MONTREAL PROTOCOL

ON SUBSTANCES THAT DEPLETE

THE OZONE LAYER

UNEP

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TECHNOLOGY AND ECONOMIC ASSESSMENT PANEL

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PROGRESS REPORT

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Foreword

The TEAP 2012 Progress Report

The May 2012 TEAP Progress Report consists of three volumes:

Volume 1: TOC Progress Reports, EUN, CUN and QPS Reports. This report is the Volume 1 report.

This May 2012 TEAP Progress Report contains an evaluation of the Essential Use Nominations followed by the Medical Technical Options Committee Progress Report.

These are followed by the Chemicals, Foams, Halons, Refrigeration and Methyl Bromide Technical Options Committee Progress Reports. The latter is followed by the CUN evaluation report by the same Technical Options Committee. After the Refrigeration report the response to decision XXIII/11 on the use of refrigeration on ships follows.

In the last part of the Progress Report the Report on QPS is presented. A short chapter on TEAP and TOC organisation complete this report. As a last piece of information, the TEAP and TOC Membership lists are given as an Annex, status May 2012.

Volume 2: The separate Volume 2 of the TEAP Progress Report contains the report of the Task Force responding to Decision XXIII/9 on alternatives to ODS. In subsequent chapters information is found on RAC, foams, fire protection and solvents.

Volume 3: The separate Volume 3 of the TEAP Progress Report contains the report of the Task Force responding to Decision XXIII/10.

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1 Essential Uses

1.1 Executive Summary of Essential Use Nominations for Metered Dose Inhalers

MTOC received 2 essential use nominations requesting a total of 696.52 tonnes of CFCs for the manufacture of metered dose inhalers (MDIs) in 2013: 1 nomination was from an Article 5 country (China); and 1 was from a non-Article 5 country (Russian Federation).

Table 1-1 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 598.82 tonnes of CFCs for the manufacture of MDIs in 2013.

Table 1-1: Recommendations for essential use nominations

Party	2013	Active Ingredients	Intended Markets
China	386.82 tonnes	Beclomethasone, beclomethasone/clenbuterol/ipratropium, budesonide, dimethicone, ipratropium/salbutamol, isoprenaline, salbutamol, sodium cromoglycate	China
Russian Federation	212 tonnes	Salbutamol	Russian Federation

MTOC thanks the Ozone Secretariat for providing meeting venue sponsorship for the MTOC meeting held in Dhaka, Bangladesh, 14-16 March 2012. MTOC member, Mr. Rabbur Reza, Beximco Pharmaceuticals, the Bangladesh Lung Foundation, and the Government of the People's Republic of Bangladesh, provided a range of organisational assistance and hospitality, for which MTOC thanks those organisations.

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 three years on, Argentina, Bangladesh, Egypt, Iran, India, Pakistan and Syria did not nominate for essential uses of CFCs for MDIs for 2013. There have been significant reductions from about 2,400 tonnes of authorised essential use CFCs in 2010 to about 697 tonnes of CFCs nominated for 2013.

1.2 Essential Use Nominations for Metered Dose Inhalers

1.2.1 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, XXII/4, and XXIII/2 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.

1.2.2 Review of Nominations

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

Four 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 Dhaka, Bangladesh, 14-16 March 2012. 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.

1.2.3 Observations

MTOC received 2 essential use nominations requesting a total of 696.52 tonnes of CFCs for the manufacture of metered dose inhalers (MDIs) in 2013: 1 nomination was from an Article 5 country (China), and 1 was from a non-Article 5 country (Russian Federation). MTOC recommendations are for a total of 598.82 tonnes of CFCs for the manufacture of MDIs in 2013.

On 3 August 2011, the Ozone Secretariat received an urgent request from Mexico for an emergency use authorization for 6 tonnes of CFC-12 for metered-dose inhalers. In consultation with the Technology and Economic Assessment Panel, the Secretariat authorized that emergency use. Mexico voluntarily decided to compensate for that consumption by destroying the same amount of CFC-11 from stockpiles.

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 three years on, Argentina, Bangladesh, Egypt, Iran, India, Pakistan and Syria did not nominate for essential uses of CFCs for MDIs for 2013. There have been significant reductions from about 2,400 tonnes of authorised essential use CFCs in 2010 to about 697 tonnes of CFCs nominated for 2013. All of these Parties are to be commended for their efforts to phase-out CFCs.

Also encouraging is the progress in China, with a 21 per cent reduction in the nominated quantities of CFCs for 2013 compared with those nominated for 2012. For 2013, China's nomination is only for CFC MDIs for domestic use, and CFCs for four active ingredients used in CFC MDIs are no longer nominated. These four active ingredients are procaterol

hydrochloride, isoprenaline hydrochloride+guaifenesin, ipratropium, and salmeterol xinafoate. Progress is also being made with one salbutamol HFC MDI approved, and others in the pipeline for likely approval within the next year or so. China is commended for these efforts. A number of challenges remain, which are elaborated under the comments within the assessment for China's nomination.

The Russian Federation nomination is for CFCs for the manufacture of salbutamol CFC MDIs for domestic use only, for the same quantity as nominated for 2012, and an 18 per cent increase over the amount nominated for 2010 and authorised by Parties for 2010, 2011 and 2012. It is encouraging that the two Russian companies are now engaged in clinical trials for salbutamol HFC MDIs, with one company anticipating market approval at the end of 2012. The GEF co-funded project is due for completion by the second half of 2013. This overall timeline has not changed from that anticipated in the 2011 nomination, although some of the interim milestones have been delayed. A number of uncertainties remain, which are elaborated under the comments within the assessment for Russia's nomination.

1.2.4 Stockpiles

Of the Parties that provided accounting frameworks for CFC use under essential use exemptions authorised for 2011 (Argentina, Bangladesh, China, Pakistan, Russia), reported stocks of pharmaceutical-grade CFCs were about 800 tonnes at the end of 2011.

1.2.5 China

Year	Quantity nominated
2013	446.52 tonnes

Specific Use: MDIs for asthma and COPD

Active ingredients and intended markets for which the nomination applies:

Active Ingredient	**Intended market**	**Quantity (Tonnes)**
Beclomethasone	China	54.03
Beclomethasone/clenbuterol/ipratropium	China	0.7
Budesonide	China	11.18
Datura metel extract/clenbuterol	China	2.00
Dimethicone	China	0.2
Ephedra, ginkgo, sophora flavescens, radix scutellariae	China	7.00
Ipratropium/Salbutamol	China	0.745
Isoprenaline	China	33.4
Salbutamol	China	332.947
Sodium cromoglycate	China	4.312
Total		**446.52**

Recommendation:

Recommend 386.82 metric tonnes of CFCs for the manufacture of MDIs for the active ingredients beclomethasone, beclomethasone/clenbuterol/ipratropium, budesonide, dimethicone, ipratropium/salbutamol, isoprenaline, salbutamol, sodium cromoglycate.

MTOC is unable to recommend 50 tonnes of CFCs for salbutamol, 9 tonnes for Traditional Chinese Medicines, and 0.7 tonnes for a company not undertaking active research and development (Changzhou Tracheitis Institute for beclomethasone/clenbuterol/ipratropium combination).

Comments:

China is commended for the detailed analysis and justification for its essential use nomination for 2013. The nomination for 2013 shows a reduction of 21 per cent from China's 2012 nominated quantity of CFCs. The nomination is only for CFC MDIs for domestic use, stating that CFCs will not be used for export in 2013. MTOC understands that significant quantities of CFC MDIs imported from China remain on sale in some countries, including Pakistan, Mexico, Chile, Colombia and Brazil in 2012. Compared with 2012, CFCs for four active ingredients used in CFC MDIs are no longer nominated for essential use exemption in 2013. These four active ingredients are procaterol hydrochloride, isoprenaline hydrochloride+guaifenesin, ipratropium, and salmeterol xinafoate. China is commended for these efforts.

The China phase-out strategy is based on the availability only of domestically produced HFC MDIs to trigger phase-out of categories of CFC MDIs when no longer essential. It does not consider imported HFC MDIs or any DPIs to be suitable alternatives. It states that, in general, the prices of imported DPIs are high and that locally made, single-dose DPIs are not convenient to patients. The nomination also states that DPIs are not suitable for relief of acute symptoms. However, according to international guidelines, DPIs are also effective in the treatment of acute symptoms.

Over 80 per cent of the requested quantity of CFCs is for short-acting beta-agonists, including more than 70 per cent for salbutamol. However, modern asthma therapy is based on preventative drugs and the proportion of short-acting beta-agonist (reliever drugs) is expected to change in future in line with international guidelines.

Companies undertaking active research and development

Currently, there are 23 companies in China listed as producing MDIs. Following MTOC's request last year for more information on research and development activities by companies nominating CFCs, China provided useful information on the activity of each company. Based on the information provided, some Chinese MDI manufacturers appear to have made significant progress during 2011. However, it appears that currently only five companies have invested in the necessary manufacturing equipment and/or have already made progress in the registration process of new CFC-free formulations. These five companies nominated about 75-80 per cent of total nominated CFCs for the manufacture of MDIs in 2013. A further five manufacturers show commitment to research and development but are at an earlier stage. Together, these 10 manufacturers account for 95 per cent of the nominated CFC quantities for MDI manufacture in China for 2013. The remaining 13 companies account for less than 5 per cent of nominated CFC quantities for 2013. It is unlikely that transition will be economically feasible for many of these small companies. For 2013, 6 small companies are not requesting CFCs. There will probably be a substantial industrial rationalisation over the period of phase-out with consolidation down to approximately 5-10 domestic MDI manufacturers. China has provided information for each company on their current research and development efforts. Some companies are "at the beginning of research" or "in the phase of marketing investigation", or "under technique review". MTOC believes that these companies may not be undertaking active research and development. In addition, some companies may struggle to achieve transition within China's planned phase-out schedule. Given these considerations, in future years MTOC may be unable to recommend CFCs for those companies nominating small quantities of CFCs without demonstrated evidence of continued progress in research and development.

Some companies have already decided that they will stop MDI production for specific products once CFCs cease to be available and are not undertaking any research and development (Beijing HaiDeRun for isoprenaline, Changzhou Tracheitis Institute for beclomethasone/clenbuterol/ipratropium combination). While CFCs have not been requested for the isoprenaline product in 2013, CFCs have been requested for the combination product (0.7 tonnes). MTOC is unable to recommend CFCs for this combination product from this company without active research and development.

Salbutamol

Currently, the major producer of salbutamol CFC MDIs (JingWei) has launched domestically a salbutamol HFC MDI, and has converted approximately half of its manufacturing plant. MTOC understands that it will produce about 12 million salbutamol CFC MDIs and 13 million HFC MDIs in 2012, out of a total manufacturing capacity of 36 million inhalers per year. Some of the HFC MDIs will be exported. It is not clear from the nomination how, and when, Jing Wei will complete its salbutamol transition, and in particular what proportion of CFC MDIs will still be produced in 2013. Given JingWei's market dominance in China, JingWei's leadership in conversion of CFC MDIs to CFC-free alternatives will largely determine the pace of transition in China.

JingWei has requested about 257 out of a total of about 446 tonnes nominated by China for 2013. JingWei has requested 209.4 tonnes of CFCs out of a total 333 tonnes nominated by China for salbutamol for 2013, and 210.7 tonnes of CFCs for salbutamol for 2012. This corresponds to a small reduction of less than one per cent from 2012 to 2013 at the same time that salbutamol HFC MDI production by Jing Wei is increasing to about 50 per cent of total salbutamol MDI production. By the end of 2012, JingWei's salbutamol HFC MDI will have

been available on the domestic market for more than 12 months. During 2011, JingWei's CFC stockpile increased from 82.5 to 113.8 tonnes.

MTOC has previously recommended that once an HFC MDI product has been available on the market for 12 months that the equivalent CFC MDI product could safely be withdrawn. MTOC would have expected to see more substantial reductions in the CFCs for salbutamol for 2013 than have been requested by China for JingWei because of the projected production of 13 million salbutamol HFC MDIs in 2012. During 2013, JingWei might be expected to increase production of salbutamol HFC MDI manufacture even further. However, the price of JingWei's salbutamol HFC MDI is almost double that of the CFC equivalent. In addition, the MDI market is increasing in China due to the increase in asthma patients and changes to medical insurance. Nevertheless, MTOC recommends a reduction of 50 tonnes on the requested quantities of CFCs nominated by China for salbutamol. JingWei's stockpile may provide an additional source of CFCs to supply demand if required.

By the end of 2012, MTOC understands that salbutamol HFC MDIs will be available on the market from 2 or 3 domestic manufacturers, and a fourth may become available in early 2013. According to China's phase-out strategy, four domestically produced salbutamol MDIs would be adequate for transition. In addition, one imported HFC MDI salbutamol (GSK) and one imported salbutamol DPI (Orion) are also available. Altogether, these would provide a wide range of alternatives for salbutamol, and would allow phase-out of salbutamol CFC MDIs.

Isoprenaline

The nomination includes 33.4 tonnes of CFCs for the non-selective[1] beta-agonist isoprenaline. MTOC has concerns about this drug for two reasons. First this drug has been withdrawn elsewhere in the world because of two epidemics of asthma mortality associated with its use[2,3]. Conversion to a selective beta-agonist, such as salbutamol, would be preferable. Second, reformulation of isoprenaline is only just beginning, and this drug will probably require a full clinical trials package, which MTOC believes is unlikely to be completed before 2016. One company is testing a DPI formulation. Another company (Beijing HaiDeRun) indicates it is not doing research and development, and will withdraw the CFC MDI product in 2014. It has not requested any CFCs for 2013. China may wish to critically assess the use of isoprenaline, and the feasibility of achieving reformulation and launch of a CFC-free inhaler before the end of 2016, China's strategy phase-out date.

Sodium cromoglycate

The nomination includes 4.3 tonnes of CFCs for sodium cromoglycate, all to be used by one company. Two companies (including the company nominating CFCs for sodium cromoglycate) are in active research and development of DPI formulations. One company is "in the phase of technique research" of an HFC formulation, and one is "in the phase of marketing investigation". MTOC considers that the DPI formulation, under development by the company nominating CFCs, will probably provide a future alternative to its own CFC MDI for sodium cromoglycate. MTOC recommends the requested CFCs for sodium cromoglycate for 2013.

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[1] Non-selective refers to beta-agonists that affect the lungs and heart. Selective beta-agonists have minimal, if any, cardiac effects.

[2] Inman, W.H.W., Adelstein, A.M., *Rise and fall of asthma mortality in relation to use of pressurized aerosols*, Lancet 1969; 2:279-83.

[3] Anderson, R.A. *et al*, *Bronchodilator treatment and deaths from asthma: case-control study*, British Medical Journal 2005; 330:117.

Combination products

MTOC restates its position from last year, that at this stage of the phase-out, a combination product is not essential when the separate drugs are available in CFC-free formulations. The nomination requests 0.745 tonnes of CFCs for the combination of salbutamol and ipratropium. Stability testing on an HFC alternative is underway by the company manufacturing the CFC MDI combination. MTOC notes that the CFC MDI combination would not be considered essential in future when sufficient salbutamol HFC MDIs are available, since ipratropium HFC MDI is already available. Because there are currently insufficient CFC-free alternatives to salbutamol CFC MDIs in China, MTOC recommends the requested CFC quantities for this combination product for 2013.

Dimethicone for pulmonary oedema

Dimethicone is a proposed treatment for acute pulmonary oedema in a CFC MDI. This use is supported by anecdotal rather than scientific evidence in the nomination. A clinical trial is expected to be completed in June 2015. The nomination requests 0.2 tonnes of CFCs for 2013, which MTOC recommends. In future years, MTOC may be unable to recommend CFCs for dimethicone MDIs without evidence of continued progress in research and development and evidence for the efficacy of inhaled dimethicone for pulmonary oedema.

Traditional Chinese Medicines

The nomination includes 9 tonnes CFCs use to manufacture MDIs containing "Traditional Chinese Medicines" from two companies. GuiYang DeChangXiang Pharmaceutical Co. produces a combination CFC MDI with "datura metel extract" with clenbuterol. Datura is stramonium, a herbal form of an anticholinergic medicine (like ipratropium), and clenbuterol, a short-acting beta-agonist. LiaoNing HaiKangEn Natural Herb Pharmaceutical Co. produces a complex CFC MDI with four ingredients (ephedra, ginkgo, sophoroflavescens, radix scutellariae). Although these ingredients have been available as Traditional Chinese Medicines (TCMs) for a long time, they have been available in CFC inhalers only in more modern times. There are many CFC-free formulations of TCMs, including oral and injectable forms. MTOC has not found the evidence in China's nominations that demonstrates the improved efficacy of TCMs in a CFC inhaler compared with other forms. MTOC does not consider CFCs for this use to be essential, according to the criteria of Decision IV/25, and is unable to recommend CFCs for these products.

Final phase-out

The China transition strategy indicates the phase-out of all CFC MDIs will be completed by the end of 2016. However, if four salbutamol alternatives become available on the market by early 2013, then accelerated transition for salbutamol becomes feasible. Since salbutamol is a major proportion of the CFC use in China's nominations, annual requests for CFCs for other active ingredients in future years may be in the range of 100 to 150 tonnes. MTOC has reported previously the possible benefits of a final campaign production of CFCs in the last stages of transition. China may wish to consider a future final campaign production of CFCs in 2014 to satisfy its total essential use requirements until final phase-out of all CFC MDI products. This may require an essential use nomination in 2013 to cover multiple years.

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

Active Ingredient	Intended market	Quantity (Tonnes)
Beclomethasone	China	54.03
Beclomethasone/clenbuterol/ipratropium	China	0.0
Budesonide	China	11.18
Datura metel extract/clenbuterol	China	0.00
Dimethicone	China	0.2
Ephedra, ginkgo, sophora flavescens, radix scutellariae	China	0.00
Ipratropium/Salbutamol	China	0.745
Isoprenaline	China	33.4
Salbutamol	China	282.947
Sodium cromoglycate	China	4.312
Total		**386.82**

1.2.6 Russian Federation

Year	Quantity nominated
2013	250 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)
2013	Salbutamol	Russian Federation	250.0

Recommendation:

Recommend 212 tonnes CFCs for MDIs for intended use in the Russian Federation for the active ingredient salbutamol for 2013.

Comments:

The Russian Federation nomination requests 250 tonnes of CFCs for the manufacture of salbutamol CFC MDIs for domestic use only, which is the same as the nomination for 2012, and an 18 per cent increase over the 212 tonnes nominated for 2010 and authorised by Parties for 2010, 2011 and 2012. Total consumption in 2011 including stockpiled material was 213.6 tonnes. Russia reports that annual demand of CFCs in 2007-2011 was 241-246 tonnes per year to satisfy fully the needs of patients.

The first National Action Plan to phase-out CFCs in MDIs was developed in 2004 to phase-out CFCs for MDI production in 2005-2007. Action Plans were revised several times due to economic and technical reasons before being put on hold in 2007 pending clarity on the

timeline for the domestic manufacturers to convert to CFC-free production. In 2009-2010, the Russian Federation, together with the two domestic pharmaceutical companies, worked with UNIDO to initiate a GEF project to phase-out CFCs in MDIs. Although approved in principle in March 2011, approval for the full project to start was not made until December that year.

Two domestic pharmaceutical companies, Altaivitaminy and Moschim-pharmpreparaty manufacture CFC MDIs, and have informal agreements to supply to the Eastern and Western regions of the Russian Federation respectively, and on the price of products. Locally produced CFC MDIs are in 90-dose packs, rather than the more conventional 200-dose pack.

The two Russian companies are now engaged in clinical trials, with one company Moschimpharmpreparaty anticipating market approval at the end of 2012. The nomination states that one company expects delivery of new manufacturing equipment in the first quarter of 2012 and is developing a 100-dose CFC-free MDI. However, MTOC understands from UNIDO that 200-dose HFC products are under development and that the tendering process to procure manufacturing equipment will not lead to delivery until the second half of 2012. The GEF project is expected to commence fully later in 2012 and be finished by the second half of 2013. This overall timeline has not changed from that anticipated in the last year's nomination, although some of the interim milestones have been delayed. Given the varying information about timelines, MTOC is uncertain about exactly when HFC MDI manufacturing equipment will be operational in the two companies. Therefore MTOC is also uncertain about the true CFC requirements during 2013.

Currently there are 6 imported HFC salbutamol MDIs launched, two of which are also available as breath-actuated MDIs, together with one domestically produced DPI. The price for the imported 200-dose CFC-free MDIs can be significantly higher than the locally produced 90-dose MDIs because the pack sizes are more than double[4]. However, dose for dose, five of the six imported HFC MDIs are cheaper per dose than the more expensive of the two locally produced CFC MDIs, for one product (with 0.019 per cent market share by quantity) by as much as 50 per cent[5]. Imported HFC MDIs are not widely stocked in pharmacies. As a result, over 70 per cent of salbutamol doses bought by patients are in CFC MDIs. It is clear that there are complex market arrangements that are influencing patient choice.

