica	All	27	449	3	6.24	Barakat et al. (2009)
Cryptolestes ferrugineus (PH3 resistant)	all st	15	720	1	30	Baltaci et al. (2008)

Species and strain Laboratory tests	Egg age (days)	Temperature (°C)	Ct-product for>99% mortality (g h m-3)	Exposure period (days). in days	SF concentration (g m-³)	Ref.
Cryptolestes ferrugineus (PH3 resistant)	all st \	15	1440	2	20	Baltaci et al. (2008)
Cryptolestes ferrugineus (PH3 resistant)	all st	15	720	3	30	Baltaci et al. (2008)
Cryptolestes ferrugineus (PH3 resistant)	all st	20	720	1	30	Baltaci et al. (2008)
Cryptolestes ferrugineus (PH3 resistant)	all st	20	720	3	10	Baltaci et al. (2008)
Cryptolestes ferrugineus	all	25	480	1	20	Baltaci et al. (2008)
Cryptolestes ferrugineus	all	25	960	2	20	Baltaci et al. (2008)
Cryptolestes ferrugineus	Allst	25	720	3	10	Baltaci et al. (2008)
Cryptolestes ferrugineus (PH3 resistant)	all st	25	720	1	30	Baltaci et al. (2008)
Cryptolestes ferrugineus (PH3 resistant)	all st r	25	960	2	20	Baltaci et al. (2008)
Cryptolestes ferrugineus (PH3 resistant)	all st	25	720	3	10	Baltaci et al. (2008)
Cryptolestes ferrugineus	all	15	1440	3	20	Baltaci et al. (2008)
Cryptolestes ferrugineus	all	15	720	1	30	Baltaci et al. (2008)
Cryptolestes ferrugineus	all	15	960	2	30	Baltaci et al. (2008)
Cryptolestes ferrugineus (PH3 resistant)	all st	20	960	2	20	Baltaci et al. (2008)

Species and strain Laboratory tests	Egg age (days)	Temperature (°C)	Ct-product for>99% mortality (g h m-3)	Exposure period (days). in days	SF concentration (g m-³)	Ref.
Carpophilus hemipterus	2	15	4320 (99)	1	180	Karakoyun and Emekci (2010)
Carpophilus hemipterus	2	20	2400	1	100	Karakoyun and Emekci (2010)
Carpophilus hemipterus	1	25	4320	1	180	Karakoyun and Emekci (2010)
Carpophilus hemipterus	2	25	1920	1	80	Karakoyun and Emekci (2010)
Cryptolestes turcicus		25	784			Bell et al. (2003)
Ephestia cautella	1	15	2160	1	90	Akan and Ferizli (2010)
Ephestia cautella	2	15	4560	1	190	Akan and Ferizli (2010)
Ephestia cautella	3	15	4560	1	190	Akan and Ferizli (2010)
Ephestia cautella	1	20	1440	1	60	Akan and Ferizli (2010)
Ephestia cautella	2	20	3360	1	140	Akan and Ferizli (2010)
Ephestia cautella	3	20	3360	1	140	Akan and Ferizli (2010)
Ephestia cautella	1	25	1440	1	60	Akan and Ferizli (2010)

Species and strain Laboratory tests	Egg age (days)	Temperature (°C)	Ct-product for>99% mortality (g h m-3)	Exposure period (days). in days	SF concentration (g m-³)	Ref.
Ephestia cautella	2	25	2160	1	90	Akan and Ferizli (2010)
Ephestia cautella	3	25	2160	1	90	Akan and Ferizli (2010)
Ephestia cautella	1	30	480	1	20	Akan and Ferizli (2010)
Ephestia cautella	2	30	720	1	30	Akan and Ferizli (2010)
Ephestia cautella	3	30	720	1	30	Akan and Ferizli (2010)
Ephestia elutella	All	25	474	22	21.3	Baltaci et al. (2006)
Ephestia elutella	All	25	557	48	11.4	Baltaci et al. (2006)
Ephestia elutella	1-4	15	465 (99)	0.75-2	11.6	Baltaci et al. (2009)
Ephestia elutella	1-4	15	1078 (99)	0.75-2	21.3	Baltaci et al. (2009)
Ephestia elutella	1-4	20	683 (99)	0.75-2	11.6	Baltaci et al. (2009)
Ephestia elutella	1-4	20	624 (99)	0.75-2	21.3	Baltaci et al. (2009)
Ephestia elutella	1-4	25	559 (99)	0.75-2	11.6	Baltaci et al. (2009)
Ephestia elutella	1-4	25	475 (99)	0.75-2	21.3	Baltaci et al. (2009)
Ephestia kuehniella	1	15	3214 (99) 2133 (P 99)	2		Bell and Savvidou (1999)
Ephestia kuehniella	2	15	7485 (99) 9293 (P 99)		25	Bell and Savvidou (1999)

Species and strain Laboratory tests	Egg age (days)	Temperature (°C)	Ct-product for>99% mortality (g h m-3)	Exposure period (days). in days	SF concentration (g m-3)	Ref.
Ephestia kuehniella	2	15	3741(99) 3471 (P 99)		43	Bell and Savvidou (1999)
Ephestia kuehniella	2	15	5149 (99) 3958 (P 99)	2		Bell and Savvidou (1999)
Ephestia kuehniella	3	15	6710 (99) 3975 (P 99)	2		Bell and Savvidou (1999)
Ephestia kuehniella	4	15	6294 (99) 2991 (P 99)	2		Bell and Savvidou (1999)
Ephestia kuehniella	4	15	3088 (99) 4846 (P 99)		25	Bell and Savvidou (1999)
Ephestia kuehniella	1	25	554 (99)		20	Bell and Savvidou (1999)
Ephestia kuehniella	2	25	937 (99) 1058 (P 99)	1		Bell and Savvidou (1999)
Ephestia kuehniella	2	25	1078 (99) 930 (P 99)		20	Bell and Savvidou (1999)
Ephestia kuehniella	3	25	795 (99) 651 (P 99)	1		Bell and Savvidou (1999)
Ephestia kuehniella	3	25	830 (99) 596 (P 99)		20	Bell and Savvidou (1999)
Ephestia kuehniella	1	15	2736			Bell et al. (1999)
Ephestia kuehniella	1	15	3214 (99 h)			Bell et al. (1999)
Ephestia kuehniella	2	15	3301			Bell et al. (1999)

Species and strain Laboratory tests	Egg age (days)	Temperature (°C)	Ct-product for>99% mortality (g h m-3)	Exposure period (days). in days	SF concentration (g m-3)	Ref.
Ephestia kuehniella	2	15	4524 (99 h)			Bell et al. (1999)
Ephestia kuehniella	3	15	2736			Bell et al. (1999)
Ephestia kuehniella	3	15	6710 (99 h)			Bell et al. (1999)
Ephestia kuehniella	4	15	2736			Bell et al. (1999)
Ephestia kuehniella	4	15	6294 (99 h)			Bell et al. (1999)
Ephestia kuehniella	1	25	473			Bell et al. (1999)
Ephestia kuehniella	1	25	452 (99 h)			Bell et al. (1999)
Ephestia kuehniella	2	25	912			Bell et al. (1999)
Ephestia kuehniella	3	25	667 (99 h)			Bell et al. (1999)
Ephestia kuehniella		20	1680	2	35	Drinkall et al. (1996)
Ephestia kuehniella		20	2520	3	35	Drinkall et al. (1996)
Ephestia kuehniella	All	20	1688	2	35	Klementz et al. (2008)
Ephestia kuehniella	All	20	1688	2	35	Klementz et al. (2008)
Ephestia kuehniella	All	20	842	3	11.7	Klementz et al. (2008)
Ephestia kuehniella	1	20	480	1		Reichmuth et al. (1999)
Ephestia kuehniella	1	20	960	2		Reichmuth et al. (1999)
Ephestia kuehniella	1	20	720	3		Reichmuth et al. (1999)
Ephestia kuehniella	2	20	480	1		Reichmuth et al. (1999)

Species and strain Laboratory tests	**Egg age (days)**	**Temperature (°C)**	**Ct-product for>99% mortality (g h m-3)**	**Exposure period (days). in days**	**SF concentration (g m-^{3})**	**Ref.**
Ephestia kuehniella	2	20	960	2		Reichmuth et al. (1999)
Ephestia kuehniella	2	20	720	3		Reichmuth et al. (1999)
Ephestia kuehniella	3	20	1440	2		Reichmuth et al. (1999)
Ephestia kuehniella	3	20	1440	3		Reichmuth et al. (1999)
Ephestia kuehniella	4	20	1440	2		Reichmuth et al. (1999)
Ephestia kuehniella	4	20	720	3		Reichmuth et al. (1999)
Ephestia kuehniella	All	22-40	1860-2255 (99.4)	1.5-2		Reichmuth et al. (2003)
Liposcelis bostrichophila		25	1000			Bell et al. (2003)
Lyctus brunneus	1		470 (97.7)			Williams and Sprenkel (1990)
Oryzaephilus mercator	all st	15	>720	1	>30	Baltaci et al. (2008)
Oryzaephilus mercator	all st	15	1440	2	30	Baltaci et al. (2008)
Oryzaephilus mercator	all st	15	720	3	10	Baltaci et al. (2008)
Oryzaephilus mercator	all st	20	>720	1	>30	Baltaci et al. (2008)
Oryzaephilus mercator	all st	20	1440	2	30	Baltaci et al. (2008)
Oryzaephilus mercator	all st	20	720	3	10	Baltaci et al. (2008)
Oryzaephilus mercator	all st	25	720	1	30	Baltaci et al. (2008)
Oryzaephilus mercator	all st	25	1440	2	30	Baltaci et al. (2008)

Species and strain Laboratory tests	**Egg age (days)**	**Temperature (°C)**	**Ct-product for>99% mortality (g h m-3)**	**Exposure period (days). in days**	**SF concentration (g m-³)**	**Ref.**
Oryzaephilus mercator	all st	25	720	3	10	Baltaci et al. (2009)
Oryzaephilus surinamensis		20	636	1	26.5	Drinkall et al. (1996)
Oryzaephilus surinamensis		20	1272	2	26.5	Drinkall et al. (1996)
Oryzaephilus surinamensis		20	958	3	13.3	Drinkall et al. (1996)
Oryzaephilus surinamensis	All	20	319	1	13.3	Klementz et al. (2008)
Oryzaephilus surinamensis	All	20	638	2	13.3	Klementz et al. (2008)
Oryzaephilus surinamensis	All	20	958	3	13.3	Klementz et al. (2008)
Oryzaephilus surinamensis	All	22-40	1860-2255 (100-99.1)	1.5-2		Reichmuth et al. (2003)
Plodia interpunctella		20	564	1	23.5	Drinkall et al. (1996)
Plodia interpunctella		20	562	2	11.7	Drinkall et al. (1996)
Plodia interpunctella		20	842	3	11.7	Drinkall et al. (1996)
Plodia interpunctella		28-31	1100-1500 av: 1353	0.93		Drinkall et al. (2003))
Plodia interpunctella	All	20	281	1	11.7	Klementz et al. (2008)
Plodia interpunctella	All	20	562	2	11.7	Klementz et al. (2008)
Plodia interpunctella	All	20	842	3	11.7	Klementz et al. (2008)
Plodia interpunctella (G)	1	25	269	1	11.2	Reichmuth et al. (1999)
Plodia interpunctella (US)	1	25	269 (99.6)	1	11.2	Reichmuth et al. (1999)

Species and strain Laboratory tests	Egg age (days)	Temperature (°C)	Ct-product for>99% mortality (g h m-3)	Exposure period (days). in days	SF concentration (g m-³)	Ref.
Plodia interpunctella (G)	1	25	239	2	4.97	Reichmuth et al. (1999)
Plodia interpunctella (US)	1	25	365	2	7.6	Reichmuth et al. (1999)
Plodia interpunctella (G)	1	25	979	3	13.6	Reichmuth et al. (1999)
Plodia interpunctella (US)	1	25	979	3	13.6	Reichmuth et al. (1999)
Plodia interpunctella (G)	2-4	25	192	1	8	Reichmuth et al. (1999)
Plodia interpunctella (US)	2-4	25	192	1	8	Reichmuth et al. (1999)
Plodia interpunctella (G)	2-4	25	365	2	7.6	Reichmuth et al. (1999)
Plodia interpunctella (US)	2-4	25	490	2	10.2	Reichmuth et al. (1999)
Plodia interpunctella (G)	2-4	25	979	3	13.6	Reichmuth et al. (1999)
Plodia interpunctella (US)	2-4	25	979	3	13.6	Reichmuth et al. (1999)
Plodia interpunctella	All	22-40	1860-2255	1.5-2		Reichmuth et al. (2003)
Plodia interpunctella	1	30	227	2	5	Schneider and Hartsell (1999)
Plodia interpunctella	2	30	640	2	15	Schneider and Hartsell (1999)
Plodia interpunctella	3	30	1180 (98.8)	2	25	Schneider and Hartsell (1999)
Plodia interpunctella	All	25	814	2		Schneider and Hartsell (1999)
Plodia interpunctella	All	25	854 (99)	2		Schneider and Hartsell (1999)

Species and strain Laboratory tests	Egg age (days)	Temperature (°C)	Ct-product for>99% mortality (g h m-3)	Exposure period (days). in days	SF concentration (g m-³)	Ref.
Rhyzopertha dominica	All	20	912	0.83		Bell (2006)
Rhyzopertha dominica	All	20	762	2.42		Bell (2006)
Rhyzopertha dominica	All	20	912	5		Bell (2006)
Rhyzopertha dominica	All	25	656	0.83		Bell (2006)
Rhyzopertha dominica	All	25	525	2.42		Bell (2006)
Rhyzopertha dominica	All	25	638	5		Bell (2006)
Rhyzopertha dominica	All	30	415	0.83		Bell (2006)
Rhyzopertha dominica	All	30	304	5		Bell (2006)
Rhyzopertha dominica	All	30	155	5		Bell (2006)
Rhyzopertha dominica		28-31	1100-1500 av: 1353	0.93		Drinkall et al. (2003)
Rhyzopertha dominica		26.7	219	0.66	13.7	Kenaga (1957)
Rhyzopertha dominica	All	23-27	1920	2	40	Ling et al. (2008)
Rhyzopertha dominica	All	23-27	1440	2	30	Ling et al. (2008)
Rhyzopertha dominica	All	23-27	1680	7	10	Ling et al. (2008)
Rhyzopertha dominica	All	23-27	840 (98.6)	7	5	Ling et al. (2008)
Rhyzopertha dominica		19.3; min 12	4277 (d)+ CO2		5.94+14.25 CO2	Xiaoping et al. (2008)
Sitotroga cerealella	2	26.7	90	0.66	5.6	Kenaga (1957)
Sitophilus granarius		25	966			Bell et al. (2003)

Species and strain Laboratory tests	Egg age (days)	Temperature (°C)	Ct-product for>99% mortality (g h m-3)	Exposure period (days). in days	SF concentration (g m-3)	Ref.
Sitophilus granarius		20	840	1	35	Drinkall et al. (1996)
Sitophilus granarius		20	1680	2	35	Drinkall et al. (1996)
Sitophilus granarius		20	1339	3	19	Drinkall et al. (1996)
Sitophilus granarius	All	20	840	1	35	Klementz et al. (2008)
Sitophilus granarius	All	20	1680	2	35	Klementz et al. (2008)
Sitophilus granarius	All	20	1339	3	18.6	Klementz et al. (2008)
Sitophilus oryzae	All	28-31	1100-1500 av: 1353	0.93		Drinkall et al. (2003)
Sitophilus oryzae	All	23-27	1920	2	40	Ling et al. (2008)
Sitophilus oryzae	All	23-27	1440	2	30	Ling et al. (2008)
Sitophilus oryzae		19.3; min 12	4277 (d) + CO2		5.94+ 14.25 CO2	Xiaoping et al. (2008)
Stegobium paniceum	All	20	437	1	18.2	Drinkall et al. (1996)
Stegobium paniceum	All	20	874	2	18.2	Drinkall et al. (1996)
Stegobium paniceum	All	20	1310	3	18.2	Drinkall et al. (1996)
Stegobium paniceum	All	28-31	1100-1500 av: 1353	0.93		Drinkall et al. (2003)
Tribolium castaneum	All	25	3030 (99 h)			Bell et al. (1999)
Tribolium castaneum		25	1869 (99 e)			Bell et al. (1999)
Tribolium castaneum		30	3958 (99 h)			Bell et al. (1999)
Tribolium castaneum		30	1243 (99 e)			Bell et al. (1999)

Species and strain Laboratory tests	Egg age (days)	Temperature (°C)	Ct-product for>99% mortality (g h m-3)	Exposure period (days). in days	SF concentration (g m-³)	Ref.
Tribolium castaneum		25	1669			Bell et al. (2003)
Tribolium castaneum		31	633-1134			Ciesla and Ducom (2009)
Tribolium castaneum		28	1154 (99)			Ciesla and Ducom (2009)
Tribolium castaneum		28-31	1100-1500 Av: 1353	0.93		Drinkall et al. (2003)
Tribolium castaneum		22-32	663-1191 (89-92)			Hartzer et al. (2010a)
Tribolium castaneum	All	20	960 + HCN (100)	2	20 + 1.5 HCN	Reichmuth and Klementz (2008a)
Tribolium castaneum	All	20	72 (HCN) (85)	2	1.5 HCN	Reichmuth and Klementz (2008a)
Tribolium castaneum	All	22-40	1860-2255 (98.8)	1.5-2		Reichmuth et al. (2003)
Tribolium castaneum		25	1157 (99.8)	2		Schneider and Hartsell (1999)
Tribolium castaneum		19.3; min 12	4277 (d) + CO_2		5.94+ 14.25 CO_2	Xiaoping et al. (2008)
Tribolium confusum		25	813 (99)			Bell et al. (1999)
Tribolium confusum		25	780			Bell et al. (1999)
Tribolium confusum	All	25	941	2		Bell et al. (1999)

Species and strain Laboratory tests	Egg age (days)	Temperature (°C)	Ct-product for>99% mortality (g h m-3)	Exposure period (days). in days	SF concentration (g m-³)	Ref.
Tribolium confusum		25	672			Bell et al. (2003)
Tribolium confusum		21	853-1345			Ciesla and Ducom (2009)
Tribolium confusum		26	1192			Ciesla and Ducom (2009)
Tribolium confusum		28	1154			Ciesla and Ducom (2009)
Tribolium confusum		31	633-1134			Ciesla and Ducom (2009)
Tribolium confusum		32	1133			Ciesla and Ducom (2009)
Tribolium confusum		22	1016			Ciesla and Ducom (2009)
Tribolium confusum		20	319	1	13.3	Drinkall et al. (1996)
Tribolium confusum		20	638	2	13.3	Drinkall et al. (1996)
Tribolium confusum		20	958	3	13.3	Drinkall et al. (1996)
Tribolium confusum		28-31	1100-1500 av: 1353	0.93		Drinkall et al. (2003)
Trogoderma inclusum		20	437	1	18.2 18.2	Drinkall et al. (1996)
Trogoderma inclusum		20	562	2	11.7	Drinkall et al. (1996)
Trogoderma inclusum		20	1310	3	18.2	Drinkall et al. (1996)
Tenebrio molitor	All	22-40	1860-2255 (99.5)	1.5-2		Reichmuth et al. (2003)

Species and strain Laboratory tests	Egg age (days)	Temperature (°C)	Ct-product for>99% mortality (g h m-3)	Exposure period (days). in days	SF concentration (g m-^{3})	Ref.
Trogoderma variabile		25	936 (100)			Bell et al. (1999)
Trogoderma variabile		25	1419 (99 h)			Bell et al. (1999)
Trogoderma versicolor	All	20	437	1	18.2	Klementz et al. (2008)
Trogoderma versicolor	All	20	562	2	11.7	Klementz et al. (2008)
Trogoderma versicolor	All	20	1310	3	18.2	Klementz et al. (2008)
Species and strain Field trials	**Egg age in days**	**Temperature (°C)**	**Ct-product for>99% mortality (g h m-3)**	**Exposure period (days). in days**	**SF dosage in (g m-3**	**Reference**
Ephestia kuehniella	Unspecified	28-31	1100-1500av:1353	0.93	49.7-67	Drinkall et al. (2003)
Ephestia kuehniella	Unspecified	25	1125	1	46.9	Ducom et al. (2003)
Plodia interpunctella	Unspecified	25	1503	1	62.5	Ducom et al. (2003)
Plodia interpunctella	1-3	33-37	612-1014 A1 (99.5 e)	1	26-42	Tsai et al. (2011)
Plodia interpunctella	1-3	30-40	520-670 A3 (94.7 h; 100.0 e)	0.94	23-30	Tsai et al. (2011)
Plodia interpunctella	1-3	-	455-713 C3 (99.7 h; 99.7 e)	0.75	25-40	Tsai et al. (2011)
Plodia interpunctella	1-3	25-30	873-1346 D3 (74.3 h; 100.0 e)	1	36-56	Tsai et al. (2011)
Sitophilus granarius	Unspecified	25	1503	1	62.5	Ducom et al. (2003)
Sitophilus zeamais	All	19-20	92 + 441 (CO2)	0.25	15.38+ 73.58 (CO2)	Guogang et al. (2008)

Species and strain Laboratory tests	**Egg age (days)**	**Temperature (°C)**	**Ct-product for>99% mortality (g h m-3)**	**Exposure period (days). in days**	**SF concentration (g m-³)**	**Ref.**
Sitophilus zeamais	All	11-15.5	3840 + 41472 (CO_2)	16	10 + 108 (CO_2)	Guogang et al. (2008)
Sitophilus zeamais	All	12-19	1680 + 38976 (CO_2)	14	5 + 116 (CO_2)	Guogang et al. (2008)
Sitophilus zeamais	All	11-15	1152 + 44160 (CO_2)	16	3 + 115 (CO_2)	Guogang et al. (2008)
Sitophilus zeamais	All	12-18	1008 + 40622 (CO_2)	14	3 + 121 (CO_2)	Guogang et al. (2008)
Sitophilus zeamais	All	13-14	2400	10	10	Guogang et al. (2008)
Tribolium castaneum	1-3	32-37	427-554 A2 (99 e)	0.98	18-24	Tsai et al. (2011)
Tribolium castaneum	1-3	30-40	520-670 A3 (96.3 h;100.0 e)	0.94	23-30	Tsai et al. (2011)
Tribolium castaneum	1-3	30-36	507-907 B1 (99.3 h)	0.98	22-39	Tsai et al. (2011)
Tribolium castaneum	1-3	29-34	775-986 B2 (94.3 h; 99 e)	0.93	35-45	Tsai et al. (2011)
Tribolium castaneum	1-3	-	455-713 C3 (98.7 h; 100.0 e)	0.75	25-40	Tsai et al. (2011)
Tribolium confusum		25	1125	1	46.9	Ducom et al (2003)

Abbreviations:
h = hatch; e = emergence; 100 = ct for no survivors; av = average;
P 99 = calculated with probit analysis for LD99; d = ct based on dosage, no explicit indication of gas losses, t½ (500 Pa - 250 Pa) =40 s; G = German strain; US = US strain; all = all egg ages; all st = all developing stages; A1-A3, B1, B2, C3, D2 and D3 different fumigated flour mills

Table 7-4: Lowest and highest reported ct-products in the literature for the complete control of eggs of the listed pest insects depending on temperature, egg age and concentration during fumigation with SF (all exposure periods).

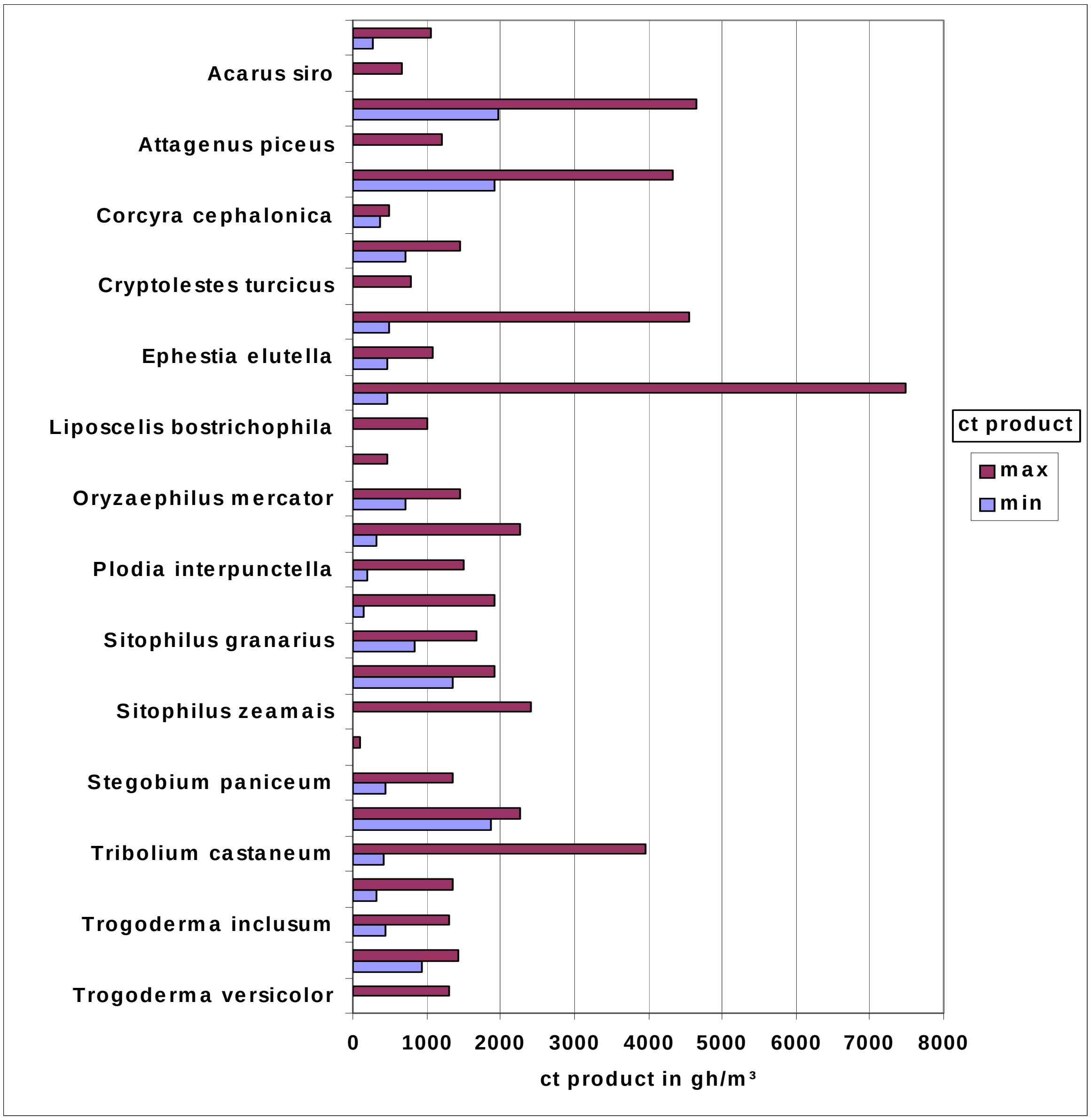


Table 7-5: Sulfuryl fluoride ovicidal efficacy data for non-quarantine pestsof stored products (Dr Spencer Walse, personal communication, USDA-ARS Parlier, 2009-present) Mortality data corrected for control mortality.

Species	**Egg age (days)**	**Temperature(°C)**	**ct-product giving stated % mortality (g h m-3)**	**Exposure (days)**	**Number of specimens in test**
Plodia interpunctella	0-3	15.6	468 (50)	1	4720
Plodia interpunctella	0-3	15.6	1567.2 (99)	1	
Plodia interpunctella	0-3	15.6	3736.8 (P9)	1	
Plodia interpunctella	0-3	21.1	266.4 (50)	1	2400
Plodia interpunctella	0-3	21.1	873.6 (99)	1	
Plodia interpunctella	0-3	21.1	2056.8 (P9)	1	
Plodia interpunctella	0-3	26.7	129.6 (50)	1	3000
Plodia interpunctella	0-3	26.7	559.2 (99)	1	
Plodia interpunctella	0-3	26.7	1610.4 (P9)	1	
Tribolium castaneum	0-2	15.6	799.2 (50)	1	3758
Tribolium castaneum	0-2	15.6	3050.4 (99)	1	
Tribolium castaneum	0-2	15.6	7992 (P9)	1	
Tribolium castaneum	0-2	21.1	909.6 (50)	1	2696
Tribolium castaneum	0-2	21.1	2424 (99)	1	
Tribolium castaneum	0-2	21.1	4908 (P9)	1	
Tribolium castaneum	0-2	26.7	607.2 (50)	1	1800
Tribolium castaneum	0-2	26.7	1416 (99)	1	
Tribolium castaneum	0-2	26.7	2604 (P9)	1	

Table 7-6: Grouping of pest species by probable, possible and unlikely control of eggs by sulfuryl fluoride at 1500 g h m-3 at 26.7°C .)