The Ministry of Health and Social Development of the Russian Federation agree the price of inhalers with suppliers. The average price of salbutamol MDIs increased across the entire range, domestic and imported, by approximately 30 per cent. This price increase may have

[4] The two Russian products sold for 62 (Altaivitaminy) and 92 (Moschim-pharmpreparaty) Roubles respectively, whereas imported HFC MDIs sold for 99-173 Roubles and breath-actuated MDIs for 134 and 431 Roubles in 2010. The weighted mean price of all MDIs (local and imported) sold in 2010 was 98.7 Roubles. The price of the most popular imported MDI (with 18 per cent market share by quantity) was 155 Roubles, or 57 per cent more expensive than the weighted mean price. The price of the cheapest imported MDI (with 0.019 per cent market share by quantity) was 99 Roubles, or almost equal to the weighted mean price. The price of the most expensive imported MDI (breath-activated, with 1 per cent market share by quantity, and third most popular imported MDI) was 431 Roubles, or 337 per cent more expensive than the weighted mean price.

[5] The two Russian products were priced at 0.69 (Altaivitaminy) and 1.02 (Moschimpharmpreparaty) Roubles per dose respectively, whereas imported HFC MDIs were 0.5-0.87 Roubles per dose and breath-actuated MDIs 0.67 and 2.15 Roubles per dose in 2010. The weighted mean price per dose of all inhalers (local and imported) sold in 2010 was 0.86 Roubles per dose. Six of the eight imported products were cheaper per dose than the weighted mean price per dose (with 18 per cent total market share by quantity).

had an impact on the affordability of MDIs. There was a 17 per cent reduction in the total number of doses sold, but despite this the value of CFC MDI sales grew by 7 per cent.

The stockpile of CFCs has been controlled at a low level in recent years. The Russian Federation reported that the allocation of CFCs for 2011 was exhausted before the end of 2011, with the result that there was no CFC in a stockpile before the end of the year. This may also have contributed to a decline in the sales of locally produced CFC MDIs in 2011.

In the 2011 report, MTOC concluded that if conversion is not achieved within 2012, 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. It is clear that affordable alternatives (by dose) have been potentially available for a number of years, although not widely stocked by pharmacies and more costly per unit. Market forces may be hindering patient access to these medicines.

In 2011, the Russian Federation previously requested a nomination for 2013, for 125 tonnes (50 per cent of the 2012 nominated quantity) to allow transition to be completed in 2013, but this was not authorised by Parties. That nomination was based on an assumption of project completion within the second half of 2013. In this year's nomination, Russia requested 250 tonnes of CFCs for 2013. If the project proceeds on schedule, MTOC would expect consumption of CFCs to be somewhere between 125 tonnes and 250 tonnes. The Russian Federation may wish to apportion the CFC quantity between the two companies depending on their relative progress in conversion, and to ensure CFC usage is kept to a minimum.

MTOC has critically considered what might be feasible and safe in reducing the nominated CFC quantities. Protecting patient health, and not the continuity of local MDI manufacturing, is a key criterion when assessing essentiality. Since the dates of manufacturing conversion for the two companies are uncertain, the true quantity of CFC requirements is also unclear. MTOC remains concerned that patient health might be compromised in the event of a sudden reduction in the availability of domestically produced CFC MDIs due to a shortfall in CFC supply. Taking all of the issues into account, MTOC considers that the volume of CFCs for manufacture of salbutamol MDIs could safely be kept at 212 tonnes, at the same level authorised for 2012. Any growth in demand should be met with increased use of imported, affordable CFC-free inhalers. Russia may wish to consider its domestic arrangements (market and pricing) to facilitate an increased use of imported products. If necessary, provision for an emergency essential use exemption of up to 20 tonnes is also available under Decision VIII/10.

The nomination states that this is anticipated to be the last year of nomination. In the event that progress is substantially delayed, MTOC continues to believe that the Russian Federation should work with local distributors and international manufacturers to make affordable imported products more widely available. Based on current information, MTOC is unlikely to recommend any future nomination.

1.3 Reporting Accounting Frameworks for essential use exemptions

The following section describes information provided in reporting accounting frameworks by Parties with authorised essential use exemptions for 2011 that are not nominating essential uses for 2013. It also provides an update on Parties with authorised essential use exemptions in previous years that have not reported accounting frameworks. The reporting accounting frameworks of Parties nominating essential uses for 2013 are summarised in the preceding sections.

1.3.1 Argentina

Parties authorised an essential use exemption of 107.2 tonnes of CFCs for the manufacture of MDIs in Argentina for 2011. Argentina's accounting framework for 2011 shows that it

acquired about 28 tonnes of CFCs, much less than the full amount authorised by Parties, and used slightly less to manufacture MDIs (about 25 tonnes). While the accounting framework mentions the United Kingdom, MTOC believes that Brazil and the United States were the sources of CFC-11 and -12 respectively. CFC stocks on hand at the end of 2011 increased to about 16 tonnes from 12 tonnes at the start of the year. Argentina used 73 per cent less CFCs to manufacture MDIs in 2011 compared with 2010. Argentina did not make an essential use nomination for 2012 or 2013.

Regarding progress with research and development of isobutane as an alternative propellant in MDIs by Laboratorio Pablo Cassará, MTOC understands that:

1. Filling equipment for a pilot plant is about to be received;
2. Long-term stability studies were initiated in the second semester of 2011;
3. Bioequivalence studies will be initiated in the first semester of 2012;
4. Submission for regulatory approval will be undertaken in the second semester 2012.

1.3.2 Bangladesh

Parties authorised an essential use exemption of 57.0 tonnes of CFCs for the manufacture of MDIs in Bangladesh for 2011. Bangladesh's accounting framework for 2011 shows that it acquired less (about 48 tonnes) than the full amount authorised by Parties, and used even less to manufacture MDIs (about 33 tonnes). As a result, CFC stocks on hand at the end of 2011 increased to about 23 tonnes from 8 tonnes at the start of the year. Bangladesh used 26 per cent less CFCs to manufacture MDIs in 2011 compared with 2010, reflecting its progress in conversion of CFC MDI manufacturing to CFC-free inhalers.

Bangladesh received an essential use exemption of 40.35 tonnes of CFCs for the production of ciclesonide, fluticasone/salmeterol, ipratropium, ipratropium/salbutamol, salmeterol and tiotropium MDIs in 2012.

During its March 2012 meeting held in Dhaka, Bangladesh, MTOC met with a selection of local pharmaceutical companies (Acme, Beximco, Square) and representatives of the Ministry of Environment and Directorate of Drugs Administration. Bangladesh was pleased to report significant progress in the transition from CFC MDIs to CFC-free inhalers.

Three companies (Beximco, Acme and Square) have received MLF funding for conversion projects to HFC MDIs: Beximco and Acme have already completed the conversion. Square is expected to complete its conversion within 2012. Beximco, Square and Acme also produce DPIs. Some molecules, which are difficult to formulate as HFC MDIs (e.g. tiotropium), are likely to be launched later in 2012 as DPIs. Subsequently, Bangladesh has not applied for any essential use nomination for 2013. Bangladesh is to be commended for its achievements in CFC MDI transition to alternatives.

At the end of 2010, the Bangladesh Lung Foundation, Ministry of Environment, UNEP, UNDP and Beximco Pharmaceuticals Ltd. jointly initiated countrywide awareness programmes to speed up CFC-free inhaler use. In this regard, 20 programmes were conducted over the last 2 years in all major cities, covering almost 7,000 doctors. Four more programmes have been planned for 2012. These programmes have the additional benefit of raising general awareness of asthma and COPD diseases and their management.

Bangladesh is therefore successfully moving toward the completion of CFC MDI phase-out.

1.3.3 Egypt

Parties authorised an essential use exemption of 227.4 tonnes of CFCs for the manufacture of MDIs in Egypt for 2010. However, no accounting framework was reported for authorised essential uses in 2010. Egypt has not made any essential use nomination since 2010. MTOC understands that Egypt is importing valves to manufacture CFC MDIs. This is a strong indication that CFC MDI manufacture is continuing in this country.

1.3.4 European Union

The European Union's accounting framework for 2009 was received on 22nd February 2011. The European Union has completed transition and has not had any authorised essential use exemptions since 2009. A stockpile of about 46.4 tonnes remained at the end of 2009. In a letter dated February 2011, the European Union indicated the likely fate of the surplus: some were to be destroyed; some "*will be used for the production of MDIs and parts thereof*"; some were sold for a non-MDI use as a process agent; no information was available for some; and some was unaccounted for on stock inventory. An accounting framework for 2011 and/or a report on available stockpiles under Decision XXIII/2 were not received from the European Union at the time of publication. Further discussion on CFC stockpiles and the deployment of surplus is presented in section 2.3.

1.3.5 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 last year on 25th March. India reported CFC stocks of 226.295 tonnes, including 24.402 tonnes of non-pharmaceutical grade CFCs manufactured during start-up of CFC manufacturing. India's essential use nomination for 2011 was withdrawn and transition has been completed by the MDI manufacturing companies. An accounting framework for 2011 and/or a report on available stockpiles under Decision XXIII/2 was not received from India at the time of publication. Further discussion on CFC stockpiles and the deployment of surplus is presented in section 2.3.

1.3.6 Iran

There are two MDI manufacturing companies in Iran. SinaDarou started CFC MDI manufacture about 16 years ago, and has converted its CFC MDI production line under an MLF project approved in July 2007. Jaber-ebne-Hayyan started CFC MDI manufacture about 4 years ago.

SinaDarou started to manufacture and market HFC inhalers in mid-2010. The other company, Jaber-ebne-Hayyan, also converted its machinery for HFC production on its own and is now manufacturing HFC products. Iran has now completed CFC MDI manufacturing phase-out. There are now an adequate quantity and number of different products available in Iran, which are affordable and distributed throughout the country.

There have been two awareness workshops so far conducted in Tehran and 3 more are scheduled in the next two months. In addition, industry has taken effective measures to raise awareness among physicians, specialists and pharmacists by distribution of relevant publications and having their medical representatives to visit them.

The major objection of patients, after starting to use HFC MDIs, was complaints about the taste and sensation (all products now manufactured are produced by two stage technique using ethanol), and the reduced sound of spraying (use of 50 micro-litre valves instead of 63).

These matters have been clarified during awareness workshops, visits to physicians and distribution of publications to stakeholders. This issue has been generally solved and both physicians and patients are satisfied.

Available HFC MDI products now in Iran are: salbutamol, beclomethasone, salmeterol, fluticasone and there are a few also in the pipeline of research and development, such as ciclesonide and combination products. Imported HFC MDIs and DPIs are also available.

1.3.7 Pakistan

Parties authorised an essential use exemption of 39.6 tonnes of CFCs for the manufacture of MDIs in Pakistan for 2011. Pakistan's accounting framework for 2011 shows that it acquired 36 tonnes of CFCs from the United States, slightly less than the full amount authorised by Parties, and used even less to manufacture MDIs (about 20 tonnes). As a result, CFC stocks on hand at the end of 2011 increased to 18.5 tonnes from 2.5 tonnes at the start of the year. Pakistan used 42 per cent less CFCs to manufacture MDIs in 2011 compared with 2010.

The shortage of MDIs in Pakistan reported last year has been overcome with CFC and HFC MDIs, and DPIs, now freely available on the market. Local pharmaceutical companies in collaboration with various professional societies have continued to conduct educational campaigns for doctors and patients on the reasons for transition to HFC MDIs, and on the role of DPIs for the better control of asthma and COPD.

MTOC notes with concern however that local production of HFC MDIs has not progressed. GSK ceased production of CFC MDIs at the local plant at the end of 2009. MTOC understands that it will commence production of HFC MDIs in the middle of 2013. In order to meet local requirements, GSK is continuing to import HFC MDIs from Europe, which cost more than double the locally produced CFC MDIs. Despite approved MLF funding for conversion, MTOC understands that Zafa has made no progress with plant conversion for the manufacture of HFC MDIs, and continues to provide CFC MDIs from its existing CFC stockpile. Macter was not eligible for MLF funding for plant conversion and MTOC understands that its intended manufacture of HFC MDIs has not materialised. It continues to produce CFC MDIs from its existing CFC stockpile.

Two major local pharmaceutical companies, Hilton Pharmaceutical and Getz Pharmaceutical, continue to import CFC MDIs from China for the local market. MTOC understands these CFC MDIs are manufactured by Jewim Pharmaceuticals (otherwise known as JingWei Pharmaceutical Co. Ltd.), which exports up to 0.5 million CFC MDIs per year. These MDIs are popular because of their low cost compared to the equivalent imported HFC MDIs. Chiesi imports HFC MDIs from Italy but these are costly compared to CFC MDIs available on the market, either locally manufactured or imported from China.

MTOC notes the increasing acceptance of DPIs by doctors and patients in Pakistan, which are cheaper than the equivalent imported HFC MDIs. At present, one company, Highnoon Pharmaceuticals, is importing a full range of DPIs under an arrangement with Cipla in India.

MTOC notes with concern the slowdown in Pakistan's transition to HFC MDIs. It does not yet have one locally produced HFC MDI on the market. Whilst problems are being encountered with the commencement of local manufacturing, consideration should be given to the import of low priced CFC-free inhalers from other countries in the region to meet local demand for affordable inhalers.

1.3.8 Syria

Parties authorised an essential use exemption of 44.68 tonnes of CFCs for the manufacture of MDIs in Syria for 2010. However, no accounting framework was reported for authorised essential uses in 2010. Syria has not made any essential use nomination since 2010. MTOC understands that Syria is importing valves to manufacture CFC MDIs. This is a strong indication that CFC MDI manufacture is continuing in this country.

1.3.9 United States

Parties authorised 92 tonnes of essential use CFCs for the manufacture of MDIs in the United States for 2010. The United States did not have any authorised essential uses for 2011 or 2012. The United States' accounting framework for 2010 was received on 19th March 2011.

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. Some of the surplus reported was manufactured pre-1996. In addition, the United States reported separately under Decision XXII/4(4) that stockpiles of 624.637 tonnes of pharmaceutical-grade CFCs were potentially available for export to Parties with essential-use exemptions in 2011. The United States advised that this stockpile quantity, held by Honeywell, was separate to the stockpile reported in its accounting framework, held by individual MDI manufacturing companies. Therefore, the United States had a total stockpile of about 793.6 tonnes of CFCs at the end of 2011. An accounting framework for 2011 and/or a report on available stockpiles under Decision XXIII/2 were not received from the United States at the time of publication. Further discussion on CFC stockpiles and the deployment of surplus is presented in section 2.3.

2 2012 Medical TOC (MTOC) Progress Report

2.1 Executive Summary

MTOC thanks the Ozone Secretariat for providing meeting venue sponsorship for the MTOC meeting held in Dhaka, Bangladesh, 14-16 March 2012. MTOC member, Mr. Rabbur Reza, Beximco Pharmaceuticals, the Bangladesh Lung Foundation, and the Government of the People's Republic of Bangladesh, provided a range of organisational assistance and hospitality, for which MTOC thanks those organisations.

The global use of CFCs to manufacture MDIs in 2011 is estimated to be less than about 900 tonnes, which is a reduction of about 45 per cent from 2010. Article 5 countries that reported accounting frameworks used about 568 tonnes of CFCs to manufacture MDIs in 2011, a reduction of 30 percent from 2010.

Of the Parties that provided accounting frameworks for 2011 (Argentina, Bangladesh, China, Pakistan and Russia), reported stocks of pharmaceutical-grade CFCs were about 800 tonnes at the end of 2011. Reports on available stockpiles were not received from the EC, India and the United States, which reported 1,020 tonnes of CFCs stockpiles at the end of 2010. Nor have accounting frameworks been received from Egypt and Syria for 2010. Having information on stockpiles would allow Parties to continue tracking management and deployment of stockpile until depleted. Information on stockpiles is particularly important in the last stages of global CFC MDI phase-out, and could be really valuable in avoiding new production.

MTOC has reported previously the possible benefits of a final campaign production of CFCs in the last stages of transition. China may wish to consider a future final campaign production of CFCs to meet its total essential use needs until final phase-out of all CFC MDI products within its nomination next year, for production in 2014. This may require an essential use nomination for CFCs to cover multiple years based on an assessment of China's total needs until phase-out. Surplus CFC stockpiles might also be available for this purpose.

Decision XIV/5 requests all Parties to submit information on CFC and CFC-free alternatives to the Secretariat by 28 February each year. 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. Decision XVIII/16(7) requests each Party to submit a report summarising the export manufacturing transition plans as part of the Party's essential use nomination. Given the advanced status of CFC MDI phase-out, there is little value in making annual reports. In future MTOC will report to Parties only significant new information resulting from these decisions.

2.2 Global use of CFCs for MDIs

The global use of CFCs to manufacture MDIs in 2011 was about 780 tonnes, based on the accounting frameworks received from Argentina, Bangladesh, China, Pakistan and Russia. This excludes countries that may or may not be using CFCs for MDI manufacture, such as India or the United States, for which stockpile remained at the end of 2010. A number of countries did not report accounting frameworks perhaps because they did not hold exemptions for 2011, e.g. India and the United States. Taking potential usage in these countries into account, global use in 2011 is estimated to be less than about 900 tonnes, which is a reduction of about 45 per cent from 2010.

Article 5 countries that reported accounting frameworks used about 568 tonnes of CFCs to manufacture MDIs in 2011, which is 73 per cent of the reported total global use of CFCs for MDIs. This is a reduction of 30 percent of the CFC use for MDI manufacture in Article 5 countries in 2010.

Figure 2-1 and Table 2-1 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 that was reported through accounting frameworks. This may not represent actual global use this year, due to reports not received and stockpile that may be depleted through on-going MDI manufacture.

Figure 2-1: Quantities of CFCs for MDI manufacture in Article 5 and non-Article 5 countries reported through accounting frameworks (metric tonnes)

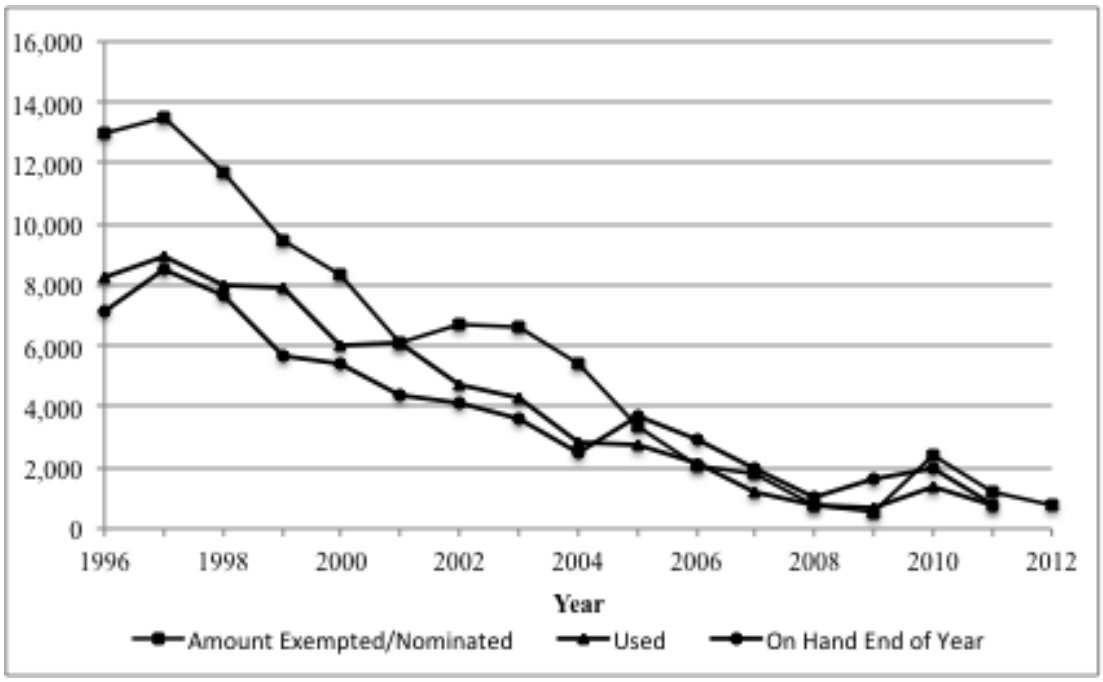


Table 2-1: Quantities (in tonnes) of CFCs for MDI manufacture in Article 5 and non-Article 5 countries

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	659.54	**1,590.16
*2010	2,366.47	1,382.93	**1,938.39
2011	1,162.95	***782.10	***798.57
2012	808.49		

* 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.