PROBABLE EGG CONTROL AT 1500 g h m-3 and 26.7°C			
Species: common name	**Species: scientific name**	**ct-product (g h m-3) giving 99% mortality**	**Reference**
Rust-red grain beetle	*Cryptolestes ferrugineus*	~720	Baltaci et. al (2008)
Merchant grain beetle	*Oryzaephilus mercator*	~720	Baltaci et. al (2008)
Warehouse moth	*Ephestia elutella*	~500	Baltaci et. al (2006)
Rice moth	*Corcyra cephalonica*	~500	Barakat et al, (2009)
Psocid	*Liposcelis bostrichophila*	1000	Bell et. al, (2003)
Grain beetle	*Cryptolestes turcicus*	780	Bell et. al, (2003)
Flour mite	*Acarus siro*	700	Bell et. al, (2003)
Warehouse beetle	*Trogoderma variabile*	~1000	Bell et. al, (1999)
POSSIBLE EGG CONTROL AT 1500 g h m-3 and 26.7°C			
Mediterranean flour moth	*Ephestia kuehniella*	500-1300	Baltaci et al (2006); Drinkall et al (2003) ; Ducon et al (2003); Reichmuth and Klementz (2008a)
Indian meal moth	*Plodia interpunctella*	1000-1300	Drinkall et al (2003) ; Ducon et al (2003);
Confused flour beetle	*Tribolium confusum*	600-1300	Bell et al (1999); Cisela and Ducom (2009); Drinkall et al (2003)
Rice weevil	*Sitophilus oryzae*	1300	Drinkall et al (2003)
Lesser grain borer	*Rhyzopertha dominica*	1300	Drinkall et al (2003)
Drugstore beetle	*Stegobium paniceum*	1300	Drinkall et al (2003)
UNLIKELY EGG CONTROL AT 1500 g h m-3 and 26.7°C F			
Almond moth	*Ephestia cautella*	1400	Akan and Ferizli (2010)
Granary weevil	*Sitophilus granaries*	1000-1500	Ducon et al (2003); Reichmuth and Klementz (2008a)
Red flour beetle	*Tribolium castaneum*	1500-1850	Drinkall et al (2003) ; Ducon et al (2003); Reichmuth and Klementz (2008a)
Dried fruit beetle	*Carpophilus hemipterus*	~4500	Karakoyun and Emekei (2010)

8 2011 Evaluations of Critical Use Nominations for Methyl Bromide and Related Matters – Interim Report

8.1 Scope of the Report

This 2011 interim report provides evaluations by MBTOC of Critical Use Nominations (CUNs) submitted for methyl bromide (MB) in 2012 and 2013 by the Parties in accordance with Decision IX/6 (Annex I, MOP16). CUNs were submitted to the Ozone Secretariat by the Parties, in accordance with Decision XVI/4 (Annex II of this report). Parties are encouraged to ensure any CUN is submitted in accordance with the timetable shown in paragraph 1 of Annex I, Decision XVI/4.

This interim report also provides information from Parties on stocks (in accordance with Decision Ex.1/4 (9f)), partial information on actual MB consumption for critical uses (in accordance with Decision XVII/9), apparent adoption rates of alternatives, as evidenced by trend lines on reduction of MB CUNs (in accordance with Decisions XIX/9, XX/5). It is noted that trend lines on adoption do not necessarily indicate true adoption rates for alternatives, as the use of stocks of MB that may have been available to the same sector or areas of production may have increased or fallen within the sector due to a range of circumstances.

MBTOC's has recently completed the 2010 Assessment Report (http://ozone.unep.org/Assessment_Panels/TEAP/Reports/MBTOC/MBTOC-Assesment-Report-2010.pdf). The MBTOC Progress Report in this TEAP report contains the most recent information on registration issues affecting the availability of alternatives for preplant and post harvest uses (in accordance with Decision Ex. 1/4 (9i) and (9j)), consideration of national, sub national and local regulations and laws on the use of MB alternatives (in accordance with Decision XX/5) and summaries of emission control, research and appropriate efforts (in accordance with Decision XXI/11, para 9).

Standard presumptions used in the 2011 round were the same as those used in the 2010 evaluations of the CUNs. MBTOC-Soils (MBTOC-S) has updated references to substantiate its standard presumptions for MB dosage rates cited in previous reports, and no further updates have been provided in this report. These standard presumptions are subject to continual review. However, any changes proposed by MBTOC are required to be approved by the Party's in the MOP preceding the year of assessment based on a draft Decision presented to the MOP in accordance with paragraph 2 in Annex 1 to the report of MOP16.

MBTOC-S has initial responsibility for issues concerning MB and its alternatives for pre-plant soil uses and for the preparation of a Progress Report on alternatives to methyl bromide for these uses. MBTOC-Structures and Commodities (MBTOC-SC) has initial responsibility for issues concerning MB uses and alternatives for structural and commodity treatments and for the preparation of a Progress Report on alternatives to methyl bromide for these uses. MBTOC QPS has initial responsibility for issues concerning MB and its alternatives for QPS uses and for the preparation of a Progress Report on alternatives to methyl bromide for these uses.

Evaluations of CUNs for the soil and structural treatments were evaluated and the results of the evaluations are reported separately below. Outcomes from deliberations by the three MBTOC subcommittees were discussed in plenary with all of the MBTOC members present at the meeting in Turkey with the aim of reaching consensus on the draft evaluations by the whole committee. Discussions on the last day in plenary reviewed all nominations and focused on nominations where there were difficulties in arriving at a recommendation.

8.2 Critical Use Nominations for Methyl Bromide

8.2.1. Mandate

Under Article 2H of the Montreal Protocol on the production and consumption (defined as production plus imports minus exports) of MB required it to be not consumed in Parties not operating under Article 5(1) of the Protocol after 1 January 2005. However, the Parties agreed to a provision enabling exemptions for those uses of MB that qualify as critical. Parties established criteria, under Decision IX/6 (see Annex 1 of this report) of the Protocol, which all critical uses need to meet in order to qualify for an exemption. TEAP and its MBTOC provided guidance to the Parties' decisions on critical use exemptions in accordance with Decisions IX/6 and Annex I of Decision XVI/4.

8.2.2. Fulfilment of Decision IX/6

Decision XVI/2 and Decision XXI/11 directed MBTOC to indicate whether all CUNs fully met the requirements of Decision IX/6. When the requirements of Decision IX/6 are met, MBTOC can recommend critical uses of MB. Where some of the conditions are not fully met, MBTOC can recommend a decreased amount depending on its technical and economic evaluation, or determine the CUN as "unable to assess" and request further information from the Party. When the information is submitted, MBTOC is required to re-assess the nomination, following the procedures defined in Annex 1 of the Sixteenth Meeting of the Parties

Several Parties presented Phase Out Plans for MB for specific nominations. For example, Japan to eliminate the use of MB for fresh chestnuts and Australia to eliminate the use of MB on packaged rice.

MBTOC recommended less methyl bromide that requested in a CUN when a technically and economically feasible alternative was considered to be available or, in a few cases, when the Party failed to show that there was no technically and economically feasible alternative. In this round of CUNs, as in previous rounds, MBTOC considered all information provided by the Parties, including answers to questions requested by MBTOC, up to the date of the evaluation.

Now that technically and economically feasible alternatives have been identified for most applications, regulations on the use of these alternatives determine their availability to the end users. In addition, comparative information on the economic feasibility/infeasibility of the use of alternatives compared to MB is critical to the outcomes of present and future CUNs. Without information on the economic feasibility of MB alternatives and pertinent regulations from the nominating Parties, further CUNs may not be assessable, as MBTOC will be unable to analyse the impact of national, subnational and local regulations and laws as required in Decision XX/5. In many cases, MBTOC has proposed that existing commercially and economically feasible alternatives should be used. Where these are not available, MBTOC has suggested research that could lead to commercial alternatives to replace MB. MBTOC has also shown how regulatory issues can hinder or promote the phase out of MB, and has directed Parties attention toward such issues.Parties are encouraged to review the section in the Progress Report concerning economic analysis as guidance to improving the economic information in the CUNs.

Paragraph 20 of Annex 1 in Decision XVI/4, Parties specifically requested that, in cases where a nomination relies on the economic criteria of Decision IX/6, MBTOC's report should explicitly state the central basis for the Parties economic argument relating to CUNs. However, there were relatively few nominations reviewed in 2011 that contained economic arguments as criteria for critical uses. Parties are encouraged to review the section in the

Progress Report concerning economic analysis as guidance to providing any economic information in future CUNs.

8.2.3 Consideration of Stocks - Decision Ex.1/4 (9f)

One criterion for granting a critical use is that MB "*is not available in sufficient quantity and quality from existing stocks of banked or recycled methyl bromide*" (paragraph 1 (b) (ii) of Decision IX/6). Parties nominating critical use exemptions are requested under decision Ex.I/4(9f) to submit an accounting framework with the information on stocks. MBTOC has not reduced its recommended amount of methyl bromide in consideration of stocks held by the Party and has instead relied on Parties to take this into consideration when approving the amounts recommended by TEAP for each nomination. To assist the Parties with their consideration of stocks, and in accordance with Decision XVIII/13(7), a summary of the data on stocks as reported by the Parties in the first year for accounting in 2006, and then reports submitted in 2008 to 2011 are summarized in Tables 8-1 to 8-4 below.

Efficient functioning of commerce requires a certain level of available stocks and additional stocks to respond to emergencies. Additionally, stocks may be held on behalf of other Parties or for exempt uses (feedstock and QPS uses). The correct or optimal level of stocks for virtually every input to production is not zero. In addition, stocks are privately owned and may not be readily available for critical uses, or there may be national regulations preventing the transfer of stocks. Despite these restrictions, Parties may wish to ensure that stocks are used wherever possible in order to minimize the quantity of MB that need to be produced each year for critical uses.

Table 8-1: Quantities of MB (metric tonnes) 'on hand' at the beginning and end of 2005, as first reported by Parties in 2006/2007 under Decision XVI/6.

Party	**Critical use exemptions authorized by MOP for 2005**	**Quantity of MB as reported by Parties (metric tonnes)**				
		Amount on hand at start of 2005	**Quantity acquired for CUEs in 2005 (production +imports)**	**Amount available for use in 2005**	**Quantity used for CUEs in 2005**	**Amount on hand at the end of 2005**
Australia	146.6	0	114.912	114.912	114.912	0
Canada	61.792	0	48.858	48.858	45.146	3.712
EU	4 392.812	216.198	2 435.319	2 651.517	2 530.099	121.023
Israel	1 089.306	16.358	1 072.35	1 088.708	1 088.708	0
Japan	748	0	594.995	594.995	546.861	48.134
New Zealand	50	6.9	40.5	47.4	44.58	2.81
USA(a)	9 552.879		7 613	not reported	7 170	443

(a) Additional information on stocks was reported on US EPA website, September 2006: MB inventory held by USA companies: 2004 = 12,994 tonnes; 2005 = 9,974 tonnes.

Table 8-2: Quantities of MB 'on hand' at the beginning and end of 2008, as reported by Parties in 2009 under Decision XVI/6.

Party	**Critical use exemptions authorized by MOP for 2008**	**Quantity of MB as reported by Parties (metric tonnes)**				
		Amount onhand at start of 2008	**Quantity acquired for CUEs in 2008 (production +imports)**	**Amount available for use in 2008**	**Quantity used for CUEs in 2008**	**Amount on hand at the end of 2008**
Australia	48.450	0	41.037	41.037	41.037	0
Canada	42.19	0.348	32.937	33.285	31.281	1.997
EU	245.146	6.409	206.146	212.555	212.463	0.092
Israel						
Japan	443.775	24.467	392.994	417.461	409.937	7.524
USA	5 336	1 730 6458(a)	3 036	9464	4 083	5381(b) 269(c)

(a) Amount of pre-2005 stocks; (b) Includes the pre-2005 stocks; (c). Amount of unused allocation for CUEs which will be reduced from following years production

Table 8-3: Quantities of MB 'on hand' at the beginning and end of 2009, as reported by Parties in 2010 under Decision XVI/6.

Party	**Critical use exemption authorized by MOP for 2009**	**Quantity of MB as reported by Parties (metric tonnes)**				
		Amount on hand at start of 2009	**Quantity acquired for CUEs in 2009 (production +imports)**	**Amount available for use in 2009**	**Quantity used for CUEs in 2009**	**Amount on hand at the end of 2009**
Australia	37.61	0	33.278	33.278	33.278	0
Canada	39.1	1.997	30.276	30.276	23.8	6.38
Israel	Not Reported					
Japan	305.380	11.882	278.616	290.498	286.532	3.966
USA	2,276	4,273(a)	2,274	6,547	2,215 1,135(d)	3,063 (b) 59 (c)

(a) Amount of pre-2005 stocks
(b) Includes the pre-2005 stocks
(c).Amount of unused allocation for CUEs which will be reduced from following years production
(d) Stocks used for CUE uses in 2009

Table 8-4: Quantities of MB 'on hand' at the beginning and end of 2010, as reported by Parties in 2011 under Decision XVI/6.

Party	**Critical use exemption authorized by MOP for 2010**	**Quantity of MB as reported by Parties (metric tonnes)**				
		Amount on hand at start of 2010	**Quantity acquired for CUEs in 2010 (production +imports)**	**Amount available for use in 2010**	**Quantity used for CUEs in 2010**	**Amount on hand at the end of 2010**
Australia	36.44	0	34.167	34.167	34.167	0
Canada	33.277	6.38	23.456	29.836	25.254	3.4
Japan	267	8.82	248.67	257.49	251.159	6.331
USA	1,956	3,063 (a)	1,955	5,018	1,955 613 (d)	1,803(b)

(a) Amount of pre-2005 stocks available at the start of 2010
(b) Amount of pre-2005 stocks available at the end of 2010.
(d) Stocks used for CUE uses in 2010

In 2006, the US predicted that pre 2005 stocks for preplant soil uses would be exhausted by 2009, yet pre 2005 stocks are still available. It is noted that the stocks recently reported by the United States (about 1,800 tonnes) were approximately three times the quantity nominated by the US for 2013 (about 604 tonnes) and suggests Parties may wish to review this information in the light of the Decision IX/6 1(b)(ii) that "…*permits production only if methyl bromide is not available in sufficient quantity and quality from existing stocks*…".

It is noted that stocks are privately held in the United States and market forces determine when and at what price stocks are used. It is also notes that the US has made allowances for some of the use of these stocks as critical allowances for CUNs when licensing critical uses of methyl bromide and suggests that Parties may wish to seek clarification on how the remaining stocks will be apportioned.

8.2.4. Reporting of MB Consumption for Critical Use - Decision XVII/9

Decision XVII/9(10) of the 17th MOP requests TEAP and its MBTOC to "*report for 2005 and annually thereafter, for each agreed critical use category, the amount of methyl bromide nominated by a Party, the amount of the agreed critical use and either:*

(a) The amount licensed, permitted or authorised; or

(b) The amount used

Since the start of the CUN reviews in 2003, MBTOC has provided the amounts of MB nominated and agreed for each critical use (Annexes III and IV). Australia, Canada, Japan and the United States that submitted nominations for 2012 and/or 2013 did not supply data under Form 2 of the accounting framework as it was not accepted by the Parties (refer p. 65 of the Handbook on Critical Use Nominations (version 6 of December 2007). The data reported here for (a) and (b) above is therefore incomplete. Some Parties record part of the information under their own local reporting requirements.

8.2.5 Trends in Methyl Bromide Use for CUEs since 2005

The nominated amounts and the apparent rate of reduction in MB or adoption of alternatives achieved by Parties are shown in Table 8-5, as well as Figures 8-1 and 8-2. It is noted that for those countries that have pre-2005 stocks of MB that are being drawn down, the reductions in CUEs from year to year cannot be taken directly as evidence of alternative adoption since pre-2005 stocks may have been used in the same sectors. Table 14-6 and 14-7 in particular show the amounts nominated by Parties for preplant soil uses and those recommended for 'Critical Use' in either 2012 or 2013.

Decision XVII/9 requires TEAP to show trends in the phase out of the critical uses of MB by the Parties. As part of the requirements of Decision XVII/9, trends in phase out by Parties are shown below. Since 2005, there has been a progressive trend in the reduction of methyl bromide for CUNs by all Parties for preplant soil uses and post harvest uses, although this has occurred at different rates. Figs 8-1 and 8- 2 show the trends in the reduction in amounts approved/nominated by Parties for 'Critical Use' from 2005 to 2013 for some key uses. The complete trends in phase out of MB by country, as indicated by change in CUE, are shown in Annexes III and IV.

Figure 8-1: Amounts of MB exempted for CUE uses in selected preplant soil industries from 2005 to 2012. Solid lines indicate the trend in CUE methyl bromide approved by the Parties. Dashed lines indicate quantity of MB nominated by the Parties in 2013. (See table 9 -7 for exact quantities nominated by the Party for 2013)

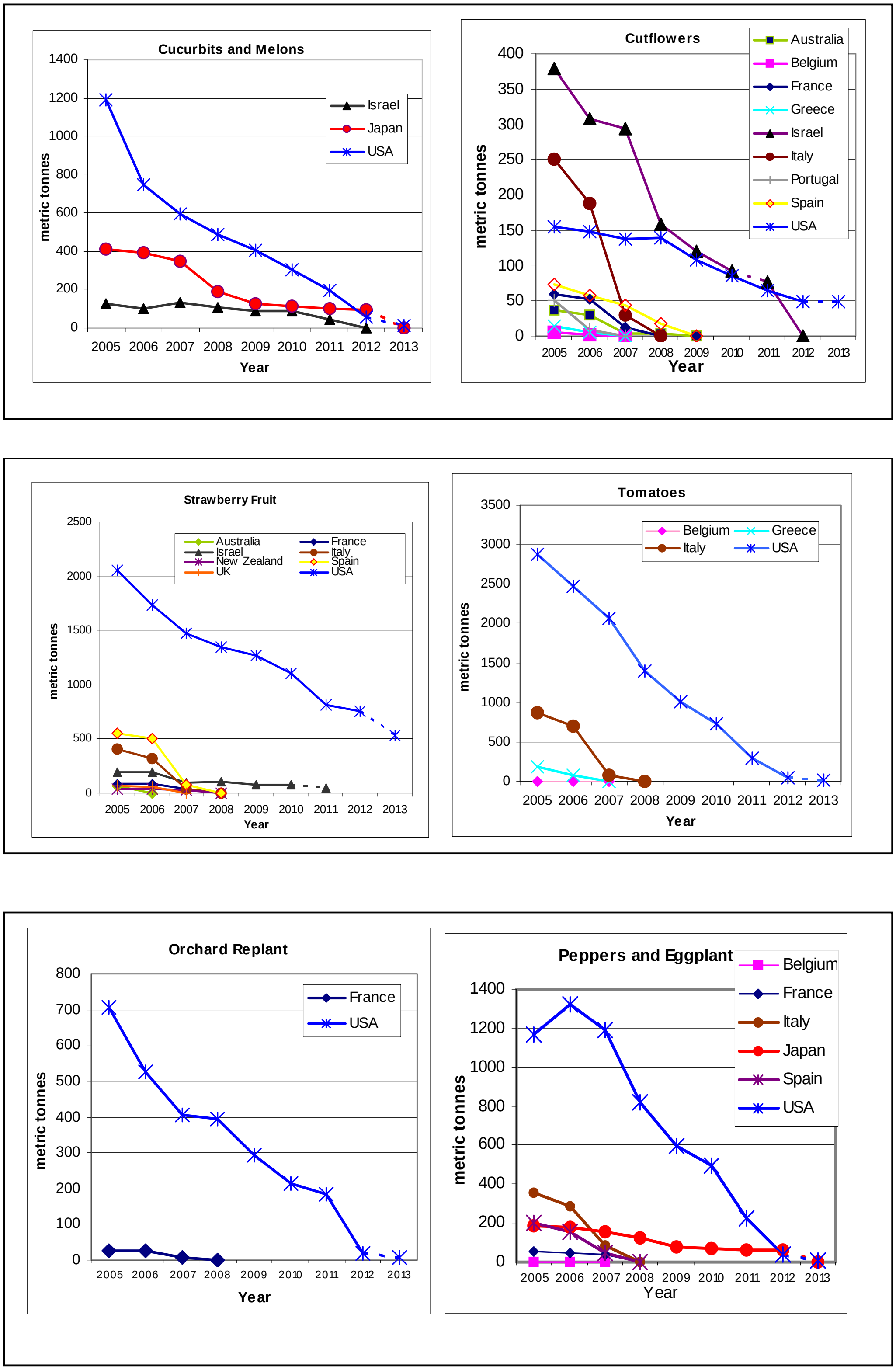
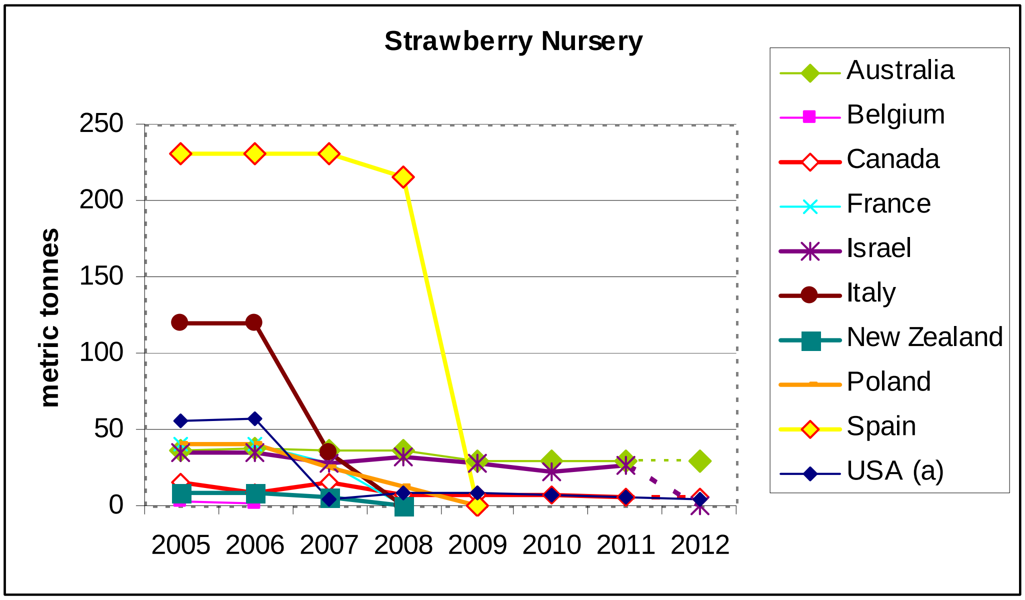


Figure 8-2: Amounts of MB exempted for CUE uses in the strawberry nursery sector from 2005 to 2013. Solid lines indicate the trends in CUE methyl bromide approved by the Parties. Dashed lines indicate quantity of MB nominated by the Party in 2013.



- Additional amounts of MB (Estimated 460 t) are exempted under QPS regulations in the USA (TEAP 2010).

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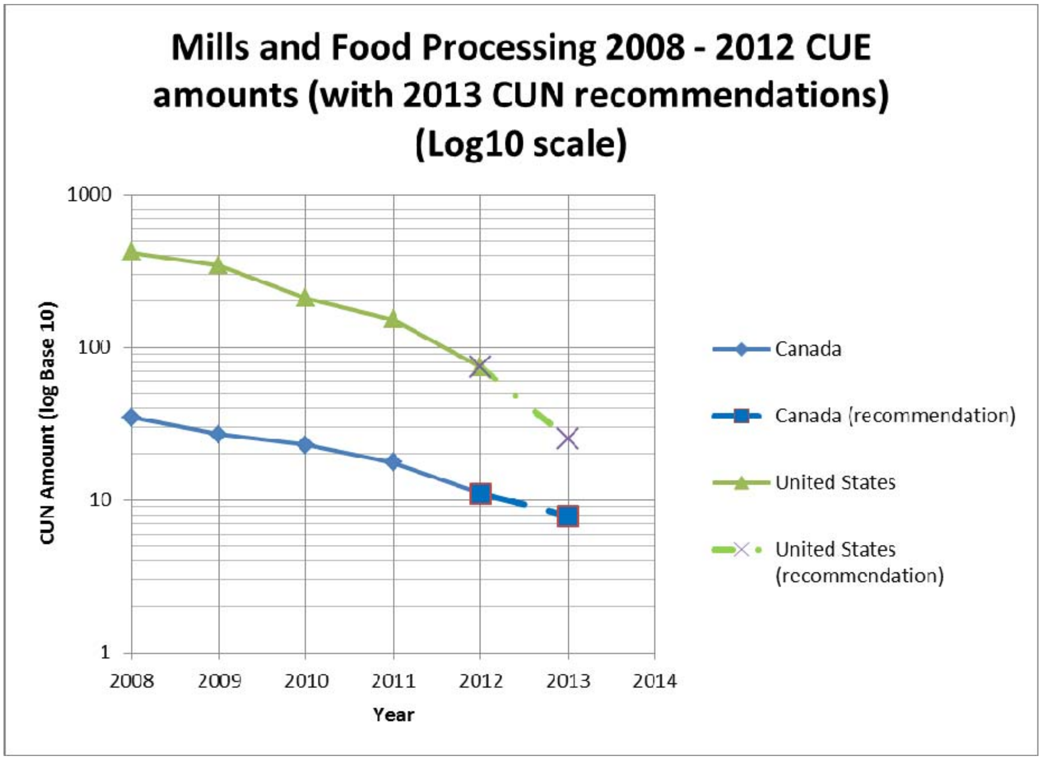
Figure 8-3: Amounts of MB exempted for CUE uses in mills and food processing facilities from 2008 to 2012. Solid lines indicate trend in CUE methyl bromide. Dashed lines indicate quantity of MB recommended by MBTOC for 2013. Chart uses Log 10 scale.



Note that a number of countries (Belgium, France, Germany, Greece, Israel, Italy, UK) have phased out MB for use in mills and food processing as of 200

Table 8-5: Summary of Critical Use Nominations and Exemptions

	Quantities Nominated									Quantities Approved								Interim Recommendation	
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2005 (1ExMOP and 16MOP)**	**2006 (16MOP+ 2ExMOP+ 17MOP)**	**2007 (17MOP + 18MOP)**	**2008 (18MOP + 19MOP)**	**2009 (19MOP)**	**2010 (20MOP + 21MOP)**	**2011 (21MOP)**	**2012**	**2012***	**2013***
Australia	206.950	81.250	52.145	52.900	38.990	37.610	35.450	34.660	32.164	146.600	75.100	48.517	48.450	37.610	36.440	28.710	31.708		32.164
Canada	61.992	53.897	46.745	42.241	39.115	35.080	19.368 +3.529	16.281	13.444	61.792	53.897	52.874	36.112	39.020	30.340 +3.529	19.368	16.281		13.109
European Community1	5754.361	4213.47	1239.873	245.00	0	0	0	0	0	4392.812	3536.755	689.142	245.146	0	0	0	0		0
Israel	1117.156	1081.506	1236.517	952.845	699.448	383.700	232.247	0	0	1089.306	880.295	966.715	860.580	610.854	290.878	0	0		
Japan	748.000	741.400	651.700	589.600	508.900	288.500	249.420	221.104	3.317	748.000	741.400	636.172	443.775	305.380	267.000	239.746	219.609		3.317
New Zealand	53.085	53.085	32.573	0	0	0	0	0	0	50.000	42.000	18.234	0	0	0	0	0		0
Switzerland	8.700	7.000	0	0	0	0	0	0	0	8.700	7.000	0	0	0	0	0	0		0
USA	10753.997	9386.229	7417.999	6415.153	4958.034	3299.490	2388.128	1181.779+ 6.270	656.366	9552.879	8081.753	6749.060	5355.976	4261.974	3232.856 +2.018	2055.200	1022.826	0.045	607.389
TOTALS	**18704.241**	**15617.837**	**10677.552**	**8297.739**	**6244.487**	**4044.380**	**2928.142**	**1460.094**	**705.291**	**16050.089**	**13418.200**	**9160.714**	**6990.039**	**5,254.838**	**3572.183**	**2343.024**	**1290.424**	**0.045**	**655.979**

* Not yet available.

1 Members of the European Community which had CUNs/CUEs included:
2005 – Belgium, France, Germany, Greece, Italy, Netherlands, Poland, Portugal, Spain, and the United Kingdom.
2006 – Belgium, France, Germany, Greece, Ireland, Italy, Latvia, Malta, Netherlands, Poland, Portugal, Spain, and the United Kingdom.
2007 – France, Greece, Ireland, Italy, Netherlands, Poland, Spain, and the United Kingdom
2008 – Poland, Spain

8.2.6 Evaluations of CUNs – 2011 Round for 2013 Exemptions

All three sub-committees of MBTOC met in Antalya, Turkey from 14 – 18 March 2011 to evaluate the requests for methyl bromide and to propose draft recommendations on the quantity of methyl bromide eligible for critical uses, to update reports, discuss issues of registration of alternatives and other matters. MBTOC sincerely appreciated the welcome and hospitality of the West Mediterranean Agricultural Research Institute (BATEM, Antalya) and the Ministry of Agriculture. MBTOC thanks BATEM and Professor Suat Yilmaz and his team for the organization of the meeting. The two MBTOC economists attended the meeting.

The meetings were held as required in accordance with the time schedule for the consideration of CUNs provided in Annex I referred to in Decision XVI/4. Consensus decisions were made in subcommittees, and comments made by members were considered in the final recommendations. The results of the draft recommendations on the critical uses of methyl bromide proposed by the MBTOC-S and MBTOC-SC subcommittees were discussed in plenary as well as to some extent after the meeting via email.

During the meeting MBTOC-Soils held bilateral meetings with the US delegation and separately with the Californian Strawberry Commission. MBTOC-SC held a bilateral with the US delegation. Arysta LifeSciences also presented to MBTOC-Soils and MBTOC-SC. All of the MBTOC-QPS members also attended the plenary presentations.

Australia, Canada, Japan, and the USA submitted nominations for either preplant soil use and/or post harvest use in 2013. These Parties have submitted nominations in previous CUN years. Twenty nominations were submitted in this round which was 16 fewer than submitted in the last round (Table 8-6). Amounts of 7.445 t and 7.537 t was nominated in 2012 and 2013 respectively for research in the USA in both the preplant soil and post harvest sectors. During the MBTOC meeting in Antalya, Party advised that the amounts for cured pork research were reduced from 1.220 t to 0.045 t for both years. The total nominated amount for all countries for 2013 was 705.291 t and this represented a 52% reduction to that nominated in 2010 for 2012. The interim recommendation for 2013 was 655.979 t, ie. 93% of that nominated (Table 8-6).

For the preplant soils CUNs, Australia and Canada submitted similar amounts to the previous rounds highlighting difficulties with phase out of MB for the strawberry nursery sector. In the USA almost all sectors were making significant progress towards phase out in this round although restrictions on the use of alternatives in California were affecting progress towards phase out in the strawberry fruit sector.

In Structures and Commodities, Parties continued to show progress in reducing the quantity of methyl bromide requested in the CUNs. The reduction was most likely the result of continuing efforts by Parties to resolve the inter-related issues of treatment logistics, costs, trade demands and effectiveness of alternatives. Canada nominated amounts for mills in 2013, but did not nominate for pasta processing facilities. Additionally, Australia and Japan submitted Phase Out Plans stating they will not submit CUNs in 2015.

MBTOC has sometimes recommended quantities of MB for 2012 or 2013 which are less those nominated. The grounds used for these recommendations are given in detail after the relevant CUNs in Tables 8-13 and 8-14. The adjustments for preplant soils use may in part be to account for presumptions given in Tables 8-10 and 8-11.

In general and as result of the review of the CUNs, they were submitted due to the following issues: regulatory restrictions that did not allow partial or full use of alternatives, difficulties in the scale-up of alternatives, alternatives considered uneconomical and to a much smaller degree, the technical unavailability of alternatives. In structures and commodities CUNs noted that the US Environmental Protection Agency has proposed phasing out the use of sulfuryl fluoride for postharvest uses. This situation is discussed further in the 2010 Assessment Report and in the Progress Report. Sulfuryl fluoride, phosphine and controlled atmospheres are the leading alternatives for structural and commodity pest control. Additionally, MBTOC-SC notes that some Parties continue to struggle with the ability to adapt previously identified alternatives to their circumstances.

In paragraph 20 of Annex 1 referred to in Decision XVI/4, Parties specifically requested that MBTOC explicitly state the specific basis for the Party's economic statement relating to CUNs. Tables 8-13 and 8-14 provide this information for each CUN. This information was prepared by MBTOC economists. Parties are encouraged to review the section in the MBTOC Progress Report (TEAP 2011) concerning economic analysis as guidance to providing any economic information in future CUNs.

8.2.7 Critical Use Nominations Review

In considering the CUNs submitted in 2011, as in previous rounds , both MBTOC subcommittees applied the standards contained in Annex I of the final report of 16 MOP, and, where relevant, the standard presumptions given below. In particular MBTOC sought to provide consistent treatment of CUNs within and between Parties while at the same time taking local circumstances into consideration. Unless otherwise indicated, the most recent CUE approved by the Parties for a particular CUN was used as baseline for consideration of continuing nominations.

In evaluating the CUNs for soil treatments, MBTOC assumed that a technically feasible alternative to MB would need to provide sufficient pest and/or weed control for continued production of that crop to existing market standards.

For commodity and structural applications, it was assumed that technically and economically feasible alternatives would provide disinfestation to a level that met the objectives of a MB treatment, e.g. meeting infestation standards in finished product from a mill, while ensuring the costs were economically feasible in the context of that nomination, to the extent that could be determined.

Consistent with Article 4(1) of the the Terms of Reference for TEAP as they apply to technical options committees, three Minority Reports were submitted by some MBTOC members after the March meeting in Turkey. TEAP considered the technical justifications provided in each Minority Report at its April meeting in Geneva Switzerland. In the first case that concerned strawberry fruit production in California, TEAP partly agreed with the Minority Report, and was able to recommend that portion of the nomination where there was no dissent after the assessment by MBTOC. The Party was invited to submit additional information for MBTOC's assessment, in the event that a greater amount of methyl bromide was required than the amount recommended by TEAP. In the second case that concerned vegetable production in the US, TEAP accepted the majority MBTOC recommendations and invited the Party to provide further information by 15 July 2011for final MBTOC's assessment; and in the third case that concerned strawberry runner production in Canada, TEAP disagreed with the Minority View and recommended methyl bromide for that use.

8.2.8 Disclosure of Interest

As in the past, each MBTOC member submitted a disclosure of interest form relating specifically to their level of national, regional or enterprise involvement for the 2011 CUN process, according to a standardised format developed by TEAP. The Disclosure of Interest declarations can be found on the internet at http://ozone.unep.org/Assessment_Panels/TEAP/index.shtml. As in previous rounds, some members withdrew from a particular CUN assessment or only provided technical advice on request for those nominations where a potential conflict of interest was declared.

8.3 Article 5 issues

Methyl bromide is due to be fully phased out in A5 Parties by Jan 1 2015, 10 years after full phaseout by non-A5 Parties. In both cases, uses for feedstock and QPS are exempted from phase out under the control measures described in Article 2H. There is also provision for exemption from phase out for uses deemed ‘critical’ according to Article 2H, as complying with Decision IX/6.

Presently, nearly 80% of the controlled consumption in A5 Parties has been phased out, well ahead of the 2015 deadline. This has been achieved largely as a result of investment projects implemented by the Montreal Protocol agencies, with MLF funding. Almost all remaining MB consuming Parties have agreements in place with the MLF for full phaseout of methyl bromide by 2015 at the latest, very often earlier. These are usually accompanied with legislation to ban further consumption of MB for controlled uses, and funding to support ongoing implementation of alternatives therefore promoting the sustainability of the phase out.

Article 5 Parties may choose to submit nominations for Critical Use Exemptions (CUEs) for remaining uses they consider appropriate for year 2015 and possibly subsequently. The first CUNs by non-A5 Parties were made in 2003 for CUEs to be in force in 2005. If a similar advanced submission period is to be followed, some A5 Parties may choose to submit CUNs in 2013 for assessment by MBTOC for potential use as 2015 CUEs.

MBTOC is mindful of the difficult and complex process that occurred during the first round of CUNs in 2003. TEAP urges Parties to consider the requirements for CUNs in due time as set out in the ‘Handbook on Critical Use Nominations’ (http://ozone.unep.org/Assessment_Panels/TEAP/Reports/MBTOC/Handbook%20CUN-version5-27Nov06.pdf).

8.4. MBTOC-Soils: Final Evaluations of 2011 Critical Use Nominations for Preplant Soil Use of Methyl Bromide

In addition to organization and welcome to the meeting in Antalya, MBTOC-S thanks the Government of Turkey, Department of Agriculture, for organization and conduct of the field tour on Wednesday 16th March.

8.4.1 Minority Reports

Three signed Minority Reports with technical justification were submitted by MBTOC members on nominations from the United States and Canada in March, 2011 as shown below. The full text of the minority reports is shown in Section 4.5.

Minority Report 1: United States of America nomination for the use of methyl bromide for strawberry fruit production in California in 2013.

Minority Report 2: United States of America nomination for the use of methyl bromide for tomato, pepper, cucurbit and eggplant production in the USA.

Minority Report 3: Nomination by Canada for the use of methyl bromide for the use of methyl bromide for the production of strawberry runners on Prince Edward Island.

At the May meeting in Geneva, TEAP by consensus agreed to the following positions in conjunction with the text provided in the recommendation boxes shown in Table 8-11.

- TEAP partly agreed with the Minority Report 1. TEAP was able to recommend that portion of the recommendation that was not in disagreement by MBTOC, but unable to recommend any further amount of MB up to that nominated until further substantiation is provided by the Party as shown in the full summary of the recommendation (Table 9 -11).

- TEAP concurred with the interim recommendation proposed by the MBTOC majority on vegetables produced in the US. TEAP invited the Party to provide substantiation of the recent failure of alternatives on each nomination for cucurbits, eggplants, peppers and tomatoes by July 15, 2011.

- With respect to Minority Report 3, TEAP concurred with the MBTOC majority.

8.4.2 Summary of Interim Recommendations

In the 2011 round, 13 CUNs were submitted for preplant soil uses, 1 for 2012 and 12 for 2013. This compared to 27 nominations submitted in the past round in 2010 as Japan and Israel no longer submitted CUNs. USA did not submit a nomination for forest nurseries and sweet potato slips, both of which had been submitted in previous rounds, but did submit a new nomination for research uses in 2012 and 2013.

MBTOC-S acknowledged the substantial reductions made by USA for 2013 in the 2011 CUNs. Further acknowledgement goes to Israel and Japan who supported their action plans to phase out MB in Israel by the end of 2011 and for Japan by the end of 2012.

The nominated amounts were for 6.111 tonnes in 2012 and 661.677 tonnes in 2013. The interim recommended amounts totaled 577.242 t for 2013 (Table 8-6 and 8-7). MBTOC was unable to assess the USA research nomination for 2012 and 2013 because insufficient details were provided to support the use (see Table 8-11). Interim recommendations on 8 of the 11 remaining nominations were made. However, the final quantity depends on the US providing further information by July 15, 2011 for MBTOC assessment on the vegetable and strawberry nominations (Table 8-13). The US ornamentals nomination was reduced as alternatives were considered suitable for a portion of the nomination.

Table 8-6: Summary of MBTOC-S nominations and interim recommendations for 2012 and 2013 by country for CUNs received in 2011 for preplant soil use of MB (tonnes)

Country	CUE approved at 22nd MOP	CUN Submitted in 2011		MBTOC-S Interim Recommendation	
	2012	2012	2013	2012	2013
Australia	29.760		29.760		[29.760]
Canada	5.261		5.596		[5.261]
Israel			0		
Japan	216.120		0		
USA	941.967		620.118		[542.221]
USA Research (New)		6.111	6.203	[Unable]	[Unable]
Total	**1193.108**	**6.111**	**661.677**		**[577.242]**

Table 8 -7: Summary of the interim recommendations by MBTOC-S (in square brackets) for CUE's for preplant uses of MB (tonnes) for 2012 and 2013 submitted in the 2011 round.

Country and Sector	Years	
	2012	2013
1. **Australia**		
1. Strawberry runners		**[29.760]**
2. **Canada**		
1. Strawberry runners		**[5.261]**
3. **USA**		
1. Cucurbits		[11.899]
2. Eggplants (field)		[1.381]
3. Nurseries stock: fruits, nuts & flowers		[0.541]
4. Orchard replant		[6.230]
5. Ornamentals		[40.818]
6. Pepper (field)		[5.673]
7. Strawberry (field)		[461.186]
8. Strawberry runners		[3.752]
9. Tomatoes (field)		[10.741]
10. Research	[Unable]	[Unable]
TOTAL	**[Unable]**	**[577.242]**

8.4.3. Issues Related to CUN Assessment for Preplant Soil Use

Key issues which influenced assessment and the need for MB for preplant use of MB in the 2010 round were:

i) Increased adoption and registration of methyl iodide (MI or iodomethane) with barier films in most states of the USA (not California) which has continued since mid 2008 which has led to commercial adoption on large scale areas in the US and substantial reduction in the US nominations in SE and Florida.

ii) Registration of methyl iodide in California in December 2010, which allowed for a 21 % reduction by the US for the strawberry fruit nomination.

iii) Continued and progressive acceptance of a 3 way fumigant strategy (1,3-dichloropropene, metham sodium, Pic) as being effective for nutsedge and pathogen control in USA.

iv) Changing regulations on key alternatives, particularly 1,3-D township caps and buffer zones on 1,3-D, metham sodium and Pic used alone or in mixtures.

v) Introduction of a new formulation of 1,3-D/Pic (Picchlor 60) in the USA which increased affected the use of 1,3-D in areas affected by township caps.

vi) Effect of restrictions on use of high rates of Pic (greater than 200 kg/ha (20 g/m^2)) in some counties of California.

vii) Lack of acceptance in specific sectors that alternatives exist, e.g. nursery industries and the classification by one Party of these uses under the QPS exemption.

viii) Movement of quantities of MB from CUE classification to an exempt 'QPS' status in some sectors (eg. US Forest nurseries).

In this round, the US indicated it no longer sought nominations for the forest nursery or sweet potato sectors. It was unclear whether this was due to uptake of alternatives or reclassification to QPS. Israel and Japan no longer sought any methyl bromide under critical use for preplant soil use, thus honoring their phase out notified to the Parties in 2010.

In the 2010 round, MBTOC also used adoption data of alternatives in specific regions where it was available, such as the Californian Department of Pesticide Regulation –Pesticide Use Report data to help with assessment, particularly the largest strawberry fruit nomination.

MBTOC continues to urge Parties to consider review of regulations covering the registration, use and adoption of alternatives, particularly review of barrier films to reduce dosage rates of MB and the alternatives, and associated emissions. As in the previous round, Parties found alternatives more difficult to adopt for propagation materials, such as strawberry runners and nurseries. There is a lack of research studies to develop and demonstrate effectiveness of alternatives in these sectors. This lack of research effort leads MBTOC to conclude that several of the CUNs do not to fully satisfy the requirements of Decision IX/6 and urges Parties to increase studies in these sectors. The impact of current reviews of volatile organic compound (VOC) emissions in California (http://www.epa.gov/iaq/voc.html) may also have a major impact on the use of MB and alternatives.

MBTOC also notes that a large proportion of MB has been nominated for uses where regulations or legislation prevent reductions of MB dosage. For many uses, the mandatory use of MB is specified at a high dosage for either treatment of certified propagation material or because regulations prevent use of barrier films which otherwise could have reduced the MB dosage rate. Also regulations on the use of alternatives are preventing their uptake for a substantial proportion of the remaining CUNs for preplant soil use. For instance, current restrictions on dose rate for methyl iodide in California prevent MBTOC accepting it as a suitable alternative for nursery uses. MBTOC urges the Parties to align their local policies and regulations with internationally accepted methodologies and to allow use of MB alternatives.

8.4.3.1. Registration of alternatives for preplant uses - Decision Ex I/4 (9i) and (9j)

Decision Ex. I/4 (9i) requires MBTOC "*To report annually on the status of re-registration and review of methyl bromide uses for the applications reflected in the critical-use exemptions, including any information on health effects and environmental acceptability*". Further, Decision Ex I/4 (9j) requires MBTOC "*To report annually on the status of registration of alternatives and substitutes for methyl bromide, with particular emphasis on possible regulatory actions that will increase or decrease dependence on methyl bromide*".

Iodomethane (MI) is registered for more than 28 crops in all US states except Washington and New York and this has greatly assisted phase out of MB in SE States of the USA including field-grown ornamentals, peppers, strawberries and tomatoes. In California approval was granted for iodomethane in December 2010, however use rates approved may be restrictive for certain uses according to the Party. MI has also gained registration in a number of Article 5 countries and non Article 5 countries, such as New Zealand and Japan and this has assisted phase out of MB for preplant uses in these countries. Registration of MI is pending in Australia and this alternative is indicated by the Party to be a main alternative which could assist phase out for MB in strawberry runners. To ensure that the mitigation measures for MI will be consistent with the measures being required for the other fumigants, the label requirements are presently being reexamined in the USA. 1,3-dichloropropene, may be subject to similar provisions when the soil fumigants are evaluated together again in 2013.

The EU has further reported that registration for 1,3-D and other alternatives including chloropicrin, dazomet and metham sodium are under review. A grace period for the registration of 1,3-D became due on 20 March 2009 and was extended, but its future registration is uncertain.

A number of other chemicals which may be alternatives to MB are being considered for impending registration in specific countries recently, including dimethyl disulphide (DMDS) in Europe and the USA.

8.4.3.2. Update on rates of adoption of alternatives for preplant uses - Decision XIX/9

As of the 2010 round, Decision XIX/9 para. 3 requests: ' *the Technology and Economic Assessment Panel to ensure that recent findings with regard to the adoption rate of alternatives are annually updated and reported to the Parties in its first report of each year and inform the work of the Panel*'.

Previous reports (see references in Table 8-11, Porter *et al.*, 2006, MBTOC 2011) show that technical alternatives exist for almost all uses requesting CUNs, but the uptake of alternatives varied between countries, crops and the pest pressure. In general, similar alternatives are being adopted by the same sectors in a number of countries, although the rate of adoption has varied depending on regulatory restrictions on use, differences in registration rates between countries and other market forces. In this round as in previous rounds of CUNs, MBTOC has recognised that a limited period of time is needed to allow the market penetration of alternatives, based on logistical, training, imports of alternatives and other information provided in the nomination by the Party (paragraph 35 in Annex 1 of the 16th Meeting of the Parties).

Figures 8-1 to 8-4 in this report show the apparent reduction rates for MB use achieved by many Parties in a number of key sectors. As noted above, true reduction and adoption rates may vary from the rate of change of CUN/CUE because of factors such as use of stocks (some Parties uses stocks and freshly produced methyl bromide from CUEs) or transfer MB between categories of use. The CUN reviews presented in Table 8-11 also provide detail of some of the key alternatives that Parties have and should consider to further replace MB for the remaining uses.

Further guidance from the Parties, particularly Australia, Canada and the US of expected rates of adoption of alternatives following registration, in accordance with paragraphs 34-35 of Annex 1 of the MOP16, as this information would assist MBTOC in evaluation of CUNs in future.

8. 4.3.3. Sustainable Alternatives for Preplant Uses

For preplant soil uses of MB, the regulatory restrictions on 1,3-dichloropropene and Pic are preventing further adoption of these products in the USA, particularly California and this is putting pressure on industries to retain MB.

MBTOC urges Parties to consider the long term sustainability of treatments adopted as alternatives to MB, to continue to adopt environmentally sustainable and safe chemical and non-chemical alternatives for the short to medium term and to develop sustainable IPM or non-chemical approaches for the longer term. Decision IX/6 1(a)(ii) refers to alternatives that are 'acceptable from the standpoint of environment and health'. MBTOC has consistently interpreted this to mean alternatives that are registered or allowed by the relevant regulatory authorities in individual CUN regions, without reference to the sustainability of the alternative. In the past, MBTOC visited flower growers in Southern Spain who have successfully adopted biodisinfestation as an efficient and sustainable alternative to MB.

8.4.4. Standard Presumptions Used in Assessment of Nominated Quantities.

The tables below (Tables 8-8 and 8-9) provide the standard presumptions applied by MBTOC-S for this round of CUNs. These standard presumptions were first proposed in the MBTOC report of October 2005 and were presented to the Parties at 17th MOP. Studies and reports to support them have been provided in previous reports and were revised for some sectors after consideration by the Parties at the 19th MOP. The rates and practices adopted by MBTOC as standard presumptions are based on maximum rates considered acceptable by published literature and actual commercial practice.

As in the evaluations in previous years, MBTOC considered reductions to quantities of MB in particular nominations to a standard rate per treated area where technical evidence supported its use. As a special case, MBTOC continues to accept a maximum rate of 200 kg/ ha (20 g/m^2) with high Pic-containing mixtures with barrier films for certified nursery production, unless regulations prescribed lower or higher rates. However, studies have indicated that rates of 200 kg/ha (20g/m^2) or less of MB: Pic 50:50 were effective with barrier films for production of 'certified' nursery material.

The indicative rates used by MBTOC were maximum guideline rates, for the purpose of calculation only. MBTOC recognises that the actual rate appropriate for a specific use may vary with local circumstances, soil conditions and the target pest situation. Some nominations were based on rates lower than these indicative rates.

Table 8-8: Standard presumptions used in assessment of CUNs for the 2009 and later assessments – soil treatments.

	Comment	CUN adjustment	Exceptions
1. Dosage rates	Maximum guideline rates for MB:Pic 98:2 are 25 to 35 g/m^2 with barrier films (VIF or equivalent); for mixtures of MB/Pic are 12.5 to 17.5 g MB/m^2 for pathogens and nutsedge respectively, under barrier films depending on the sector. All rates are on a 'per treated hectare' basis.	Amount adjusted to maximum guideline rates. Maximum rates set dependent on formulation and soil type and film availability.	Higher rates accepted if specified under national legislation or where the Party had justified otherwise.
2. Barrier films	All treatments to be carried out under low permeability barrier film (e.g. VIF, TIF)	Nomination reduced proportionately to conform to barrier film use.	Where barrier film prohibited or restricted by legislative or regulatory reasons
3. MB/Pic Formulation: Pathogen control	Unless otherwise specified, MB/Pic 50:50 (or similar) was considered to be the standard effective formulation for pathogen control, as a transitional strategy to replace MB/Pic 98:2.	Nominated amount adjusted for use with MB/Pic 50:50 (or similar).	Where MB/Pic 50:50 is not registered, or Pic (Pic) is not registered
4. MB/Pic Formulation: Weeds/nutsedge ass control	Unless otherwise specified, MB/Pic 67:33 (or similar) was used as the standard effective formulation for control of resistant (tolerant) weeds, as a transitional strategy to replace MB/Pic 98:2.	Nominated amount adjusted for use with MB/Pic 67:33 (or similar).	Where Pic or Pic-containing mixtures are not registered
5. Strip vs. Broadacre	Fumigation with MB and mixtures to be carried out under strip	Where rates were shown in broadacre hectares, the CUN was adjusted to the MB rate relative to strip treatment (i.e. treated area). If not specified, the area under strip treatment was considered to represent 67% of the total area.	Where strip treatment was not feasible e.g. some protected cultivation, emission regulations on MB, or open field production of high health propagative material

Table 8-9: Maximum dosage rates for preplant soil use of MB by sector used in the 2009 and later assessments (standard presumptions).

Film Type	**Maximum MB Dosage Rate (g/m^2) in MB/Pic mixtures (67:33, 50:50) considered effective for:**			
	Strawberries and Vegetables	**Nurseries***	**Orchard Replant**	**Ornamentals**
Barrier films - Pathogens	12.5	15	15	15
Barrier films - Nutsedge	15.0	17.5	17.5	17.5
No Barrier films – Pathogens	20	20	20	20
No Barrier films - Nut sedge	26	26	26	26

* Maximum rate unless certification specifies otherwise

8.4.5. Adjustments for Standard Dosage Rates Using MB/Pic Formulations

One key transitional strategy to reduce MB dosage has been the adoption of MB/Pic formulations with lower concentrations of MB (e.g. MB/Pic 50:50, 45:55 or less). These formulations are considered to be equally as effective in controlling soilborne pathogens as formulations containing higher quantities of MB (e.g. 98:2, 67:33) (e. g. Porter 2006; Melgarejo *et al*., 2001; Santos *et al*., 2007; Hamill *et al.*, 2004; Hanson *et al.*, 2006). Parties are urged to consider even lower dosage rates of MB for the remaining CUNs. This includes rates as low as 75 kg/ha (7.5 g/m^2) with mixtures of 30:70 or 33:67 mixtures (at 250 kg/ha or 25 g/m^2) or 100 kg/ha (10 g/m^2) of MB in 250 kg/ha (25 g/m^2) of 50:50 MB/Pic mixtures in conjunction with barrier films (Table 8-10).

Table 8-10: Actual dosage rates applied during preplant fumigation when different rates and formulations of MB/Pic mixtures are applied with and without barrier films. Rates of application reflect standard commercial applications rates.

Commercial application rates of formulation	**MB/Pic formulation (dose of MB in g/m^2)**			
	98:2	**67:33**	**50:50**	**30:70**
A. With Standard Polyethylene Films				
400	39.2	26.8	20.0	12.0
350	34.3	23.5	17.5	10.5
300	29.4	20.1	15.0	9.0
B. With Low Permeability Barrier Films (LPBF)				
250	24.5	16.8	12.5	7.5
200	19.6	13.4	**10.0***	6.0
175	17.2	11.8	8.8	5.3

** Note: Trials from 1996 to 2008 (Annex III) show that a dosage of 10g/m^2 (e.g. MB/Pic 50:50 at 200kg/ha with LP Barrier Films) is technically feasible for many situations and equivalent to the standard dosage of >20g/m^2 using standard PE films*

8.4.6. Use/Emission Reduction Technologies - Low Permeability Barrier Films and Dosage Reduction

Decision XXI/11 (para 9) requested further reporting on Decision IX/6 to ensure Parties adopted emissions controls where possible. For preplant soil use, this includes the use of barrier films and lowest effective dose of MB with mixtures of chloropicrin. Other methods include deep shanking and use of ammonium thiosulphate and different irrigation technologies (Yates *et al.,* 2007, Yates *et al.,* 2009). These latter technologies have not been reported or adopted widely by Parties and need to be evaluated more widely for future CUN uses.

In southeast USA the reported use of barrier films in vegetable crops has expanded to over 20,000 hectares and it is also exclusively used with the alternative MI to assist its effectiveness at low dosage rates (Allan, pers. comm., 2008; Chism, pers.comm, 2009). An exception to the adoption of barrier films is in the State of California in the USA where a regulation currently prevents use of barrier films with MB (California Code of Regulations Title 3 Section 6450(e)), but not with the alternatives. Barrier films are consistently improving the performance of alternatives at lower dosage rates.

8.5 Minority Reports

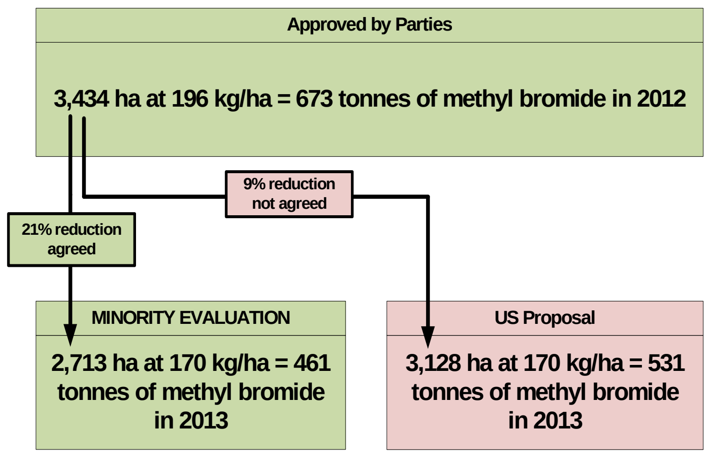
8.5.1. Minority Report 1: United States of America Nomination for the Use of Methyl Bromide for Strawberry Fruit Production in California in 2013

Signed by: Janny Vos, Cao Aocheng, Antonio Bello, Suat Yilmaz, Alejandro Valeiro, Tom Batchelor, Raquel Ghini

In 2011, the US nominated 531.737 tonnes of methyl bromide for the treatment of 4,406 ha in 2013 at an application rate of 170 kg/ha[1]. At the meeting in Turkey in March 2011, the US delegation in a meeting with MBTOC corrected the area to be treated from 4,406 ha to 3,128 ha. The nominated amount of 531.737 tonnes and treatment rate of 170 kg/ha remained the same.

MBTOC's recommendation for the 2010 nomination for 2012 that was approved by the Parties was based on 3,434 ha at an application rate of 196 kg/ha. MBTOC encouraged the Party to reduce this application rate as lower rates were considered feasible. This recommendation was the result of MBTOC's Soils Sub-committee meeting in the strawberry growing region of San José (California) in September 2010. The MBTOC Soils meeting was specifically held in that location last year to see firsthand the strawberry production in California and to fully understand the concerns of growers.

Figure 8-4: Reductions in the critical uses of methyl bromide approved and proposed



The signatories of this Minority Report hold firmly to the view that the MB-treated area in 2013 should be calculated on the basis of the approved area in 2012, namely 3,434 ha. A 21% reduction should therefore result in a MB-treated area of no more than 2,713 ha in 2013, as this is 21% less than the area proposed for treatment in 2012 of 3,434 ha. This area of 2,713 ha would result in a recommendation by MBTOC of 461.186 tonnes of methyl bromide at the rate of 170 kg/ha (see summary of these figures in 8-4).

The California Strawberry Commission (CSC) also presented information to MBTOC at the meeting in Turkey. The CSC advised MBTOC that it was "in dispute" with the US nomination of 531.737 tonnes[1], as it believed the nominated amount for California in 2013 should be 685.896 tonnes of methyl bromide[2]. This larger quantity was more than the amount approved by the Parties for producing strawberry fruit in California in 2012. An increased quantity would be inconsistent with paragraph 7 of Decision ExI/3 that says, "…Parties should aim to significantly and progressively reduce their production and consumption of methyl bromide for critical-use exemptions…", and inconsistent with previous annual reductions (8-5).

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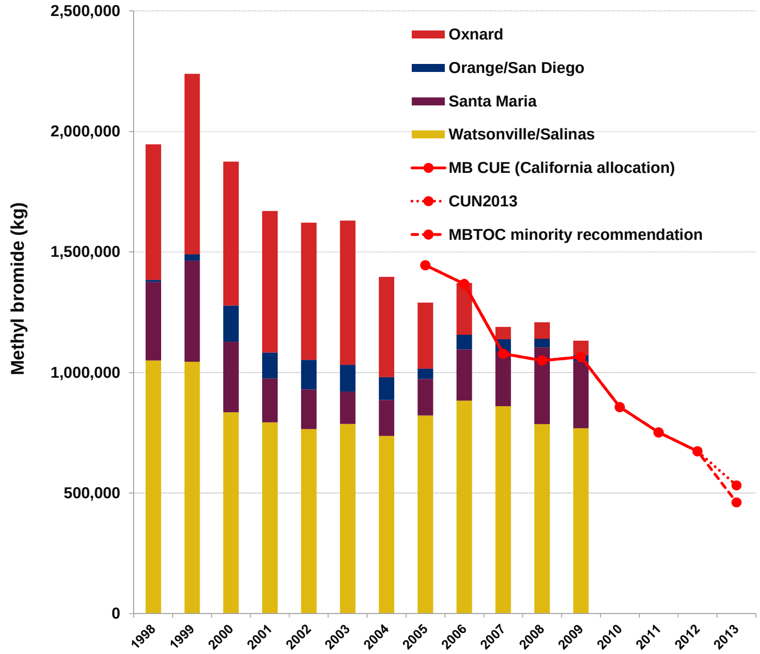
1 USA. 2011. Nomination for critical uses. USA_CUN13_SOIL_Strawberry_Fruit_Open_Field—CA.

2 California Strawberry Commission. 2011. 2013 CUE application. MBTOC meeting in Turkey March 2011. Slide 4.

3 CSC. 2011. 2013 CUE application. MBTOC meeting in Antalya Turkey March 2011. Slide 15.

Figure 8-5: Use of methyl bromide for strawberry fruit production in California districts (bar graph), compared with methyl bromide approved by the Parties (solid line) and proposed (dotted and dashed lines)



Sources: California DPR - Pesticide Use Report database (MB use till 2009), TEAP reports (MB CUE for California), CUN2013 and the minority recommendation

At the 2010 meeting in Turkey, MBTOC asked the US delegation to resolve the inconsistencies between the US nominated amount and the CSC amount and to correct the errors in estimating the area to be treated with methyl bromide in the nomination. The US 2011 nomination for 2013 did not provide any reasons for the inconsistencies and errors in their nomination.