*** For 2011, reported CFC use and stockpiles at the end of year include accounting framework information received from Argentina, Bangladesh, China, Pakistan and Russia. Reports were not received from the EC, India and the United States, which reported 1,020 tonnes of CFCs stockpiles at the end of 2010. For India and the United States, CFC MDI manufacturing may still be occurring from stockpile. No information is yet available about the quantities of stockpiles remaining in these three countries at the end of 2011.

2.3 CFC stockpiles

Table 2-1 presents historical stockpile reported by Parties with essential use exemptions through accounting frameworks. Of the Parties that provided accounting frameworks for 2011 (Argentina, Bangladesh, China, Pakistan and Russia), reported stocks of pharmaceutical-grade CFCs were about 800 tonnes at the end of 2011, a significant reduction on previous years. Stockpiles reported by some individual Parties increased slightly from 2010 to 2011 (Argentina, Bangladesh, Pakistan), reinforcing the need to manage CFCs carefully in the final stages of phase-out.

Reports on available stockpiles have not yet been received from the EC, India and the United States, which reported 1,020 tonnes of CFCs stockpiles at the end of 2010. For India and the United States, CFC MDI manufacturing may still be occurring from stockpile. No information is yet available about the quantities of stockpiles remaining in these countries at the end of 2011.

Decision XXI/4, XXII/4 and XXIII/2 encouraged Parties with stockpiles of pharmaceutical-grade CFCs potentially available for export to notify the Ozone Secretariat by 31st December 2009, 2010 and 2011 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 was 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 were 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 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 for 2010.

The European Union has completed MDI manufacturing transition. 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 reported in its accounting framework stockpile of about 46 tonnes at the end of 2009.

India reported in its accounting framework stockpile of about 202 tonnes of pharmaceutical-grade CFCs, and 24 tonnes of non-pharmaceutical grade CFCs, available at the end of 2010.

MTOC understands that Egypt and Syria, which had essential use exemptions for 2010, are importing valves to manufacture CFC MDIs. This is a strong indication that CFC MDI manufacture is continuing in these countries.

Accounting frameworks and/or reports on available stockpiles under Decision XXIII/2 were not received from the EC, India or the United States for 2011 at the time of publication. Nor have accounting frameworks been received from Egypt and Syria for 2010. Consequently, MTOC is unable to report to Parties on the use or depletion of surplus CFCs in these countries that were

accumulated under essential use exemptions authorised by Parties to manufacture MDIs, or how much might be available for acquisition by Parties with authorised essential uses.

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*".

Decision VII/28, paragraph 2(c) states that for the years 1996, 1997, 1998, 1999, 2000 and 2001, "*The Parties granted essential use exemptions will reallocate, as decided by the Parties, to other uses the exemptions granted or destroy any surplus ozone depleting substances authorised for essential use but subsequently rendered unnecessary as a result of technical progress and market adjustments*".

Having information on stockpiles, that were accumulated under CFC essential use exemptions granted by Parties for previous years, would allow Parties to continue tracking management and deployment of stockpile until depleted. Information on stockpiles is particularly important in the last stages of global CFC MDI phase-out, and could be really valuable in avoiding new production.

2.4 Manufacture of CFC MDI valves using CFCs

MTOC has received information indicating that CFC stockpiles accumulated in non-Article 5 countries under essential use exemptions are being used in a non-Article 5 country to manufacture valves for CFC MDIs produced in other countries (Egypt, Pakistan, Russia and Syria). The valve is the metering device for an MDI, and a key component. CFCs are used to wash and clean elastomers to remove leachable contaminants, such as nitrosamines, for all of the valves manufactured. The elastomers in the valve for a CFC MDI must be washed with CFCs because this is the substance that the valve will be in contact with during the CFC MDI's operational life. This is probably a relatively small CFC use in volume terms, where fugitive emissions are minimal. For an approved CFC MDI product, valve suppliers cannot be substituted without considerable difficulty. To do this, the product dossier would have to be up-dated showing that the MDI performance is the same, and that the product stability and shelf life do not change with valve substitution. Depending on the long-term customer need, CFCs could be used for this purpose in the short term (e.g. in 2013) and then the manufactured valves stockpiled for 3-5 years.

Additionally some CFCs are also used to test batch samples of valves for proper functioning.

As the CFCs are used in the manufacturing process for valves supplied to CFC MDI manufacturers, and as this process is essential in ensuring regulatory standards for CFC MDI products made with these valves, MTOC considers the uses of CFCs for this purpose meet the essential use criteria of Decision IV/25. In the past, MTOC recommended CFC essential use nominations from the European Union that included a specific volume of CFCs nominated for use in the manufacture of valves. Any future essential use nominations may wish to specify and elaborate this use and its associated CFC consumption. TEAP does not consider the testing of valves with CFCs to be a laboratory or analytical use.

2.5 CFC production

In principle under the Montreal Protocol, China or any other Parties, including India, could produce CFCs for export to other countries for the purposes of essential use exemptions in the importing countries. However, in the case of China and India, the production sector agreement under the Multilateral Fund determines the specified limits to any production of CFCs within the production closure plans. At the 60th ExCom (April 2010), a decision was taken to allow China and India to produce pharmaceutical-grade CFCs for export to other countries with essential use exemptions for 2010, with provision for annual review. The Executive Committee will consider again this issue at the 66th ExCom (April 2012) to decide whether to permit China to produce CFCs for essential uses granted to other Parties for 2012. MTOC understands that Russia is interested to supply its CFCs under its authorised essential use exemption for 2012 from China, and is awaiting this decision.

MTOC has reported previously the possible benefits of a final campaign production of CFCs in the last stages of transition. This is a period when bulk CFC production could drop to levels that might not economically sustain production for pharmaceutical-grade CFCs. China may wish to consider a future final campaign production of CFCs to meet its total essential use needs until final phase-out of all CFC MDI products within its nomination next year, for production in 2014. This may require an essential use nomination for CFCs to cover multiple years based on an assessment of China's total needs until phase-out. There are likely also large stocks of CFCs in the United States and India that might be available. These might otherwise need to be destroyed if Parties that produce CFC MDIs do not use them.

2.6 Transition away from the use of CFC MDIs

Technically satisfactory alternatives to CFC MDIs to treat asthma and COPD are available in all countries worldwide except China. 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. The significant uptake of DPIs and the increased use of MDIs are also indicated. MTOC notes the importance of awareness programmes to facilitate the uptake of CFC-free inhalers among patients.

2.7 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[1].

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.

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;*"

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

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.

All Article 5 Parties currently nominating for essential use exemptions to produce or import CFCs for the manufacture of MDIs (China only for 2013) have submitted initial transition strategies and preliminary plans of action.

Further recent information on transition strategies is contained in the *2010 MTOC Assessment Report*[2].

2.7.1 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 2012, progress reports about progress made with implementation of national transition strategies were received within essential use nominations for China and the Russian Federation.

Article 5 countries that develop their own national transition strategy are expected to 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.

2.8 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 2012, a report was received from Canada[3] only. Canada reported that it prescribed about 5.75 million DPIs, 1,817 CFC MDIs and 9.1 million HFC MDIs in 2011. The small number of imported CFC MDIs might indicate minor cross-border movements of redundant technology, and is declining each year.

Thirty-nine Article 5 and non-Article 5 countries have submitted data pursuant to Decision XIV/5 since its inception. However much of the data is up to 10 years old and no longer relevant to today's markets.

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 has information for the European Community only.

Given the advanced status of CFC MDI phase-out, there is little value in making annual reports. In future MTOC will report to Parties only significant new information resulting from these decisions.

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

[3] http://montreal-protocol.org/new_site/en/essential_use_information.php

2.9 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). With the cessation of export of CFC MDIs by the last country, China, there is little value in making annual reports. In future MTOC will report to Parties only significant new information resulting from this decision.

3 2012 Chemicals TOC (CTOC) Progress Report

3.1 Executive Summary

The CTOC met on 29 February – 2 March in Hong Kong, with eleven out of sixteen members attending.

Process Agents

The 2010 data for makeup and emission quantities for ODS in process agent applications (Table B) were reviewed, and estimates made of the ODP and GWP of total emissions. Three applications, of the fourteen in table A following Decision XXIII/7, have been discontinued. Five of the remaining uses were reviewed, and it was noted that chloroform can substitute for CTC in some applications associated with chlorine gas production. In most cases, however, it has not been possible to recommend alternatives to the use of ODS as process agents, but emissions can be minimised by good industrial practice.

Feedstocks

CTC is commonly used as a feedstock because its combination of carbon and chlorine provides a valuable building block for industrial production of other chemicals. As a consequence, it is difficult to suggest alternatives to the use of ODS as feedstocks, especially given the investment in present production facilities. The 2010 data reported to UNEP are included in this report, and it is estimated that emissions form feedstock use could total 5083 MT or 2166 ODP tonnes.

n-Propyl bromide

Little new information is available about production and consumption of nPB. However, there are increasing concerns about workplace health and safety when nPB is used as solvent.

CTC in vinyl chloride monomer (VCM) production

The CTOC made a particular study of the role played by CTC in the production of VCM by pyrolysis of EDC, and concluded that, because all or most of the CTC is destroyed or irreversibly transformed, this is a feedstock use, not process agent. Not all Parties in which VCM is produced have responded to the request for information. Approximately 85% of VCM is produced by the pyrolysis route, with the remainder generated directly from acetylene, which is the route used in China.

EUN for aerospace use of CFC-113 in Russian Federation

The request for the Essential Use of 95 MT of CFC-113 in the Russian Federation space industry was accompanied by information that EUNs for 85 MT in 2014 and 75 MT were anticipated in future years. The end date for use of CFC-113 is projected to be 2016. Among other solvents being tested, are some HCFCs that show promise and a new CFC, RC-316 (1,2-dichloro-1,2,3,3,4,4-hexafluorocyclobutane) is also being assessed. This is not a controlled substance under the Montreal Protocol, and no ODP or GWP estimates are available for it. On the basis that progress continues to be made in reducing the use of CFC-113, and that an end-date has been nominated, CTOC recommends approval of the essential use of 95 MT in 2013.

Laboratory and analytical and uses of ODS

CTOC has provided further information about alternative methods of analysis, some of them standard methods, in which ODS are not used. Interactions with Parties, both directly and via meetings of ozone officers, are reported. The Green Chemistry movement supports efforts to avoid the use of

ODS, notably of CTC. Industry forums and journal publication policies militate against work using ODS.

CTC emissions and stratospheric concentrations

The development of concerns about CTC emissions and the gap between 'bottom up' quantities based on estimated uses and emissions, and 'top down' quantities derived from consideration of stratospheric concentrations and lifetime, is reviewed. New information is provided on CTC concentrations in the lower atmosphere near cities. Large quantities of CTC are contained in the large volumes of air containing even low concentrations of CTC, and could these data could help to reconcile the bottom up and top down figures. The CTC probably derives from legacy sources such as dry cleaning and industrial solvent facilities, rather than from current activities that have been assessed in earlier reviews of this matter.

Preliminary advice

CTOC reports on a small number of cases in which preliminary advice was provided on uses of ODS, that had been referred to the Ozone Secretariat by Parties.

Destruction technologies

Trials planned for the forthcoming year should allow comparison of DE and DRE and destruction criteria. No further work has been done on verification, and no new data have been submitted on plasma destruction of methyl bromide.

3.2 Introduction

The CTOC met on 29 February through 2 March, 2012 in Hong Kong. Eleven out of sixteen CTOC members participated in the meeting. Attending members were from Australia, Chile, China (2), Japan, Kuwait, Mauritius, Russian Federation, and United States of America (3). Subsequent to the meeting, it was learned that Dr Michael Kishimba (Tanzania), a CTOC member since 2006, had died in late 2011.

The meeting covered issues requested by the Parties including process agents, laboratory and analytical uses, n-PB, CTC issues, and feedstocks. Attention was also given to considering TEAP/TOC operating procedures and the requirement of Decision XXIII/10 that the present terms of office of members would end in 2013 or 2014, although renomination was possible. The CTOC also reviewed an essential use nomination from the Russian Federation on solvent use of CFC-113 for aerospace industries. Subsequent to the CTOC meeting, a brief report on destruction technologies was prepared by the co-chairs of the 2011 task Force on destruction, Paul Ashford and Ian Rae in conjunction with TEAP and TF member Bella Maranion.

3.3 Process Agents

3.3.1 Introduction

At MOP-23 in 2011, Parties were requested to submit information to the Secretariat on make-up quantities and emissions from applications for which process agent exemptions exist. Parties were also requested to revisit the maximum values for both make-up and emissions as there have been many processes that have ceased operation and no longer need process agent exemption for the volumes used when in operation. This report addresses requests from Parties to TEAP, specifically those in Decision XXIII/7 (3-7).

3.3.2 Response to Decision XXIII/7(6)

This decision asked for information under a number of headings to be provided to the thirty-second meeting of the Open-ended Working Group in mid-2012.

3.3.2.1 Descriptive overview of the processes using ODS as process agents

To be accepted as a process agent, the ODS in the specified process must meet two of the following criteria:

(i) Chemical inertness during the process.

(ii) Physical properties.

(iii) Action as a chain-transfer reagent in free radical reactions.

(iv) Control of product physical properties such as molecular weight or viscosity.

(v) Ability to increase yield.

(vi) Non-flammable/non-explosive.

(vii) Minimisation of by-product formation.

Only fourteen entries remain in Table A of Decision X/14 following its revision in 2011 (Decision XXIII/7(1)), and most of them are of long standing. They were extensively reviewed in 1997 (TEAP Report, Volume 2). Nine of the fourteen process agent applications employ carbon tetrachloride (CTC). In most of the other applications, ODS are used as solvents to create unique yields, selectivity and/or resistance to harsh chemical environments, with the result that production is achieved with high efficiency. ODS are also used as solvents to take advantage of their solvent properties while avoiding the flammability hazards of alternatives. Legacy processes built around these properties make it difficult or impossible to convert in a cost effective and timely manner, and only a few examples are known.

The processes are operated in large, continuous and high investment facilities with a high degree of controls and instrumentation that lends itself to limit emissions to minimal levels. This concern with emissions was the reason, at the MOP-10, that process agent exemptions were allowed for non-Article 5 Parties while not for Article 5 Parties, although this distinction has since been removed. Emissions in non-A(5) counties, where sophisticated, well instrumented and well maintained and operated facilities are the norm, are fully two orders of magnitude lower than those from small batch operations prevalent in Article 5 Party applications.

It has not been possible, in the time available, for the CTOC to review all of the process agent uses, but five cases are presented here, with others to follow in subsequent Progress Reports. The numbered paragraphs below refer to the positions in Table A as it appears in Decision XXIII/7.

1. CTC is used by a number of parties to remove nitrogen trichloride (NCl_3) in chlor-alkali production. The process consists of the electrolysis of sodium chloride (common salt) in solution (brine) by passing an electric current through the solution, during which elemental chlorine and sodium hydroxide (caustic soda) are produced. Both are valuable chemical products and the process is operated frequently on a very large scale. In many cases the raw material, salt, is of high purity, but when nitrogenous materials are present in the salt, these can react with the chlorine gas to produce NCl_3. This substance is dangerously explosive and so it is removed from the chlorine by extraction into a solvent, and treating the solution with a reagent to destroy the NCl_3. The requirements placed on the solvent are that it be a good solvent for the NCl_3, and that it not be affected by the chlorine, which is a highly reactive substance. CTC is already fully chlorinated and cannot react further with chlorine. It meets criteria (i), (vi) and (vii).

If purer salt were to be used, then less NCl_3, or perhaps even none at all would be produced and the use of CTC would be unnecessary. Some producers use salt with almost no nitrogenous impurities,

but in other cases the experience of a Colombian company, Quimpac S.A. (formerly known as Prodesal S.A.) shows how the difficulty may be overcome. Until November 2011, Quimpac was using 0.32 metric ton of carbon tetrachloride (CTC) each year as process agent for removal of NCl_3 but with support from the MLF it has been able to make changes to eliminate the use of CTC. When the project was approved by the ExCom, three alternatives were considered: (a) compressor change (centrifugal compressors could be used instead of reciprocating compressors actually used), (b) chloroform to replace CTC, and (c) washing with caustic soda (NaOH). The first of these was capital intensive, and while information concerning the third option was explored with countries where this technology is used, useful information was not obtained. The final solution combined two modifications - processing the brine to reduce its nitrogen content and replacing CTC with chloroform. As well as avoiding the use of an ODS, there was an additional advantage because the concentration of the solvent impurity (chloroform) in the chlorine product fell to <10 ppm whereas with CTC it had been 20-30 ppm. The Colombian experience could be valuable to other parties seeking to reduce the consumption of CTC in the chlor-alkali industry.

2. In the industrial process for production of elemental chlorine, described above, the chlorine is first released as a gas, and then recovered as a liquid under moderate pressure. Subsequent to the liquefaction step, vapours known as 'tail gas' still contain small quantities of chlorine, and this is recovered by 'scrubbing' the vapour stream with a suitable solvent. CTC is commonly used in this process because it is already fully chlorinated and cannot react further with chlorine. It meets criteria (i), (v) and (vi). However, the CTOC draws attention to the use of chloroform in the preceding application, and raises the possibility that it could be useful in sequestering chlorine from tail gas.

6. The chlorofluorocarbon CFC-11 ($CFCl_3$) is used as solvent in the production of synthetic fibre sheet. Information was provided to a Process Agent Task Force in 1997 that over one hundred possible alternatives were tested by satisfactory results could only been obtained with CFC-11. It was understood that the search for a non-ODS process agent continued, but no subsequent information has been received. The use satisfies criteria (i), (ii) and (vi).

9. CTC is used as solvent in the production of cyclodime, a cyclic substance that possesses an oxime (>C=N-OH) group and for which the chemical name is cyclododecanone oxime ($C_{12}H_{23}NO$, CAS. No. 946-89-4). This substance is formed by photochemical reaction of nitrosyl chloride with the cyclic hydrocarbon, cyclododecane. The oxime is subsequently transformed into a lactam and this in turn into polyamide-12. During the nitrosation step, special conditions are needed to ensure that side-reactions are suppressed and that the product of the reaction is not deposited in the reactor. While some patents claim the use of chloroform, a non-ODS, as solvent in this reaction, the process has been operated since 1971 in France by Arkema and predecessor companies, during which time the use of alternatives solvents has been investigated but not found satisfactory. Residues from the process are destroyed but most CTC is recycled; reported emissions in 2010 were 0.103 MT, and make-up was 723.126 MT. In this process, CTC meets criteria (i), (v) and (vii).

14. Production of high modulus polyethylene fibre by 'spinning' the molten polymer into the chlorofluorocarbon CFC-113 was carefully reviewed by the CTOC in 2005. While another manufacturer has found a non-ODS that performs satisfactorily in this process, the proponent reported that 'hundreds of non-ODS materials' had been tested as replacements for CFC-113, none had been able to achieve required technical performance criteria on flammability, boiling point, toxicity, compatibility with materials of construction, economy, and recoverability, while retaining product properties and performance. The use satisfies criteria (i), (ii) and (vi).

3.3.2.2 Information about alternatives to ODS in process agent uses:

Accepted process agent applications using ODS have been in operation since 1999 or earlier. As such, they are well established commercial operations. Parties have responded to the challenge to seek non-ODS alternatives. The Protocol has been very successful in this regard by phasing out many smaller and batch operations over the past few years especially those operating in Article 5 Parties.

This has resulted in the listing of exemptions in Table A being reduced from over 40 applications to a current 14 exemptions. The remaining uses are largely high volume, continuous processes involving higher level of controls compared with the small batch units. Resulting emissions are far reduced and are comparable to emissions from feedstock uses. Transition to non-ODS uses would be challenging as these generally represent high investment facilities that benefit from non-flammability of ODS being used. While in some cases, non-ODS can be considered, safety issues might require redesign of these facilities requiring major new investment, disruption of production and interruption of supply to the market. In cases where chlorine is being managed, CTC is usually the only acceptable solvent that can meet the stringent requirements and can stand up to chlorine attack.