The CSC stated that further information would be available in June 2011 on the availability of a key alternative, and that such information would be made available to MBTOC at that time.

8.5.1.1. Reasons for "unable to assess" the US critical use nomination for strawberry fruit in California

MBTOC is required to "…categorize the nomination as 'unable to assess' if there is insufficient information to make an assessment, and clearly explain what information was missing"[3]. Consistent with paragraph 4 of Section 2.4 in Decision XVI/4, the "…the Party may be requested via the Ozone Secretariat to submit further information".

The signatories of this Minority Report considered the US nomination for strawberry fruit "Unable to Assess" as:

- The information provided by the US delegation was not consistent between the nomination and the information provided at the meeting with MBTOC;

4 Annex to Decision XVI/4 (Annex I of MOP16 report).

- There was disagreement between the California Strawberry Commission and the US government on the area eligible for methyl bromide and the quantity of methyl bromide to nominate as a critical use;
- The majority recommended 70 tonnes more methyl bromide[4] than would otherwise be recommended following the spreadsheet calculations developed to satisfy the criteria in Decision IX/6; and
- Further information on the availability of an alternative will be forthcoming from the nominating Party in June 2011.

The signatories of this minority report respectfully request TEAP to categorise the nomination as "unable to assess" in this TEAP Progress Report until such time that the nominating Party submits further information for subsequent assessment by MBTOC.

8.5.2 Minority Report 2: United States of America Nomination for the Use of Methyl Bromide for Tomato, Pepper, Cucurbit and Eggplant Production in the USA

Signed by: Tom Batchelor, Antonio Bello, Janny Vos

The US submitted four nominations for 10.741, 5.673, 11.890 and 1.381 tonnes of methyl bromide for critical uses for the production of tomato, pepper, cucurbit and eggplant respectively[5]. The total nominated was 29.685 tonnes.

MBTOC's majority recommendation of methyl bromide for critical uses in 2013 for these four crops was inconsistent with paragraph 1(a)(ii) of Decision IX/6. This paragraph requires methyl bromide to qualify as critical only when "…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[5]". As evidence of alternatives being available, one of the US members of MBTOC presented a paper at an international conference in Morocco[6] held several days before the MBTOC meeting in Turkey that stated that "…30 tonnes of methyl bromide nominated by the US in 2013 for tomato, pepper, cucurbit and eggplant is less than 1% of the amount approved by the Parties for use on these crops in 2005"[7]. Therefore alternatives to methyl bromide are available for this use as more than 99% of the methyl bromide that was used in 2005 for the production of these four crops would be replaced by an alternative in 2013. The paper citing the availability of many alternatives for these crops is consistent with previous MBTOC reports[7]. In addition, the US agreed at the meeting with MBTOC to supply further information by 15 July 2011 in support of this nomination.

The signatories of this Minority Report request TEAP to consider the US nomination for tomato, pepper, cucurbit and eggplant "Unable to Assess" as:

- The recommendation was not compliant with Decision IX/6[6];
- The Party agreed to send further information in July 2011.

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4 5 May 2011 TEAP Progress Report

5 Decision IX/6. 1997. Critical use exemptions for methyl bromide. UNEP Ozone Secretariat website.

6 Schneider, S. 2011. Vegetable production without methyl bromide in the USA: Current situation, constraints and perspectives. Proceedings of International Symposium on "Vegetable Production without methyl bromide: A challenge for developed and developing countries". Agadir, 10-11 March 2011. Project MP/MOR/08/004/17-51. In publication.

7 For example, MBTOC. 2010. Assessment Report. Section 4.4.4: Vegetables / Solanaceous crops and cucurbits. Pp93-96.

The signatories of this Minority Report respectfully request TEAP to categorise the nomination as "unable to assess" in this TEAP Progress Report until such time that the nominating Party submits further information for subsequent assessment by MBTOC.

8.5.3 Minority Report 3: Nomination Submitted by Canada for the Use of Methyl Bromide for the Production of Strawberry Runners on Prince Edward Island

Signed by Tom Batchelor, Janny Vos, Antonio Bello

Canada submitted a nomination for 5.261 tonnes of methyl bromide for critical uses for the production of strawberry runners on Prince Edward Island.

The quantity of methyl bromide nominated for 2013 is the same amount approved by the Parties for use in 2011 as well as 2012. The quantity of methyl bromide is not reducing each year, as required by paragraph 7 of Decision ExI/3 that says "…Parties should aim to significantly and progressively reduce their production and consumption of methyl bromide for critical-use exemptions…".

The MBTOC Soils subcommittee determined that the Party is not undertaking research as required by paragraph 1(b)(iii) of Decision IX/6 that says "…Parties must demonstrate that research programmes are in place to develop and deploy alternatives and substitutes". The company has been testing organic production with different varieties and has found one variety that compared favorably to conventional production using methyl bromide. It was not clear why this one variety had not been put into production as a way to produce runners free of methyl bromide. The organic production testing ceased in 2009 and research has not continued after this date.

Chloropicrin is registered in Canada but the PEI authorities have denied a permit for its use until groundwater testing has been conducted. The Party has not undertaken ground water testing that was planned by the Party to commence in 2008. MBTOC Soils subcommittee determined that the Party had demonstrated "insufficient effort" to evaluate, commercialize and secure national regulatory approval of alternatives and substitutes, as required by paragraph 1(b)(iii) of Decision IX/6.

According to paragraph 1(b) of Dec IX/6, MBTOC is required to recommend methyl bromide for consumption only if the proposed critical uses show, inter alia, that research programmes are in place and that appropriate effort is being made to substitute methyl bromide.

The signatories of this Minority Report respectfully request TEAP to categorise the nomination as "Not recommended" in this TEAP Progress Report.

Table 8-11: Final evaluations of CUNs for preplant soil use submitted in 2011 for 2012 or 2013

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
Australia	Strawberry runners	35.750	37.500	35.750	35.750	29.790	29.790	**29.790**	**29.760**	-	**29.760**	-	**29.760**

MBTOC comments 2011:

MBTOC recommends a CUE of 29.760 tonnes for 2013. There has only been minor reductions made in last 5 CUEs submitted and no reduction in use rate as this is regulated by certification rules.

The Party states that the key pests affecting strawberry runner production are fungi (*Phytophthora, Pythium, Rhizoctonia* and *Verticillium* spp.) and weeds (*S. arvensis, Agrostis tenuis, Raphanus spp., Poa annua, Cyperus spp*). The Party also states that MB:Pic 50:50 at a MB dose of 25 g/m^2 is required to meet certification standards. Although this quantity exceeds MBTOC's standard presumption of 20 g/m^2, the lower rate is unregistered. The Party's first 2-year effort using a reduced rate of 18.75 g/m^2 resulted in unsatisfactory results in the second year of testing. The Party initiated another 2-year study using MB/Pic (50/50) @ 400 kg/ha [20g/m^2] and the standard rate MB/Pic (50/50) at 500 kg/ha [ie. MB at 25g/m^2]. Yields from the plot treated with MB/PIC [20g/m^2] were 25% less than the yields from the standard rate. Two additional commercial trials were initiated in 2010/2011 using the lower rate of 20g/m^2 as APVMA requires 2 years of trials before approving a reduced rate. The Party states that the most promising alternative, MI/Pic, has been demonstrated in commercial scale field trials to compare with the efficacy to MB:Pic. The registrant has indicated that additional data has been requested by APVMA which will be submitted this year and should lead to registration in late 2011. While more data has been submitted to support the registration of EDN, the Party indicates that the registration status is still highly uncertain. A key alternative, 1,3-D:Pic, is considered ineffective due to phytotoxicity and doubling of plant back times in the heavy and wet soil conditions in the high elevation regions. The Party also indicates that the Victorian Strawberry Certification Authority (VSICA) completed the second year of a 2-year development program for soil-less systems for production of foundation stock strawberry runners. Results indicated that the productivity of the soil-less system is similar to the current method of production in MB:Pic fumigated soils, and the economics of the soil-less system compares favourably with the current method of production. VSICA plans to establish a commercial facility by 2012 which, if successful, would eliminate VSICA's need for MB for foundation stock in 2011/2012.

MBTOC requires that the Party: (1) report the results with reduced rates of 20 g/m^2 of MB with its next CUN submission as well as the decision on whether to register the reduced rates; (2) provide a comprehensive update of the registration status of MI and EDN, (3) provide the results from the new trials using recaptured MB & Pic as well as a comprehensive plan for commercialization and (4) since the production of 60,000 foundation generation has been found to be economically feasible, the Party needs to provide the economic analysis that supports their assertion that any further expansion is not economically feasible. Although this nomination provides results of extensive research results with highly promising alternatives MBTOC expects significant adoption of these in any future nominations.

MBTOC comments on economics 2011:

The nomination was not based on economic arguments

<table>
<tr><th>Country</th><th>Industry</th><th>CUE for 2005[1]</th><th>CUE for 2006[2]</th><th>CUE for 2007[3]</th><th>CUE for 2008[4]</th><th>CUE for 2009[5]</th><th>CUE for 2010[6]</th><th>CUE for 2011[7]</th><th>CUE for 2012[8]</th><th>CUN for 2012 (addtl or new)</th><th>CUN for 2013</th><th>MBTOC rec. for 2012 (addtl or new)</th><th>MBTOC rec. for 2013 (new)</th></tr>
<tr><td></td><td colspan="13"><u>Comments requested in Dec. XX1/11 (para 9)</u>
• Dec. IX/6 b(i) Emission control: no, but standard films are claimed by the Party to perform the same as VIF in the cold temperatures and heavy wet soils typical for strawberry runner production.
• Dec. IX/6 b(iii) Research program: ongoing research is being conducted in (a) supporting reduced application rates of MB:Pic, (b) supporting the registration of MI; unknown for EDN; (c) use of recaptured MB & Pic;
• Dec. IX/6 b(iii) Appropriate effort: research effort is adequate but commercialization may be confronted with regulatory obstacles.</td></tr>
<tr><td>Canada</td><td>Strawberry runners (PEI)</td><td>6.840</td><td>6.840</td><td>7.995</td><td>7.462</td><td>7.462</td><td>7.462</td><td>5.261</td><td>5.261</td><td>-</td><td>5.596</td><td>-</td><td>5.261</td></tr>
<tr><td></td><td colspan="13">MBTOC comments 2011:
MBTOC recommends a reduced CUE of 5.261 tonnes for this use in 2013. In 2012 the requested amount was 5.261 t. In this round, the Party stated that the nomination had been reduced by 25%, but as it increased, MBTOC only recommends the quantity approved in 2012. The CUN for 2013 is based on a reduced rate for MB of 20 g/m², and MBTOC acknowledges the Party's reduction in the absence of formal registration for this dose rate.

The Party has attempted to replace MB with 1,3-D, but 1,3-D was banned for use in Prince Edward Island in January 2003 due to ground water contamination. Chloropicrin (PIC 100) has been registered by PMRA, but the PEI authorities have denied a permit for its use until further groundwater testing has been conducted. MI registrant has not applied for registration in Canada. The company has been testing organic production from 2006 - 2009 with different varieties and has found that they obtained significant reductions in yield ranging from 40% to 70%. Only one variety using the organic production system compared favorably to conventional production. While MB:Pic 67:33 at 500 kg/ha is the only use rate registered for strawberry runners, which exceeds MBTOC's standard presumption of 200 kg/ha, the grower petitioned PMRA to use a lower rate under barrier films. PMRA, in the absence of a formal label amendment, granted permission to use a lower rate, but at the grower's own risk and liability. In 2008 the grower tested two plots totalling 2.4 ha using 25% & 30% lower rates under barrier films and expanded the area tested in 2009. The results were comparable using the reduced rates with barrier films. The CUN for 2013 is based entirely on a reduced rate for MB of 200 kg/ha for the entire area to be fumigated.

For future submissions, MBTOC suggests actions for the Party to (1) complete the necessary ground water studies to obtain the PIC 100 permit which was indicted by the Party to commence in 2008 and (2) test the adoption of soiless cultures for at least part of the production cycle, 3) provide an update on barriers to adoption of other key alternatives (especially methyl iodide/chloropicrin). MBTOC requests greater substantiation of effort (ie trial data) be provided to support any future nominations as required in Decision IX/6.

MBTOC comments on economics 2011:
The nomination was not based on economic arguments.</td></tr>
</table>

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
	<u>Comments requested in Dec. XX1/11 (para 9)</u> • **Dec. IX/6 b(i) Emission reduction**: Yes, uses barrier films with reduced application rate of MB conforming to MBTOC's presumptions • **Dec. IX/6 b(iii) Research program**: No recent research; previous focus has been on organic production testing; registrant for Midas has not submitted any registration application materials at this time. • **Dec. IX/6 b(iii) Appropriate effort**: The Party has not demonstrated an active research program on its most critical issue since it has been unable to obtain assistance to do the necessary GW testing required by PEI authorities before approving the use of PIC100 in PEI.												

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
United States	Cucurbits	1187.800	747.839	592.891	486.757	407.091	302.974	195.698	**59.500**	**-**	**11.899**	**-**	**11.899**

MBTOC comments 2011:

MBTOC recommends a CUE of 11.899 tonnes for this use in 2013, provided the Party submits further explanation on the specific issues that have arisen for the alternatives by July 15th, 2011 recognizing that the nominated amount represents an almost complete phase-out in this industry. The USG may either support or withdraw this nominated sector at the OEWG. If the US proposes an increased amount, MBTOC will need to reassess. From this amount, 0.815 t are for Georgia squash, 0.657 tonnes for Georgia cucumber; 2.415 tonnes for Georgia melon; and 7.665 t for the Southeast region and 0.348 t for Mardel area.

The Party states that the major disease problems addressed by grafting in cucurbits include fusarium wilt (Thies *et al.*, 2008), the main problem in Mardel area. Rootstocks resistant or tolerant to *Fusarium oxysporum* are available for melon, watermelon and cucumber (Blestos, 2005; Crinó *et al.*, 2007). Cost still is the major factor limiting grafting in the US. However, the cost of grafting vegetables has decreased dramatically internationally since the mid-1990s. Methyl iodide applied under metallized tarps has shown to be as efficacious as MB (Hausbeck and Cortright, 2007; Olson and Kreger, 2007), but this fumigant is not registered for cucurbits and the producing company does not pursue its registration (Brilleman, pers.com. March 2011). In Georgia, fumigant combinations using 1,3-D, chloropicrin and metham sodium (TELPICVAP) were as effective as methyl bromide for controlling *Meloidogyne incognita*, *Pythium irregulare*, *Rhizoctonia solani* and *Cyperus esculentus* in squash crops (Desaeger *et al.*, 2008). A study suggests that - as in bell pepper- in cucumber, squash and zucchini crops TELPICVAP and smooth low density black or black polyethylene mulch (metal) could give the highest net revenue per acre making it the most profitable fumigant and mulch option if compared with others (Ferrer *et al.,* 2010)

MBTOC acknowledges the substantial reduction made by the Party of 80% from 2012. Past reductions have been based on a transition to a 3 way combination of 1,3 D + chloropicrin, followed by chloropicrin alone, followed by metam-sodium, that shows good results against key cucurbit pests in spring season fumigation. However, MBTOC continues to stress the need of considering also non chemical methods within an integrated pest management strategy. MBTOC notes that, although being a key herbicide to control the most important crops´ weeds, there is a controversy about potential phytotoxic effects of halosulfuron on cucurbits. However, a recent set of studies show that, even though this could be partially true, some windows could be found to use halosulfuron in a way and timing to control weeds while minimizing impacts on yields and quality of fruits (Brandenberger *et al.,* 2005; Norsworthy et al., 2007; Trader *et al.*, 2007; Macrae *et al.*,2008; Sosnoskie *et al.*, 2008; Culpepper *et al.,* 2009).

MBTOC comments on economics 2011:

The same economic information is provided as in the previous year. CUN is not based on economic arguments

<u>Comments requested in Dec. XX1/11 (para 9)</u>

- **Dec. IX/6 b(i) Emission reduction:** Rates consistent with use of barrier films are used in the application. The amount used was reduced by 80%.

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
	• **Dec. IX/6 b(iii) Research program:** The Party states that several studies are been conducted in recent years and many continue to be. The Party states that studies done in southern U.S. tomato and pepper production systems are also included in the list above, because these systems are similar to southern U.S. cucurbit production in terms of soil environment, key pests, etc. • **Dec. IX/6 b(iii) Appropriate effort:** The party has shown efforts by the reduction of 70% from its last nomination. The current nomination is asked for specific cases such as Karst soils												
United States	Eggplant	76.721	82.167	85.363	66.018	48.691	32.820	19.725	**6.904**	**-**	**1.381**	**-**	**1.381**
	MBTOC comments 2011: MBTOC recommends 1.381 tonnes for this use for 2013, provided the Party submits further explanation on the specific issues that have arisen for the alternatives by July 15th, 2011. Of this amount, 0.769 t are for Georgia and 0.612 t are for Florida. If substantiation is not provided, MBTOC does not recommend this nomination.The USG may either support or withdraw this nominated sector at the OEWG. If the US proposes an increased amount, MBTOC will need to reassess. The Party has made an 80 % reduction in MB use from the amount approved by the Party's for 2012 (6.904 t). The US nomination is only for those areas where the alternatives are still under extensive evaluation and pest pressure (nutsedge, nematodes and *P. capsici*) is high. The Party is projecting rates of 125 kg/ha both for pathogens and for nutsedge. The Party states that the treatment, known as the "UGA 3-WAY", consisting of three successive soil fumigations, beginning with 1,3-D + Pic application, followed by a Pic application, followed by a metham-sodium or metham-potassium application (Culpepper, 2007) is an alternative for MB in spring crops. For summer and fall crops, this system needs further development for use in areas with moderate to high nutsedge pressure. In addition, metham sodium and metham potassium in the fall require longer waiting periods for planting than MB. Delays could result in missed market windows. A further constraint to adoption of the UGA-3 WAY is that 1,3-D is restricted in areas of Karst topography where ground water is vulnerable to leaching from 1,3-D. This research is on-going, however specific studies conducted or in progress since the last nomination were not cited in the CUN. The Party states that dimethyl disulfide (DMDS) plus Pic are also feasible alternatives, but this combination does not effectively control certain grasses (Culpepper et al., 2008). Trials will continue with this alternative. An application to register DMDS is under consideration at USEPA. MI is not registered for eggplant. The US nomination is only for those areas where the alternatives are still under extensive evaluation and pest pressure (nutsedge, nematodes and P. capsici) is high. The Party states that a 50:50 formulation (MB/Pic) is widely used in Florida but does not provide information about the formulation used in Georgia. MBTOC acknowledges the substantial reduction by the Party for uptake of alternatives, particularly the use of the 3 way system and the combination of DMDS and chloropicrin. MBTOC considers that further reductions in MB amount may be possible with changes to formulations of 30:70 used in combination with barrier films commercially feasible. MBTOC considers that the Party should develop non chemical alternatives e.g. grafting, biofumigation, soil less culture, which are widely used in many countries and regions with similar climate and pest (Besri, 2008). It is important to note that MB is not used in any other non A5 country on eggplant. There is no indication in the nomination that research in these areas is continuing.												

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
	MBTOC comments on economics 2011: The same economic information is provided as in the previous year. CUN is not based on economic arguments **Comments requested in Dec. XX1/11 (para 9)** • **Dec. IX/6 b(i)- Emission Reduction:** There is no information in the nomination about the use of VIF or equivalent film, however, the rates (125 kg/ha) are consistent with the use of VIF. • **Dec. IX/6-b(iii)-Research Program:** This research is on-going, however specific studies conducted or in progress since the last nomination were not cited in the CUN. • **Dec. IX/6-b(iii)-Appropriate Efforts:** It appears that the party is making an appropriate effort to replace MB with alternatives such as the Georgia 3-Way and Meth Iodide. More effort to implement grafting, resistant root stocks, etc. may facilitate the phase out of MB in areas where regulatory constraints prevent the use of som of the chemical alternatives.												
United States	Nurseries stock (fruit, nut, flower)	45.800	64.528	28.275	51.102	25.326	17.363	7.955	**1.591**	**-**	**0.541**	**-**	**0.541**
	MBTOC comments 2011: MBTOC recommends 0.541 tonnes of MB for this use in 2013. This represents a reduction of 66% from previous amounts. The Party states that the requested amount is for those crops that require certification but do not move across controlled boundaries e.g. counties and cannot use the preferred alternatives such as 1,3-D due to township caps or on specific soil conditions. The treatment for crops such as fruit and nut trees and rose nurseries are required to meet certification standards for a crop that is in the ground for two years. Some portions of the crops in this sector are now produced in substrates and alternatives are used wherever possible. The target pest for certification is nematodes, but control of soilborne pathogens and weeds also impacts product quality. **MBTOC comments on economics 2011:** The same economic information is provided as in the previous year. CUN is not based on economic arguments **Comments requested in Dec. XX1/11 (para 9)** • **Dec. IX/6 b(i) Emission reduction:** Yes. Barrier films cannot be used for this nomination in California, but rates conform to the standard presumptions. • **Dec. IX/6 b(iii) Research program:** Yes, An area wide program is evaluating the key alternatives, including methyl iodide/Pic. • **Dec. IX/6 b(iii) Appropriate effort:** A range of alternatives are being considered and commercialized.												

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
United States	Orchard replant	706.176	527.600	405.400	393.720	292.756	215.800	183.232	**18.324**	**-**	**6.230**	**-**	**6.230**

MBTOC comments 2011:

MBTOC recommends 6.230 tonnes for this use in 2013. This includes 4.318 t for stone fruit, 0.213 t for raisins, 0.627 t for walnuts, 0.564 t for almond and 0.508 t for wine grapes. The CUN is for orchard/vineyard replant disorder of unknown etiology for a portion of replant sites in California where alternatives are not suitable or available (1,3-D) or where the data on the effectiveness of lower rates of methyl iodide (MI which is currently registered in California) are still being collected and effectiveness is not yet known.

The Party states that alternatives are not available because of regulatory restrictions or physical characteristics such as unacceptable soil type, moisture or topography. The CUN is for heavy soils or soils which cannot be effectively treated to a sufficient depth to effectively use the reduced rates of 1,3-D now allowed in California. Regulatory constraints (maximum labelled rates) prevent the use of 1,3-D at the rates needed for effective kill of old roots and the associated pathogens in deeper soil. Although methyl iodide has been registered in California since December 2010 for replant, successful trials have only been reported with rates higher than registered (Browne *et. al*., 2010; Schneider *et. al*, 2005). Trials at the registered, lower, rates have been initiated. The best alternatives for orchard replant that have been identified are 1,3-D or 1,3-D with chloropicrin, and/or metam-sodium, especially in coarse-textured soils. Under certain soil and moisture conditions (less than 12% to 1.5 meters) 1,3-D is an effective management tool for replant problems and is currently used to replant the majority of orchard and vineyard sites.

MBTOC acknowledges that the CUN is for a substantially smaller amount that is 34 % of the previously approved CUN. The Party confirms that MB/Pic 67:33 formulation is used for California stone fruit, raisin grapes, and wine grapes, and now as well for almond and walnut at a dose rate of 20g/m^2.

MBTOC comments on economics 2011:

The same economic information is provided as in the previous year. CUN is not based on economic arguments.

Comments requested in Dec. XX1/11 (para 9)

- **Dec. IX/6 b(i) Emission reduction:** No, high barrier films cannot be used in California due to regulatory constraints. Rates conform to the standard presumptions without barrier films. Rates conform to the standard presumptions with barrier films.
- **Dec IX/6 b(iii) Research program:** Yes, research effort have been conducted on alternatives.
- **Dec. IX/6 b(iii) Appropriate effort:** Substantial reduction indicates appropriate efforts.

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
United States	Ornamentals	154.000	148.483	137.835	138.538	107.136	84.617	64.307	**48.164**	**-**	**48.164**	**-**	**40.818**

MBTOC comments 2011:

MBTOC recommends a reduced amount of 40.818 tonnes for this use in 2013. This includes 39.907 t for California and 0.911 t for Florida.

The Party states that the nomination is for a large number of species, mostly grown in the field. In Florida, the main species using MB are gladioli, lilies and snapdragon. Additional species using MB in California include alstroemeria, carnations, delphinium, gerbera, chrysanthemums, pompons, rose and others. There are several types of cut flower, foliage, and bulb crops grown each year and often several species are grown in the same field simultaneously. MB is needed to control diseases (e.g., *Fusarium* spp., *Pythium* spp., *Phytophthora* spp., and *Rhizoctonia* spp.), plant parasitic nematodes (e.g., root knot, root lesion, stunt and dagger), weeds (e.g. *Cyperus* spp., *Portulaca*, *Ambrosia* and others), and previous crop propagules. Methyl iodide (MI) is now registered in California but as yet there is little data as to efficacy at the reduced rates on the California label. MI has been registered since 2009 in Florida and some data as to its efficacy is available, but there are some concerns on its applicability for widespread use on certain soil conditions (Kokalis-Burelle *et al.*, 2010; Rosskopf *et al.,* 2010 ab). The major issue with MI is the potential cultivar sensitivity and this requires more research with the many cultivars and flower crops produced.

MBTOC considers other alternatives are available in Florida, such as 1,3-D/Pic and solarization sometimes combined with chemicals (McSorley *et al.*, 2006 ab; McSorley *et al.*, 2008). Steaming systems and application methods were evaluated in California and provided pest control statistically similar to hot-gas methyl bromide (Gilbert *et al.*, 2009; Rainbolt *et al.,* 2010). MBTOC has reduced the nomination by 15% for California and 25% for Florida, respectively, based on implementation of substrates, steam and uptake and improvement in MI technologies by 2013 and the registration time (and rate) for MI.

MBTOC comments on economics 2011:

The same economic information is provided as in the previous year. CUN is not based on economic arguments.

Comments requested in Dec. XX1/11 (para 9)

- **Dec. IX/6 b(i) Emission reduction:** Yes, for part of the nomination. Barrier films are currently used in Florida. Barrier films cannot be used in California due to regulatory constraints. Rates conform to the standard presumptions with barrier films.
- **Dec. IX/6 b(iii) Research program:** Yes, research efforts have been conducted on alternatives.
- **Dec. IX/6 b(iii) Appropriate effort:** The nomination indicates significant efforts have been made to switch to alternatives. Substantial reduction indicates appropriate efforts particularly in Florida. In California, efforts have been made within the constraints imposed by regulations.

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
United States	Peppers (field)	1094.782	1243.542	1106.753	756.339	548.984	463.282	206.234	**28.366**	**-**	**5.673**	**-**	**5.673**

MBTOC comments 2011:

MBTOC recommends 5.673 tonnes for this use in 2013, provided the Party submits further explanation on the specific issues that have arisen for the alternatives by July 15th, 2011. If substantiation is not provided, MBTOC does not recommend this nomination. The USG may either support or withdraw this nominated sector at the OEWG. If the US proposes an increased amount, MBTOC will need to reassess the nomination.

Of the recommended amount, 0.068 t is for the Southeast, 0.189 t is for Georgia and 5.415 t is for Florida.

The Party has made an 80 % reduction in MB use from the amount approved by the Party's for 2012. MBTOC acknowledges the substantial reduction by the Party for uptake of alternatives. The Party did not submit a CUN for Michigan for 2013. The Party is projecting rates of 125 kg/ha (12.5 g/m^2) for both pathogens and nutsedge. In addition, the party states that the treatment, known as the "UGA 3-WAY", consisting of three successive soil fumigations, beginning with 1,3-D + Pic application, followed by a Pic application, followed by a metham-sodium or metham-potassium application (Culpepper, 2007a), is an alternative for MB in spring crops. For Georgia fall crops, this system needs further development for use in areas with moderate to high nutsedge pressure. 1,3-D is restricted in areas of Karst topography where ground water is vulnerable to leaching from 1,3-D. In addition, metham sodium and 1,3-D in the fall require longer waiting periods for planting than MB. Delays could result in missed market windows. Midas, a mixture of MI and Pic, has received state-level approval in 47 US states (California, Washington, and New York are the exceptions at this time). However, the Party states that some time will be necessary before Midas achieves a full adoption. The main constraints to the widely use of MI are : (1) the cost of MI formulations which is higher than MB, (2) growers and researchers will need time to evaluate MI use in the various local production conditions covered by this nominations, and (3) growers and applicators will need to make some equipment modifications to adapt to the lower flow rates typical with less expensive MI application rates and to avoid the corrosion of some metals that can occur with MI (Sumner 2005, Noling *et al.*, 2006).

MBTOC considers that further reductions in MB amount is possible with changes to formulations of 50:50 MB/Pic or less (e.g. to 30:70) used in combination with barrier films, MBTOC considers that the Party should also develop some non chemical alternatives e.g. grafting, biofumigation, soil less culture, etc. which are widely used in many countries and regions with similar climate and pest. It is important to note that MB is not used in other non Article 5 countries on pepper.