3.3.2.3 Information on quantities used for process agent uses as reported in accordance with Article 7 of the Montreal Protocol

Table 3-1: Process agent emissions and make-up 2010 (MT)

No.	ODS	Process	Country	Makeup	Emission
1	CTC	Elimination of NCl_3 in chlor-alkali production	Colombia EU Israel USA	0.64 34.726 2.4	 0.211 (note 1)
2	CTC	Chlorine recovery by tail gas absorption in chlor-alkali production	EU Mexico USA	123.466 40.9954	0.683 (40.9954) (note 1)
3	CTC	Production of chlorinated rubber	EU	10.02	0.185
4	CTC	Production of chlorosulfonated polyolefin (CSM)	China USA	179.3	(179.3) (note 1)
5	CTC	Production of aramid polymer (PPTA)	EU	24.8	0.105
6	CFC-11	Production of synthetic fibre sheet	USA		(note 1)
7	CFC-12	Photochemical synthesis of perfluoropolyetherperoxide precursors of Z-perfluoropolyethers and difunctional derivatives	EU	195.19	0
8	CFC-113	Preparation of perfluoropolyether diols with high functionality	EU	4.903	0
9	CTC	Production of cyclodime	EU	723.126	0.103
10	CTC	Production of chlorinated polypropene	China	(note 2)	
11	CTC	Production of chlorinated ethylene vinyl acetate (CEVA)	China	(note 2)	
12	CTC	Production of methyl isocyanate derivatives	China	(note 2)	
13	BCM	Bromination of a styrenic polymer	USA		(note 1)
14	CFC-113	Production of high modulus polyethylene fibre	USA		(note 1)

Note 1. The USA emission figures are reported to the Ozone Secretariat as aggregates covering the six process listed above, the total being 59.79 ODP-weighted MT. Maximum emissions set in Decision X/14 were 181 MT.

Note 2. China has informed the CTOC that these facilities operating three processes have been dismantled or transformed to non-ODS use by the end of 2009. Parties may wish to remove the processes from table A at the next opportunity.

Following the attention directed to data gaps in previous CTOC reports, reporting to Table B of Decision X/14 has improved, but it is possible that there is still under-reporting by Parties unaware of the exact uses to which ODS are put in their countries. While no information is available about the quantity of ODS tied up in reuse and recirculation in process agent uses, annual makeup or consumption should be no more than 5000.5 tonnes in any year, based on Table B limits. Data reported to the Secretariat (see table 3-1) indicated makeup volumes well below that figure, at approximately 1500 tonnes for the year 2010.

3.3.2.4 Information on estimated emissions of ODS from process agent uses and their impact on the ozone layer and climate

The elimination of many of the smaller, batch and lower technology applications has reduced the ODS emissions per unit of output and the contribution of process agent uses to ozone layer damage and global warming. Data provided by Parties are incomplete and so full evaluation of this question is difficult, but the following approach provides some useful estimates. Most applications are now in developed countries where emission controls are expected to be effective. In the EU for example, emissions total 1.287 MT, approximately 0.33% of the make-up quantity (393.105 MT). In the emissions column of table 7.2.1 (above), some figures are actual emissions and others maximum emissions allowed by the Protocol (assuming all make-up is required to replace emissions). Their sum is 284 MT (admitting a small error by taking the US figure as MT rather than ODP-adjusted MT). Using a 100-yr GWP of 1400 for CTC (4th Assessment Report), the annual 100 year contribution is calculated to be 284 x 1400 = 397,600 tonnes CO_2e. An upper bound in this figure could be reached by assuming that most of the ODS is CTC (ODP = 1.1), in which case the estimated ozone depletion impact is 312 ODP-tonnes/yr, and climate impact 397,100 tonnes CO_2e. Both figures, of course, involve considerable uncertainty.

3.3.2.5 Practicable measures to avoid and reduce emissions from process agent uses

While each of the process agent applications is unique, there exists a suite of measures that can be applied to minimize make-up and emissions and each needs to be considered by an operator. These measures include limiting make-up to the essential minimum, ensuring tight systems (no leaking valves and joints); evacuation and purging with recovery prior to opening equipment; closed loop transfer systems; proximity of production and use of the ODS; monitoring sensors at potential leak locations to provide alerts for prompt repair; use of absorbents such as activated charcoal on vents; and destruction of vent gases.

3.4 Feedstocks

3.4.1 Introduction

Carbon tetrachloride (CTC), 1,1,1-trichloroethane (TCA), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and methyl chloroform, all ozone depleting substances, serve as chemical building blocks fpr the preparation of other chemicals. They allow incorporation of fluorine atoms into molecule structures and they have been carefully selected as feedstocks in these uses so there are no other technologically and economically viable alternative routes at this time. Their use in chemical reactions provides cost-effective manufacture of materials such as refrigerants, blowing agents, solvents, polymers, pharmaceuticals and agricultural chemicals, to benefit society. As raw materials, they are converted to other products except for *de minimus* residues and emissions. As a result, their environmental impact is minimal. Emissions in feedstock use consist of residual levels in the ultimate products (typically miniscule) and fugitive leaks in the production, storage and/or transport processes.

3.4.2 Montreal Protocol definitions

The Montreal Protocol defines “Production” in the following way. “Production means 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 phaseout 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.

3.4.3 How the ODS are used as feedstocks

The ODSs 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.

With a few exceptions, the use of an ODS as feedstock leads to the production of another ODS and shows the ingenuity of industrial chemists in devising ways to construct molecules with carbon-fluorine and carbon-chlorine bonds. The following is a listing of common feedstock applications which shows the major uses but is not necessarily exhaustive:

- Conversion of HCFC-21 in the synthesis of HCFC-225 which finds application as a solvent

- Conversion of CFC-113 to chlorotrifluoroethylene which 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. Work has been done for decades to identify and develop a commercial direct route that does not use HCFC-22 in production of TFE, but 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 until the Article 5 HCFC phaseout 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 phaseout 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 phaseout of CFC production and consumption is now limited to only a very few essential uses, e.g., limited amounts of propellant production for metered dose inhalers, the volume of CTC required for this application has dramatically reduced.

- Conversion of CTC to chlorocarbons which, in turn, are used as feedstocks in production of HFC-245fa and other fluorochemicals including the newly developed HFO family of compounds.

- 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 phaseout.

- 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. CTOC is not aware of processes using HCFC-123 as a starting material at this time.

- HCFC-124 can be used as a feedstock in the manufacture of HFC-125.

- Halon-1301 can be used as feedstock in the manufacture of pharmaceuticals

- CTC in the synthesis of synthetic pyrethroids and some other chemicals.

3.4.4 Estimated emissions of ODS

Data have been received from the Ozone Secretariat showing reported production, import and export of ODS used as feedstocks for the year 2010. These also include volumes used as process agents as Parties are directed to report such consumption in a manner consistent to what is done for feedstocks. Detailed information can be found in the spreadsheet provided by UNEP as an attachment. Total production for feedstock uses was 1,016,697 tonnes and represents a total of 433,188 ODP tonnes.

Estimation of emissions is subject to personal experience and is an inexact science. Sophistication of the operating entity can heavily influence emission amounts. Highly automated, tight and well instrumented facilities with proper procedures closely observed can have emission levels as low as 0.1% of the amount used as feedstock. On the other extreme would be batch processes of limited scale with less tight and less concern for operational excellence can have emission levels up to 5%. The largest volumes of feedstock use are at the lower end of the scale as large capacity plants have the most investment and are able to control emission levels well. For the sake of estimation, the IPCC guideline for HFC plants of 0.5% of feedstock is used to generate guidance levels of feedstock emissions. Based on using this guidance figure, the total emissions associated with feedstock and process agent use was approximately 5083 tonnes or 2166 ODP tonnes.

Emissions can be minimized by having tight equipment; monitoring equipment allowing for detection of leaking material; strict procedures that call for rapid repair when leaks are detected; and procedures to evacuate, recover and reuse material from all lines prior to opening for servicing. Further, all transfers should be done on a closed loop basis with no venting of tanks or lines to the environment. All process vents should go to scrubbing/destruction devices to avoid leakage to the atmosphere. The CTOC notes that in China, steps are taken to minimize emissions by generating the ODS in close proximity to the facility where it is used as feedstock (line-to-line arrangement) so that transportation emissions are minimized.

Table 3-2: Data on Feedstocks for the Year 2010

Annex Group	Production for Feedstock Uses (ODP Tonnes)	Imports for Feedstock Uses (ODP Tonnes)	Exports for Feedstock Uses (ODP Tonnes)
AI	183,614.5	961.6	141.6
AII	8,999.0	0.0	
BI		24.0	
BII	195,896.4	968.4	964.5
BIII	11,672.3		
CI	29,086.6	1,790.0	1,567.8
CII	21.2	0.3	0.3
CIII	91.6	104.9	191.7
EI	3,806.5	445.0	360.7
TOTALS	**433,188.0**	**4,294.2**	**3,226.6**

Table 3-2: Data on Feestocks for the year 2010 ..continued..

Annex Group	Substances	ODP	Production for Feedstock Uses (MT)	Imports for Feedstock Uses (MT)	Exports for Feedstock Uses (MT)	Production for Feedstock Uses (ODP Tonnes)	Imports for Feedstock Uses (ODP Tonnes)	Exports for Feedstock Uses (ODP Tonnes)
AI	CFC-12	1		20.00	20.00	-	20.0	20.0
AI	CFC-113	0.8	146,337.80	1,177.00	152.00	117,070.2	941.6	121.6
AI	CFC-114	1	66,544.30			66,544.3	-	-
AII	HALON-1301	10	899.90			8,999.0	-	-
AII	HALON-2402	6		0.00		-	0.0	-
BI	CFC-112	1		24.00		-	24.0	-
BI	CFC-217	1		0.01		-	0.0	-
BII	Carbon Tetrachloride	1.1	178,087.61	880.36	876.80	195,896.4	968.4	964.5
BIII	Methyl Chloroform	0.1	116,722.50			11,672.3	-	-
CI	HCFC-22	0.055	386,348.83	27,543.02	23,813.33	21,249.2	1,514.9	1,309.7
CI	HCFC-122	0.08		0.03		-	0.0	-
CI	HCFC-123**	0.02	6,186.59	5,676.07	4,844.64	123.7	113.5	96.9
CI	HCFC-124	0.04			22.88	-	-	0.9
CI	HCFC-124**	0.022	82.40		22.88	1.8	-	0.5

Annex Group	Substances	ODP	Production for Feedstock Uses (MT)	Imports for Feedstock Uses (MT)	Exports for Feedstock Uses (MT)	Production for Feedstock Uses (ODP Tonnes)	Imports for Feedstock Uses (ODP Tonnes)	Exports for Feedstock Uses (ODP Tonnes)
CI	HCFC-133	0.06	1,490.10		180.00	89.4	-	10.8
CI	HCFC-141B**	0.11	15,021.48			1,652.4	-	-
CI	HCFC-142B**	0.065	91,838.37	2,486.41	2,292.06	5,969.5	161.6	149.0
CI	HCFC-235	0.52	1.12			0.6	-	-
CII	HBFC-22 B1	0.74	28.30	0.30		20.9	0.2	-
CII	HBFC-31 B1	0.73	0.29	0.06	0.35	0.2	0.0	0.3
CIII	Bromochloro-methane (Halon 1011)	0.12	763.70	874.56	1,597.20	91.6	104.9	191.7
EI	Methyl Bromide	0.6	6,344.15	741.64	601.25	3,806.5	445.0	360.7
TOTALS			**1,016,697.44**	**39,423.46**	**34,423.40**	**433,188.0**	**4,294.2**	**3,226.6**
Mismatch between Imports and Exports				**87%**	**115%**		**75%**	**133%**

3.5 n-Propyl bromide update

Responding to the request for annual reporting on n-propyl bromide (Decision XIII/7(3), the CTOC notes that production is located primarily in India and China, although no production figures are available. No production facilities were found in the United States. n-Propyl bromide usage for 2010 was 2500 metric tonnes in Japan and 7000 metric tones in the US, according to import records of those countries. It appears that usage rates have been increasing in those countries over the last 10 years.

Several regulatory and health updates have occurred since the 2010 CTOC progress report. These include the publication of the National Toxicology Program report (NTP TR 564, August 2011) and the American Conference of Governmental Industrial Hygenists (ACGIH®) reduction of the TLV® for n-propyl bromide from 10 ppm to 0.1 ppm (February 2012). The U.S. EPA SNAP office has proposed to make n-propyl bromide "unacceptable" for the aerosol solvent sector and for the Adhesive carrier solvent sector (August 2010). In addition, a petition was submitted to the U.S. EPA to add n-propyl bromide to the List of Hazardous Air Pollutants Regulated under Section 112 of the Clean Air Act (October 2010). As reported earlier, a European distributor has indicated that n-propyl bromide was pre-registered for REACH and will be registered in the future, at which time usage data for Europe should become available..

3.6 CTC involvement in production of vinyl chloride monomer (VCM)

3.6.1 Introduction

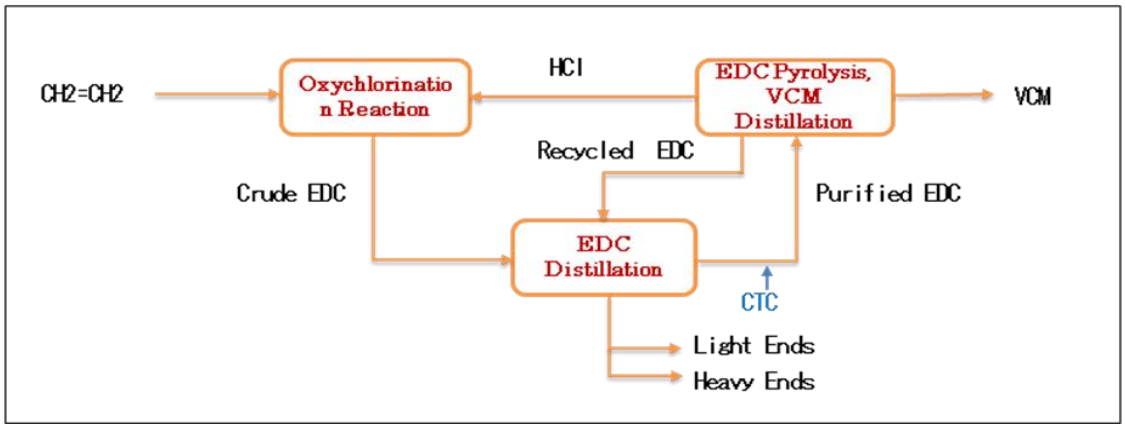
Decision XXIII/7(8) considered the use of carbon tetrachloride for production of vinyl chloride monomer to be feedstock, on an exceptional basis until 31 December 2012. Clause (9) of the Decision requests the TEAP to review the use of carbon tetrachloride (CTC) for the production of vinyl chloride monomer (VCM) process in India and other parties, if applicable, and to report on that review in its 2012 progress report. Whether CTC is a process agent or a feedstock in the production of VCM by pyrolysis (thermal cracking) of ethylene dichloride (EDC) is the question to be addressed.

This use of CTC was added to the list of process agents (Table A of Decision X/14) in 2007 at the 19th MOP, following provision of information by Brazil. It was not known at this time that the process was also operated in several other countries, where it was regarded as a feedstock use that did not need to be reported to the Montreal Protocol, although the quantities of CTC would have been included in the aggregate reported feedstock uses. When Brazil ceased the use of CTC in the production of VCM, and notified accordingly, this process agent use was removed from table A at the 23rd MOP. It was discussion in a contact group at that meeting, at which various aspects of CTC consumption and emission were considered, that led to the inclusion of he matter in Decision XXIII/7.

3.6.2 Chemistry of the process

This method of VCM production requires two reaction steps. In the first step, ethylene is converted to EDC by oxychlorination (using HCl as source of Cl), and in the second, the pyrolysis of EDC results in the formation of VCM. Conversion of EDC to VCM proceeds to the extent of about 40-50%, and unreacted EDC together with unreacted CTC is recycled, as shown in the flow diagram below (Figure 3-1). The HCl produced in this second step is normally recycled into the first step, as a source of chlorine.

Figure 3-1: General Manufacturing Process for VCM



Although it depends on the reaction conditions and catalyst used, it is often the case that CTC is produced at about 1000 ppm level during the oxychlorination process, so the EDC proceeding to the second or pyrolysis step contains this small amount of CTC. Research and patent literature indicates that CTC is not just an impurity, but is an important component of the mixture being pyrolysed because it takes part in the chemical reaction. When present at levels of ~0.15% (1000 ppm) it increases the yield of VCM.

The pyrolysis of EDC proceeds by radical chain reactions as shown below.

1) $CH_2Cl\text{-}CH_2Cl \rightarrow CH_2Cl\text{-}CH_2\bullet + Cl\bullet$ (initiation by C-Cl bond cleavage)

2) $Cl\bullet + CH_2Cl\text{-}CH_2Cl \rightarrow HCl + \bullet CHCl\text{-}CH_2Cl$ (H abstraction by Cl•)

3) $\bullet CHCl\text{-}CH_2Cl \rightarrow CH_2{=}CHCl + Cl\bullet$ (product formation, chain propagation)

4) $Cl\bullet + CH_2Cl\text{-}CH_2\bullet \rightarrow CH_2{=}CHCl + HCl$ (product formation)

If CTC is not present in the EDC, then a small amount may be added to the material going forward to pyrolysis.

The key step that initiates the chain reaction is the thermal cleavage of a C-Cl bond in EDC, thus producing a chlorine radical, Cl•. When CTC is present, chlorine radicals can also be generated by thermal cleavage of the CTC molecule (a common step in a number of feedstock uses of CTC):

5) $CCl_4 \rightarrow CCl_3\bullet + Cl\bullet$

The activation energy for this thermal cleavage of a C-Cl bond in CTC is lower than that of EDC, and so most chlorine radicals, on which the chain reaction depends, will come from CTC, not EDC, and moreover, take place at lower temperatures and proceed at faster rates. This is the reason why the addition of a small amount of CTC is an effective way to increase the conversion of EDC into VCM.

The fate of CTC in the pyrolysis step is still unclear. Because the CTC concentration is very low, and there are many byproducts of the reaction, a complete mass balance has been impossible to obtain, but most CTC is ultimately destroyed in the process.

A detailed report from the European Union, sourced from a company in a member country that produces VCM via EDC, supports this view. India reported that an independent expert appointed by the MLF had confirmed that CTC involved in production of VCM by pyrolysis of EDC was used as feedstock. Any CTC not consumed in the process is destroyed along with by-product materials. CTC is not present in the EDC produced in India, and consequently a small quantity is added to the

pyrolysis mixture.. Mexico has provided some information about the process operated in their country, and further detail is being sought. No information has yet been received from the United States or South Africa, where the pyrolysis process is also believed to be used for production of VCM. Global production of VCM is believed to be 42.7×10^6 tons, with 82% being produced by the pyrolysis route. From these figures, the amount of CTC consumed as feedstock would be 5.8×10^5 tons. A significant proportion of the 18% of VCM not produced by the EDC pyrolysis route may be that produced in China by the addition of HCl to acetylene:

6) $HC{\equiv}CH + HCl \rightarrow CH_2{=}CHCl$

3.6.3 Conclusion

After careful consideration, CTOC members came to the conclusion that CTC is destroyed or irreversibly transformed during the pyrolysis process as described above, and therefore is best described as a feedstock. Variations on the process are possible, and information from other countries listed above would be needed before this evaluation could be applied to all facilities in which VCM is prepared from EDC.

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

3.7.1 Introduction

For several years the Russian federation has been granted an Essential Use Exemption for the use of CFC-113 in their domestic space program while research was conducted to identify suitable solvents that would not damage some components of the rocket guidance systems that were not resistant to common solvents. Most recently, Decision XXIII/3 in 2011 approved an essential use exemption of 100 metric tonnes of CFC-113 in 2012 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 2011 Progress Report Vol.1 (p54-56). The Russian Federation explained the delay on its phase-down schedule but Decision XXIII/3 also requested the Russian Federation to provide as part of its next essential-use exemption nomination a final phase-out plan with an expected end-date, and the gradual reduction steps.

On 28 December 2011, The Ministry of National Resources and Environment of the Russian Federation sent a new request for Essential Use Exemptions of 95 metric tonnes of CFC-113 for manufacturing the missile and space equipments in the year 2013 to the Ozone Secretariat, and nominated 2016 as the final date for CFC-113 use in this application.

3.7.2 CTOC Comments on EUE of CFC-113 in 2013 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. The new request by the Russian Federation for an Essential Use Exemption for 95 metric tonnes of CFC-113 in the year 2013, which is 5 metric tonnes lower than the approved volume for 2012, 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 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.

The Russian Federation still needs CFC-113 for solvent application in this aerospace sector, and the quality of imported product has been found not to meet their strict requirements. Some portions of the CFC-113 use can be replaced by HCFC-122 and HCFC-141b, and work is underway to produce the quantities of these substances required. Efforts have been made to accelerate the ODS phase out process. It is expected that EUNs for 85 MT in 2014 and 75 MT in 2015 will be made, and the expected end-date (2016) is mentioned in the EUN. This relies, however, on the alternative solvents available in the international market and not prohibited under the Montreal Protocol.