MBTOC comments on economics 2011:

The same economic information is provided as in the previous year. CUN is not based on economic arguments

Comments requested in Dec. XX1/11 (para 9)

- **Dec. IX/6 b(i) Emission Reduction:** There is no information in the nomination about the use of VIF or equivalent film, however the nomination does indicate that there is an active program of research into the use of various barrier films and the rates **(125 kg/ha**) are consistent with the use of barrier films and MBTOC's standard presumptions
- **Dec. IX/6 b(iii) Research Program:** Yes, equivalent research is on-going in similar sectors,

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
	• **Dec. IX/6 b(iii) Appropriate Efforts:** It appears that the Party is making an appropriate effort to replace MB with alternatives such as the Georgia 3-Way and Methyl Iodide. More effort to implement grafting, resistant root stocks, etc. may facilitate the phase out **of MB in areas where regulatory constraints prevent the use of some of the chemical alternatives**												
United States	Strawberry (field)	2052.846	1730.828	1476.019	1349.575	1269.32	1007.477	812.709	**678.004**	**-**	**531.737**	**-**	**461.186**
	MBTOC comments 2011 After reviewing the MBTOC report, including the text of the minority report, TEAP made a recommendation for a reduced amount of 461.186 tonnes for strawberry fruit in California for 2013 and that the Party provide further substantiation of why the 70.551 tonnes (or part there of) can not use alternatives demonstrated by MBTOC. The amount approved is part of the nominated amount of 531.76 t by the Party. After TEAPs Decision, a report was written by nine members of the majority to restate their position on the recommendation (see below) - this report was not reviewed by TEAP. MBTOC reiterates its previous suggestions in 2010 that shank injection of 1,3-D/Pic may result in improved disease control compared to drip application, but recognise that township cap regulations impose a penalty on shank injection. MBTOC continues to urge the Party to reconsider the evidence that led to this regulation. Regulations in California also prohibit the use of VIF films with MB application, and therefore discourage reduction of MB dose rates as well as emission control through use of VIF. PUR use data for 2009 indicate that MB:Pic 57:43 formulations are used on 73% of the MB fumigated acreage, and that 50:50 formulations are used on 5% of the California use area. The Party has adopted a dose rate of 170 kg MB/ha in its CUN for 2013. MBTOC commends this transition to 170 kg/ha as MBTOC encourages wider use of 50:50 formulations, which still allow for complying with regulatory restrictions on Pic use. The registration progress of MI/Pic in California was completed successfully in December 2010, however MI/Pic use is restricted by buffer zones and other restrictions. MBTOC notes the barriers to adoption of MI, as cited by the California Strawberry Commission (CSC) that alluded to actions by environmental groups and market stakeholders, the conditional nature of the MI registration in California, and observations of phytotoxicity. MBTOC requests the Party to confirm the area of critical need, with a complete breakdown of that unable to use 1,3-D or Pic or their mixtures and those unable to use methyl bromide in any future nominations. MBTOC continues to urge the Party to develop an action plan for California, particularly addressing the restrictions on the use of alternatives adopted elsewhere in the USA, and showing stepwise reductions to effectively progress the transition to MB alternatives. MBTOC notes and commends the withdrawal of MB for this use in Florida and Eastern USA, where full transition to alternatives has been completed. **Majority position** At the March meeting of MBTOC in Turkey, a majority view (15 of 24 committee members present) supported nomination by the Party of 531.76 tonnes for use in 2013 which is a 21% reduction (for methyl iodide uptake) based on the 673.085 tonnes MB approved at the MOP in 2010 for use in 2012. The area stated for use in 2013, as corrected in the bilateral with the U.S. government, is 3,128 ha which is a 21% reduction of the area estimated: 170 kg/ha x 3.128 ha= 531.760 tonnes. MBTOC has accepted, in 2010, a dose rate of 196 kg/ha in California, however encouraged the Party to reduce its dose rate to 170 Kg/ha which the Party accepted.												

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)

MBTOC acknowledges this effort in the dose reduction.

The majority considers that in the past, there has been variability in the area of land treated with methyl bromide as farmers lease land and crop practices change within regions and counties and therefore it is difficult to identify the exact area to be treated. Analysis and models to predict with precision the location of production do not exist and MBTOC has relied on historical data to predict future trends. As the Party is making a good transition to a new alternative the majority accepted the Party reduction. The Party proposed a transition of 21% from the 2012 CUE amount of 673.085. The nomination is therefore based on a dose rate of 170 kg/ha and an area of 3,128 ha which was a 21% reduction of 3959 ha.

Further elaboration of the rationale for the majority recommendation of 531.76 tonnes appears immediately following this table.

Minority position
The minority position was signed by seven members. The minority recommended that the nomination was 'Unable to Assess' and that the amount recommended should be based on the nominated dosage rate of the Party at 170 kg/ha and a 21% reduction of the critical area of 3.434 ha (for methyl iodide uptake), which was the area used by MBTOC last year to determine the 2012 CUE and approved by the MOP. Also, that a decision not be made until the Party confirm the critical area that cannot use alternatives, particularly 1,3-D or Pic and their mixtures, as determined by MBTOC is incorrect. The critical area in 2010 was calculated by the minority just as in past opportunities, using information from the Californian Pesticide Use Reports and information on restrictions provided by the Party on use of 1,3-D and Pic. This information was discussed and given to the Parties during bilateral discussions in 2011.

TEAP recommendation
At the May meeting in 2011, and after listening to the majority and minority points of views, TEAP agreed to support a part of the nominated amount which was not questioned by the majority and the minority positions of MBTOC (ie 461.186 t). The additional amount, 70.551 tonnes requires, further substantiation of the critical area not able to use the alternatives (1,3-D and Pic and their combinations) as provided by MBTOC to the Party. The Party is invited to provide further information by 15 July 2011 for further evaluation by MBTOC for any amount above the minority recommendation up to the nominated amount.'

MBTOC comments on economics 2011:
CUN includes a partial budget for the use of iodomethane by California strawberry producers, in addition to Pic+MB and 1,3D+Pic as in the previous year. CUN shows that the gross margin (termed net revenue in the CUN) declines from $688 per hectare using methyl bromide to a loss of $3889 per hectare using iodomethane, $8614 using Pic+MB, and $8042 using 1,3D+Pic, the latter two as a result of a yield loss of 15% and 14% respectively. MBTOC cannot verify the accuracy of the data, but notes that UC Davis estimates the return to strawberry production in California as $6700 per acre, or more than $16500 per hectare (http://coststudies.ucdavis.edu/current.php).

Comments requested in Dec. XX1/11 (para 9)

- **Dec. IX/6 b(i) Emission reduction:** In California VIF is not used;

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
	• **Dec. IX/6 b(iii) Research program:** Yes, there is an ongoing research program, which the CUN refers to; • **Dec. IX/6 b(iii) Appropriate efforts:** In California there is varying effort in the different production districts.												
United States	Strawberry runners	54.988	56.291	4.483	8.838	7.944	4.690+ 2.018	6.036	**3.752**	**-**	**3.752**	**-**	**3.752**

MBTOC comments 2011:

MBTOC recommends 3.752 tonnes for this use in 2013, This CUE recommendation is based on an area of approximately 19 ha at a rate of 20 g/m^2 in California.

The Party stated that the amount applied for is lower than those required by the nematode certification program which specifies rates of 22.4 to 33.6 g/m^2 MB used on sandy and clay loam soils according to the of California Dept of Agriculture Nursery Inspection Procedures Manual No. 7. Studies in other nursery industries have shown that MI in combination with Pic and metham has given equivalent effectiveness for nematodes at rates of 336 kg/ha. Methyl iodide has been approved for nursery certification purposes, but the present rates required for certification (26 g/m^2) are greater than those presently registered in California (10 g/m^2). A major proportion (99%) of the hectares are exempted under QPS. The key pests previously stated as affecting strawberry runners are weeds (purple and yellow nutsedge), fungi (*Rhizoctonia* and *Pythium spp* in SE, *Phytophthora*,*Verticillium* in California), nematodes (root-knot, sting in CA). Alternatives evaluated in research trials over the past several years showed that 1,3-D/chloropicrin, 1,3-D/chloropicrin + metam-sodium, 1,3-D and metam-sodium, and dazomet as a follow-up application to 1,3-D/chloropicrin or chloropicrin (Fennimore *et al.*, 2008b) were very effective. These formulations have been shown to give similar pathogen control in soils and will meet requirements of certification (Kabir et al., 2005; Fennimore *et al.* 2007, 2008; MBAO). However, regulations in California on the use of 1,3-D and chloropicrin restrict key alternatives used in some locations.

MBTOC acknowledges that trials are now underway to evaluate efficacy of the lower registered rates for certified nursery use and approval and expect future nominations to update on trials with these products. Transition rates to MI have not been considered by the Party for this CUE. The CUN does not specify regions for use. MBTOC requests that a full review of trials with feasible alternatives (especially MI/Pic) be provided with future nominations as required under Decision IX/6.

MBTOC comments on economics 2011:

The same economic information is provided as in the previous year. CUN is not based on economic arguments

<u>Comments requested in Dec. XX1/11 (para 9)</u>

- **Dec. IX/6 b(i) Emission control**: Yes in Florida and Eastern states, with use of VIF; No in California where VIF is not used; Rates conform to standard
- **Dec. IX/6 b(iii) Research program**: Yes, ongoing research is being conducted showing that MI/Pic especially is effective, but it is not yet registered at rates suitable for certification in California.
- **Dec. IX/6 b(iii) Appropriate effort**: No, trials have not been provided showing use of MI/Pic at lower rates. MI has qualified for certification use by CFDA, however it is not yet registered at suitable rates.

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
United States	Tomatoes (field)	2876.046	2476.365	2065.246	1406.484	1003.876	737.584	292.751	**54.423**	**-**	**10.741**	**-**	**10.741**

MBTOC comments 2011:

MBTOC recommends an amount of 10.741 tonnes for this use in 2013, provided the Party submits further explanation on the specific issues that have arisen for the alternatives by July 15th, 2011. If substantiation is not provided, MBTOC does not recommend this nomination. The USG may either support or withdraw this nominated sector at the OEWG. If the US proposes an increased amount, MBTOC will need to reassess.

Of the nominated amount, 0.1 t is for Maryland, 0.129 t for Virginia, 1.633 t for SE, 0.776 t for Georgia, and 8.331 t for Florida.

The Party has projected a significant transition to alternatives, about an 80 % reduction in MB use from the amount approved by the Party's for 2012 use (54.423 tonnes). The UGA 3-WAY has been shown to be effective for tomatoes in Georgia. However, the use of any alternative strategies involving 1,3-D are limited by regulatory restrictions in areas with karst topography. Plant back timing is also a constraint in some regions as it affects market timing. In addition, there is still the need for more research to determine the fumigant rates and mulch combinations needed for pest control and crop safety where there is heavy pest pressure. Midas, a mixtur of MI and Pic, is registered in the tomato nominated states. This product has shown good efficacy against key tomato pests, including nutsedge, in a number of trials wi tomatoes (Olsen 2008). Midas has received state-level approval in US states, except in Washington, and New York. DMDS has a Federal registration but not yet in Florida and California and has demonstrated effectiveness, however there are still some technical and application issues to be resolved under some conditions. Treatments with DMDS plus chloropicrin and/or metam-sodium are not significantly different from methyl bromide + chloropicrin. However the strong odor of DMDS is a impairment to its widespread adoption.Grafting is widely used in many countries and regions with similar climate and pest (Besri 2008). Many authors (Burelle et al. 2008, Kubota 2008, Louws 2009, Bausher 2009) provides evidence that root stocks e.g. 'Big Power', 'Beaufort', and 'Maxifort' can be utilized in US to manage soil born pathogens. Freeman et al. (2009) reported that although grafted plants add significantly to input costs at current prices, the net economic result is often positive when infestations are high. It is important to note that MB is not used any more in developed countries (e.g. European countries , Australia, Japan, Israel) and in many developing countries (e.g. Morocco, Lebanon, Turkey) on tomato.

MBTOC acknowledges the substantial reduction by the Party for uptake of alternatives, particularly the use of the "UGA 3-WAY", consisting of three successive soil fumigations, beginning with 1,3-D + Pic application, followed by a Pic application, followed by a metam-sodium or metam-potassium application as well as the increase use of methyl iodide (Culpepper, 2007, Gilreath et al. 2006, Noling et al. 2006). MBTOC considers present issues with MI amd DMDS to be transition issues.

MBTOC comments on economics 2011:

The same economic information is provided as in the previous year. CUN is not based on economic arguments.

Comments requested in Dec. XX1/11 (para 9)

- **Dec. IX/6 b(i)- Emission Reduction:** No, there is no information in the nomination about the use of VIF or equivalent film, however there is an active program of research into the use of various barrier films.

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
	• **Dec. IX/6-b(iii)-Research Program:** Yes, the research is on-going, however specific studies conducted or in progress since the last nomination were not cited in the nomination • **Dec. IX/6-b(iii)-Appropriate Efforts:** The Party made large reductions. Adoption of chemical and non chemical alternatives may facilitate the phase out of MB in areas where regulatory constraints prevent the use of some of the chemical alternatives.												
United States	Research									**6.111**	**6.203**	**Unable**	**Unable**
	MBTOC comments 2011: MBTOC was unable to recommend this nomination in total at this time. Decision XVII/9 (7) states that Parties should endeavour to source quantities for research from stocks. At present rate of drawdown of about 1200 tonnes annually (US Accounting Framework for 2009, 2010), pre-2005 stocks should be exhausted by end of 2011. The nomination of 7.445 and 7.537 tonnes for 2012 and 2013 respectively covers three distinct areas of MB-related research: (1) research targeted directly at developing or improving QPS procedures involving use of methyl bromide, (2) research directed at gathering full scale performance and emission data on films, using methyl bromide and other fumigants, to meet regulatory requirements and approval processes, and (3) research on alternatives where methyl bromide is used as a performance benchmark during development and approval of alternatives. In several particular nominated uses, the quantity nominated for research exceeds the nomination for the use itself. Parties may wish to consider quantities for research used for category (1), development of QPS treatments, be considered as exempt from control measures in the same way as QPS treatments themselves. MBTOC recommends that uses in category (2) be approved as a CUE, provided that best endeavours have been used to source the required quantities from stocks and that these have been unsuccessful. MBTOC recommends that quantities nominated in category (3) be approved, provided that best endeavours have been used to source the required quantities from stocks and that these have been unsuccessful, and suggests that this be only in cases where the need to benchmark performance of potential alternatives is specifically required to eet regulatory and registration requirements. In cases where this is not so, MBTOC suggests that an alternative benchmark be used to assess comparative effectiveness. The Party has submitted research plans in one case (Cured Pork CUN) to explain the nominated quantities. This part of this CUN has been disaggregated from the nomination and is considered separately in the Structures and Commodities text boxes. MBTOC seeks detail on the plans in the other sectors within this CUN and confirmation of the quantities requested, how these are allocated to the various categories of use, and the background to the regulatory need for methyl bromide as a performance benchmark in each use. This should enable MBTOC to finalise its recommendations for this complex nomination.												

[1]1ExMOP and 16MOP; [2]16MOP+2ExMOP+17MOP; [3]MOP17+MOP18; [4]MOP18+MOP19; [5]MOP19+MOP20; [6]MOP20+MOP21; [7]MOP21+MOP22; [8]MOP22

8.6. Report Presented after the TEAP Decision on the US Strawberry CUN by Some Members who Supported the Majority Position after the MBTOC Meeting

Signed by: Abraham Gamliel, Jim Schaub, Ken Vick, Sally Schneider, Peter Caulkins, George Lazarovits, Andrea Minuto, Chris Bell, Nick Vink, Akio Tateya, Darka Hamel

TEAP Statement

Section 8.6 is a signed statement by the majority segment of voting MBTOC members in response to the signed minority report concerning the US strawberry CUN and recommendations of TEAP itself. This statement was submitted after the TEAP meeting where TEAP made recommendations on this CUN and TEAP members did not review the statement. Therefore the views expressed by the segment of voting MBTOC members reflects the opinion of the signatories and not necessarily the views of other MBTOC or TEAP members.

The strawberry textbox in the Oct 2010 TEAP report notes that the Party nominated 751.596 tonnes for an area of 4421 ha treated at 170 kg/ha for California in use year 2012 and this is shown in the CUN, as well. Later in the same textbox, there is language that says that MBTOC has accepted a dose rate of 196 kg/ha in California. This could be text left over from previous years, as higher rates were nominated in earlier years. It is unlikely that MBTOC would recommend a higher rate than the Party had nominated, and thus is reasonable to assume a use rate of 170 kg/ha. MBTOC recommended and the Parties approved 90% of the nominated amount, so a reasonable estimate of the area using the 170 kg/ha nominated rate and the approved amount for California of 673.085 tonnes would be 3,959 ha. The area stated for use in 2013, as corrected in the bilateral with the U.S. government, is 3,128 ha which is a 21% reduction of the area estimated. When multiplied by 170 kg/ha, the result is 531.760 ha, essentially the amount nominated. This is the most likely scenario, since the CUNs for both 2012 and 2013 nominated a use rate of 170 kg/ha.

If indeed MBTOC approved, and the Party used, a use rate of 196 kg/ha instead of the 170 kg/ha that was nominated, the approved amount of 673.085 tonnes could be used to treat 3,434 ha. A 21% reduction from 3,434 ha is 2,713 ha. If this reduced area is then multiplied by 196 kg/ha would give 531,748 tonnes, which is again the nominated amount.

Absent specific information from the party or documentation in a textbox, an inconsistent interpretation would be to use 196 kg/ha for one part of the calculation, then use 170 kg/ha for the other part; i.e. to ignore the part of the 2010 textbox that said the Party nominated a use rate of 170 kg/ha and choose instead the part of the textbox that said MBTOC accepted 196 kg/ha when calculating the estimated treatment area for 2012, <u>and then</u> use then choose the 170 kg/ha rate for the calculation of the 2013 recommendation.

It should be noted that the vast majority of the strawberry growers rent lands where they grow strawberries and these rental choices are not constrained to counties or townships. Therefore, to attempt this precision for the strawberry CUE is not practical. Analysis and models to predict with precision the location of production do not exist. Hence, the recommendation along previous years never identified specific hectares for strawberry production and their locations

The underlying approach used by the Party and accepted by the majority included:

- Calculate area to be treated in 2012 based on amount approved (673.085t) and use rate (170 kg/ha)
- Apply transition to alternatives (21% for uptake of methyl iodide) to calculated area
- Calculate amount based on reduced area and consistent use rate.

These calculations are shown in the table below.

	Consistent – Reflects Use Rate from Party	Alternate Use Rate, but consistent	Inconsistent
2012 Amt Approved	673.085 tonnes	673.085	673.085
2012 Use rate	**170** kg/ha	**196** kg/ha	**196** kg/ha
Calculated 2012 ha	3,959 ha	3,434 ha	3,434 ha
21% Reduction of 2012 ha	3,128	2,713 ha	2,713 ha
2013 Use Rate	**170** kg/ha	**196** kg/ha	**170** kg/ha
Calculated Amount Recommended	531.760 tonnes	531.748 tonnes	461.210 tonnes
% Reduction from 2012 Amount Approved	21%	21%	32%

The Party proposed a transition of 21% from the 2012 CUE of 673.085. The nomination is based on a dose rate of 170 kg/ha and an area of 3128 ha which was 21% reduction of 3959 ha.

8. 7. Interim CUN Report – Issues Specific to MBTOC-Structures and Commodities

MBTOC Structures and Commodities (SC) met at Antalya, Turkey in March 2011. At the kind invitation of the Government of Turkey, Ministry of Agriculture, and the Western Mediterranean Agricultural Research Centre (BATEM), MBTOC SC and QPS jointly conducted a field trip to view quarantine proceedures for of dried fruits, nuts and packaging materials in the main growing and export region of Izmir. We also visited two grower cooperatives engaged in export of dried fruit and nuts to learn about their use of MB and alternatives for quarantine and preshipment uses.

The earthquake and tsunami in Japan occurred just before the MBTOC meeting. MBTOC was very concerned but can report, with relief, that its two Japanese members were safe and even able to attend the MBTOC meeting.

MBTOC SC assessed the 2011 CUNs and prepared the Progress Report. A short bilateral meeting was held with United States to discuss questions about the CUNs and to improve understanding of recent proposed regulatory changes which might affect the future use of sulfuryl fluoride. Additionally, MBTOC SC met with Arysta LifeScience to understand requirements of the safe use of methyl iodide for postharvest disinfestation of chestnuts in Japan.

Parties continue to make progress on some CUNs, reducing many MB uses by continuing to resolve the inter-related issues of treatment logistics, costs, trade demands and effectiveness of alternatives.

Last year, MBTOC noted a concern that progress in adopting alternatives had stalled. This year there was a complete change; all Parties nominated very significant decreases in MB use. To illustrate this change, last year the Government of the United States informed MBTOC that no further adoption of alternatives seemed possible for dried fruit and nut sector. To assist further adoption of alternatives, MBTOC discussed alternatives in its text box and provided a review of research on alternatives for dates included in the US CUN. Perhaps for this reason, this year, the USG nominated a 66% decrease in its commodity CUN. Australia and Japan both nominated decreases in their CUNs for rice and chestnuts respectively, and in addition committed to new phase out plans which committed to zero MB use by 2015.

This year the Government of Canada did not submit a critical use nomination for pasta facilities. MBTOC believes the Party and its applicant have conducted tests of heat treatment and sulfuryl fluoride treatment, perhaps making sufficient adaptations to have allowed adoption of alternatives in this sector. This sector may have achieved phase out of MB use and if so, MBTOC congratulates the Government of Canada.

As well this year, the Government of the United States did not submit a critical use nomination for those food processing facilities formerly included in the CUN of the National Pest Management Association (NPMA). In its final report in 2010, MBTOC discussed the then recent change in regulatory interpretation by the US Environmental Protection Agency which was able to result in the applicant withdrawing its CUN. MBTOC congratulates the United States for its ability to resolve a regulatory issue which then led to phase out of MB in the food processing sectors included in the former NPMA CUN.

The use of methyl bromide in Canadian and American grain and cereal milling continues to decrease, largely through the adoption of heat treatment and sulfuryl fluoride treatment (SF). Although millers in both countries have adopted both types of treatments, millers in Canada have tended to adopt heat more than they have adopted SF, whereas millers in the US have tended to adopt SF more than they have adopted heat treatment. Depending on possible regulatory changes pertaining to SF use in the future, this may be significant.

MBTOC notes the uncertainty caused by the recent US EPA proposed regulation, which has been brought about as part of a range of actions to reduce the incidence of fluoride in the diet of some sectors of the US population. The regulation proposes to eventually eliminate food contact by the fumigant sulfuryl fluoride.. MBTOC continues to watch this situation with interest. This matter was discussed in the Assessment report and is further discussed in the MBTOC SC Progress Report.

The US decreased its CUN for regional cured pork in storages in spite of a lack of effective and registered alternatives, largely through IPM improvements. There is an ongoing research project to test alternatives. This year MBTOC learned about the scale-up of phosphine research as a possible alternative for pests of this commodity. MBTOC notes that phosphine efficacy has yet to be demonstrated on commercial scale for the mites which are sometimes pests of this commodity. The planned research may find ways to combine phosphine treatment with other methods to achieve effective pest control.

Although IPM is not a common programme in meat processing facilities, which are usually more concerned with control of microorganisms, perhaps in this instance, research to develop and evaluate specific IPM methods for meat processing may contribute to achieving effective control.

This year, the US submitted a CUN for MB to support various research projects. The CUN included some soils research and also research on regional cured pork. Later correspondence with the US corrected the amount nominated for cured pork and provided more information about the intended research use of MB.

8.7.1. Standard Dosage Presumptions and Adjustments for Standard Dosage Rates

MBTOC assessed CUNs for appropriate MB dosage rates and deployment of MB emission/use reduction technologies, such as appropriate sealing techniques.

Decision IX/6 requires that critical uses should be permitted only if 'all technically and economically feasible steps have been taken to minimise the critical use and any associated emission of methyl bromide'. Decision Ex.II/1 also mentions emission minimisation techniques, requesting Parties "…to ensure, wherever methyl bromide is authorised for critical-use exemptions, the use of emission minimisation techniques that improve gastightness or the use equipment that captures, destroys and/or reuses the methyl bromide and other techniques that promote environmental protection, whenever technically and economically feasible."

With the beginning of the CUN process in 2005, MBTOC published its standard presumptions for structures (20g m^{-3}) and indicated that the European Plant Protection Organization's (EPPO) published dosage rates for commodities should be considered standard best practice for fumigation world wide. Since that time all Parties submitting CUNs stated their adherence to those practices. The EPPO dosage rates for commodity treatment vary by commodity, sorption rate and environmental conditions. They can be found in annexes to the MBTOC 2006 Assessment Report (MBTOC, 2007). Where possible, reduced dosages, combined with longer exposure periods, can reduce MB consumption, while maintaining efficacy. (MBTOC 2007).

8.7.2. Details of Evaluations

Parties have submitted seven CUNs for the use of MB in structures and commodities in 2011. In addition, one aspect of the US research CUN was for cured pork; it was separated from the research CUN and is responded to here. The text box for the remaining aspects of the CUN is located in the MBTOC Soils report. This year all CUNs were for one year – 2013.

MBTOC was unable to assess the CUN for cured pork because commercial scale trials with phosphine are planned or are being conducted. If there was to be a successful outcome of those trials, the use of phosphine might eliminate the need for methyl bromide.. MBTOC has recommended 0.045 tonnes of MB to enable the research to be done. Phosphine is registered but there are no published commercial-scale results showing efficacy for the pests of this commodity. If MBTOC receives research results by mid-August, then MBTOC will be able to re-evaluate this CUN by conference call and email in September. Therefore the final evaluation for this CUN will be found in the October MBTOC report.

The total MB volume nominated in 2011 for non-QPS post-harvest uses, including research, was 43.47 tonnes.

Of nominations in 2011 for 2013, MBTOC recommended 39.74 tonnes (Table 8-12)

Table 8-13 provides the MBTOC-SC interim recommendations for the CUNs submitted.

Table 8-12: Summary of the interim recommendations by MBTOC-SC (in square brackets) for CUE's for postharvest uses of MB (tonnes) for 2013 submitted in the 2010 round.

	Years
Country and Sector	**2013**
Australia. Packaged rice	**[2.374]**
Canada. Mills	**[7.848]**
Japan. Fresh Chestnuts	**[3.317]**
USA	
1. Commodities	
2. Mills and Food Processing Structures	**[0.822]**
3. Cured Pork	**[25.334]**
4. Research in Cured Pork Alternatives*	**[Unable]**
5. Research in Post harvest Emissions and	**[0.045]**
QPS (Unable to Assess)	**[Unable]**
(*See also US Research CUN in Soils)	
TOTAL	**[39.74]**

Table 8-13: Final evaluations of CUNs for structures and commodities submitted in 2011 for 2012 or 2013

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (Addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
Australia	Rice	6.150	6.150	.205	9.200	7.820	6.650	4.87	**3.653**	**-**	**2.374**	**-**	**2.374**

MBTOC comments 2011:

MBTOC recommends 2.374 tonnes of MB, the amount nominated by the Party, for use on packaged rice in 2013. This represents an approximate 35% decrease over the amount of MB granted by the Parties for this use in 2012. MBTOC had until that point noted that the Australian rice applicant had not adopted alternatives in spite of the availability and use of technically effective alternatives in Australia and worldwide. MBTOC notes, however, that the treatment of packaged rice with sulfuryl fluoride, one of the alternatives in use elsewhere, is not registered in Australia. The Party indicates that the applicant is pursuing the adoption of phosphine. In mid-2010, Australia submitted a new CUN and phase out plan nominating a 25% reduction for its 2010 submission and also for each following year with the result that in 2015, there would be no further MB CUN nomination. The Party indicated that regardless of the volumes of rice harvested or the continuation of drought, this phase out plan would be required of its rice applicant. MBTOC continues to note that it does not seem that the applicant has adopted alternatives, but with the recent improvement of water availability in the growing region, rice harvests for 2011 are expected to improve significantly and that therefore it seems likely that alternatives will be adopted.

The Party has noted some difficulties in achieving the level of technical efficacy required by its applicant; MBTOC has volunteered to assist by providing a summary of research of efficacy of sulfuryl fluoride for the pest species of concern. MBTOC's summary of pertinent research of interest to Australia and any Party with similar concern can be found in the MBTOC/TEAP Progress Report of May 2011.

Emission Reduction: Yes. The applicant now sends the majority of its MB-fumigated rice through MB recapture equipment.

Research Program. Trials with sulfuryl fluoride are ongoing; the applicant says further work is needed to see if results can be improved. MBTOC notes, however, that there is already extensive research available on the efficacy of SF against the pests of concern and has provided a summary in the Progress Report. A research project in 2009 was interrupted due to the unfortunate death of the scientist in charge.

Appropriate effort. As with all postharvest registration issues, neither the applicant nor the Party mandated with Montreal Protocol nominations has control over pesticide registration. This applicant has not made appropriate efforts to adopt alternatives, since no alternatives have been adopted in spite of registration of technically effective and affordable alternatives being available. MBTOC agrees with the Party that its new phase out plan will likely result in the applicant adopting alternatives soon as harvest quantities are expected to increase and MB availability has decreased.

MBTOC comments on economics 2011:

Applicant argues that phosphine fumigation, following milling but before packaging, is the best technical and economical alternative, and is therefore gearing up to transition to phosphine

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (Addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
Canada	Mills	47 (included mills and pasta)	34.774	30.167	28.650	26.913	22.878	14.107	**11.020**	**-**	**7.848**	**-**	**7.848**

MBTOC comments 2011:

MBTOC recommends 7.848 tonnes, the amount nominated by the Party for use in mills in 2013. This is an approximate 29% decrease over the amount granted by the Parties for 2012. The Party advises that mills that are producers of durum semolina or have integrated/contiguous bakery mix plants and those that are particularly large structures are the remaining methyl bromide users. The CUN states that the amount requested is only sufficient for a single treatment of 7-8 of the 17-18 mills in the application, so most mills would not be fumigated in 2013. As per Canadian regulation, mills which are listed in the CUN may, if necessary, share some of the total CUN amount granted so that is why more mills are listed than will actually be fumigated. The 2011 CUN includes at least one less mill than in 2010, due to adoption to alternative treatments such as heat.

Evaluation of alternatives to methyl bromide in progress include: heat treatments; the just recently registered ECO$_2$Fume formula (carbon dioxide and phosphine mixed in gas cylinders), sulfuryl fluoride (SF) (but only if there is no food contact); plus integrated pest management programs alone or in combination with heat treatments and fumigations with the aforementioned alternative fumigants.

Current research is directed towards practical trials with heat and other IPM upgrades, and SF. The results of current trials on a principal alternative, SF, have indicated poorer than expected efficacy, probably because adequate temperatures are not being maintained and the vulnerability of concentration level maintenance in windy conditions. Additionally, SF, at the applied dose, has been found to be less effective for the eggs of red flour beetle than for confused flour beetle. This is significant because red flour beetle is the pest of most concern in Canadian mills yet confused flour beetle is the most commonly used species in trials.

For all alternatives, the recent tightening of food safety regulations in Canada has increased the pressure to raise the already high efficacy levels of treatments to eliminate pests. Mills have to operate according to a “Required efficacy” standard which in Canada means no live insects, including eggs, in milled grain product fractions leaving the mill for customer destinations. There is intensifying regulatory pressure in North America to improve food safety by eliminating all human pathogens, contaminants and stored product pests from food ingredients and processed foods.

The Party advised MBTOC that a number of mills are acquiring heat treatment equipment in 2010 and 2011 with the expectation to completely phase out MB use by 2012. Other mills are still having difficulty in achieving the required efficacy through use of alternatives. Until problems can be resolved commercial adoption of SF will be delayed, even if registration is eventually extended beyond empty structures. There is registration of SF for empty facilities but the widening of this registration originally expected in the summer of 2009 was not achieved as of March 2011.

<table>
<tr><th>Country</th><th>Industry</th><th>CUE for 2005[1]</th><th>CUE for 2006[2]</th><th>CUE for 2007[3]</th><th>CUE for 2008[4]</th><th>CUE for 2009[5]</th><th>CUE for 2010[6]</th><th>CUE for 2011[7]</th><th>CUE for 2012[8]</th><th>CUN for 2012 (Addtl or new)</th><th>CUN for 2013</th><th>MBTOC rec. for 2012 (addtl or new)</th><th>MBTOC rec. for 2013 (new)</th></tr>
<tr><td></td><td colspan="13">Heat treatments may also be somewhat less successful than conventional MB fumigations, particularly as the size of the structure increases. Some areas of each structure act as “heat sinks” that absorb large amounts of heat, rendering them difficult to heat to the temperature and for the duration required to kill all life stages of insect pests. Complete evaluation of the heating requirements for any single milling facility is a process of trial and error, unique to each site and one that takes time to complete.

The CUN summarizes that, treatment with SF or the heat and phosphine combination treatment (phosphine, heat and carbon dioxide) controlled insect populations in flour mills for over 18 weeks. In the nine treatments, only once did the next fumigation need to be scheduled earlier expected (Fields, 2007).

Emission control. The majority of mills are now not even fumigated annually, which reduces emissions.

Ongoing research – Excellent research multi-mill, multi-stakeholder research program in past with several full reports submitted to MBTOC (SF, heat and DE, SF and elevated temperature, phosphine + CO2, etc). Research has not been reported in past two years; MBTOC is not convinced that further research in this field is absolutely necessary. When mills are not MB fumigated, they are being heat treated and all are now in enhanced IPM.

Appropriate effort in the CUN? Full registration of SF has not been achieved; there is still no food tolerance for F residues from SF treatment of mills. This action has been delayed for several years and hinders ability to fully adopt SF as an alternative treatment. Neither the millers nor the Party can affect fumigant registration. In spite of delay in achieving full registration, the mills are continuing to make progress.

MBTOC comments on economics 2011:

CUN states that the transition to heat treatment or enabling structural modifications such as replacement of wooden floors and exterior wall cladding and insulation to reduce insect harbourage, which require capital investment, is negatively affected by the economic downturn. However, the purpose of the phase-out is to permit a gradual economic adjustment in the absence of federal or provincial government financial assistance programs.</td></tr>
<tr><td>Japan</td><td>Chestnuts</td><td>7.100</td><td>6.800</td><td>6.500</td><td>6.300</td><td>5.800</td><td>5.400</td><td>5.35</td><td>3.489</td><td>-</td><td>3.317</td><td>-</td><td>3.317</td></tr>
<tr><td></td><td colspan="13">MBTOC comments 2011:

MBTOC recommends 3.317 tonnes of MB, the amount nominated by the Party for fresh chestnuts in 2013. This is a 5% reduction over the amount of MB granted by the Party for this use in 2012.

As a result of its research program, Japan determined that methyl iodide (MI) would be an effective alternative to the use of MB in fresh chestnuts. It was registered in 2009 and an MRL for methyl iodide residues in food was later established (0.5ppm), which allowed for the use of MI. However, the registration did not result in the immediate commercial availability of the fumigant. The registrant of MI in Japan has a product stewardship program which requires more stringent and modern application methods for MI than are required for MB, which was an older process. The registrant had to first design filling and packaging systems to make the fumigant available for its different applications. The registrant then investigated current fumigation practises as a prerequisite to beginning training in the safe use of the fumigant according to multinational standards of fumigation practise.</td></tr>
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<table>
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<tr><td></td><td colspan="13">The additional stringency has resulted in the requirements for the building of better containment fumigation chambers, among other things. These more stringent requirements for the safe use of MI, plus the training requirement, have resulted in the need for more time to complete the adoption. The Party is still establishing technically effective methods to use MI in fumigation consistent with their requirements for 2 hour fumigation times required in periods of peak harvest.

The CUN notes that Japan will have completely transitioned this use to MI by the end of 2014. The amount of MB requested by the Party is consistent with the phase out plan leading to zero use of methyl bromide in 2015. MBTOC asks if Japan has established an MRL for iodide.

Emission reduction. To date regular reductions in MB use through logistical improvements. Consolidation of fumigation loads also reduces emissions.

Research program in past 12 months. Extensive research program has been completed, no further research needed other than to see if reduced dosage of MI can be achieved, and that is optional. There is established efficacy of MI for this purpose in Japan and it has been registered.

Appropriate effort? Registration for methyl iodide proceeded as per normal and was registered after appropriate review. Now extensive effort is required to change logistics and treatment facilities to allow the safe use of methyl iodide as per multi-national fumigation standards.

MBTOC comments on economics 2011:
The nomination was not based on economic arguments.</td></tr>
<tr><td rowspan="2">United States</td><td>Commodities</td><td>89.166</td><td>87.719</td><td>78.983</td><td>58.921</td><td>45.623</td><td>19.242</td><td>5.000</td><td>2.419</td><td>-</td><td>0.822</td><td>-</td><td>0.822</td></tr>
<tr><td colspan="13">MBTOC comments 2011:
MBTOC recommends 0.822 tonnes, the amount nominated by the Party for MB treatment of dried fruit, walnuts and dates in 2013. This represents a 66% reduction over the amount granted by the Parties for use in 2012. The USG has nominated a very challenging decrease in MB use for this sector, which MBTOC supports. If it were to be provided, a phase out plan would inform MBTOC and Parties of the continued timing of its transition to alternatives.

MBTOC notes that logistical improvements and investments may be needed which could lead to the adoption of cold storage for the post-drying processing of dried fruits which could assist this sector to phase out of MB entirely. We would expect that any further commodities CUN would not include dried plums since they should be protected from post-process re-infestation with treatments other than MB.

Additionally, MBTOC notes that controlled atmosphere treatment would provide an effective non-chemical treatment for all the commodities in this CUN. Parties may find the section on controlled atmosphere treatment and associated tables found in the Structures and Commodities Chapter of the MBTOC Assessment Report to be helpful in understanding controlled atmosphere. Transition to controlled atmosphere might be additionally useful given the US Environmental</td></tr>
</table>

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (Addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
	Protection Agency regulation which proposes to phase out the use of SF for food contact. This is particularly significant given that the CUN, which was prepared before the announcement of the proposed regulation, reports that the sector is moving to SF. If the US government phases out the use of SF on foods, it may delay the transition to alternatives, since the use of SF has assisted this transition. **Emissions reduction**. This sector has very considerably reduced use of MB, and therefore emissions. Fumigation takes place in chambers or suitable enclosures. **Research effort.** Research on dates is ongoing but focused on the use of sulfuryl fluoride. The US Environmental Protection Agency has proposed phasing out the use of SF for foods and so MBTOC does not know if this proposed regulation will affect research or adoption of alternatives. **Appropriate effort**. Several alternatives are already registered. Also controlled atmosphere could be used. **MBTOC comments on economics 2011:** **Walnuts:** The CUN provides a detailed financial analysis in the form of a partial budget of the cost of fumigating walnuts with methyl bromide, with sulfuryl fluoride, and with phosphine. SF results in an increase in gross margin because the price per unit is lower, even though the dosages applied are higher. Phosphine requires capital investment in fumigation chambers in the first year because of the longer fumigation time and the danger of missing a market window, but thereafter is cheaper to use as the unit cost is lower than that of methyl bromide. The full cost of the fumigation chambers is charged in the first year. **Dried fruit:** The CUN shows that treatment with SF results in a higher gross margin, and that treatment with phosphine, while resulting in a lower gross margin in the first year because of the need to provide fumigation chambers, will in later years also lead to a higher gross margin. **Dates:** SF is the only technically feasible alternative in dates, and the CUN shows that its use results in an increase in gross margin. The CUN is not based on economic arguments, but on the need for a phase-out period.												

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (Addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
United States	Mills and processors	483.000	461.758	401.889	348.237	291.418	291.418	173.023	**74.510**	**-**	**25.334**	**-**	**25.334**

MBTOC comments 2011

MBTOC recommends 25.334 tonnes, the amount recommended by the Party for use in food processing structures in 2013. This represents a 66% reduction in the amount granted by the Parties in 2012. This CUN includes amounts for three sectors and the recommendation is divided as follows: for rice milling, 2.467 t; for pet food facilities .004665 t; for mills 18.201 t. The USG has nominated a very challenging decrease in MB use for this sector, which MBTOC supports. If it were to be provided, a phase out plan would inform MBTOC and Parties of the continued timing of its transition to alternatives.

This nomination is for facilities, or portions of facilities, that are unsuitable for the alternatives, or where the alternatives are not economically feasible. USG is requesting methyl bromide for this sector to allow time for the industry to purchase equipment, modify structures, and/or practice using alternatives.

The lethal effects of sulfuryl fluoride (SF) are highly dependent upon temperature. The Party reported that, should a facility need fumigation during cold temperatures, this chemical may not be a cost-effective solution because of the requirement to use supplemental heat and additional dosage. SF requires higher dosages to kill the eggs of structural pests than for other life stages. Phosphine, although it is used in combination with heat and CO_2 in some Canadian mills, can be corrosive to many metals that are present in facilities, especially in the computers and other electronic process control instrumentation.

There is some confusion as to the commodities that may be directly fumigated with SF. According to the SF label in the US, pet food is not listed as a material approved for direct treatment. If not on the label the commodity can not be treated, leaving the question of incidental fumigation if the structure is treated with SF. This "incidental" fumigation of commodities inside a food processing structure has resulted in problems with label interpretation. Some companies insist that all pet food products would need to be removed from treatment areas or sufficiently protected to prevent the formation of residues of SF and fluoride ion on the pet food products. This is also a factor for mills that produce mixes with multiple ingredients (e.g. cake mixes, muffin mixes, etc.).

The industry reports that complete removal of non-sulfuryl fluoride treatable ingredients and product from the target facility would present significant logistical challenges, including multiple forklifts and forklift drivers, plus rented truck trailers onto which the ingredients could be loaded. These trailers would then be removed from the facility, most likely to available space in the parking lot. This process that would add labor and trailer rental costs as well as costs associated with additional downtime needed to accomplish the ingredient removal task.

Heat is dependent on several parameters: the structural composition, as different building components expand and contract at different rates; the building design/layout factors, which affect the ability to evenly distribute heated air; and the availability of convenient and economical sources of heat. Facilities constructed primarily from wood, which the CUN reports comprise about 25 percent of the flour mills in the U.S., may not be able to use heat because of warping of the wood. Some areas of each structure act as "heat sinks" that absorb large amounts of heat, rendering them difficult to heat to the temperature and for the duration required to kill all life stages of insect pests. In addition, heat may not be a viable option for structures where a variety of heat-sensitive food products or commodities are also present. There is also a high initial investment to purchase explosion-proof heaters, modify sprinkler systems, and educate personal on heat treatments.

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (Addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
	In spite of the availability of heat treatment methods, the US structural sector has largely relied on transition to SF as it reduced MB use. The current registration of SF remains unchanged in the US for the uses in this nomination. Greater transition to the use of heat treatment might be useful given the US Environmental Protection Agency regulation which proposes to eventually phase out the use of SF for food processing structures. If the US government phases out the use of SF for food processing structures, it may delay the transition to alternatives, since the use of SF has assisted this transition. **Emission reduction**. The sector has widely adopted SF which requires greater attention to sealing and so if MB is also used emissions would be reduced. **Research effort**: No new research reported, but research is not needed. Instead trials and adaptation of known methods are needed at the individual mill sites. **Appropriate effort.** As with all postharvest registration issues, neither the applicant nor the Party mandated with Montreal Protocol nominations has control over pesticide registration. Many of the companies formerly associated with this CUN have switched to alternatives and/or decreased their use of MB. **MBTOC comments on economics 2011:** **Pet food facilities:** The CUN provides a partial budget that shows that heat treatment in the first year will result in a decline in the gross margin of 0.05%. In the years after the initial investment the result will be an increase in the gross margin of 0.02%. In the budget provided, the capital cost is charged to the year of investment. **Mills and other food processors:** The CUN identifies SF and heat treatment as the best technical alternatives, and provides a partial budget showing the economic impact of these two alternatives. In the case of heat treatment, the capital costs are again charged to the first year. The use of SF results in a decline of 0.01% in gross margin, while heat treatment, taking into account the capital costs, results in a decline of 0.13%. Once the capital costs have been charged, gross margin increases by 0.14%. The CUN is not based on economic arguments, but on the need for a phase-out period.												
United States	Cured pork	67.907	40.854	18.998	19.669	18.998	4.465	3.73	**3.730**	**-**	**3.730**	**-**	**Unable to assess**
	MBTOC comments 2011: MBTOC is unable to assess this CUN pending the receipt of the results of large scale trials to be conducted in spring and summer of 2011 and 2010. The Party had nominated 3.730 tonnes, the amount nominated by the Party, for use in cured pork sector in 2013. This is the same amount granted by the Parties for this use in 2012. See also the US research CUN text box following. The CUN reported that investigators achieved 100 % mortality of all life stages of red legged ham beetles and ham mites with 48 hours exposure of 400 and 1000 ppm of phosphine, respectively (Phillips, 2009). In addition, residual phosphine concentrations in dry cured hams that were fumigated for 48 hrs at 1000												

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<tr><td></td><td colspan="13">
ppm were below 0.01 ppm, the legal residual limit in stored food products (Sekhon, et al. 2009b; Sekhon et al., 2010c), and consumer panelists could not detect differences between control and phosphine fumigated samples at 1000 ppm (Sekhon et al. 2009b; Sekhon et al., 2010c). Therefore, phosphine can now be considered a potential alternative to methyl bromide for controlling arthropod pests of southern dry cured hams.

Further testing with a greater number of mites has indicated that a greater concentration of phosphine (>1000 ppm) is likely necessary to kill substantial mite infestations. In addition, commercial applications of phosphine are planned for 2010-2011 to determine the efficacy of using phosphine at the plant level. The CUN noted that the effectiveness of phosphine will be evaluated in upcoming years through the use of both bioassays (with ham present) and on hanging hams in a simulated dry cured ham aging room. Other portions of this upcoming research include the economical analysis of using phosphine in comparison to methyl bromide, if it is effective at eradicating mites. Additional items that will be researched in the future (if funding is obtained) include the effect of multiple fumigations on the sensory quality and residual concentration of phosphine in ham, and the effectiveness of using phosphine in dry cured ham facilities. Many processors have indicated that they would be willing to help evaluate the efficacy of phosphine (at controlling ham mite infestations) in their plant as part of a research project, which truly demonstrates the willingness of the industry to do everything that they can to help determine if potential alternatives to methyl bromide exist.

The USG has indicated in correspondence that phosphine is registered for use on processed meats, which would include cured pork. MBTOC notes the Degesch America Phostoxin® (aluminium phosphide) and Fumicel® (magnesium phosphide) labels in the US lists processed meats if maximum residue limits do not exceed 0.01ppm. The Horn Diluphos Fosfoquim label also lists processed meats with the same maximum residue limits.

CA could be used but since the ham storage structures also require disinfestations, then adoption of CA would require a fast investment in new cured pork storage facilities.

Emissions reduction. Over the years the applicants have made facility improvements to improve gastighness, but this is a traditional meat curing process and some of the facilities are older and unusual. The research program continues to work with the applicants to improve gastightness, IPM and other process improvements which reduce the need for fumigation and result in decreased use of MB. This work needs to continue.

Research effort. Excellent research effort to date and still ongoing. Now researching phosphine effectiveness on commercial scale. A multi-state, multi-university research program is ongoing and full reports of research have been made available to MBTOC.

Appropriate effort. As with all postharvest registration issues, neither the applicant nor the Party mandated with Montreal Protocol nominations has control over pesticide registration. Phosphine is registered for use on processed meats such as cured pork.

MBTOC comments on economics 2011:

CUN states that an economic analysis was not conducted because there are no technically feasible alternatives.
</td></tr>
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Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for 2007[3]	CUE for 2008[4]	CUE for 2009[5]	CUE for 2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUN for 2012 (Addtl or new)	CUN for 2013	MBTOC rec. for 2012 (addtl or new)	MBTOC rec. for 2013 (new)
United States	Research-cured pork element									**0.045**	**0.045**	**0.045**	**Unable to assess**
	MBTOC comments 2011: The USG submitted a Research CUN, which included aspects of research on soils, QPS and one postharvest commodity – cured pork. MBTOC has desegregated this CUN so that the postharvest element is dealt with by MBTOC-SC. Accordingly, MBTOC recommends a maximum of 0.045 tonnes to enable the USG to conduct research on alternatives to control pests in cured pork in 2012, provided that best endeavours have been used to source the required quantities from stocks and that these have been unsuccessful (Decision XVII/9, para 7). The CUN also nominated MB for research in 2013, but MBTOC will evaluate the necessity for further MB for research in a later year if the CUN is resubmitted. The USG CUN for research amounts originally nominated 1.220 tonnes of MB for use in cured pork research in 2012. During MBTOC's bilateral meeting with the USG, this amount was noted as an error and was corrected in correspondence to 0.045 tonnes. Separately, MBTOC assessed the amount needed to provide controls for commercial scale trials of phosphine, and determined that 0.045 tonnes of MB should be ample, given the dosages required for pest control, and given the possibility of failure of the alternative or the need to repeat a trial. **MBTOC comments on economics 2011:** The nomination was not based on economic arguments												
	Research: Emission reduction and QPS									**0.114**	**0.114**	**Unable to assess**	**Unable to assess**
	MBTOC comments 2011: The US also nominated 0.114 tonnes for postharvest emissions control and QPS research. That aspect of the US research CUN is unable to assess pending further information from the Party on the intended use.												

[1]1ExMOP and 16MOP; [2]16MOP+2ExMOP+17MOP; [3]MOP17+MOP18; [4]MOP18+MOP19; [5]MOP19+MOP20; [6]MOP20+MOP21; [7]MOP21+MOP22; [8]MOP22

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Chapter 8 - Common Acronyms

1,3-D	1,3- Dichloropropene
CUE	Critical Use Exemption
CUN	Critical Use Nomination
DOI	Disclosure of Interest
EPA	Environmental Protection Agency
EPPO	European Plant Protection Organisation
EU	European Union
MI	Methyl iodide (or Iodomethane)
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
ISPM	International Standard Phytosanitary Measure
LPBF	Low Permeability Barrier Film (including VIF films)
MB	Methyl Bromide
MBTOC	Methyl Bromide Technical Options Committee
MBTOC-SC	Methyl Bromide Technical Options Committee Structures and Commodities Subcommittee
MBTOC-S	Methyl Bromide Technical Options Soils Subcommittee
MBTOC-QPS	Methyl Bromide Technical oprtions Quarantine and Preshipment Subcommittee
MITC	Methyl isothiocyanate
MOP	Meeting of the Parties
MS	Metham sodium
OEWG	Open Ended Working Group
Pic	Chloropicrin
QPS	Quarantine and Pre-shipment
SF	Sulfuryl fluoride
TEAP	Technology and Economic Assessment Panel
TIF	Totally impermeable films
VIF	Virtually Impermeable Film

ANNEX 1 TO CHAPTER 8. Decision IX/6

1. To apply the following criteria and procedure in assessing a critical methyl bromide use for the purposes of control measures in Article 2 of the Protocol:

(a) That a use of methyl bromide should qualify as "critical" only if the nominating Party determines that:

(i) The specific use is critical because the lack of availability of methyl bromide for that use would result in a significant market disruption; and

(ii) There are no technically and economically feasible alternatives or substitutes available to the user that are acceptable from the standpoint of environment and health and are suitable to the crops and circumstances of the nomination;

(b) That production and consumption, if any, of methyl bromide for critical uses should be permitted only if:

(i) All technically and economically feasible steps have been taken to minimise the critical use and any associated emission of methyl bromide;

(ii) Methyl bromide is not available in sufficient quantity and quality from existing stocks of banked or recycled methyl bromide, also bearing in mind the developing countries' need for methyl bromide;

(iii) It is demonstrated that an appropriate effort is being made to evaluate, commercialise and secure national regulatory approval of alternatives and substitutes, taking into consideration the circumstances of the particular nomination and the special needs of Article 5 Parties, including lack of financial and expert resources, institutional capacity, and information. Non-Article 5 Parties must demonstrate that research programmes are in place to develop and deploy alternatives and substitutes. Article 5 Parties must demonstrate that feasible alternatives shall be adopted as soon as they are confirmed as suitable to the Party's specific conditions and/or that they have applied to the Multilateral Fund or other sources for assistance in identifying, evaluating, adapting and demonstrating such options;

2. To request the Technology and Economic Assessment Panel to review nominations and make recommendations based on the criteria established in paragraphs 1 (a) (ii) and 1 (b) of the present decision;

3. That the present decision will apply to Parties operating under Article 5 and Parties not so operating only after the phase-out date applicable to those Parties.

Para. 2 of Decision IX/6 does not assign TEAP the responsibility for determining the existence of "significant market disruption" specified in paragraph 1(a)(i).

TEAP assigned its Methyl Bromide Technical Options Committee (MBTOC) to determine whether there are *no technically and economically feasible alternatives or substitutes available to the user that are acceptable from the standpoint of environment and health and are suitable to the crops and circumstances of the nomination*, and to address the criteria listed in Decision IX/6 1(b).

ANNEX II TO CHAPTER 8. Decision XVI/4

Review of the working procedures and terms of reference of the Methyl Bromide Technical Options Committee

Report of the Sixteenth Meeting of the Parties to the Montreal Protocol (Annex I), Prague, 22–26 November 2004), paragraph 15.

A. Working procedures of the Methyl Bromide Technical Options Committee relating to the evaluation of nominations for critical uses of methyl bromide

15. An annual work plan will enhance the transparency of, and insight in, the operations of MBTOC. Such a plan should indicate, among other things:

(a) Key events for a given year;
(b) Envisaged meeting dates of MBTOC, including the stage in the nomination and evaluation process to which the respective meetings relate;
(c) Tasks to be accomplished at each meeting, including appropriate delegation of such tasks;
(d) Timing of interim and final reports;
(e) Clear references to the timelines relating to nominations;
(f) Information related to financial needs, while noting that financial considerations would still be reviewed solely in the context of the review of the Secretariat's budget;
(g) Changes in the composition of MBTOC, pursuant to the criteria for selection;
(h) Summary report of MBTOC activities over the previous year, including matters that MBTOC did not manage to complete, the reasons for this and plans to address these unfinished matters;
(i) Matrix with existing and needed skills and expertise; and
(j) Any new or revised standards or presumptions that MBTOC seeks to apply in its future assessment of critical-use nominations, for approval by the Meeting of the Parties.

ANNEX III TO CHAPTER 8 - Part A: Historical Trend in MB Preplant Soil Nominations and Exemptions

List of nominated (2005 – 2012 in part) and exempted (2005 – 2011 in part) amounts of MB granted by Parties under the CUE process for each crop or commodity.

Party	Industry	Total CUN MB Quantities									Total CUE MB Quantities							
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2005	2006	2007	2008	2009	2010	2011	2012
Australia	Almonds	1.900	2.100								1.900	2.100						
Australia	Rice consumer packs	12.300	12.300	10.225	9.200 1.8	9.2	7.82	5.66	3.653	**2.374**	6.150	6.150	9.205	9.200	7.820	6.650	4.870	**3.653**
Belgium	Artefacts and structures	0.600	0.307								0.590	0.307						
Belgium	Antique structure & furniture	0.750	0.199								0.319	0.199						
Belgium	Churches, monuments and ships' quarters	0.150	0.059								0.150	0.059						
Belgium	Electronic equipment	0.100	0.035								0.100	0.035						
Belgium	Empty silo	0.050	0.043								0.050	0.043						
Belgium	Flour mill see mills below	0.125	0.072								See mills below	0.072						
Belgium	Flour mills	10.000	4.170								9.515	4.170						
Belgium	Mills	0.200	0.200								0.200	0.200						
Belgium	Food processing facilities	0.300	0.300								0.300	0.300						

Party	Industry	Total CUN MB Quantities									Total CUE MB Quantities							
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	Food Processing premises	0.030	0.030								0.030	0.030						
Belgium	Food storage (dry) structure	0.120	0.120								0.120	0						
Belgium	Old buildings	7.000	0 .306								1.150	0.306						
Belgium	Old buildings and objects	0.450	0.282								0	0.282						
Belgium	Woodworkin g premises	0.300	0.101								0.300	0.101						
Canada	Flour mills	47.200	34.774	30.167	28.650	26.913	22.878	14.107	11.020	**7.848**	(a)47	34.774	30.167	28.65	26.913	22.878	14.107	**11.020**
Canada	Pasta manufacturin g facilities	(a)	10.457	6.757	6.067	4.740	4.740	2.084			(a)	10.457	6.757	6.067	4.740	3.529		
Canada	Commodities					0.068												
France	Seeds sold by PLAN-SPG company	0.135	0.135	0.100							0.135	0.135	0.096					
France	Mills	55.000	40.000	8.000							40.000	35.000	8.000					
France	Rice consumer packs	2.000	2.000								2.000	2.000						
France	Chestnuts	2.000	2.000	1.800							2.000	2.000	1.800					
Germany	Artefacts	0.250	0.100								0.250	0.100						

Party	Industry	Total CUN MB Quantities									Total CUE MB Quantities							
		2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Germany	Mills and Processors	45.000	19.350								45.000	19.350						
Greece	Dried fruit	4.280	3.081	0.900							4.280	3.081	0.450					
Greece	Mills and Processors	23.000	16.000	1.340							23.000	15.445	1.340					
Greece	Rice and legumes		2.355									2.355						
Ireland	Mills		0.888	0.611								0.888						
Israel	Artefacts	0.650	0.650	0.600							0.650	0.6500						
Israel	Dates (post harvest)	3.444	3.444	2.200	1.800	2.100					3.444	2.755	2.200	1.800	2.100	1.040		
Israel	Flour mills (machinery & storage)	2.140	1.490	1.490	0.800	0.300					2.140	1.490	1.040	0.312	0.300			
Israel	Furniture– imported	1.4220	1.4220	2.0420							1.4220	0						
Italy	Artefacts	5.500	5.500	5.000							5.225	0	5.000					
Italy	Mills and Processors	160.000	130.000	25.000							160.00 0	65.000	25.000					
Japan	Chestnuts	7.100	6.500	6.500	6.300	5.800	5.400	5.350	3.489	**3.317**	7.100	6.800	6.500	6.300	5.800	5.400	5.350	**3.489**
Latvia	Grains		2.502									2.502						
Netherlands	Strawberry runners post harvest		0.120	0.120		0.120						0	0.120					
Poland	Medicinal herbs & dried mushrooms as dry commodities	4.000	3.560	1.800	0.500						4.100	3.560	1.800	1.800				
Poland	Coffee, cocoa beans	(a)	2.160	2.000	0.500							2.160	1.420	1.420				
Spain	Rice		50.000									42.065						

Party	Industry	Total CUN MB Quantities									Total CUE MB Quantities							
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2005	2006	2007	2008	2009	2010	2011	2012
Switzerland	Mills & Processors	8.700	7.000								8.700	7.000						
UK	Aircraft			0.165									0.165					
UK	Mills and Processors	47.130	10.195	4.509							47.130	10.195	4.509					
UK	Cereal processing plants		8.131	3.480					(a)			8.131						
UK	Cheese stores	1.640	1.248	1.248							1.640	1.248	1.248					
UK	Dried commodities (rice, fruits and nuts) Whitworths	2.400	1.256								2.400	1.256						
UK	Herbs and spices	0.035	0.037	0.030							0.035	0.037						
UK	Mills and Processors (biscuits)	2.525	1.787	0.479							2.525	1.787						
UK	Spices structural equip.	1.728									1.728	0	0.479					
UK	Spices stored	0.030									0.030	0						
UK	Structures buildings (herbs and spices)	3.000	1.872	0.908							3.000	1.872	0.908					

Party	Industry	Total CUN MB Quantities									Total CUE MB Quantities							
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2005	2006	2007	2008	2009	2010	2011	2012
UK	Structures, processors and storage (Whitworths)	1.100	0.880	0.257							1.100	0.880	0.257					
UK	Tobacco equipment	0.523									0.050							
UK	Woven baskets	0.770									0.770							
USA	Dried fruit and nuts (walnuts, pistachios, dried fruit and dates and dried beans)	89.166	87.719	91.299	67.699	58.912	19.242	10.041	2.419	**0.822**	89.166	87.719	78.983	58.921	45.623	19.242	5.000	**2.419**
USA	Dry commodities / structures (cocoa beans)	61.519	61.519	64.028	52.256	51.002					61.519	55.367	64.082	53.188				
USA	Dry commodities / structures (processed foods, herbs and spices, dried milk and cheese processing facilities) NPMA	83.344	83.344	85.801	72.693	66.777	37.778	17.365	0.200		83.344	69.118	82.771	69.208	54.606	37.778	17.365	

Party	Industry	Total CUN MB Quantities									Total CUE MB Quantities							
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2005	2006	2007	2008	2009	2010	2011	2012
USA	Smokehouse hams (Dry cure pork products) (building and product)	136.304	135.742	40.854	19.669	19.699	4.465	3.730	3.730	**3.730**	67.907	81.708	18.998	19.699	18.998	4.465	3.730	**3.730**
USA	Mills and Processors	536.328	505.982	401.889	362.952	291.418	173.023	135.299	74.51	**25.334**	483.000	461.758	401.889	348.237	291.418	173.023	135.299	**74.510**
USA	Research								**0.159**	**0.159**								

ANNEX IV TO CHAPTER 8 – Part B: Historical Trend in MB Structural and Commodity Nominations and Exemptions

List of nominated (2005 – 2012 in part) and exempted (2005 – 2011 in part) amounts of MB granted by Parties under the CUE process for each crop or commodity.