The Russian Federation EUN described a new solvent, RC-316 (1,2-dichloro-1,2,3,3,4,4-hexafluorocyclobutane) that has proved in a preliminary survey to be excellent replacement for CFC-113. Further testing of this substance is underway.

The CTOC acknowledged the research development of Russian Federation to reduce essential use of CFC-113 and the emphasis being placed on a new solvent. RC-316 is a not controlled substance but it is a chlorofluorocarbon (CFC), the ODP and GWP values of which are not known so far. CTOC has referred these questions to the Ozone Secretariat for an opinion from the Science Assessment panel on the environmental evaluation to this compound.

3.7.3 Recommendation

After substantial review and discussion, the CTOC recommends the Essential Use Exemption for 95 metric tonnes of CFC-113 in 2013 for the domestic space industry of the Russian Federation.

3.8 Alternatives to the use of CTC in analysis of oil, grease and total petroleum hydrocarbons in water, soil, or air

3.8.1 Introduction

Decision XXIII/6 requested the CTOC to again address the global laboratory and analytical-use exemption. A major concern has been the standard methods of analysis in which CTC and CFC-113 have been used as solvents to extract the oily material from the matrix, following which the solution can be subjected to quantitative analysis by infrared spectroscopy.

3.8.2 Alternative solvents

The alternative solvent S-316 or IrSol-316 (2,2,3,3-tetrachlorohexafluorobutane, a dimer of chlorotrifluoroalkene, with possibly some of the trimer included in the commercial product) is described in a standard method (ASTM D-7066-04, "Standard test method for dimer/trimer of chlorotrifluoroethylene (S-316) recoverable oil and grease and nonpolar material by infrared determination"). It is expensive but some laboratories use it. Another alternative solvent which has been tested and found to be satisfactory is tetrachloroethylene (perchloroethylene, perc) but it is not covered by standard methods. The validation of this alternative solvent was presented in 9th International Conference on Environmental Science and Technology[1]. A new substance, RC-316 (1,2-dichloro-1,2,3,3,4,4-hexafluorocyclobutane – see section 7.6.2), has recently come to the

[1] E. Farmaki, T, Kaloudis, K. Dimitrou, N. Thanasoulias, L. Kousouris and F. Tzoumerkas; "Validation of an FT-IR method for the determination of oils and grease in water, with use of tetrachloroethylene as the extraction solvent"; 9th International Conference on Environmental Science and Technology. Rhodes Island, Greece, 1-3 September 2005.

attention of the CTOC. It is a cyclic substance with no C-H bonds, and may be suitable for use in this analysis. However, its ODP is not known and the method is not a standard one.

3.8.3 Other analytical methods

Other methods for oil, grease and total petroleum analysis not using ODS can give excellent detailed results although some of the methods involve the use of more expensive equipment. The most expensive methods, those using mass spectrometry, are able to provide qualitative information - details about the components of the oil - in addition to quantitative analysis. A recent article in a leading journal described a very advanced technique (B. Brkić, N. France, S. Taylor, 'Oil-in-Water Monitoring Using Membrane Inlet mass Spectrometry, *Analytical Chemistry*) and also listed, for comparison, a number of other analytical techniques and provided literature references. Integral techniques are described as 'user-friendly, relatively fast for oil detection, and do not need sample preparation' but give no information about components of the oil. They provide summative information by means of gravimetry, infrared spectra, ultraviolet spectra or ultraviolet fluorescence. Differential techniques, on the other hand, 'can determine detailed nature of the analytes with high reliability, but they require higher technical skills, longer detection times, and sample preparation. Coming from a developed country (UK), the authors may not have thought it relevant to mention the cost of the necessary instrumentation required for gas chromatography or liquid chromatography combined with mass spectrometry (LC-MS and GC-MS).

The European Union forwarded a copy of a report by the Nordic Council on laboratory uses of ODS, which was published in 2003 and had been described in the CTOC section of the TEAP Progress report in May 2008. The principal aims of the targets of the research leading to the report were to:

- recognize the laboratory use purposes of ODS
- assess the amounts of ozone depleting substances used for various use purposes
- recognize possible substitute methods, especially for oil-in-water-assays
- recognize obstacles to substitution
- gather information on the fate of the ozone depleting substances
- gather background information for future policies and especially
- give information for the laboratories on the possibilities to substitute the substances.

The report can be downloaded from this site: http://www.norden.org/sv/search?SearchableText=use+of+ozone+depleting+substances+in+laboratories; or http://www.norden.org/sv/publikationer/publikationer/2003-516/at_download/publicationfile.

In 2010 the European Commission had provided a consultancy report in which a number of alternative methods not using ODS were described. The report is too long for inclusion here but can be made available to interested Parties. The Commission also drew attention to its 'Licensing manual for ozone depleting substances' in laboratory and analytical uses (August 2011) which, although the measures it describes are specific only for the EU, contains much information that would be of interest to other Parties. The manual may be accessed at http://circa.europa.eu/Public/irc/review_2037/library?l=licensing_manuals/manual_laboratories.

ASTM International has been developing standard methods that do not use ODS. An analytical chemist who has been involved in the development of standard methods by sub-committee D02.05 provided the following information about a method for assessing the extent of oxidation of hydrocarbon fuels (Standard test method for peroxide Number of Aviation Fuels, Gasoline and Diesel

Fuels). The material being tested is first dissolved in a solvent and then reacted with potassium iodide in water, whereupon iodine is formed by the reaction between iodide and the peroxide. Titration with sodium thiosulfate (iodometric titration) is used to estimate the quantity of iodine and therefore of peroxide. The original standard D3703 was published in 1978 as Standard Test Method for Peroxide Number of Aviation Turbine Fuels. This test method used carbon tetrachloride (CCl_4) as solvent, but this was determined to be carcinogenetic and so was later replaced with 1,1,2-trichloro-1,2,2 trifluoroethane (CFC-113) (Method D3703-99(2004)). However, the CFC an ODS, which precluded its use by many operators. Beginning with the D3703-07 method version, the use of CFC-113 was replaced with 2,2,4-trimethyl pentane and this conferred a number of advantages including the avoidance of use of an ODS (Method D3703-07e1).

Some simpler techniques, embodied in standard methods, that do not use ODS are:

- ASTM D5765-05 (2010)[2] is a solvent extraction method of total petroleum hydrocarbon (TPH) from soils and sediments (i.e. only solid samples), using closed vessel microwave heating, for subsequent determination by gravity or GC techniques. Provide information on the availability of petroleum hydrocarbons to leaching, water quality changes, or site conditions.

- ASTM D7575-11[3] covers the determination of oil and grease in produced and waste water samples over the concentration range of 5-200 mg/L, that can be extracted with an infrared-amenable membrane and measured by infrared transmission through the membrane.

- US EPA Method 1664, Revision A[4], for determination of n-hexane extractable material (HEM; oil and grease) and n-hexane extractable material that is not adsorbed by silica gel (SGT-HEM; non-polar material) in surface and saline waters and industrial and domestic aqueous wastes. Extractable materials that may be determined are relatively non-volatile hydrocarbons, vegetable oils, animal fats, waxes, soaps, greases, and related materials. The method is based on prior EPA methods for determination of "oil and grease" and "total petroleum hydrocarbons".

- US EPA Method 8440[5], for the measurement of total recoverable petroleum hydrocarbons (TRPHs) extracted with supercritical carbon dioxide from sediment, soil and sludge samples using Method 3560. It is not applicable to the measurement of gasoline and other volatile petroleum fractions, because of evaporative losses.

- US EPA method 1664)[6] is a gravimetric method that involves extracting the oil into a solvent (n-hexane) and then evaporating the solvent and weighing the residue – is suitable for oily samples not containing volatile material. Laboratories should assess whether this simple analysis would

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[2] ASTM D5765-05 (2010), "Standard practice for solvent extraction of total petroleum hydrocarbons from soil and sediments using closed vessel microwave heating".

[3] ASTM D7575-11, "Standard test method for solvent-free membrane recoverable oil and grease infrared determination".

[4] US EPA Method 1664, Revision A: Method 1664, Revision A: "N-Hexane extractable material (HEM; oil and grease) and silica gel treated n-hexane extractable material (SGT-HEM; non-polar material) by extraction and gravimetry".

[5] US EPA Method 8440 (formerly Draft Method 9073), "Total recoverable petroleum hydrocarbons by infrared spectrophotometry".

[6] US EPA Method 1664, Revision A: "N-Hexane extractable material (HEM; oil and grease) and silica gel treated n-hexane extractable material (SGT-HEM; non-polar material) by extraction and gravimetry".

meet their needs, since many environmental samples will have already lost their volatile components before being sampled for analysis.

3.8.4 Provision of advice

CTOC and its members provide advice on these matters in the annual progress reports and through attendance at regional meetings of ozone officers and other stakeholders. However, there is a need to deliver the advice directly to laboratories and parties, and CTOC can assist with this. Individual visits by CTOC experts would be prohibitively expensive, but email dialogues between laboratory staff and CTOC experts might help to assist any network country in eliminating Laboratory and analytical uses of ODS.

CTOC members have participated in Ozone meetings in several countries including Turkey, Nepal, Paraguay, and Mexico explaining alternative methods and techniques not using ODSs for laboratory and analytical purposes. These alternative methods and techniques include gravimetric, infrared, fluorescence, gas chromatography, and mass spectrometry amongst others. During those meetings, the advantages as well as the disadvantages of those methods / techniques were highlighted to the participants. For example, GC-MS is highly desirable but costly. CTOC members also stressed that CTC is classified as a "B2 Carcinogen - possible human carcinogen"[7] and poses health risk to people who handle it. During those meetings, the importance of informing academics that alternatives to ODS are available was stressed. CTC producing countries (e.g. China and India) are requested to monitor strictly the production and use of this substance domestically for feedstock use only, and not for non-feedstock use.

Discussion of laboratory and analytical uses in Canada covered some uses for which alternatives are available and advice was provided on these. Canada identified some other uses for which no alternatives are available, including one that has been described in previous CTOC Progress Reports, the use of very small quantities of CTC as reference material when analyses are conducted for CTC contamination or presence in the environment. In some laboratory uses the CTC is destroyed or irreversibly transformed. In others, unchanged CTC is collected from laboratories and destroyed along with other hazardous wastes materials.

3.8.5 Standard methods of analysis

At a regional meeting of Ozone officers in 2011, some countries (e.g. Nepal and Australia) highlighted the importance of changing the international standards that currently recommend use of CTC (either to have standards reviewed or use the EU standard). In this regard, some effort – coordinated by CTOC and TEAP – has commenced, looking into the existing European Standards. The Ozone Secretariat's effort to forge a contact with ASTM/ISO has made little progress, and a joint meeting with ISO/ASTM has been proposed in order to make progress on this matter.

ASTM international has provided information about their work to replace methods using ODS with more ozone-friendly solvents. A number of such methods are available and could potentially replace existing analytical methods where ODSs are used. The following list details those methods:

- ASTM D5629-11 [8], measures the acidity of hydrochloric acid (HCl) in aromatic isocyanate or polyurethane prepolymer samples of below 100 ppm acidity. Applicable to products derived from

[7] National Toxicology Program, Department of Health and Human Services; "Report on carcinogens, Twelfth Edition (2011)", pages 86-88.
US EPA; Integrated Risk Information System; http://www.epa.gov/iris/subst/0020.htm, accessed February 2012.

[8] ASTM D5629-11, "Standard test method for polyurethane raw materials: Determination of acidity in low-acidity aromatic isocyanates and polyurethane prepolymers".

toluene diisocyanate and methylene di(phenylisocyanate). The solvent used is n-propanol. This method is equivalent to ISO 14898, Method B[9].

- ASTM D4693-07 [10], for determination of the extent to which a test grease retards the rotation of a specially-manufactured, spring-loaded, automotive-type wheel bearing assembly when subjected to low temperatures. Torque values, calculated from restraining-force determinations, are a measure of the viscous resistance of the grease. This test method suggested n-heptane as an alternative to 1,1,1-trichloroethane.

- ASTM D4170-10 [11], which evaluates the fretting wear protection provided by lubricating greases. This method uses n-heptane reagent grade or ASTM Motor Fuel Grade 3, which replaces the 1,1,1-trichloroethane.

- ASTM D3703-07 [12], for determination of the hydroperoxide content expressed as hydroperoxide number of aviation turbine, gasoline and diesel fuels. This method allows the detection of hydroperoxides such as t-butyl hydroperoxide and cumene hydroperoxide. However this method does not detect sterically-hindered hydroperoxides such as dicumyl and di-tbutyl hydroperoxides. Di-alkyl hydroperoxides added commercially to diesel fuels are not detected by this test method. This method replaces the use of the ODS 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113) by 2,2,4-trimethylpentane (iso-octane).

Some methods specify the use of cleaning media that are safe, non-film forming and do not in any way attack or etch the surface chemically. In addition, no Class 1 ozone depleting substances conforming to Section 602(a) of the Clean Air Act Amendments of 1990 (42USC7671a) as identified in Section 326 of PL 102-484 should be used. Some examples are the following methods:

- ASTM D2625-94 [13], covers the determination of the endurance (wear) life and load-carrying capacity of dry solid film lubricants in sliding steel-on-steel applications.

- ASTM D1748 – 10 (366/84) [14], covers the evaluation of the rust-preventive properties of metal preservatives under conditions of high humidity.

Following detailed recommendations from CTOC in recent reports in which alternatives were suggested for a range of laboratory and analytical uses of ODS, one country provided information about a number of uses of CTC and sought specific advice. The uses included some for which replacements could easily be found by trials with alternative solvents (academic activities, trituration of crude chemical compounds, mobile phase in thin layer chromatography (TLC), and some chemical reactions), and this is what CTOC advised. Some uses for which there was no alternative (use as a

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[9] ISO 14898, Method B, "Plastics – Aromatic isocyanates for use in the production of polyurethane – Determination of acidity".

[10] ASTM D4693-07, "Standard test method for low-temperature torque of grease-lubricated wheel bearings".

[11] ASTM D4170-10, "Standard test method for fretting wear protection by lubricating greases".

[12] ASTM D3703-07, "Standard test method for hydroperoxide number of aviation turbine fuels, gasoline and diesel fuels".

[13] ASTM D2625-94, "Standard test method for endurance (wear) life and load-carrying capacity of solid film lubricants (Falex Pin and Vee Method)".

[14] ASTM D1748 – 10 (366/84),"Standard test method for rust protection by metal preservatives in the humidity cabinet".

standard in calibration of equipment for trace analyses) involved only very small quantities. For others, in which no alternative was yet available despite some experimentation with alternatives (for example, bromination with N-bromosuccinimide), CTOC advised on procedures to prevent emissions of the ODS, including solvent recovery.

3.8.6 Green chemistry

As it has been mentioned in past CTOC reports, the Green Chemistry movement is slowly changing customary approaches to chemical operations. For example, the international research journal *Green Chemistry*[15], has published guidelines that must be observed by authors who submit work for publication. Under these guidelines, the use of CTC would not be acceptable. Guidelines have been advised by the editor of the American Chemical Society journal *Organic Process Research and Development*. Environmental impact is an important criterion for solvent selection, under which carbon tetrachloride is mentioned specifically.

The pharmaceutical manufacturing industry is moving to discriminate against the use of a wide range of solvents on health and environment grounds. Such changes can be expected to influence laboratory research. A roundtable that included representatives of the industry and the American Chemical Society[16] reported that the Pfizer Company assessed solvents in three categories – preferred, usable and undesirable – with text in 'traffic light' colours. CTC was listed in the 'undesirable' or 'red' category. A recent text specifically mentions the ozone depleting potential of carbon tetrachloride as a reason for discrimination against it pharmaceutical production[17].

3.9 Carbon tetrachloride

3.9.1 Request for information

Decision XXIII/8 requests the Technology and Economic Assessment Panel, in cooperation with Scientific Assessment panel, to continue to investigate the possible reasons for the discrepancy between emissions of carbon tetrachloride (CTC) reported or estimated on the basis of likely emission factors and those inferred from atmospheric measurements, and to report on its response to the Twenty-Fourth Meeting of the Parties in November 2012. Attention was focussed on the extent to which the discrepancy could be due to:

(a) Incomplete or inaccurate historical reporting of carbon tetrachloride produced;

(b) Uncertainties in the atmospheric life-time of carbon tetrachloride;

(c) Carbon tetrachloride from unreported or underestimated sources from both parties operating under Article 5 and those not so operating.

3.9.2 Early concern with CTC emissions

The ATOC section of the 1998 TEAP Report cited a research publication by Simmonds *et al*. (the correct reference is to P.G. Simmonds, D.M. Cunnold, R.F. Weiss, R.G. Prinn, P.J. Fraser, A. McCulloch, F.N. Alyea and S.O'Doherty, Global trends and emission estimates of CCl4 from in situ background observations from July 1978 to June 1996, *Journal of Geophysical Research* 1998, **103**

[15] Published by the Royal Society of Chemistry in Britain.

[16] C.R. Hargreaves and J.B. Manley, "Collaboration to deliver a solvent selection guide for the pharmaceutical industry"; www.acs.org/gcipharmaroundtable, accessed February 2012.

[17] P.J. Dunn, 'The importance of green chemistry in process research and development', chapter 6 in J.A. Blacker and M.T. Williams, *Pharmaceutical Process Development*, 2011, Royal Society of Chemistry, London, 2011.

(D13), 16,017-16,027) in which the atmospheric lifetime of CTC was taken as 42±12 years and annual emissions of CTC were estimated to be 94 (-11, +22) ktonnes for the period 1979-1988 and 49 (-13, +26) ktonnes for 1991-1995. ATOC considered likely emission rates from industrial uses of CTC, the main one being its use as feedstock for production of CFCs in A(5) and CEIT countries, to be 28.5-32 ktonnes in 1996. This estimate was included in the 1998 TEAP Assessment Report as '41,000 tonnes (-25%, +50%)' – that is, approximately, 30-60 ktonnes.

The 2002 ATOC Assessment Report noted that the 2002 Science Assessment was that global emission of CTC was 26 (23-42) ktonne, some 25% lower than reported in the previous assessment. ATOC also reviewed the scientific literature on atmospheric concentrations of CTC, and reported that these were approximately 100 ppt, declining at about 1% a year.

3.9.3 TEAP estimates of emissions

Decision XVI/14 (Prague 2004) noted with concern the measured atmospheric concentrations of CTC and requested the TEAP to assess emissions from feedstock and process agent uses, by-products, wastes and incidental quantities not destroyed in timely or appropriate manner. Responding in its May 2006 progress report, the TEAP noted the decline in production and use of CTC being brought about by sector agreements with A(5) countries under the Montreal Protocol and, after reviewing the feedstock and other uses of CTC made estimates of emissions but qualified these by observing that they were likely to be under-estimated. For 2002, the industry emissions were estimated to be in the range 35,100 and 46,920 tonnes (35-47 ktonnes), but calculations based on historically observed atmospheric concentrations of CTC showed 70±6 ktonnes. The parties considered this report and came to Decision XVIII/10, noting the large discrepancy, asked the TEAP to continue its work. Attention was directed, in particular, to gaining better data for industrial emissions; investigating production (including by-product production), use, storage, transport and destruction of CTC; and estimating sources such as landfills. TEAP was unable to complete this task by the following year, but reported in 2007 that the study was still in progress. However, it was able to rule out landfills as a specific source of CTC emissions, on the basis of landfill gas emissions reported to the scientific literature. As we shall see, later study has caused a re-evaluation of emissions from other sources such as 'historical chemical dumps' which, together with groundwater, were thought to be unlikely to 'provide sufficient sustained releases to account for the apparent discrepancy'.

The TEAP was unable to complete the evaluation in time for inclusion in the May 2008 Progress Report, but reported to the 28th OEWG (Bangkok 2008) that it had been unable to resolve the discrepancy between 'bottom up' estimates, based on emissions, and 'top down' estimates based on atmospheric concentrations. A task force established by the TEAP and the Science Assessment Panel found that global production of CTC in 2006 was 200 ktonne, of which 161 ktonne was used as feedstock. However, to maintain the measured 2006 atmospheric concentration required annual emissions of 70 ktonnes, and it was inconceivable that such a large proportion of the production (34%) could have been emitted. One suggestion was that there was substantial unreported production of CTC but the large production needed to resolve the discrepancy was unlikely to have gone unnoticed. A suggestion considered by the TEAP, but not included in its report, was that error limits on both emission estimates might be so large that the discrepancy might be accommodated by their overlap, but such error limits would need to be unrealistically large. At the subsequent MOP, the TEAP was requested to continue its work on this problem.

3.9.4 MLF estimates

No new information was available to the TEAP in 2009, but the Executive Committee of the Multilateral Fund (MLF) for the Implementation of the Montreal Protocol (ExCom) reported in June 2009 on its study of the emissions estimates (UNEP/OzL.Pro/ExCom/58/50). The ExCom estimated annual CTC production in 2006-8 as being approximately 200 ktonne, with emissions estimated at 24 ktonnes with possibly another 7.5 ktonnes emitted during storage and transport. It was concluded that it was unrealistic to imagine unreported production sufficient to account for emissions required to

maintain the observed atmospheric concentration (a further 40 ktonnes) for this quantity. CTC was a by-product of the production of chloroform, used as feedstock for the production of HCFC-22, the production and consumption of which had greatly increased in recent years, but the quantity so-produced was smaller than that of CTC produced for feedstock uses. Drawing attention to the need for further study, the ExCom reported that 'possible emissions from industrial waste could not be quantified at this stage' and that 'anecdotal evidence pointed to ad-hoc disposal of wastes containing chlorine by many industries for over half a century until even less than 20 years ago'.

3.9.5 Discussions in 2011

The TEAP did not report on CTC emissions in 2010, but the May 2011 included a brief review of previous work and described relevant sections of the 2010 Assessment report of the Science Assessment Panel (SAP). The SAP noted the sensitivity of the estimate of emissions based on the observed atmospheric concentration of CTC, it felt that uncertainties in the atmospheric lifetime (the SAP considered lifetime sin the range 23-33 years), which had been suggested as a possible cause of the discrepancy between the two estimates, could not be explained in this way. The TEAP provided some European data which included emission data not previously reported, but these were so small (on the order of 60 tonnes) as not to affect the argument. Overall, CTC use was declining but the TEAP drew attention to the possibility that chlorination reactions of many kinds might be a continuing source of by-product CTC that was otherwise unaccounted for. This factor had been raised in previous TEAP reports and also in the ExCom study of 2009.

Discussion of this section of the TEAP 2011 report at the Montreal OEWG resulted in the formation of an informal group, consisting of delegates, CTOC members and co-chairs, SAP members and representatives of the MLF, who discussed ways to take the matter further. The group heard examples of possibly unreported production and by-production of CTC, possible losses during storage, transfer and transport and participants subsequently provided some data for consideration.

3.9.6 CTC in the air of cities

A new way of assessing CTC emissions from legacy sources such as chemical dumps, contaminated sites, landfills and materials being transported between venues was brought to the group's attention by a member of the SAP, who reported persistent low concentrations of CTC in the air of Melbourne, a city of approximately 3 million people where CTC had been widely used in previous years. The idea that low concentrations of CTC in large air volumes associated with cities was taken up by other members of the group, who reported similar figures. The results are summarised in Table 3-4.

Table 3-4: Recent data provided by Parties to CTOC concerning concentrations of CTC in ambient air.

Location	Concentration	Comment
Australia	0.55-0.62 μg/m^3 (2007-11)	Melbourne 2007-2011; leads to calculated emissions 140±35 tonnes/y
Sweden	0.00052 μg/m^3 (workplace) ‹0.0040 μg/m^3 (farmland)	Low concentrations in soil and water.
Canada	0.53–0.71 μg/m^3	Mean values for 5-10 years of observations in a number of cities.
Thailand	0.3-0.7 μg/m^3	Bangkok
United States of America	0.23 μg/m^3 0.24 μg/m^3	East Chicago, Fort Wayne Fort Gary
China	0.73 μg/m^3	Average over 46 cities; leads to calculated emissions in 2009 of 2.2-4.1 ktonne.

While most of these results are from cities, the data from Sweden are from a rural district and they show the difference between non-industrial air and air in CTC is present, probably arising from previous uses in industry and from legacy sites.

3.10 Preliminary advice to Parties

From time to time, Parties approach the Ozone Secretariat for evaluation or review of technical issues involving ODS, such as classification of a use as a feedstock. These requests are forwarded to TEAP and CTOC co-chairs, who consult members with appropriate expertise before providing the Secretariat with advice.

Recent cases have involved uses of CTC and Halon-1301, in each case the ODS being irreversibly transformed. These substances form part of the 'toolkit' of the synthetic organic chemist, in industry or academe, allowing the incorporation of a CCl_3- or CF_3- group, respectively, into a molecular structure. Both were advised to be feedstock uses.

3.11 Destruction technologies

Decision XXIII/12(3) requested the TEAP to continue to investigate the performance criteria, Destruction Efficiency (DE) and Destruction and Removal Efficiency (DRE), for ODS destruction. Although no detailed work has been undertaken by the TEAP, it is noted that the Multilateral Fund, at its April 2012 meeting of the Executive Committee, had before it a proposal from UNDP to conduct a project in Colombia in which CFC-11, CFC-12 and foam containing CFC-11 would be incinerated and data collected that would allow comparison of DE and DRE. Once the results of the trials become available, they could be assessed by the TEAP.

No further work has yet been undertaken on verification criteria, although there continue to be developments in the field regarding best practice in ODS recovery and destruction verification. TEAP would propose to revisit this subject in its 2013 Report to provide an appropriate update at that point on the potential value that might be added by the introduction of the verification criteria as proposed in 2011. Regarding destruction of methyl bromide by plasma destruction technology (Decision XXIII/12(2)), there has been no update by the proponent of data submitted in 2011. The destruction and removal efficiency reported then was affected by the way the methyl bromide, being less volatile than CFCs, was introduced into the plasma arc. It has been ascertained that, at this stage, the proponent does not wish to modify the existing system so as to overcome this difficulty. Further

evaluation of the plasma technology for destruction of methyl bromide will not be possible until this is done.

4 2012 Foams TOC Progress Report

This chapter provides a short summary of the main progress in the foam sector since the publication of the 2010 Assessment Report. However, the main details of emerging technologies and their likely influence on the implementation of Decision XIX/6 are contained in the TEAP Task Force Report responding to Decision XXIII/9. The key messages are as follows:

- The transition out of HCFCs in the foams sector remains a key element of many Protocol Phase 1 compliance strategies in the period to 2015. However, there are elements of the foam sector (particularly PU Spray Foam and some XPS) that will be part of the post-2015 Phase 2 strategies when additional technical options will be available

- The foam sections of most HPMPs have now been submitted and several have had funding approved based on initial technology proposals. The final choice on technology remains at the enterprise level based on emerging experience and local situations but the funding cap will remain.

- The HPMP preparation process has confirmed that there is a large tail of small enterprises in a number of developing countries, including large numbers with consumption below 1 tonne of blowing agent annually. Therefore, it may be necessary to manage these situations through the implementation of umbrella projects involving local systems houses.

- There is concern that HCFC phase-out might not be consistently achieved and may impact market competitiveness in some sectors, especially if HCFCs continue to be traded in the sector. The identification of blowing agent imports as a component of fully formulated polyols is particularly important and is a key part of HPMP preparation and implementation.

- Particularly for smaller enterprises a range of alternative low GWP solutions have emerged. These include improved CO_2 (water), HFOs and HCOs (such as methyl formate and methylal). The 25% increase in the threshold for funding assistance is helping marginally in this respect, although the definition of 'low GWP' remains open in view of the on-going discussions on refrigerants.

- There is a level of interest in potential two-step transitions via saturated HFCs where enterprises are willing to sign commitments to later transitions to HFOs. This is facilitated by a greater level of confidence in commercialisation timelines from the main potential producers

- Proposed changes in fire regulations for building insulation in China in the aftermath of significant fires in 2010 and 2011 may jeopardise planned transitions to hydrocarbons in the XPS sector. This could result in greater reliance on CO_2 technologies where applicable, or otherwise on saturated HFCs or, eventually, HFOs.

- Unsaturated HFCs (HFOs) are attracting real interest in developed countries for their high level of thermal efficiency and low GWP characteristics.

- As previously reported, the use of blowing agent blends continues to proliferate as foam technology evolves.

- More generally, insulation foams are increasingly being used in building renovation strategies, both in internal and external applications.

- With respect to the management of ODS banks, the shorter lifetime products (e.g. appliances and pipe insulation) now entering the waste stream are typically non-ODS containing, making the average GWP of the waste flows relatively low. The consequence is that, despite the higher 'per kg' recovery/destruction cost, some longer lifetime building foams offer more cost-effective options from a climate perspective because of their high ODS content.

- The overall economic case for ODS bank management involving building foams is still highly dependent on the baseline segregation practices deployed at national level. The incremental cost of ODS recovery/destruction can be affordable where levels of segregation are already high.

- Low carbon prices are continuing to discourage the use of carbon finance to assist the recovery/destruction of blowing agents from foams, and the main focus remains on refrigerants. A forthcoming UNDP pilot destruction project scheduled for Colombia may shed further light on the underlying drivers.

5 2012 Halons TOC (HTOC) Progress Report

The Halons Technical Options Committee (HTOC) met from 5th -7th March, 2012 in Manchester, UK. Attending members were from Canada, Denmark, India, Italy, Japan, Jordan, United Kingdom, United States of America, and Venezuela. The following is the HTOC update for 2012.

5.1 Alternative Agents

Testing of the new alternative agents and technologies mentioned in the 2010 HTOC Assessment Report continues.

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.

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. Performance testing was carried out in 2011; minimum performance test requirements were passed in accordance with the International Aircraft Systems Fire Protection Working Group Minimum Performance Standard (MPS) for portable extinguishers. Values for ODP (0.005) and 100-year GWP (0.003) have been recently published. Toxicology testing is planned for 2012.

A second fluoroketone is under development aimed at replacing halon 1211 (and possibly halon 2402) in streaming applications. Notification was provided to the manufacturer in early 2012 that product review had been completed under the United States Environmental Protection Agency Significant New Alternatives Policy (SNAP) program with an acceptability listing pending a final rulemaking.

Novel, non-corrosive and low toxicity water-based agents, which employ multiple additives to achieve a very low freezing point (-70°C) without the use of glycols, continue to be evaluated. One such material was tested in military vehicle and aviation applications in 2011; results are currently under review.

A fire protection systems integrator company is commercialising an aerosol (non-pyrotechnic) for aircraft engine nacelle and auxiliary power unit applications. All of the required MPS tests have been passed; the SNAP review is complete with an acceptability listing pending a final rulemaking; and a final full scale aircraft engine fire extinguishing demonstration is planned for 2012.

The chemical manufacturer that was developing unsaturated HFC compounds for various uses, including as a total flooding fire extinguishing agent, has withdrawn their application to the National Fire Protection Association's 2001 Standard. Development of this product is complete, but supply based concerns may not be resolved soon and commercialisation of the product is unlikely for at least another two years.

5.2 Halon 1301 Use as a Feedstock

Halon 1301 (CF_3Br) continues to be produced in China and France for use as a feedstock in the manufacture of the pesticide Fipronil. Production in France remains steady at approximately 400 MT per annum. Production in China has varied over the past six years but is believed to be steady now. However, a current production figure was not available to the HTOC.

5.3 Halon Recovery and Recycling in Article 5 Countries

Indian users have identified sufficient supplies of halon 1301 and halon 1211, from both internal and international recycling companies. Halon 2402 is no longer in short supply as it is being obtained from shipbreaking in India.

In China, halons recovered from decommissioned equipment are no longer considered as hazardous wastes. China is now moving ahead with recovery and recycling programs. Approximately 1900 MT of halon 1211, produced before 2006, remain available for use. However, China's use is only about 20 MT per annum. Despite the shortage of halon 1211 globally, it is unclear whether this material can be exported in bulk. Parties may wish to consider ways to resolve this situation.

Halon recycling and banking in the Middle East has proven to be problematic. The only bank still operating is in Jordan. However, that bank may not be sustainable in the long term owing to low throughput. Parties may wish to consider bringing this matter to the attention of the regional network of ozone officers for consideration of the potential establishment of regional banking arrangements to ensure adequate supplies of halons for the region. This approach may also be viable for other regions facing similar challenges.

5.4 Contaminated Recycled Halons

Previously, the HTOC reported that contaminated halon had been supplied by one company for use in aviation fire extinguishers. Prompt action by industry and regulators ensured that aircraft safety was not compromised. This led to a review of recycled halon standards and purity testing methods. Over the past year, the HTOC has been working closely with ASTM International to update the halon 1301 standard D5632. The HTOC recommends strict adherence to this and other international halon specifications and standards to avoid the potential risks from increased agent toxicity, reduced fire extinguishing performance, or a worst case scenario where discharge of the chemicals into the fire actually contributes to the fire..

5.5 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 13th June 2011, the ICAO Council approved the proposals brokered 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 Council approved the following:

- amendments to Annex 6, Parts I, II and III became applicable on 15th December 2011 to require halon alternatives for lavatory fire extinguishing systems for in-production aircraft with an implementation date of 31st December 2011, and for hand-held extinguishers for in-production aircraft with an implementation date of 31st December 2016;

- amendments to Annex 8 became applicable on 31st December 2011 to require halon alternatives for engines and auxiliary power unit fire extinguishing systems for newly designed aircraft with an implementation date of 31st December 2014.

ICAO will be sending a letter to its contracting States requesting information on halon needs and halon supplies.

The next step is for contracting States to report to ICAO on whether or not they will comply with the amended Chicago Convention requirements by the agreed upon dates. The HTOC will provide an update at the 2012 OEWG.

The HTOC plans to continue to work with ICAO on establishing a phase out date for the use of halons in cargo bays on new aircraft designs and to determine the stocks of halon held by the aviation sector.

5.6 HTOC Membership

In accordance with Decision XXIII/10, the HTOC has started the process of seeking re-nominations of its members. The Committee has decided to stagger the process annually over the next three years. During 2011, two non-Article 5 members resigned from the Committee as their employment functions had changed. However, the HTOC has recently added two new non-Article 5 members with expertise in various aspects of aviation fire protection. The HTOC is currently seeking an expert with military fire protection experience in the European sector.

6 2012 Refrigeration, AC and Heat Pumps TOC (RTOC) Progress Report

The Refrigeration TOC met in Prague in August 2011 (back to back with the IIR Congress in Prague) to start a discussion on membership and outline for the RTOC 2014 Assessment report. The meeting draw some preliminary conclusions and will continue in May 2012 to come to the final membership composition and decisions on chapter outlines and deadlines.

The 2012 RTOC Progress Report below is presented following the chapter subdivision of the RTOC 2010 Assessment report in the subchapters 6.1-6.9. The different subchapters below were drafted by the RTOC Chapter Lead Authors (see TEAP and TOC membership lists, Annex I to Chapter 11), reviewed, re-drafted and once more reviewed for consistency.

6.1 Refrigerants

A number of new refrigerants were commercialized for use either in new equipment or as service fluids (to maintain or convert existing equipment) since the 2010 RTOC Assessment Report. Of them, five obtained standardized designations and safety classifications, namely R-407F

[R-32/125/134a (30.0/30.0/40.0)], R-442A [R-32/125/134a/152a/227ea (31.0/31.0/30.0/3.0/5.0)], R-511A [R-290/E170 (95.0/5.0)], R-512A [R-134a/152a (5.0/95.0)], and R-1234ze(E) [trans-1,3,3,3-tetrafluoro-1-propene, CHF=CHCF3]. R-443A [R-1270/290/600a (55.0/40.0/5.0)] is waiting for public review for assignment of a standardized designation and safety classification, but the assignments are not final yet. Additional refrigerants were commercialized without seeking standard designations and safety classifications.

As manifested by these new refrigerants, focus continues on both hydrofluorocarbons (HFCs) and non halogenated candidates, with emphasis on those having practically no ozone depletion potential (ODP) and low or very low global warming potential (GWP). Additional refrigerants, including blend components, still are being developed to enable completion of scheduled phase-outs of ozone-depleting substances (ODSs). As for the 2010 RTOC Assessment, the shift in development efforts forces more attention than in the past on flammable -primarily low-flammability- candidates. The industry and governments are formulating recommended measures to facilitate such use with particular emphasis on refrigerants classified as A2L (lower degree of toxicity, lower flammability and heat of combustion, and the low burning velocity – all predicated on prescribed criteria), a new safety classification.

Additional research seeks to increase and improve the physical, safety, and environmental data for refrigerants, to enable screening, and to optimize equipment performance. Likewise, research continues to expand the heat transfer, thermophysical, stability, compatibility, and additional engineering data to enable design of efficient, durable, and reliable equipment using them. Recent patent applications suggest heightened attention to inclusion of additives, in both refrigerants and associated lubricants, to chemically stabilize them in contact both with common materials of construction for internal refrigerant circuits and with contaminants, especially air and moisture.

The chapter-update summaries that follow elaborate on progress in evaluation, selection, and introduction of substitute refrigerants for specific applications.

Note: *The status of some of the named new refrigerants and potentially others may change in the near future. Likewise, the author of the above section is aware of at least two additional blends for which designation and safety applications are anticipated this year. Accordingly, the status described is in flux, is likely to change, and will be updated in future RTOC reports.*

6.2 Domestic Refrigeration

No significant new technology options have been identified for domestic refrigeration since the 2010 Assessment. HFC-134a and HC-600a continue to be the preferred refrigerant options for new production. A small percentage of global production uses other regionally available refrigerants such as HFC-152a, HC-290/HC-600a mixtures, LPG etc. New product development focuses on improved energy efficiency with extended usage of upgraded components such as variable speed compressors and vacuum insulation panel insulation. Increased use of electronic controls provides energy benefit by avoiding single point optimisation at highly stressed energy label conditions. Progress slowly continues on product redesign to facilitate transition from HFC-134a to HC-600a in certain countries. Initial developments to assess the HFC-134a replacement by HFC-1234yf have also begun.

Regulatory changes continue to facilitate application of flammable refrigerants. An example of this is the approval of a field service process for recovery of flammable refrigerants by the U.S. EPA. Recovery of all refrigerants during service or disposal of domestic refrigerators is required by the U.S. law. This approval removes a deterrent to the application of flammable refrigerants in the U.S. Similarly, the regulatory consideration of HFC-1234yf has been initiated in the U.S.

6.3 Commercial refrigeration

Commercial refrigeration covers a wide variety of equipment, over a wide range of refrigeration capacity, design and refrigerant choices. According to the type of system, the refrigerant charge varies from some hundreds grams to hundreds of kilograms.

Since the 2010 Assessment the available options have not really changed. They depend on the equipment size and the levels of evaporation temperature. HFC-134a with a relatively low volumetric capacity is still the preferred choice in small equipment (stand-alone equipment and some condensing units) whereas HCFC-22 or R-404A, with larger refrigeration capacities, are used in large commercial systems but also in smaller systems for freezing applications (evaporation at -35°C or lower).

Especially in Europe, the phase-out of HCFC-22 is associated with an increase in available refrigerant options. Refrigerants as diverse as hydrocarbons (HC-600a and HC-290), R-744, intermediate blends (R-422D or R-427A for drop-in or nearly drop-in replacement of HCFC-22) and the usual HFC-134a and R-404A are in competition. Choices very much depend on the emphasis set on GWP, safety and energy efficiency as a HCFC-22 replacement. With more emphasis than before, new refrigerant options are proposed using HFC-1234yf either as a pure refrigerant or as a component of new blends. The use of indirect systems with significantly lower refrigerant charges (-50 to -75%) is increasing in case of large supermarkets.

Hot climates with high ambient temperatures lead to high condensing temperatures and thus high condensing pressures. Those high pressures and temperatures have several consequences:

- COPs of medium and low temperature commercial systems are 20 to 25% lower in hot climates compared to moderate climates (ambient temperatures).

- For low-temperature applications (frozen food), the discharge temperatures of compressors are so high that liquid injection has to be used either at a suction port or at an intermediate stage when using HCFC-22.

- Systems with economizers are not popular in commercial refrigeration yet, because of high costs and the preference for customary design. In terms of energy efficiency and reliability the two-stage system is the preferred option for low temperature industrial applications as it is in the food industry.

Discharge temperature and pressure constraints in hot climates lead to the choice of "medium pressure" refrigerant such as HFC-134a or HFC-1234yf for single stage systems. Except for HC-290

(where there are charge limitations for large systems due to safety concerns), there is a lack of low-GWP refrigerants with a large refrigeration capacity in order to replace R-404A or HCFC-22 in single stage refrigeration systems.

6.4 Large systems

Within the group of large systems there are three distinct segments, i.e., industrial refrigeration, industrial air-conditioning and large heat pumps. The majority of systems in the refrigeration and air-conditioning sectors use R-717 or HCFC-22 (where its use is still permitted). The large heat pump market is divided between R-717 systems, generally using screw or reciprocating compressors, and HFC-134a systems, using centrifugal compressors.