Party	Industry	Total CUN MB Quantities									Total CUE Quantities							
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2005	2006	2007	2008	2009	2010	2011	2012
Australia	Cut Flowers – field	40.000	22.350								18.375	22.350						
Australia	Cut flowers – protected	20.000									10.425							
Australia	Cut flowers, bulbs – protected Vic	7.000	7.000	6.170	6.150						7.000	7.000	3.598	3.500				
Australia	Strawberry Fruit	90.000									67.000							
Australia	Strawberry runners	35.750	37.500	35.750	35.750	29.790	29.790	29.790	29.790	**29.760**	35.750	37.500	35.750	35.750	29.790	29.790	23.840+ 5.95	**29.760**
Belgium	Asparagus	0.630	0.225								0.630	0.225						
Belgium	Chicory	0.600	0.180								0.180	0.180						
Belgium	Chrysanthemums	1.800	0.720								1.120							
Belgium	Cucumber	0.610	0.545								0.610	0.545						
Belgium	Cut flowers – other	6.110	1.956								4.000	1.956						
Belgium	Cut flowers – roses	1.640																
Belgium	Endive (sep from lettuce)		1.650									1.650						
Belgium	Leek & onion seeds	1.220	0.155								0.660							

Party	Industry	Total CUN MB Quantities									Total CUE Quantities							
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	Lettuce(& endive)	42.250	22.425								25.190							
Belgium	Nursery	Not Predictable	0.384								0.900	0.384						
Belgium	Orchard pome & berry	1.350	0.621								1.350	0.621						
Belgium	Ornamental plants	5.660									0.000							
Belgium	Pepper & egg plant	5.270	1.350								3.000	1.350						
Belgium	Strawberry runners	3.400	0.900								3.400	0.900						
Belgium	Tomato (protected)	17.170	4.500								5.700	4.500						
Belgium	Tree nursery	0.230	0.155								0.230	0.155						
Canada	Strawberry runners (PEI)	14.792	6.840	7.995	7.462	7.462	7.462	5.261	5.261	**5.596**	(a)14.792	6.840	7.995	7.462	7.462	7.462	5.261	**5.261**
Canada	Strawberry runners (Quebec)		1.826	1.826							(a)	1.826	1.826					
Canada	Strawberry runners (Ontario)			6.129									6.129					
France	Carrots	10.000	8.000	5.000							8.000	8.000	1.400					
France	Cucumber	85 revised to 60	60.000	15.000							60.000	60.000	12.500					
France	Cut-flowers	75.000	60.250	12.000							60.000	52.000	9.600					
France	Forest tree nursery	10.000	10.000	1.500							10.000	10.000	1.500					
France	Melon	10.000	10.000								7.500	6.000						

Party	Industry	Total CUN MB Quantities									Total CUE Quantities							
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2005	2006	2007	2008	2009	2010	2011	2012
France	Nursery: orchard, raspberry	5.000	5.000	2.000							5.000	5.000	2.000					
France	Orchard replant	25.000	25.000	7.500							25.000	25.000	7.000					
France	Pepper	Incl in.tomato cun	27.500	6.000								27.500	6.000					
France	Strawberry fruit	90.000	86.000	34.000							90.000	86.000						
France	Strawberry runners	40.000	4.000	35.000							40.000	40.000	28.000					
France	Tomato (and eggplant for 2005 only)	150(all solanaceou s)	60.500	33.250							125.000	48.400						
France	Eggplant		27.500	33.250								48.400						
Greece	Cucurbits	30.000	19.200								30.000	19.200						
Greece	Cut flowers	14.000	6.000								14.000	6.000						
Greece	Tomatoes	180.000	73.600								156.000	73.600						
Israel	Broomrape			250.000	250.000	125.000	12.500	12.500					250.000	250.000	125.000	12.500		
Israel	Cucumber - protected new 2007			25.000	18.750		18.750	12.500					25.000	18.750	-	15.937		
Israel	Cut flowers – open field	77.000	67.000	80.755	53.345	42.777	42.554	23.292			77.000	67.000	74.540	44.750	34.698	28.554		
Israel	Cut flowers – protected	303.000	303.000	321.330	163.400	113.821	72.266	52.955			303.000	240.000	220.185	114.450	85.431	63.464		
Israel	Fruit tree nurseries	50.000	45.000	10.000							50.000	45.000	7.500					
Israel	Melon – protected & field	148.000	142.000	140.000	87.500	87.500	87.500	35.000			125.650	99.400	105.000	87.500	87.500	70.000		

Party	Industry	Total CUN MB Quantities									Total CUE Quantities							
		2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Israel	Potato	239.000	231.000	137.500	93.750	75.000					239.000	165.000	137.500	93.750	75.000			
Israel	Seed production	56.000	50.000			22.400					56.000	28.000			NR			
Israel	Strawberries – fruit (Sharon)	196.000	196.000	176.200	64.125	52.250	47.500	28.500			196.000	196.000	93.000	105.960	42.750			
Israel	Strawberries – fruit (Sharon & Ghaza)															57.063		
Israel	Strawberry runners (Sharon)	35.000	35.000		20.000	15.800	13.570	13.500			35.000	35.000	28.000	31.900	15.825			
Israel	Strawberry runners and fruit Ghaza				87.875	67.500	67.500	34.000							47.250			
Israel	Strawberry runners (Sharon & Ghaza)															22.320		
Israel	Tomatoes			90.000									22.750					
Israel	Sweet potato					95.000	20.000	20.000						111.500	95.000	20.000		
Italy	Cut flowers (protected)	250.000	250.000	30.000							250.000	187.000	30.000					
Italy	Eggplant (protected)	280.000	200.000	15.000							194.000	156.000						
Italy	Melon (protected)	180.000	135.000	10.000							131.000	131.000	10.000					
Italy	Pepper (protected)	220.000	160.000	67.000							160.000	130.000	67.000					

Party	Industry	Total CUN MB Quantities									Total CUE Quantities							
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2005	2006	2007	2008	2009	2010	2011	2012
Italy	Strawberry Fruit (Protected)	510.000	400.000	35.000							407.000	320.000						
Italy	Strawberry Runners	100.000	120.000	35.000							120.000	120.000	35.000					
Italy	Tomato (protected)	1300.000	1030.00	418.000							871.000	697.000	80.000					
Japan	Cucumber	88.300	88.800	72.400	68.600	61.400	34.100	29.120	26.162		88.300	88.800	72.400	51.450	34.300	30.690	27.621	
Japan	Ginger – field	119.400	119.400	112.200	112.100	102.200	53.400	47.450	42.235		119.400	119.400	109.701	84.075	63.056	53.400	47.450	
Japan	Ginger – protected	22.900	22.900	14.800	14.800	12.900	8.300	7.770	6.558		22.900	22.900	14.471	11.100	8.325	8.300	7.036	
Japan	Melon	194.100	203.900	182.200	182.200	168.000	90.800	77.600	67.936		194.100	203.900	182.200	136.650	91.100	81.720	73.548	
Japan	Peppers (green and hot)	189.900	200.700	169.400	162.300	134.400	81.100	68.260	61.101		187.200	200.700	156.700	121.725	81.149	72.990	65.691	
Japan	Watermelon	126.300	96.200	94.200	43.300	23.700	15.400	13.870	12.075		129.000	98.900	94.200	32.475	21.650	14.500	13.050	
Malta	Cucumber		0.096									0.127						
Malta	Eggplant		0.128									0.170						
Malta	Strawberry		0.160									0.212						
Malta	Tomatoes		0.475									0.594						
New Zealand	Nursery material	1.085	1.085									0						
New Zealand	Strawberry fruit	42.000	42.000	24.78							42.000	34.000	12.000					
New Zealand	Strawberry runners	10.000	10.000	5.720							8.000	8.000	6.234					
Poland	Strawberry Runners	40.000	40.000	25.000	12.000						40.000	40.000	24.500					
Portugal	Cut flowers	130.000	8.750								50.000	8.750						

Party	Industry	Total CUN MB Quantities									Total CUE Quantities							
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2005	2006	2007	2008	2009	2010	2011	2012
Spain	Cut Flowers – Cadiz	53.000	53.000	35.000							53.000	42.000						
Spain	Cut Flowers – Catalonia	20.000	18.600	12.840	17 (+Andalucia)						20.000	15.000	43.490 (+Andalucia)					
Spain	Pepper	200.000	155.000	45.000							200.000	155.000	45.000					
Spain	Strawberry Fruit	556.000	499.290	80.000							556.000	499.290	0.0796					
Spain	Strawberry Runners	230.000	230.000	230.000	215.000						230.000	230.000	230.000					
UK	Cut flowers		7.560									6.050						
UK	Ornamental tree nursery	12.000	6.000								6.000	6.000						
UK	Strawberry (& raspberry in 2005)	80.000	63.600								68.000	54.500						
UK	Raspberry nursery		4.400								4.400	54.500						
USA	Chrys. Cuttings/roses	29.412									29.412	0						
USA	Cucurbits – field	1187.8	747.839	598.927	588.949	411.757	340.405	218.032	59.500	**11.899**	1187.800	747.839	592.891	486.757	407.091	302.974	195.698	**59.500**
USA	Eggplant – field	76.761	101.245	96.48	79.546	62.789	34.732	21.561	6.904	**1.381**	76.721	82.167	85.363	66.018	48.691	32.820	19.725	**6.904**
USA	Forest nursery seedlings	192.515	157.694	152.629	133.140	125.758	120.853	106.043			192.515	157.694	122.032	131.208	122.060	117.826	93.547	
USA	Ginger	9.2									9.2	0						

Party	Industry	Total CUN MB Quantities									Total CUE Quantities							
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2005	2006	2007	2008	2009	2010	2011	2012
USA	Orchard replant	706.176	827.994	405.415	405.666	314.007	226.021	203.591	18.324	**6.230**	706.176	527.600	405.400	393.720	292.756	215.800	183.232	**18.324**
USA	Ornamentals	210.949	162.817	149.965	138.538	137.776	95.204	70.178	48.164	**48.164**	154.000	148.483	137.835	138.538	107.136	84.617	64.307	**48.164**
USA	Nursery stock - fruit trees, raspberries, roses	45.789	64.528	12.684	51.102	27.663	17.954	7.955	1.591	**0.541**	45.800	64.528	28.275	51.102	25.326	17.363	7.955	**1.591**
USA	Peppers – field	1094.782	1498.53	1151.751	919.006	783.821	463.282	212.775	28.366		1094.782	1243.542	1106.753	756.339	548.984	463.282	206.234	
USA	Strawberry fruit – field	2468.873	1918.40	1733.901	1604.669	1336.754	1103.422	1023.471	753.974	**531.737**	2052.846	1730.828	1476.019	1349.575	1269.321	1007.477	812.709	**678.004**
USA	Strawberry runners	54.988	56.291	4.483	8.838	8.837	7.381	7.381	3.752	**3.752**	54.988	56.291	4.483	8.838	7.944	4.690 + 2.018	6.036	**3.752**
USA	Tomato – field	2876.046	2844.985	2334.047	1840.1	1406.484	994.582	336.191	54.423	**10.741**	737.584	2476.365	2065.246	1406.484	1003.876	737.584	292.751	**54.423**
USA	Turfgrass	352.194	131.600	78.040	52.189	0						131.600	78.04	0				
USA	Sweet potato	224.528			18.144	18.144	18.144	14.515	8.709					18.144	18.144	14.515	11.612	
USA	Research								**6.111**	**6.203**								

9 Response to Decision XXII/22 – Membership Changes on the Assessment Panels

9.1 Executive Summary

Decision XXII/22 requested TEAP to draw up guidelines for the nomination of experts by the Parties, and to consider the need for balance and appropriate expertise when appointing members to Technical Options Committees (TOCs), task forces and other temporary subsidiary technical bodies (TSBs) in accordance with the TEAP terms of reference (TOR). To address this task, TEAP set up a balanced task force (TF) of eight members, which included members of all TOCs plus two TEAP senior experts.

The TF recommends that "balance" should be considered for Article 5 versus non-Article 5 membership and also include the need for adequate regional distribution. TOC members are chosen by the TOC Co-chairs in consultation with TEAP. TOC Co-chairs are continually looking for new members to round out expertise and balance by adding, removing or altering membership as assessment needs change. Parties are one important source of nominations but are not the only source. TOC Co-chairs also look for qualified candidates through recommendations of existing TOC members, including those from other TOCs, of persons they have worked with in the recent past, professional and academic organizations, and others.

TSB members are assigned by TEAP. In this regard they are similar to TOC members in that the Parties do not confirm appointment. However, unlike TOC members, it is possible that an assigned TSB Co-chair who was not a member of TEAP becomes a temporary member of TEAP. Task Force Co-chairs and other Temporary TEAP members are appointed to the TEAP by consensus, typically for one year or less.

When anticipated recurring expertise is needed within TEAP that does not come from the TOC Co-chairs, the TEAP solicits nominations for additional expert members while staying within the Parties' direction to maintain TEAP at 18 – 22 members.

Currently, the TEAP and TOC call for experts is managed through updates of a simple matrix that is publicized through the Ozone Secretariat website and which is regularly updated by TEAP. The TF recognized that this matrix does not provide sufficient information on the nomination or selection process for new members so that Parties can make appropriate and timely nominations of needed expertise.

The TF identified specific improvements to a Matrix of Needed Capabilities and Matrix of Current Capabilities, including harmonizing the current matrices used by TEAP and TOCs, as well as proposed timelines for regular review and updates of these matrices. If agreed to by the Parties, a searchable database for the TEAP website, TEAP/TOC Roster of Expertise, could be developed if financed and managed by the Ozone Secretariat.

The TF further recommended that the TEAP consider creating a standard Nominations Form or at least standardize the nomination content to assist the Parties in collecting and providing the necessary information that TOC Co-chairs would use in making appointments, and which TEAP would use in recommending appointment for Parties' consideration and confirmation. For this purpose, the TF compiled a list of relevant information that is needed for the preliminary assessment of a nomination and the Parties are requested to consider whether or not TEAP should develop a standard nomination form.

9.2 Introduction

9.2.1 Mandate and Scope of the Report

Decision XXII/22 requested the Technology and Economic Assessment Panel (TEAP) and its Technical Options Committees (TOCs) to,

> *"…draw up guidelines for the nomination of experts by the parties, in accordance with section 2.9 of the terms of reference of the Technology and Economic Assessment Panel, for presentation to the parties prior to the thirty-first meeting of the Open-Ended Working Group;"*

and

> *"… to consider the need for balance and appropriate expertise when appointing members of the technical options committees, task forces and other subsidiary groups in accordance with sections 2.1, 2.5 and 2.8 of the terms of reference of the Panel;"*

The sections of the terms of reference of TEAP (found in Annex V of the report of the Eighth Meeting of the Parties, as amended by Decision XVIII/19, and included in the *Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer* (Eighth edition, 2009)) cited in the above decision are as follows:

> **2.1 Size and Balance**
>
> *The membership size of the TEAP should be about 18-22 to allow it to function effectively. It should consist of the Co-chairs of the TEAP, the Co-chairs of all the TOCs and 4-6 Senior Experts for specific expertise or geographical balance not covered by the TEAP Co-chairs or TOC Co-chairs. Each TOC should have two or, if appropriate, three Co-chairs. The positions of TOC Co-chairs as well as of the Senior Experts must be filled to promote a geographical and expertise balance. The overall goal is to achieve a representation of about 50 per cent for Article 5(1) Parties in the TEAP and TOCs.*
>
> **2.5 Appointment of Members of TOCs**
>
> *Each TOC should have about 20-35 members. The TOC members are appointed by the TOC Co-chairs in consultation with the TEAP.*
>
> **2.8. Subsidiary Bodies**
>
> *Temporary Subsidiary Technical Bodies (TSBs) can be appointed by the TEAP/TOCs to report on specific issues of limited duration. The TEAP/TOCs may appoint and dissolve, subject to review by the Parties, such subsidiary bodies of technical experts when they are no longer necessary. The Code of Conduct must be followed by the members of TSBs to avoid conflict of interests in the performance of their duties. For issues which cannot be handled by the existing TOCs and are of substantial and continuing nature TEAP should request the establishment by the Parties of a new TOC.*
>
> **2.9. Guidelines for Nominations**
>
> *The TEAP/TOCs will draw up guidelines for nominating experts by the Parties. The TEAP/TOCs will publicize a matrix of expertise available and the expertise gap in the TEAP/TOCs so as to facilitate submission of appropriate nominations by the Parties.*

Based on the four paragraphs cited above, this report provides the following: 1) an overview and discussion of TEAP's process to meet the need for balance in appointing members to TOCs and TSBs – the TEAP considered the appointment by Parties of members of TEAP beyond the scope of the request in Decision XXII/22 - and 2) guidelines for Parties for nominating experts to TEAP, TOCs and TSBs, along with a framework for an expanded matrix showing current and needed expertise, that is yet to be developed.

9.2.2 Organization of Work

In response to Decision XXII/22, TEAP set up a balanced task force (TF) of eight members, which included members of all TOCs plus two TEAP senior experts, as follows:

<u>Co-chairs</u>	
Marta Pizano (A5)	*MBTOC (and TEAP Co-chair)*
Dan Verdonik	*HTOC (non-A5)*
<u>Members</u>	
Paul Ashford	*FTOC (non-A5)*
Bella Maranion	*TEAP Senior Expert (non-A5)*
Roberto Peixoto	*RTOC (A5)*
Helen Tope	*MTOC (non-A5)*
Maasaki Yamabe	*CTOC (non-A5)*
Shiqiu Zhang	*TEAP Senior Expert (A5)*

Task Force work was conducted primarily by electronic communication. Drafts were then circulated to all TEAP members, and discussed and reviewed during the TEAP meeting held in Geneva, May 8-12, 2011. When addressing the assigned tasks, the TF considered the existing TEAP Terms of Reference (TOR), and supplemental information collected or developed by TEAP in its efforts to develop an internal standard operating procedure (SOP) over the past two years.

9.3 On Size and Balance

TOR paragraph 2.1 requires that TEAP has between 18 and 22 members. Currently (2011), the TEAP has 20 members: 3 TEAP Co-chairs, two of which are TOC Co-chairs and one that is a Senior Expert member; two additional Senior Expert members and 15 additional TOC Co-chairs.

Decision XXII/22 requested TEAP to consider the need for balance and appropriate expertise when appointing members of TOCs, TF and other temporary subsidiary technical bodies (TSBs) in accordance with sections 2.1, 2.5 and 2.8 of the TEAP TOR. As Parties, not TEAP, must confirm the appointment of a member to TEAP, no discussion is included in this report on how TEAP balance is achieved. The exceptions to this are that both temporary TOC Co-chairs and TSB Co-chairs who if not already members of TEAP become temporary members of TEAP while they are TSB Co-chairs; and this specific case will be addressed in section 9.3.2 below.

The TF recognizes that there are many different ways possible to represent the present balance of the TEAP and its TOCs. The TF discussed the different possibilities including whether or not to include gender in defining balance. The TEAP recommends that "balance" should be considered for Article 5 versus non-Article 5 and within that overall major balance, also a need for adequate regional distribution. The current representation of balance for TEAP and its TOCs is provided in Table 9-1.

Table 9-1: Regional Distribution of TEAP and TOCs as of 2011

	Non-A5	A5	CEIT*	NAM	SAM	E	AF	MEA	EE	A	O
						Regional Distribution**					
TEAP***	**12**	**7**	**1**	**4**	**4**	**4**	**1**		**1**	**3**	**3**
TOCs											
CTOC	8	7	1	3	1	1	2	1	1	6	1
FTOC	13	5		6	2	5	1			3	1
HTOC	11	8	2	4	1	6	1	2	2	5	
MTOC	18	11		7	3	8	1	1		7	2
MBTOC	24	15	1	8	4	11	4	2	1	5	3
RTOC	18	7		5	3	13	1			3	
TOC Total	**91**	**53**	**4**	**33**	**14**	**44**	**10**	**6**	**4**	**29**	**8**

* CEIT – Formerly known as Countries with Economies in Transition.

** NAM: North America, SAM: South America, E: Europe, AF: Africa, MEA: Middle East Asia, EE: Eastern Europe, A: Asia, and O: Oceania

*** **TEAP Members** (as of 2011): **Co-chairs**: Stephen O. Andersen, Lambert Kuijpers, Marta Pizano; **Senior Expert Members:** Bella Maranion, Shiqiu Zhang; **TOC Co-chairs: CTOC:** Ian Rae, Masaaki Yamabe, Jiang Biao; **FTOC:** Paul Ashford, Miguel Quintero; **HTOC:** Dave Catchpole, Sergey Kopylov; Daniel Verdonik; **MTOC:** Jose Pons, Helen Tope, Ashley Woodcock; **MBTOC:** Mohamed Besri, Michelle Marcotte, Marta Pizano, Ian Porter; **RTOC:** Lambert Kuijpers, Roberto Peixoto.

9.3.1 Balance in the TOCs

The TOCs members are chosen by the TOC Co-chairs in consultation with TEAP, per paragraph 2.5 of the TOR. TOC Co-chairs are continually reviewing the need for or looking for new members to round out expertise and balance. This can happen throughout the year, particularly when existing members retire from a TOC. More commonly this review of TOC membership balance is done at the completion of a TEAP progress report cycle or a report on a particular decision. At a broader level, the TOC Co-chairs look to refresh their TOC membership in preparation for an upcoming assessment, typically a four-year cycle, by adding, removing or altering required expertise, as assessment needs change. Throughout this process, the TOC Co-chairs are very mindful of balance between Article 5 and non-Article 5 Parties and the need for geographic balance as well.

TOC Co-chairs do not limit themselves in where they look for new members. Parties are an important source of nominations but are not the only source. TOC Co-chairs also look for qualified candidates through recommendations of existing TOC members, including those from other TOCs, recommendations from persons they have worked with in the recent past, professional and academic organizations, and others. In appointing new members, the TOC Co-chairs strive for balance while maintaining the technical expertise required in order to meet the needs of the Parties.

9.3.2 Balance and Membership in TSBs

TSB members are appointed by TEAP. In this regard they are similar to TOC members in that the Parties do not confirm appointments. A TSB Co-chair who is not currently a member of TEAP becomes a temporary member of TEAP for the period of the TSB assignment.

As with the TOC make-up, TEAP also considers balance for appointment of TSB members. For example, the membership of the Decision XXII/22 TF was assigned by the TEAP to have as balanced a membership as possible. The TF consists of three Article 5 members and five non-Article 5 members. There are two members from North America, two from South America, two from Asia, one from Europe and one from Oceania. Beyond this, the TEAP achieved, in this case, gender balance with four male and four female members.

The appointment of TSB Co-chairs and members typically comes from within TEAP. When anticipated recurring expertise is needed within TEAP that is not currently available within its membership, TEAP solicits nominations for additional expert members while striving to maintain TEAP at 18 – 22 members. When the current TEAP membership does not have the expertise required for a one-time TSB, then the TEAP Co-chairs may recommend to the TEAP membership that a non-TEAP member may be assigned as a TSB Co-chair and hence becomes a temporary TEAP member. TEAP members will consider balance in appointing a temporary member and TSB Co-chair, however, the expertise required to meet the needs of the Parties is the deciding factor. Task Force Co-chairs and other Temporary TEAP members are appointed to the TEAP by consensus, typically for one year or less.

9.4 Matrices of Gaps and Available Expertise

9.4.1 Current Matrix of Needed Expertise

Currently, the TEAP and TOC call for experts is managed through updates of a simple matrix that is publicized through the Ozone Secretariat website at http://ozone.unep.org/Assessment_Panels/TEAP/TEAP-Nominations.shtml.

This matrix is updated regularly by TEAP. Table 9-2 is an update of the matrix that currently appears on the website.

Table 9-2: TEAP current openings for qualified experts

Body	Required Expertise	Position(s)
TEAP	Senior Expert member with cross-cutting experience in engineering, economics, market transformation, and data analysis	Member
Methyl Bromide TOC	Quarantine and pre-shipment Certification of nursery plant materials related to movement of plant pathogens across state and international boundaries Risk, assessment International conventions (i.e. IPPC)	Member from A5 particularly for QPS
Halons TOC	Aviation Fire Protection specialists Military Fire protection experts from Europe and A5	Member
Foams TOC	Experts in implementing HFC, HC and other alternatives to CFC and HCFC foam with knowledge of activities in Eastern Europe, Africa, South & Central Asia and the Middle East	Member
Refrigeration TOC	Experts in low-GWP alternatives to HCFC and HFC refrigeration and AC with knowledge of applications Non-A5 experts in transport and large sized refrigeration Experts from the Middle East region	Member
Medical Products TOC	Experts not currently required.	
Chemicals TOC	Experts in destruction technologies Experts in industrial chemistry or chemical engineering	Member Members from A5 and non-A5

In addition to the above matrix of needed expertise, the TEAP page of the Ozone Secretariat website provides limited background information on TEAP, a brief overview of general qualifications and responsibilities of TEAP, TOC, and Task Force members, and directs interested Parties to contact the TEAP Co-chairs for further information.

9.4.2 Update to Matrix of Needed Expertise

The TF recognizes that the current matrix of expertise needed as presented on the Ozone Secretariat website, may not provide sufficient information so that Parties can make appropriate and timely nominations of experts. The current webpage also does not provide specific guidance on the nomination or selection process for new members.

The TF believes the following information may be helpful to Parties in improving this matrix, and the present nomination and selection procedures for experts to TEAP and TOCs:

- More descriptive information on the required expertise may be needed for either a nominator or nominee to consider if the combination of education, work and related experience of the nominee would be a good fit for the TEAP or TOC position.

- A more user-friendly website may be needed, with more background and practical information about TEAP or TOC membership. This information would be provided through links to documents that already exist such as the TEAP Terms of Reference. New documents could also be developed such as the following: TEAP Origin and Evolution, Description of TEAP Positions, Roles and Responsibilities (for positions of TEAP Co-chairs, TOC Co-chairs, Senior Expert Members, TOC and TSB Members), typical time commitments for members for meetings and reports, voluntary (unpaid) nature of the assignment (Article 5 travel and accommodation are funded by the Ozone Secretariat, but those of non-Article 5 members are not), and language requirement (meetings are conducted and reports are written in English).

The TEAP/TOC Co-chairs will develop more detailed descriptions for each of the experts and expertise needed for which they are seeking nominations. Depending on the position and requirements of TEAP or the relevant TOC, certain academic qualifications, work experience, or skills may be preferred over others when nominees are evaluated. This "selection guidance" can be included in the detailed descriptions.

9.4.3 Matrices of Current Capabilities

Currently, TEAP and TOC have varying processes for tracking the expertise contained within each group's membership. Tables 9-3, 9-4, and 9-5 provide examples of the current capabilities of members of TEAP, MBTOC's QPS Subcommittee and CTOC, respectively.

Table 9-3: Qualifications for 2011 TEAP members

TEAP Member	Highest Degree	Degree Subjects	Employment History	Current Employment
Stephen O. Andersen	PhD	Economics Agriculture	Government University NGO Industry	Consultant NGO
Paul Ashford	BSc	Chemistry	Industry	Consultant
Mohamed Besri	PhD	Plant Pathology	Government University	Agricultural Institute
Biao Jiang	PhD	Chemistry	Government Industry	Chemical Institute
David Catchpole	BA (Hons)	Mathematics	Industry	Consultant
Sergey Kopylov	PhD	Chemistry Engineering	Government Industry	Fire Protection Institute
Lambert Kuijpers	PhD	Physics	Industry University	University
Bella Maranion	BSc	Biology, Electrical Engr	Government	Government
Michelle Marcotte	BA	Home Economics, Food & Nutrition	Education Association Industry	Consultant
Roberto de A. Peixoto	PhD	Mechanical Engineering	University	Technology Institute
Marta Pizano	MSc	Plant Pathology	Industry Trade Association	Consultant
Jose Pons Pons	MSc	Engineering	Manufacturing industry	Manufacturing Industry
Ian Porter	PhD	Plant Pathology	Government University	Government Institute
Miguel Quintero	MSc	Chemistry	Industry University	University
Ian D. Rae	PhD	Chemistry	University	University
Helen Tope	PhD	Chemistry	Government	Consultant
Ashley Woodcock	MD	Medicine	Medicine	Hospital
Daniel Verdonik	Eng.Sc. D	Chemical Metallurgy	Government Industry	Consultant
Masaaki Yamabe	MSc	Chemistry	Industry Government	National Institute
Shiqiu Zhang	PhD	Economics	University	University

Table 9-4: Example 1 - MBTOC QPS subcommittee Members - October 2010

Name	Gender	Affiliation	Expertise	Length of service	Country	A5/non A5 status
Co-chair						
1. Marta Pizano	F	Consultant	MB alternatives, particularly horticulture (pre-plant soils uses) (MSc)	> 10 years	Colombia	A5
Members						
2. Jonathan Banks	M	Consultant	QPS, stored grains, fumigation technologies, recapture systems (PhD)	>10 years	Australia	Non A5
3. Tom Batchelor	M	Touchdown Consulting	Technical issues on QPS (PhD)	1-5 years or >10 years*	Belgium	Non A5
4. Ken Glassey	M	MAF, New Zealand (Government research)	Phytosanitary quarantine treatments, biosecurity	1-5 years	New Zealand	Non A5
5. Takashi Misumi	M	MAFF (Government research)	Quarantine Disinfestation Technologies	5- 10 years	Japan	Non A5
6. David Okioga	M	Kenya Ozone Office (Government)	Plant quarantine services, MB alts (PhD)	>10 years	Kenya	A5
7. Ian Porter	M	Consultant and Department of Victorian Primary Industries (Government)	Researcher, soils MB use and alts, particularly fungal pathogens and IPM (PhD)	>10 years	Australia	Non-A5
8. Ken Vick	M	Consultant	Research in MB alternatives, for soil, structures and commodities including QPS. Entomologist (PhD)	>10 years	USA	Non A5
9. Eduardo Willink	M	Estación Experimental Agroindustrial Obispo Colombrés (Government research)	Quarantine treatments, systems approach and pest host status	1-5 years	Argentina	A5
TOTALS	F 1 M 8					A5 = 3 Non A5 = 6

Source: MBTOC CUN Final report Sept 2010

*Dr Batchelor was a member of MBTOC between 1992 and 2002. He was appointed to MBTOC again in 2009

Table 9-5: Example 2 - The expertise required for the CTOC members

	Chemistry	Chemical Engineering	Experience on Industry / Government	Experience on regulation	Knowledge / Experience on International Organization
Process Agent	Essential	Essential	Essential	Not Relevant	Not Relevant
Lab. & Analytical uses	Essential	Desirable	Desirable	Essential	Essential
Feedstock	Essential	Essential	Essential	Not Relevant	Not Relevant
EUN	Essential	Essential	Essential	Essential	Desirable
CTC	Essential	Essential	Essential	Desirable	Desirable
Solv./ n-PB	Essential	Essential	Essential	Essential	Not Relevant
Destruction	Essential	Essential	Essential	Essential	Desirable

9.4.4 Updated Matrix of Current Capabilities

The TF believes that it would be helpful to standardize and improve the differing matrices listing current capabilities. The information on current and historical TEAP/TOC experts and expertise, based on information TEAP has already compiled, could be made into a searchable database, such as a TEAP/TOC Roster of Expertise. This would be a complex task that would need to be significantly aided by the Ozone Secretariat, which has the means and resources to do so. The database would be searchable by one or a combination of different search fields (e.g., degrees and fields of study and/or experience, ODS sector, regional experience (e.g., A5, or specific regionssuch as Asia or Africa), government / military / industry / academia affiliations, years of experience, years of TEAP/TOC affiliation, relevant publications, etc.). This would require standardizing information reported by TEAP/TOC members so that their expertise could be compiled into this database. Again, if the Parties consider this to be a good option, TEAP would need financial and management assistance from the Ozone Secretariat to complete this task.