The 2010 Assessment presented several issues related to R-717, where this subchapter gives some detailed regional information for the use of R-717. The acceptance of R-717 as the refrigerant is strongly influenced by national regulations which may restrict where it can be used, limit the amount that can be used in any system, and prescribe the documentation that must be held on the installation and maintenance of the facility. However, it does not imply that a country with complex or strict regulations will necessarily avoid the use of R-717. The United States of America for example requires strict compliance with system design requirements, maintenance and record keeping (including the reporting of any leak of more than 45 kg to a national database within 15 minutes of the discovery of the leak) and yet R-717 is widely accepted in the industrial sector. Canada has similar regulations but also requires a full-time staff of technicians on site for any system where the compressor power is greater than 25 kW. The cost of this provision is a severe impediment for all but the very large systems that would require that level of attendance anyway. Similar differences exist between otherwise equivalent European countries. For example R-717 is widely accepted in Germany, which has a strict set of regulations, but it is not common in France because there is a limit on the distance to occupied buildings for all systems over 150 kg charge and a requirement for government approval of large installations.

Where regulations inhibit the charge of R-717, or where there are other reasons for reducing the quantity on site, cascade systems with R-744 have been implemented, or secondary heat transfer fluids have been used. HFC refrigerants have not been so widely adopted, with the exception of HFC-134a in large heat pumps. The cost of the refrigerant is cited as a major impediment.

For Article 5 countries, HCFC-22 was historically the most common refrigerant in places where R-717 was not acceptable. R-717 was frequently seen to be too dangerous or too complicated, and HCFC-22 or R-502 systems were cheaper to construct and safer to maintain. There is therefore a large bank of ODS refrigerants in existing large systems in Article 5 countries and other places where the phase-out of HCFCs for service is not yet complete. There is a growing realisation that none of the HFCs are a good match for HCFC-22 in large systems because they are less efficient, more expensive, or require larger compressors or higher pressures. Nevertheless, R-717 systems are not universally accepted. Development over the last twenty years of simple, automatic, low charge systems will help ease the adoption of R-717 systems in Article 5 countries and in places with stricter or more costly regulations. However, in some countries it is likely that a change of the laws will also be required if the cost burden of moving away from ODS refrigerants is to be eased.

6.5 Transport refrigeration

The vast majority of new transport refrigeration equipment continues to utilise HFC refrigerants in vapour compression cycles. HCFC-22 has been completely phased out in intermodal marine containers globally; it has been phased out in road transport equipment in the developed countries. HCFC-22 continues to be used aboard ships, and as part of R-502 retrofit refrigerants in road transport equipment in developing countries. Systems based on other than the vapour compression principle exist, but their installed quantities are small.

In 2011, the European Commission requested public consultation on a number of policy options, aiming to revise the current EU regulation on fluorinated gases (the F-Gas Regulation). It is mentioned that refrigerated transport will be considered in the legislative proposal. A first consideration of the proposal can be expected this year (2012), though adoption of a final regulation will not happen before the end of 2013.

At least two global manufacturers presented marine and trailer refrigeration units charged with R-744 at exhibitions and have now started field testing them. Hydrocarbons continue to be field tested in trucks and home delivery vans in the UK and Germany. Applications of unsaturated fluorocarbons (HFC-1234yf, etc.) are being explored as well, however, no prototype equipment has been revealed to date.

Safety issues affected several different brands of marine container units in 2011. Three explosions were reported to be caused by refrigerant imitation; they were added to intermodal container refrigeration units during servicing in Vietnam. The result was the docking of hundreds of containers and fear among port workers; they refused to work on certain vessels. This case emphasises the requirement for inexpensive and safe working fluids in the global trade.

Over the last years the shipping industry has been looking at various options to replace HCFC-22. The European Commission contracted CE Delft to carry out a research project analysing options to reduce greenhouse gas emissions from international maritime transport. The CE report has been debated in the Vessel Operators Forum and by the operators. Although one has started to apply recommended systems in new and some retrofitted ships, the cost sensitive segments of the shipping industry rejected the project conclusions --for the time being-- and continue to favour HFC-based retrofits.

6.6 Air-to-air air conditioners and heat pumps

On a global basis, air conditioners for cooling and heating (including air-to-air heat pumps) ranging in size primarily from 2.0 kW to 35 kW (although in some cases up to 420 kW) comprise a significant segment of the air conditioning market. Nearly all air conditioners and heat pumps manufactured prior to 2000 used HCFC-22 as their working fluid.

Compared to data in the 2010 Assessment, new information is that the installed base of units in 2012 represents an estimated HCFC-22 bank exceeding 1.5 million tonnes. Approximately 75% of the installed population uses HCFC-22. In 2012, the global HFC demand represents approximately 20% of the total refrigerant demand for these categories of products.

Most Article 5 countries are continuing to utilise HCFC-22 as the predominant refrigerant in air conditioning applications, although several major producing countries within Asia, Middle East and South America are now initiating actions to introduce non-ODS alternatives.

The HFC based refrigerant blend R-410A is the dominant alternative used to replace HCFC-22 in air-conditioners. Whilst the use of R-407C in new product designs was common, it is currently decreasing rapidly. HC-290 is also being used to replace HCFC-22 in products having low refrigerant charges. It is anticipated that HFC-32, R-744 and possibly HFC-161 may also be used in the future.

Air conditioners using R-410A (and to a lesser extent R-407C) are widely available in most non-Article 5 countries. Moreover, equipment using R-410A is being manufactured in several Article 5 countries. This in particular in China, where a large export market has created demand for these products. However, these R-410A units are typically not sold in the domestic market because of their higher cost.

In addition to the high GWP HFCs (R-410A and R-407C), there are several low and medium GWP alternatives being considered as replacements for HCFC-22 in Article 5 countries. These include HC-290, HC-1270, R-744 as well as HFC-161 (low GWP) and HFC-32 (medium GWP). Apart from R-744, these are flammable and will need to be applied in accordance with an appropriate safety

standard such as IEC-60335-2-40, which establishes maximum charge levels and other special construction requirements. In some countries, national regulations place controls on flammable refrigerants. Some small countries are introducing bans on imports of HFC-containing air conditioners. Current standards restrict the permitted charge of R-744 due to physiological effects. In general, most standards limit the system charge quantity of any refrigerant within occupied spaces.

HC-290 and HC-1270 have a GWP < 20 and are currently considered mainly for systems with smaller charge sizes due to the higher flammability (class 3). The operating pressures and capacities are similar to HCFC-22 and the efficiency is at least as high as HCFC-22. Several manufacturers in China and India are now introducing HC-290 charged split air conditioners.

R-744 has a GWP of 1 but is considered to have limited applicability for air conditioners in Article 5 countries. Whilst R-744 offers a number of desirable properties as a refrigerant, it has a low critical temperature which results in reduced efficiency when the ambient (heat rejection) temperature exceeds the level of about 30°C. A number of cycle enhancements and component additions can be made to improve the efficiency under such conditions, although detrimental to system cost.

HFC-161 has a GWP of 12 and is currently under evaluation for systems with smaller charge sizes due to its higher flammability (class 3). The operating pressure and capacity is similar to HCFC-22 and the efficiency is at least as high as HCFC-22. HFC-32 has a GWP of 717 and is currently being considered for various types of air conditioners. It is a so-called mildly flammable refrigerant (class 2L). The operating pressure and capacity are similar to R-410A and its efficiency is similar or better than that of R-410A.

Other low GWP single component HFCs, such as HFC-1234yf (GWP = 4) and HFC-152a (GWP = 130), are unlikely to be used as a replacement for HCFC-22 in air conditioners principally because of their low volumetric refrigerating capacity.

There are various mixtures currently under development specifically for air conditioning applications, which comprise, amongst others, HFC-32, HFC-152a, HFC-161, HFC-1234yf and HFC-1234ze. These mixtures will tend to have operating pressures and capacities similar to HCFC-22 or R-410A, with GWPs ranging from 150 to around 1000 and various types of flammability, including non-flammable (class 1) and mildly flammable (class 2L) ones. Some of the developments are focussing on performance improvement for high ambient conditions. Currently, the above mentioned mixtures are not commercially available and technical data is not in the public domain.

6.7 Water heating heat pumps

Heat pumps are classified by heat source (air, water, or ground) and heat sink (air, water), resulting in designations such as “air to water” (air source, water sink) heat pumps. This section covers only systems where water is the sink. Heat pump water heaters are designed especially for heating service hot water (including domestic water) to a temperature between 55 and 90 ºC. Air-to-water heat pumps have experienced significant growth in Japan, Europe, China, and Australia during the last five years. Sales forecasts show significant growth in Japan, China and Europe.

Efficient heat pumps can reduce global warming impact significantly compared with fossil fuel burning systems. The reduction depends on the efficiency level of the heat pump and the carbon emission per kWh of the electricity generation. The tendency of decarbonisation of electricity and the increase of the efficiency levels of the heat pumps strengthens this positive effect.

The current refrigerant options for new heat pumps, R-410A, HFC-134a, HC-290, HC 600a, R-717 and R-744. HFC-134a and HFC blends R-407C and R-410A are currently used for new water heating and space heating heat pumps to replace HCFC-22 (R-407C with limited product redesign and R-410A for completely redesigned products). HC-290 has properties similar to those of HCFC-22 apart from flammability. Until 2004 almost half of the heat pumps sold in the EU used HC-290, where use has declined due to introduction of the Pressure Equipment Directive. R-717 is a non-ODS refrigerant

and has a very low GWP, but it has higher toxicity and lower flammability characteristics. R-717 is used mainly for large capacity systems (see section 6.4).

Development of R-744 heat pumps started around 1990. R-744 heat pump water heaters were introduced to the market in Japan in 2001, with heat pumps for heating of bath or sanitary water as the main application. Although the current market for space heating heat pumps for commercial buildings with combined radiator and air heating systems is limited, R-744 is considered to be a promising refrigerant.

Extra future refrigerant options for new heat pumps include HFC-32 (GWP=717) and the refrigerants R-1234yf, R-1234ze and blends with these refrigerants. HFC-32 has a low flammability with a low burning velocity. Heat pumps with HFC-32 are characterised by a lower charge than heat pumps with R-410A.

HFC-1234yf is similar in thermophysical properties to HFC-134a. For water heating and space heating heat pumps using HCFC-22, R-410A or R-407C, significant design changes would be required to optimize for HFC-1234yf. HFC-1234yf has low flammability with a low burning velocity and has high potential (due to its low GWP) in applications that currently use HFC-134a.

Heat pumps are expected to increase in quantity leading to higher net refrigerant requirements and emissions in future. It is important to emphasize that there is a large potential for reducing CO_2 emissions from fossil fuel combustion heating systems by replacing them with heat pump systems.

6.8 Chillers

Chillers are predominantly used for comfort air conditioning in commercial buildings and building complexes. They are coupled with chilled water distribution and air handling/air distribution systems. Chillers also are used for cooling in commercial and industrial facilities such as data processing and communication centres, electronics fabrication, and moulding. HFC-134a and R-410A are being used in new chillers with positive displacement compressors. HCFC-22 still is being used in new chillers in countries where the HCFC phase-down has not yet started. Scroll and screw chillers predominate in the positive-displacement category. Limited production of reciprocating compressors continues primarily for service and replacement in existing chillers.

No new option has come forward since the 2010 Assessment, but some new trends can be observed. Some chillers are available with R-717 or hydrocarbon refrigerants – primarily HC-290, HC-600a, or HC-1270. Such chillers are manufactured in small quantities compared to HFC chillers of similar capacities and require attention to flammability, and for R-717 also toxicity concerns, as reflected in safety codes and regulations.

A continuing trend in chiller development is to improve both full-load and seasonal energy efficiency to address energy-related global warming impacts, building energy regulations and incentives, and operating costs. Chillers adapted for heat pump service are increasing in market share.

Chiller refrigerants suggested as alternatives to ODS or high-GWP refrigerants include R-717, hydrocarbons, R-744, HFC-32, and new low-GWP refrigerants such as HFC-1234yf and HFC-1234ze(E). Testing and evaluation programs are under way for low-GWP refrigerants in several countries. An example is the Low-GWP Alternative Refrigerants Evaluation Program conducted by the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) in the U.S. Tests are planned for six or more low-GWP refrigerants or blends of refrigerants in screw and centrifugal chillers during 2012. Chiller tests have been conducted in Japan as well.

A number of low-GWP refrigerants are classified as A2L refrigerants with low flammability and low burning velocity. Risk analyses and development of requirements for safe use of these refrigerants in chiller applications are being conducted in parallel with the testing programs.

Absorption chillers using ammonia-water or water-lithium bromide working pairs are an alternative to chillers employing the vapour-compression cycle. They are particularly suitable for applications where surplus heat can be recovered. Chillers with solar hot water as the heat source continue to be further developed.

6.9 Vehicle Air Conditioning

In the last decade, car manufacturers and suppliers have evaluated several refrigerant options for new car (and truck) air conditioning systems, especially the three options R-744, HFC-152a, and HFC-1234yf, which all have GWPs below the EU threshold of 150 and can achieve fuel efficiency comparable to the existing HFC-134a systems with appropriate hardware and control development. The decision to go for HFC-1234yf as a new refrigerant for car and light truck air conditioning was mainly made based on additional considerations including regulatory approval, costs, system reliability, and servicing.

The future refrigerant for bus and rail air conditioning systems is not yet determined. On the one hand, R-744 seems to be well suited for this application. On the other hand, it would not be surprising if the transition to low-GWP refrigerants in bus and rail air conditioning systems might follow the developments set forth by the car manufacturers.

Compared to the 2010 Assessment, it can now be stated that the global car manufacturers have chosen HFC-1234yf as the new refrigerant for car and light truck air conditioning. They indicate that they will design HFC-1234yf mobile air conditioning (MAC) systems in such a way that these systems can safely be used with the refrigerant HFC-134a refrigerant as well. The US Environmental Protection Agency's (EPA) Significant New Alternatives Policy (SNAP) program lists HFC-1234yf as an acceptable substitute for use in the motor vehicle air conditioning end-use as a replacement for ozone-depleting substances under the following use conditions:

HFC-1234yf MVAC systems must adhere to all of the safety requirements of SAE J639, including requirements for a flammable refrigerant warning label, high-pressure compressor cutoff switch and pressure relief devices, and unique fittings.

Manufacturers must conduct Failure Mode and Effect Analysis (FMEA) as provided in SAE J1739.

However, the California Air Resources Board of the California EPA does not anticipate a widespread adoption of low GWP refrigerant technology until after 2017, due to the high price and limited availability of HFC-1234yf in the near term.

R-744 is considered a refrigerant with good heat pumping properties, which makes it interesting for hybrid and battery-driven electric vehicles. R-744 is one of the front running candidates for future bus and train air conditioning. Fleet tests of R-744 systems in public transportation buses are reported to be ongoing.

One large OEM still considers HFC-152a as a viable future option but has not moved further in this direction.

The use of hydrocarbons or blends of hydrocarbons as a refrigerant has also been considered but has not received support so far from vehicle manufacturers due to safety concerns.

One global chemical company has recently presented two zeotropic HFC blends (with still undisclosed composition) as interesting future options due to their expected relatively low price and high availability. Regarding thermophysical properties, environmental impact, and flammability, both blends are comparable to HFC-1234yf.

7 Use of refrigerants on ships – Decision XXIII/11

7.1 Introduction

Decision XXIII/11, taken by the Parties at their 23rd Meeting mentions in paragraph (7) the following:

To request the Technology and Economic Assessment Panel to provide in its 2012 progress report a summary on the available data concerning the use of ozone-depleting substances on ships, including the quantities typically used on different types of ships, the estimated refrigerant bank on ships and an estimation of emissions.

TEAP and its RTOC have dealt with this request as follows. The RTOC chapter 6, dealing with transport refrigeration, has gone back to the information supplied in the RTOC Assessment Report 2010 and has supplemented it with some recent material. The results are given below.

7.2 Overview

From a commercial and regulatory point of view, size and type are two key parameters that characterize ships.

The overall size of a ship is measured in terms of gross tonnage (GT). Nearly all vessels larger than 100 GT have a refrigeration system for food storage and an air conditioning system for occupied cabin space. Although vessels above 100 GT are monitored by organizations such as IHS Fairplay, in general only medium and large vessels (above 500 GT) are covered by classification societies, trading organizations, the Safety of Life at Sea (SOLAS) convention etc. Ships below 100 GT are likely to carry only permanently sealed equipment where refrigerant leaks are limited (domestic refrigerators/freezers or self-contained air conditioners).

Types of vessels are numerous and their coding systems typically reflect the requirements of those wishing to perform analysis. In order to meet various demands, IHS Fairplay recently launched a coding system that recognizes 318 types of vessels (Statcode, level 5).

Air pollutant emissions from ships are covered by Annex VI of the Marine Pollution Convention, MARPOL 73/78, of the International Maritime Organization (IMO). MARPOL Annex VI (Regulation 12) prohibits new installations containing chlorofluorocarbons (CFCs) on all ships from May 19, 2005, but new installations containing HCFC refrigerants are permitted until January 1, 2020. As of February 29, 2012, there were 68 contracting states that represent 91 % of the world tonnage /IMO12/.

Revised MARPOL Annex VI entered into force on July 1, 2010. It includes the requirement for all ships of 400 GT and above to maintain a list of equipment containing ozone depleting substances (ODS) and an ODS record book. The requirements concerns rechargeable systems and does not apply to permanently sealed equipment. The record book can be used to establish a refrigerant usage figure as well as to monitor, whether a system started to leak.

Until a dedicated database is assembled, one has to estimate the use of ODS on ships based on their number and refrigerant charge on average. Although refrigerant charge can be assumed to be correlated with the vessel size and type, such information is currently not available. It may be obtained from shipyards, large fleet operators, or alike.

IHS Fairplay, which is the sole global issuing body of the IMO numbering system, claims to have in its Sea-web register data on over 180,000 ships of 100 GT and above /IHS12/. According to the most recent Review of Maritime Transport /Rev11/, as of January 2011 there were 103,392 seagoing commercial (merchant) ships in service (> 100 GT). The Food and Agriculture Organization estimates

that there are about 50,000 fishing vessels of the same tonnage worldwide /FAO12/. Types of the remaining about 30,000 vessels in the commercial Sea-web register could not be identified without access.

7.3 Refrigerants used

HCFC-22 has been by far the most commonly used refrigerant at sea. It is considered that the majority of ships built prior to 1999 have refrigeration equipment containing HCFC -22. Following the phase-out, an increasing portion of the HCFC -22 banks is being replaced by alternatives formulated for aftermarket use as service fluids refrigerants (R-407C, R-417A, R-421A and R-422D). Although the production and consumption of CFCs was banned in the non-Article 5 countries beginning in 1996 and in Article 5 countries in January 2010, limited amounts of CFCs are still in use. The remaining banks will gradually decrease in a few years.

HFC-134a has been the most often used alternative to HCFC -22 in new vessels for both air conditioning in central systems and for refrigeration, while R-410A is the most common for unitary systems serving individual cabins. Other HFC refrigerants used are R-404A, R-407C and R-410A; however, their individual shares are unknown. Applications of non-fluorinated refrigerants are being debated concerning costs, space and safety. They have been used in limited numbers to date – for example, R-717 started to be used in large fishing vessels and reefers in indirect and cascade systems.

A typical refrigerant charge for vessels above 100 GT is estimated between 100 and 500 kg for direct expansion systems (single-stage and cascade). Indirect systems use a much smaller refrigerant change. They utilize a primary refrigeration system to cool a heat transfer ("secondary") fluid, which then circulates through a closed loop to locations where refrigeration duty is needed. Such indirect systems typically use HFCs or R-717 as the refrigerant, and R-744, brine, ice slurry or water as the secondary fluid. The refrigerant charge of indirect systems is estimated between 10 and 100 kg.

The annual refrigerant leakage rate can be as high as 20- 40 % of the initial charge, especially for systems not maintained properly. Leakage monitoring equipment and regular inspections can manage to decrease the rates down to single percentage points on average. Then, emissions resulting from damage to a ship, service losses, and end of live losses become equally important.

7.4 Banks and emissions

Table 7-1 summarizes the estimates of approximate refrigerant banks and emissions rounded to 10. The data are based on estimates of the fleet size, refrigerant charge per system, refrigerant share in the fleet, and refrigerant emissions per system, which are all presented in Tables 7-2 through 7-4. Since the 2010 Assessment Report, the estimate of the fleet size has been increased to 180 thousand, the estimate of the CFC banks has been reduced (from 10 to 5%), and "drop in" replacements to HCFC-22 have been added (estimated share of 5%).