9.5 Guidelines for Nominations

9.5.1 TEAP Expert Members.

The TEAP is limited by the TOR to 18 – 22 members. When the TEAP has less than 22 members, the TEAP can include the additional expertise that would benefit the Parties in the Matrix of Required Capabilities. If the vacancy is the result of losing one or more TEAP Expert members, TEAP can also update the Matrix of Current Capabilities. These updates can be made on an annual basis and will be included in the TEAP progress report beginning in 2012. This timing would allow Parties to make nominations, coordinate with TEAP at the OEWG and/or MOP and confirm new TEAP members per the TOR.

9.5.2 Co-chairs of TOCs

The TOR indicates that TOCs should have 2 or sometimes 3 Co-chairs. Parties nominate and appoint TOC Co-chairs, according to TEAP TOR paragraph 2.3. When a TOC needs one or more Co-chairs, the TOC will notify the TEAP, who will include the needs in the Matrix of

Required Capabilities. If the vacancy is the result of losing one or more TOC Co-chairs, the TEAP will also update the Matrix of Current Capabilities. This can be done on an annual basis and will be included in the TEAP progress report beginning in 2012. This timing will allow Parties to make nominations, coordinate with TEAP at the OEWG and/or MOP and confirm new TEAP members per the TOR.

9.5.3 TOC Members

The TOC Co-chairs appoint TOC members in coordination with TEAP. When a TOC needs additional expertise, TOC Co-chairs, in coordination with TEAP, and the Ozone Secretariat as necessary, can update the Matrix of Required Capabilities. It is typical that this would follow the same general timeframe as for TEAP needs but since the TOC collectively have many more members, the need to replace retiring members can happen at any time during the year. The TOC Co-chairs can review and update, if needed, the Matrix of Required Capabilities and the Matrix of Current Capabilities on semi-annual July 1 and January 1 basis, at least, beginning in 2012.

In preparation for Assessment Reports, some TOCs may choose to refresh or restructure their TOCs and potentially could ask significant numbers or even all of its members to retire essentially dissolving their TOC and then reforming the TOC to maximize flexibility in achieving the required expertise and overall balance. Other TOCs may have much reduced needs to dissolve TOCs and may ask selected members to retire. The decision remains with the TOC Co-chairs who, in coordination with TEAP, and the Ozone Secretariat as needed, will update the Matrix of Required Capabilities and the Matrix of Current Capabilities based on their decisions on the level of TOC renewal, turnover and continuity. In this case, the matrices will be updated no later than July 1st of the year before the Assessment Report is to be completed (e.g., July 1st 2013 if the Assessment will be completed by end 2014.)

9.5.4 Nomination Information

The TEAP and its TF recommended creating a standard Nominations Form or at least standardizing the nomination content, to assist the Parties in collecting and providing the necessary information about nominees that TOC Co-chairs would use in making appointments of TOC members. The TF compiled the following list of relevant information that is needed for the preliminary assessment of a nomination independent of whether or not the Parties would like TEAP to develop a standard nomination form.

- Cover letter. The nomination should explain how the nominee’s experience, qualifications and competence match the position for which you are seeking to be nominated.
- Formal education and other qualifications. An advanced academic degree is desirable but not necessary when a combination of experience and specialization may offer sufficient qualification.
- Employment and other relevant work experience as an expert. This would include Montreal Protocol experience, for example positions held and products developed, and where; policy and regulatory experience on a national or international level; academic, government, consultancy or industry experience related to ODS phase-out which could relate to a specific region; direct experience with ODS transition in sectors of use, including evaluation of alternatives and their commercial adoption by previous ODS users, design and/or manufacturing of equipment using ODS alternatives, international experience and description of any work performed in an international group/environment; experience in a multidisciplinary environment, preferably but not necessarily in an international context; communication skills based

on teaching experience, public presentations, active participation in meetings, publications, preparation of reports.

- Past performance conducting similar or related work. This criterion seeks to evaluate, when possible, the applicant's ability to successfully complete and/or manage similar work. For example, the applicant's ability to prepare a report, and/or participate on a committee, work to manage diverse and opposing views, resolve conflict, and meet deadlines. Information provided by the applicant and also relevant information from other sources will be considered.
- English Language Proficiency: Good command of the English language is required. The TEAP and its TOCs work and write only in English as per TEAP TOR paragraph 3.1. Nominees and their nominators need to consider the ability of any potential nominee to converse in English on both technical and programmatic issues.
- Relevant professional references. This may include, for example, recommendations by colleagues or peers, or performance when working with implementing agencies and others.
- Relevant publications. These may include those that support the applicant's experience and / or qualifications.

Additional information or qualifications that would aid the selection process include but are not limited to:

- Professional memberships and / or awards
- The country and / or world region (i.e., Africa, Latin America) where the nominee is situated or has experience.
- Source of funding or support for position. Article 5 candidates receive funding for travel and accommodation from the Ozone Secretariat, but non-Article 5 members do not. Lack of funding can make participation difficult or even impossible.

The workload on TEAP and TOCs can be extensive. TEAP members are expected to participate in at least three meetings per year: TEAP meeting, the Open-ende Working Group (OEWG) and the Meeting of the Parties (MOP). TEAP members that are TOC Co-chairs would typically have one or more TOC meetings per year depending up workload for an Assessment year and /or the need to make recommendations on Essential Use Nominations or Critical Use Nominations. Members from Article 5 Parties have their travel funded by the Ozone Secretariat.

In addition to the travel requirements, there is also extensive workload in between meetings. This is especially the case during the months before completing reports, which are due annually 6 weeks before the OEWG and at the end of an Assessment year. The need to participate in TFs or other TSBs adds further to this workload.

9.6 Summary and Findings

To respond to Decision XXII/22, TEAP convened a TF to review the existing information and processes for nominations of experts by Parties and to review how balance and appropriate expertise is realized within the TOCs, TFs, and other TSBs. The findings of the TF are summarized below:

- The TF identified the need for TEAP/TOC Co-chairs to develop more detailed descriptions for each of the experts and expertise required for which they are seeking nominations for members;

- The TF recognized that there are many different ways possible to represent the present balance of the TEAP and its TOCs, including whether or not to include gender in defining balance. When considering balance, the TEAP recommends that "balance" should be considered for Article 5 versus non-Article 5 and within that overall major balance, the need for adequate regional distribution as well.
- The TF identified specific improvements to a Matrix of Needed Capabilities and a Matrix of Current Capabilities, including harmonizing the current matrices used by TEAP and TOCs, as well as proposed timelines for the regular review and updates of these matrices
- If agreed to by the Parties, a searchable database for the TEAP website, TEAP/TOC Roster of Expertise, could be developed if financed and managed by the Ozone Secretariat
- The TF recommended that the TEAP consider creating a standard Nominations Form or at least standardizing the nomination content to assist the Parties in collecting and providing the necessary information that TOC Co-chairs would use in making appointments, and which TEAP would use in recommending appointment for Parties' consideration and confirmation.

The TF compiled a list of relevant information that is needed for the preliminary assessment of a nomination and the Parties are requested to consider whether or not TEAP should develop a standard nomination form.

10 TEAP Operating Procedures

TEAP actions to improve its procedures on disclosure of interest, recusal of members, and minority views.

In the first 20 years of TEAP, TOC, and Temporary Subsidiary Bodies (TSBs) operation (1989 through 2009), there were fewer than five minority statements, with a total of three minority reports – two from MBTOC members and one from a TEAP member. An additional minority report was submitted by a MBTOC member in the 2010 TEAP Progress Report. In the 2011 TEAP Progress Report there were three formal minority reports from MBTOC members. In addition, minority views were reported in the 2010 FTOC Assessment Report.

The minority views reported by FTOC in its 2010 Assessment (published in May 2011) involved the use of methyl formate as a foam blowing agent. The technical and economic performance of methyl formate foam was also the subject of correspondence to UNDP co-signed as from the Global Fluorocarbon Producers Forum (GFPF) Issues Managers Committee and the European Diisocyanate & Polyol Producers Association (ISOPA). The connection to TEAP is that the expert writing the UNDP report was a member of the FTOC and among those with minority views on methyl formate in the 2010 FTOC Assessment Report.

In response to the three MBTOC minority reports, the minority FTOC views on methyl formate in the FTOC report, and the GFPA/ISOPA correspondence TEAP took the following actions:

1. Confirmed that GFPA/ISOPA was mistaken in suggesting that the FTOC had commented as a body on the UNDP report on methyl formate, although a few FTOC members, acting in their own capacity and not representing the FTOC, had commented;
2. Co-ordinated with the Ozone Secretariat in reiterating to TEAP members that work instructions come only from the TEAP terms of reference and periodic Decisions of Parties (and do not come from the MLF Executive Committee or staff, Implementing Agencies, or other bodies);
3. Requested the MBTOC to explain the sequence of events and complications leading to minority reports and to suggest any changes in future TEAP operating procedures;
4. Requested the FTOC to explain the sequence of events and complications leading to minority views and to suggest any changes in future TEAP operating procedures;
5. With the Ozone Secretariat, TEAP will review reports of the MBTOC and FTOC and take any additional steps, as necessary;
6. Instructed the FTOC Co-Chairs to request the resignation of any members that violated TEAP Terms of Reference in circulating confidential draft reports or who disclosed internal deliberations of the FTOC and to report back to TEAP and the Ozone Secretariat;
7. Instructed TEAP members to redouble efforts to update and assure completeness of disclosures of interest and requested the Ozone Secretariat to improve the UNEP Ozone Secretariat Website to track the date of postings;
8. Asked the MBTOC to organize its 2012 MBTOC meeting agenda to allow members of each subcommittee to attend discussions on each topic necessary to contribute to an informed decision and to consider other strategies to support achieving consensus on CUEs and other important topics;

9. Developed guidelines on recusal when a TEAP/TOC member has a direct interest in the outcome, particularly in cases of Essential Use Nominations EUNs, Critical Use Nominations (CUNs), Process Agents Review, and specification of technical performance; and
10. Developed guidelines on the importance of consensus and, where appropriate, on how to properly include minority views.

11 TEAP Guidelines on Recusal

These guidelines apply to all members of the Technology and Economic Assessment Panel (TEAP) and its Subsidiary and Temporary Subsidiary Bodies (including Technical Options Committees (TOCs) & Task Forces.

Members' Interests

TEAP, TOC, and TSB Expert Members' Interests

Financial Interests:

Working for a government, company, or environmental non-governmental organization (NGO) with financial interest in the outcome of TEAP reports or recommendations

Ownership, intellectual property, or investment in enterprises profiting from ODSs or their alternatives and substitutes

Private Enterprise Interests

Research grants or operating grants directly related to actions of the Montreal Protocol, including environmental NGOs, universities, and standards organizations receiving funding to support action under the Montreal Protocol

Professional Interests:

Rewards from participation in global efforts to protect ozone & climate, early knowledge of next-generation technology, inside information on treaty and regulatory incentives, and the opportunity to work with other experts most involved in new technology

Not All Interests are a Conflict with the Montreal Protocol

It is the interest of Parties to have the experts most involved in ODS-free and low-GWP technology as members of TEAP, TOCs, and TSBs. Therefore, disclosing interests in compliance with the TEAP TOR does not in itself indicate an actual Conflict of Interest. Members and co-chairs of TEAP, TOCs and subsidiary bodies seek to avoid the appearance of conflicts of interest by recusal in topics, discussions, and deliberations where there is a direct financial interest or significant private enterprise or professional interest that may unduly influence participation.

Disclosure of Interests

TEAP, TOC, and TSB members are required to disclose any interest that may be seen as influencing their actions, including, but are not limited to, the following:

- Part time, full time, or contract employment for the Party nominating Critical or Essential Uses,
- Paid or unpaid advice to the Party or affected companies on Critical or Essential Use nominations,

- Part time, full time or contracted employment for a company, industry association, or other business, or environmental, consumer or other NGO that has a professional, institutional or financial interest in the outcome of the TEAP, TOC, and TSB findings,

- Part time, full time or contracted employment for a government or government agency or institution that has an interest in the outcome of the deliberations,

- Immediate family financial interests including stocks, grants, salary, contractual / working arrangement, travel re-imbursement, promises of employment or any other situation of value,

- Personal and/or professional interest affected by TEAP/TOC/TSB outcomes (reputation of the member, immediate family, employer, or financer),

- Income or contract funding from the Multilateral Fund or its implementing agencies, and

- Direct or indirect assistance to others seeking MLF funding, including paid or unpaid employment as an independent assessor, reviewer, or advisor.

Recusal Guidelines

Recusal can be defined as "to disqualify from specific participation for good reason."

The purpose of recusal is to avoid the appearance or consequences of a conflict of interest.

Interests subject to recusal include:

Financial interest (if outcome impacts profit, wage, dividend, bonus, promotion, etc.),

Political Advocacy interest (if member instructed or rewarded for outcome),

Other consumer-, environmental-, or industry-NGO Advocacy Interest (if member instructed or rewarded for outcome, or NGO (consumer, environmental, or industry) benefits professionally, institutionally, or financially from the outcome).

Interests that are not subject to recusal if no direct financial interest include:

Professional ethics and codes of conduct (e.g. Hippocratic Oath)

Rights of free speech and professional judgment

Appearance of a conflict of interest occurs when a member or immediate family member has a direct financial or other interest in the outcome of a decision or finding, or the member's or immediate family member's employer, consumer, environmental, or industry NGO affiliation has an interest (financial or otherwise) in the outcome of a decision or finding, and an interested party would have good reason to question the objectivity and fairness of their involvement.

Recusal is only necessary for actions such as those listed below that have direct financial or other impact for the member or the organization that the member is affiliated with.

The TEAP/TOC actions with likely impact on direct financial or other interests include:

- ✓ Process Agent and Feedstock declaration
- ✓ Listing of approved Destruction Technology
- ✓ Essential Use Exemption (EUE)
- ✓ Critical Use Exemption (CUE)
- ✓ Finding on the technical performance & market potential of technology subject to intellectual property rights

Self-Recusal:

When the member believes there may be the appearance of a conflict of interest and prefers not to participate in decision-making.

Self-recusal can be reconsidered and withdrawn, at which time the member can fully participate.

Request for Recusal by Co-Chairs:

TEAP and TOC Co-Chairs can request recusal of members by consensus or simple majority.

1. If there is no-degree of separation from applicant interest: the recused member ***can*** answer questions, ***cannot*** participate in discussions and ***cannot*** participate in consensus or ballot findings and recommendations.

Examples of no-degree of separation:

- Is employed by an applicant:
  - Holds a position of responsibility,
  - Involved or consults in the application for an exemption,
  - Will implement the outcome of the decision, such as for essential or critical uses, or
  - Process or product is under member's direct control, ownership, or marketing;
- Provided advice, for personal or professional gain (financial, commercial, political, etc.), to an applicant on the application within the last 4 years;
- Has a current financial interest, e.g. shares or bonds under the direct control of the member, in a commercial entity with an interest in the outcome;
- Participated in the preparation of the application as part of duties for a third party with an interest in the outcome;
- Employment affected by TEAP/TOC findings or recommendations

2. If there is no degree of separation from competitive interest: the recused member ***can*** answer questions, ***cannot*** participate in discussions and ***cannot*** participate in consensus or ballot findings and recommendations.

Examples of no-degree of separation:

- Has a financial interest in the denial or approval of the application;
- Works for a commercial entity that stands to benefit by denial or approval;
- Has current proprietary interest in a substance, technology or process (e.g. ownership of a patent) subject to the application;
- Works for a consumer, environmental, or industrial NGO that stands to benefit financially, professionally, or politically by denial or approval.

3. If there is one degree of separation from the applicant: the recused member ***can*** answer questions, ***can*** participate in discussion, but ***cannot*** participate in consensus or ballot findings and recommendations.

Examples of one-degree of separation:

- Application developed by someone who has influence over (financial, political, professional etc.) the TEAP/TOC member or someone who reports to the member;
- Organization preparing the application also sponsors the member's travel.

4. If there is one degree of separation from interest of a Party: the recused member ***can*** answer questions, ***can*** participate in discussions, but ***canno***t participate in consensus or ballot findings and recommendations.

    - Works for, advises, or receives financial assistance from the competent authority forwarding the application and was substantially associated with the processing of the application;

    - Manages or conducts research directly related to the specific proposed critical or essential use (on either the proposed use or an alternative) that is funded by organizations with an interest in the application.

In any case of recusal by self or chairs, all other members of the relevant body (TEAP and/or TOC) must immediately disclose any financial or other interest in the topic of the recusal.

Annex TEAP TOC Membership List Status May 2011

The disclosure of interest (DOI) of each member can be found on the Ozone Secretariat website at: http://ozone.unep.org/Assessment_Panels/TEAP/toc-members-disclosures.shtml. The disclosures are updated whenever necessary.

Technology and Economic Assessment Panel (TEAP)

Co-chairs	Affiliation	Country
Stephen O. Andersen	Institute for Governance and Sustainable Development	USA
Lambert Kuijpers	Technical University Eindhoven	Netherlands
Marta Pizano	Consultant	Colombia

Senior Expert Members	Affiliation	Country
Bella Maranion	U.S. EPA	USA
Shiqiu Zhang	Center of Environmental Sciences, Peking University	China

TOC Chairs	Affiliation	Country
Paul Ashford	Caleb Management Services	UK
Mohamed Besri	Institut Agronomique et Vétérinaire Hassan II	Morocco
Biao Jiang	Shanghai Institute of Organic Chemistry	China
David Catchpole	Petrotechnical Resources Alaska	UK
Sergey Kopylov	All Russian Research Institute for Fire Protection	Russian Federation
Michelle Marcotte	Marcotte Consulting LLC and Marcotte Consulting Inc	Canada
Roberto de A. Peixoto	Maua Institute (IMT), Sao Paulo	Brazil
Jose Pons-Pons	Spray Quimica	Venezuela
Ian Porter	Department of Primary Industries	Australia
Miguel Quintero	Consultant	Colombia
Ian D. Rae	University of Melbourne	Australia
Helen Tope	Energyinter Consultancy	Australia
Ashley Woodcock	Wythenshawe Hospital Manchester	UK
Daniel Verdonik	Hughes Associates	USA
Masaaki Yamabe	National Inst. Advanced Industrial Science and Technology	Japan

TEAP Chemicals Technical Options Committee (CTOC)

Co-chairs	Affiliation	Country
Biao Jiang	Shanghai Institute of Organic Chemistry	China
Ian D. Rae	University of Melbourne	Australia
Masaaki Yamabe	National Inst. Advanced Industrial Science and Technology	Japan

Members	Affiliation	Country
D. D. Arora	The Energy and Research Institute	India
Steven Bernhardt	Honeywell	USA
Olga Blinova	Russian Scientific Center for Applied Chemistry	Russia
Jianxin Hu	College of Environmental Sciences & Engineering, Peking University	China
Michael Kishimba	University of Dar-es-Salaam	Tanzania
Abid Merchant	Consultant	USA
Koichi Mizuno	National Inst. Advanced Industrial Science and Technology	Japan
Keichi Ohnishi	Asahi Glass	Japan
Claudia Paratori	Coordinator Ozone Programme -CONAMA	Chile
Hans Porre	Teijin Aramids	Netherlands
John Stemniski	Consultant	USA
Fatemah Al-Shatti	Kuwait Petroleum Corporation	Kuwait
Nee Sun Choong Kwet Yive (Robert)	University of Mauritius	Mauritius

TEAP Flexible and Rigid Foams Technical Options Committee (FTOC)

Co-chairs	Affiliation	Country
Paul Ashford	Caleb Management Services	UK
Miguel Quintero	Consultant	Colombia

Members	Affiliation	Country
Terry Arrmitt	Hennecke	UK
Chris Bloom	Dow	USA
Row Chowdhury	Australia Urethane Systems	Australia
Kyoshi Hara	JUFA	Japan
Mike Hayslett	Maytag/AHAM	USA
Mike Jeffs	Consultant	UK
Candido Lomba	ABRIPUR	Brazil
Yehia Lotfi	Technocom	Egypt
Christoph Meurer	Solvay	Germany
Francesca Pignagnoli	Dow Europe	Italy
Ulrich Schmidt	Haltermann	Germany
Enshang Sheng	Huntsman Co	China
Helen Walter-Terrinoni	DuPont	USA
Tom Werkema	Arkema	USA
Dave Williams	Honeywell	USA
Allen Zhang	Owens Corning	China

TEAP Halons Technical Options Committee (HTOC)

Co-chairs	Affiliation	Country
David V. Catchpole	Petrotechnical Resources Alaska	UK
Sergey Kopylov	All Russian Research Institute for Fire Protection	Russian Federation
Daniel P. Verdonik	Hughes Associates	USA

Members		
Tareq K. Al-Awad	King Abdullah II Design & Development Bureau	Jordan
Jamal Alfuzaie	Kuwait Fire Department	Kuwait
Seunghwan (Charles) Choi	Hanju Chemical Co., Ltd.	South Korea
Michelle M. Collins	Consultant- EECO International	USA
Salomon Gomez	Tecnofuego	Venezuela
Andrew Greig	Protection Projects Inc	South Africa
Zhou Kaixuan	CAAC-AAD	PR China
H. S. Kaprwan	Consultant – Retired	India
Nikolai Kopylov	All Russian Research Institute for Fire Protection	Russian Federation
David Liddy	United Kingdom Ministry of Defence	UK
John J. O'Sullivan	Bureau Veriitas	UK
Emma Palumbo	Safety Hi-tech srl	Italy
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Donald Thomson	Mantoba Hydro & MOPIA	Canada
Caroline Vuillin	European Aviation Safety Agency	France
Robert T. Wickham	Consultant-Wickham Associates	USA
Mitsuru Yagi	Nohmi Bosai Ltd & Fire and Environment Prot. Network	Japan
Yong Meng Wah	Singapore Civil Defence Force	Singapore

Consulting Experts		
Thomas Cortina	Halon Alternatives Research Corporation	USA
Matsuo Ishiyama	Nohmi Bosai Ltd & Fire and Environment Prot. Network	Japan
Steve McCormick	United States Army	USA
John G. Owens	3M Company	USA
Mark L. Robin	DuPont	USA
Joseph A. Senecal	Kidde-Fenwal	USA
Ronald S. Sheinson	United States Naval Research Laboratory – Retired	USA
Ronald Sibley	Defense Supply Center, Richmond	USA

TEAP Medical Technical Options Committee (MTOC)

Co-chairs	Affiliation	Country
Jose Pons Pons	Spray Quimica	Venezuela
Helen Tope	Energy International Australia	Australia
Ashley Woodcock	University Hospital of South Manchester	UK

Members	Affiliation	Country
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Paul Atkins	Oriel Therapeutics Inc.	USA
Sidney Braman	Rhode Island Hospital	USA
Nick Campbell	Arkema SA	France
Hisbello Campos	Centro de Referencia Prof. Helio Fraga, Ministry of Health	Brazil
Jorge Caneva	Favaloro Foundation	Argentina
Christer Carling	Private Consultant	Sweden
Guiliang Chen	Shanghai Institute for Food and Drug Control	China
Davide Dalle Fusine	Chiesi Farmaceutici	Italy
Charles Hancock	Charles O. Hancock Associates	USA
Eamonn Hoxey	Johnson & Johnson	UK
Javaid Khan	The Aga Khan University	Pakistan
Katharine Knobil	GlaxoSmithKline	USA
Suzanne Leung	3M	USA
Nasser Mazhari	Sina Darou Laboratories Company	Iran
Gerald McDonnell	STERIS	UK
Hideo Mori	Private Consultant	Japan
Tunde Otulana	Aerovance Inc.	USA
John Pritchard	Philips Home Healthcare Solutions	UK
Rabbur Reza	Beximco Pharmaceuticals	Bangladesh
Raj Singh	The Chest Centre	India
Roland Stechert	Boehringer Ingelheim	Germany
Ping Wang	Chinese Pharmacopoeia Commission	China
Adam Wanner	University of Miami	USA
Kristine Whorlow	National Asthma Council Australia	Australia
You Yizhong	Journal of Aerosol Communication	China

TEAP Methyl Bromide Technical Options Committee (MBTOC)

Co-chairs	Affiliation	Country
Mohamed Besri	Institut Agronomique et Vétérinaire Hassan II	Morocco
Michelle Marcotte	Marcotte Consulting	Canada
Marta Pizano	Consultant –Hortitecnia Ltda	Colombia
Ian Porter	Department of Primary Industries	Australia

Members	Affiliation	Country
Jonathan Banks	Consultant	Australia
Tom Batchelor	Touchdown Consulting	Belgium
Chris Bell	Consultant	UK
Antonio Bello	Centro de Ciencias Medioambientales	Spain
Fred Bergwerff	Eco2, Netherlands	The Netherlands
Aocheng Cao	Chinese Academy of Agricultural Sciences	China
Peter Caulkins	US Environmental Protection Agency	USA
Ricardo Deang	Consultant	Philippines
Patrick Ducom	Consultant	France
Abraham Gamliel	Agricultural Research Organisation	Israel
Raquel Ghini	EMBRAPA	Brasil
Ken Glassey	MAFF - NZ	New Zealand
Eduardo Gonzalez	Fumigator	Philippines
Darka Hamel	Inst. For Plant Protection in Ag. And Forestry	Croatia
George Lazarovits	A & L Biologicals	Canada
Andrea Minuto	CERSAA, Albenga	Italy
Takashi Misumi	MAFF - Japan	Japan
David Okioga	Ministry of Environment and Natural Resources	Kenya
Christoph Reichmuth	BBAGermany	Germany
Jordi Riudavets	IRTA – Department of Plant Protection	Spain
John Sansone	SCC Products	USA
Jim Schaub	US Department of Agriculture	USA
Sally Schneider	US Department of Agriculture	USA
JL Staphorst	Plant Protection Research Institute	South Africa
Akio Tateya	Japan Fumigation Technology Association	Japan
Robert Taylor	Consultant	UK
Alejandro Valeiro	Department of Agriculture	Argentina
Ken Vick	Consultant	USA
Nick Vink	University of Stellenbosch	South Africa
Janny Vos	CABI International	The Netherlands
Chris Watson	IGROX	UK
Jim Wells	Environmental Solutions Group	USA
Eduardo Willink	Ministerio de Agricultura	Argentina
Suat Yilmaz	BATEM Horticulture Research Station	Turkey

TEAP Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee (RTOC)

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Lambert Kuijpers	Technical University Eindhoven	Netherlands
Roberto de A. Peixoto	Maua Institute, IMT, Sao Paulo	Brazil

Members	Affiliation	Country
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James M. Calm	Engineering Consultant	USA
Radim Cermak	Ingersoll Rand	Czech Republic
Guangming Chen	Inst. For Refrigeration and Cryogenic Eng., Shanghai	China
Denis Clodic	Ecole des Mines	France
Daniel Colbourne	Consultant	UK
Sukumar Devotta	Consultant	India
Martin Dieryckx	Daikin Europe	Belgium
Dennis Dorman	Trane	USA
Kenneth E. Hickman	Consultant	USA
William Hill	Consultant	USA
Martien Janssen	Re/genT	Netherlands
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Michael Kauffeld	Fachhochschule Karlsruhe	Germany
Fred Keller	Consultant	USA
Jürgen Köhler	University of Braunschweig	Germany
Holger König	Heat AG, Vienna	Germany
Edward J. McInerney	Consultant	USA
Petter Nekså	SINTEF Energy Research	Norway
Horace Nelson	Manufacturer	Jamaica
Alexander C. Pachai	Johnson Controls	Denmark
Andy Pearson	Star Refrigeration Glasgow	UK
Per Henrik Pedersen	Danish Technological Institute	Denmark
Sulkan Suladze	Consultant	Georgia
Paulo Vodianitskaia	Consultant	Brazil