Table 7-1: Estimate of approximate refrigerant banks (t) and approximate refrigerant emissions (t/y)

	CFC	HCFC	HFC*	Non-fluorinated	Total
Refrigerant banks (t)	1250	26400	4480	130	32260
Refrigerant emissions (t/y)	500	7920	570	10	9000

* Includes HCFC-22 "drop in" refrigerants where HFCs are main components

Table 7-2: Estimate of fleet size and refrigerant charge

Vessel type	System type	Share (%)	Fleet (x 10^3)	Refrigerant charge (kg)
Merchant	Direct	90	90	200
	Indirect	10	10	50
Fishing	Direct	70	35	200
	Indirect	30	15	50
Other	Direct	100	30	200
	Indirect	0	0	50

System type: Direct = direct expansion; Indirect = secondary loop

Table 7-3: Estimate of approximate refrigerant share

Vessel type	System type	CFC-11 CFC-12	HCFC-22	R-417A R-422D	HFC-134a	R-404A R-407C R-410A R-421A	R-717	R-744
Merchant	Direct	5%	80%	5%	7%	3%		
	Indirect		80%		5%	5%		10%
Fishing	Direct	5%	80%	5%	7%	3%		
	Indirect		80%		5%	5%	2%	8%
Other	Direct		85%	5%	10%			
	Indirect							

System type: Direct = direct expansion; Indirect = secondary loop

Table 7-4: Estimate of approximate refrigerant emissions in % of charge, per year, including leaks, total charge losses due to ruptures, service losses and end of life losses

Vessel type	System type	CFC-11 CFC-12	HCFC-22	R-417A R-422D	HFC-134a	R-404A R-407C R-410A R-421A	R-717	R-744
Merchant	Direct	40%	30%	20%	10%	10%		
	Indirect		30%			10%		10%
Fishing	Direct	40%	30%	20%	10%	10%		
	Indirect		30%			10%	5%	10%
Other	Direct		30%	20%	10%			
	Indirect							

System type: Direct = direct expansion; Indirect = secondary loop

7.5 References

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/Rev11/ Review of maritime transport, United Nations Conference on Trade and Development, New York and Geneva, 2009, http://www.unctad.org/en/Docs/rmt2011en.pdf

/FAO12/ http://www.fao.org/fishery/topic/1616/en

8 2012 Methyl Bromide TOC (MBTOC) Progress Report

This chapter updates trends in methyl bromide (MB) production and consumption for controlled uses, and gives progress in the development and adoption of alternatives in the preplant soil, structures, commodities and quarantine and preshipment (QPS) sectors. Trends in MB production and consumption for QPS uses are presented in Chapter 10, as they are part of MBTOC's response to Decision XXIII/5. Special sections deal with key issues and remaining challenges relating to Article 5 5 countries and particularly to MB uses for which CUNs are still being submitted.

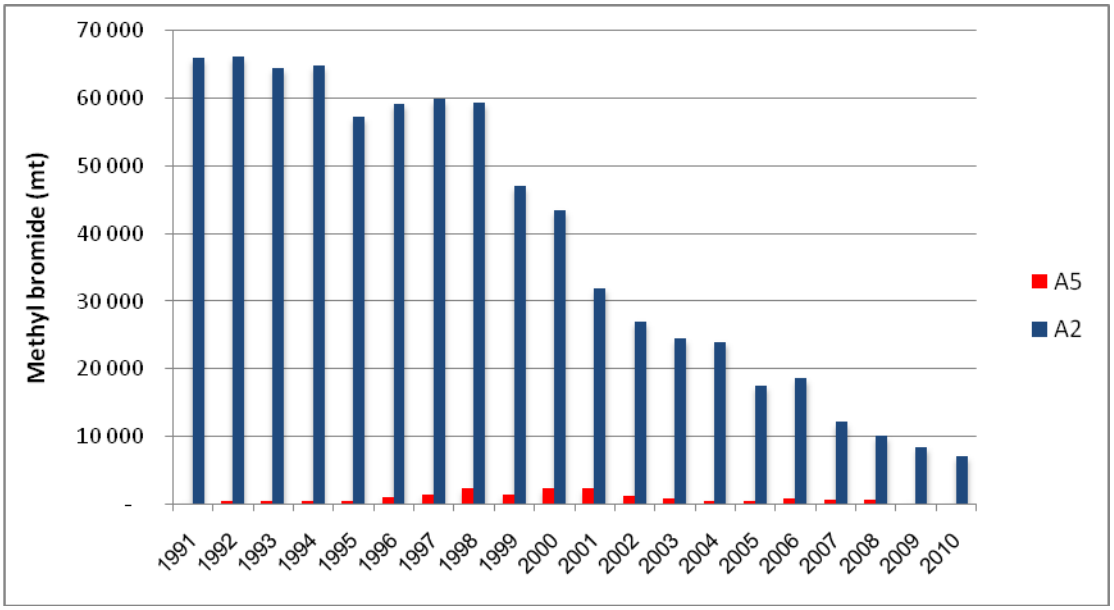
8.1 Trends in Methyl Bromide production and consumption for controlled uses

An update on MB production and consumption for controlled uses was compiled primarily from the database on ODS consumption and production of the Ozone Secretariat available in February 2012. Under the Protocol, consumption at the national level is defined as '*MB production plus MB imports minus exports, minus QPS, minus feedstock'*; it thus represents the national supply of MB for uses controlled by the Protocol (i.e. non-QPS). Some countries have revised or corrected their historical consumption data, and as a consequence official figures and baselines have changed. At the time of writing this report, three Article 5 Parties had not submitted data for 2010.

8.1.1 Production trends

Trends in the reported production of MB for all controlled uses (excluding QPS and feedstock) in non Article 5 and Article 5 countries are shown in Figure 1 and have been falling consistently from 1991 to 2010. The 2010 production continued the downward trend, totalling 7,567 tonnes or about 11% of the baseline.

Fig 8-1: Historical trends in reported global MB production for controlled uses 1991-2010



Sources: Data for 1991 and 1995-2010 were taken from the Ozone Secretariat dataset of February 2012. Data for 1992-94 were estimated from Table 3.1 of MBTOC's Assessment Report (2002) and Table 3.1 of MBTOC's Assessment Report (2011).

Non-Article 5 countries reduced their MB production for controlled uses from about 66,000 tonnes in 1991 (non-Article 5 baseline) to 7,231 in 2010.

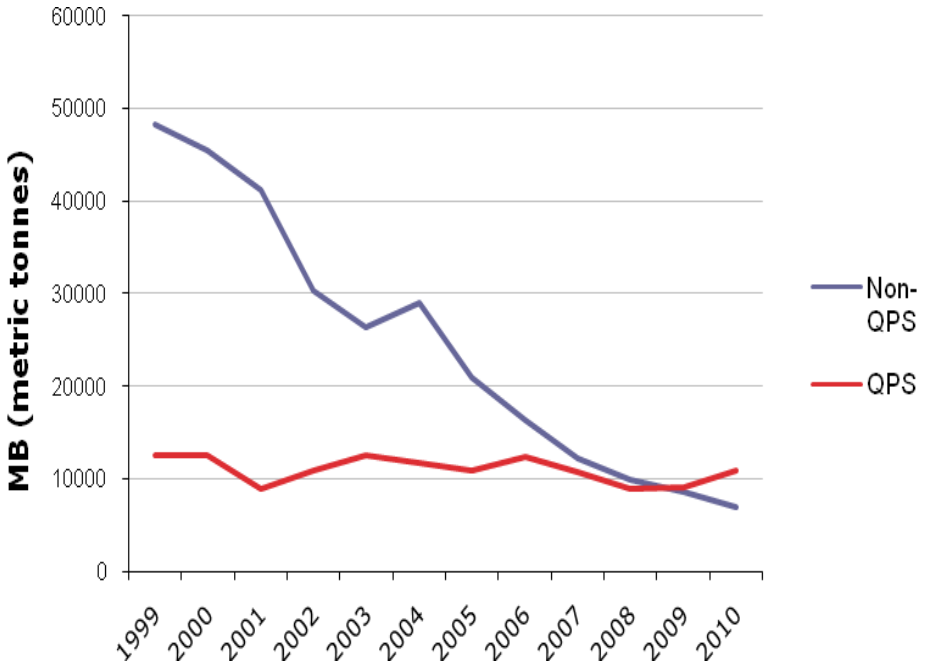
Article 5 countries reduced their production for controlled uses from a peak of 2,397 tonnes in 2000 to about 336 tonnes in 2010, which represents 26% of the baseline. At present, production of MB for controlled uses in Article 5 countries takes place entirely in China and a MLF project to phase-out this activity is approved and on going. In 2010, MB was produced for controlled uses in one Article 5 country (China) and three non- Article 5 countries (Israel, Japan and USA).

8.1.2 Quarantine and Preshipment (QPS)

A detailed analysis of methyl bromide production and consumption trends for QPS purposes is included as Chapter 10 of this report, in response to tasks mandated by the Parties in Decision XXIII/5.

Reported global consumption of methyl bromide for QPS uses was greater than consumption for controlled (non-QPS) uses for the first time in 2008. This trend, which is related to progress made in phasing out methyl bromide for controlled uses globally, has continued since that year as seen in Fig 8-2.

Figure 8-2: Comparison of non-QPS and QPS global consumption from 1999 to 2010 (tonnes)

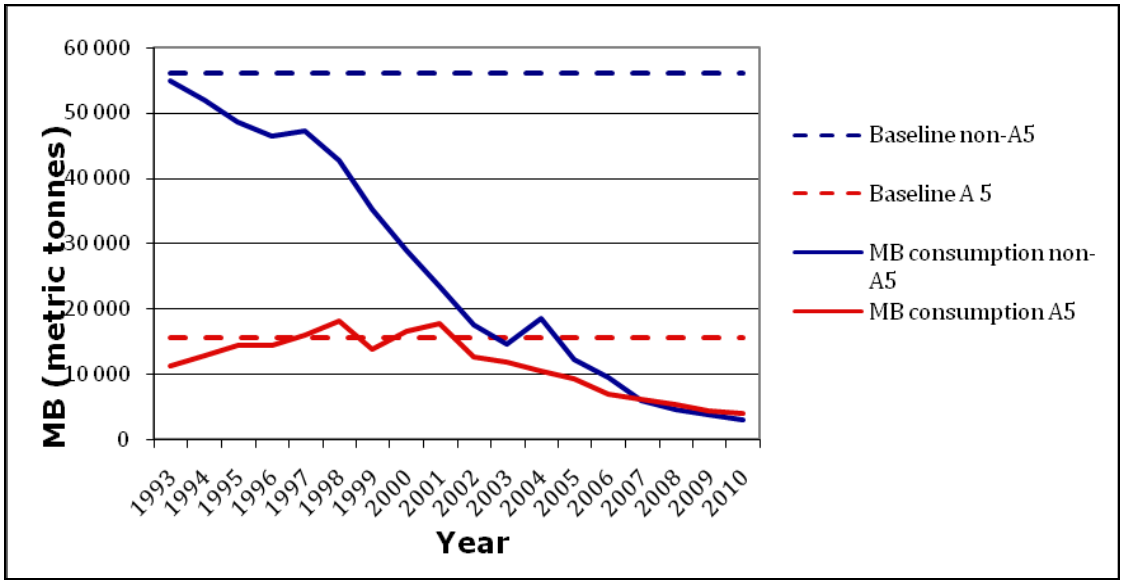


Source: Ozone Secretariat Data Centre, February 2012.

8.1.3 Global consumption for controlled uses

On the basis of Ozone Secretariat data, global consumption of MB for controlled uses was estimated to be about 64,420 tonnes in 1991 and remained above 60,000 tonnes until 1998. Global consumption was reported as 45,527 tonnes in 2000, falling to 26,336 tonnes in 2003 and to 6,937 tonnes in 2010 as illustrated by Fig 8-3 below.

Figure 8-3: Baselines and trends in MB consumption in Non- Article 5 and Article 5 regions, 1991 – 2010

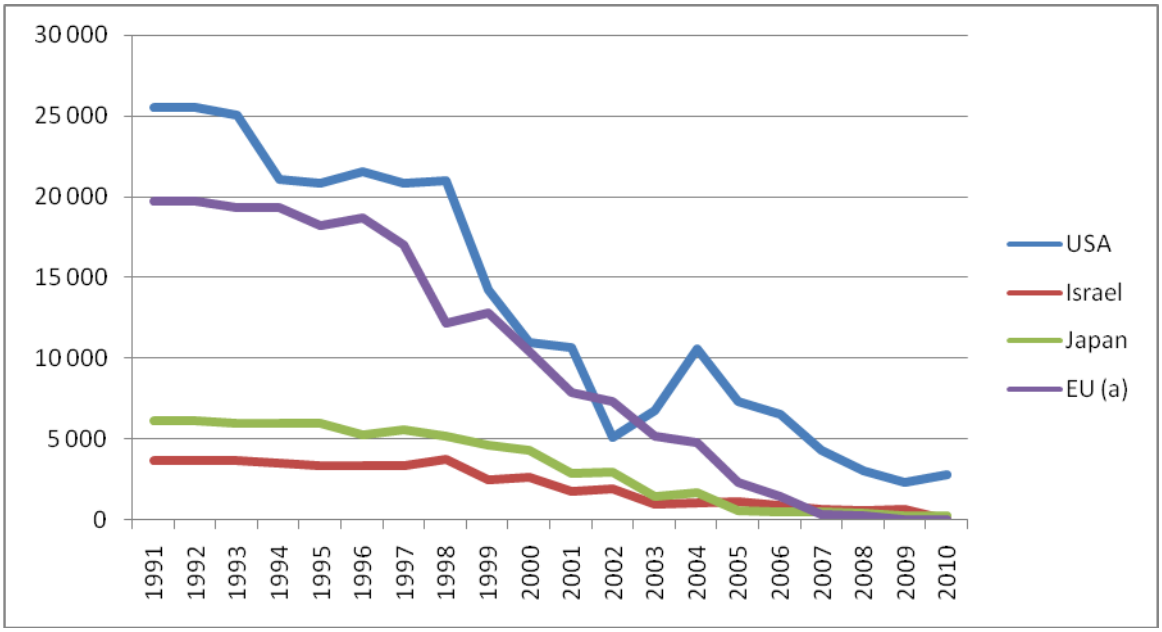


Source: MBTOC estimates and Ozone Secretariat Data Access Centre February 2012.

8.1.4 Consumption trends in Non-Article 5 countries

Figure 8-4 shows the trends in MB consumption in Non-Article 5 countries for the period between 1991 and 2010. The official baseline for Non-Article 5 countries was 56,050 tonnes in 1991 and since the consumption has declined steadily. In 2008 the estimated consumption based on quantities approved or licensed amounted to 6,996 tonnes or about 12% of the baseline. For 2010 about 2,938 tonnes were approved or licensed which is a further reduction to about 5% of the baseline.

Figure 8-4: MB consumption trends in non-Article 5 countries for controlled uses 1991-2010



Source: Ozone Secretariat Data Access Centre, February 2012

8.1.5 Consumption trends in Article 5 countries

Figure 8-5 shows the trend in MB consumption in Article 5 countries in the period between 1991 and 2010. Trends can be illustrated as follows:

- The Article 5 baseline was 15,703 tonnes (average of 1995-98), rising to a peak consumption of more than 18,125 tonnes in 1998. ARTICLE 5 consumption was reduced to 67% of baseline in 2004 (10,512 tonnes) and 25% in 2010 (3,998 tonnes, although this could increase slightly once all Article 5 Parties have reported consumption).

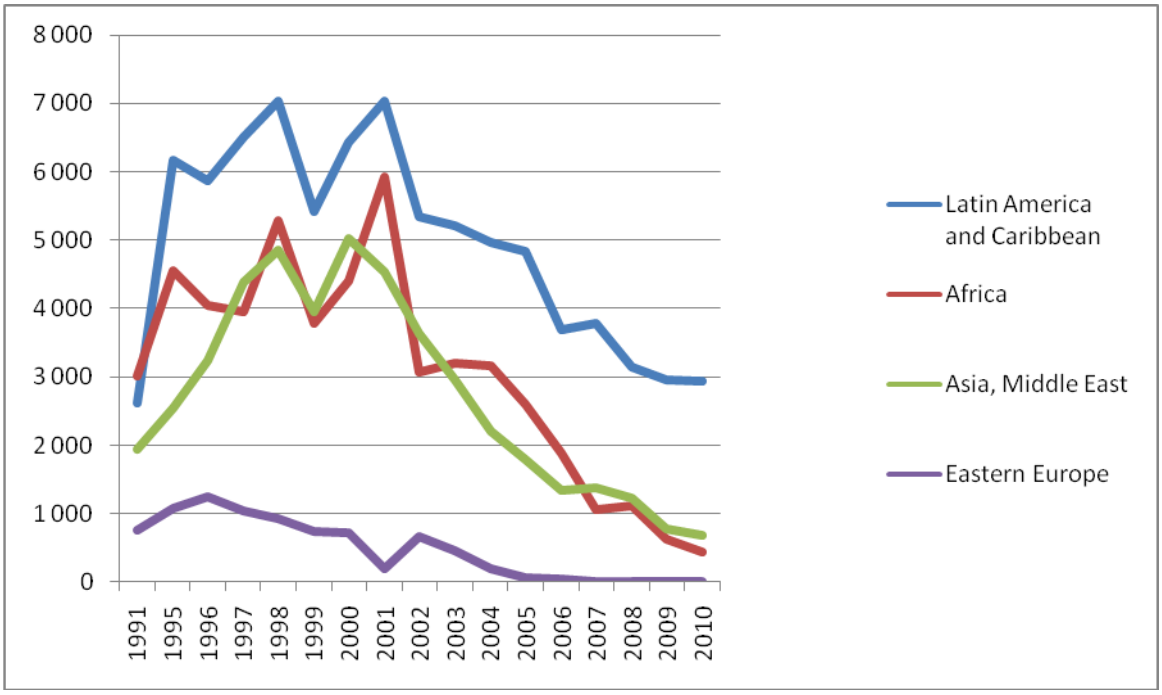
- Most Article 5 Parties have continued to make substantial progress in achieving reductions in MB consumption at a national level, as illustrated by the following information.

- Latin America continues to be the region showing the smallest relative reduction in MB consumption with respect to its baseline. Eastern Europe achieved total phase-out in 2008 and reports zero consumption since that year.

The status of MB phase-out in Article 5 regions in 2010, compared to the regional baselines (1995-98 average) is as follows:

- Latin America has phased-out 55% of its regional baseline
- Africa has phased-out 90% of its regional baseline
- Asia including Middle East has phased-out 84% of its regional baseline
- Eastern Europe region has phased-out 100% of its regional baseline

Fig. 8-5: MB Consumption trends in Article 5 countries 1991 – 2010



Source: Ozone Secretariat database, 2010

Many Article 5 countries are finishing or have finished implementing MLF projects to reduce or totally phase-out MB. This includes 14 of the 15 largest MB consuming countries (i.e. countries that

consumed more than 470 metric tonnes, which together accounted for 80% of the Article 5 baseline consumption). Several parties previously in this group (e.g. Brazil, Turkey and Lebanon), which reported consumption larger than 500 tonnes in the past, have phased out completely during the last three years. South Africa reported zero consumption in 2010, and is the only country that has not implemented an investment project with funding from the MLF. China has made great strides in reducing MB consumption for controlled uses, which in 2010 amounted to about 25% of its baseline.

8.2 Methyl Bromide uses for QPS

Decision XXIII/5 requests MBTOC *"to conduct an analysis of trends in production and consumption of methyl bromide for QPS purposes, and to suggest strategies that Parties may wish to consider to report such uses per category"*. This information is included in Chapter 10 of this report. The following sections present recent research on alternatives to MB for QPS, an update on registration of alternative fumigants, and a description of activities carried out by the International Plant Protection Convention (IPPC), which MBTOC considers are relevant to QPS.

8.2.1 Recent research on alternatives to MB for QPS uses

Several papers were presented at the Methyl Bromide Alternatives Outreach (MBAO) meeting in November 2011 in San Diego, California, USA, dealing with research to develop quarantine treatments for quarantine uses currently using MB. Some of the treatments described in these papers are not currently registered as pesticides in the USA but may be registered for these uses in some other countries. Brief summaries of the findings presented follow:

Mitcham *et al* (2011) reported that Vapormate (16.7% ethyl formate by weight in liquid carbon dioxide) is not currently registered as a pesticide in the USA, although it has been in the past. Registration status in other countries is given in section 8.2.2 of this report. Bean thrips are a quarantine pest of navel oranges in some countries. The authors showed that fumigation for one hour of thrip-infested navel oranges at 5˚C with 31mg/L ethyl formate concentration gave a 100% kill of over 35,000 thrips treated in the test. The fumigation had no deleterious effect on navel orange quality. Fumigation of some varieties of table grapes with Vapormate™ at a quarantine effective concentration for light brown apple moth, did, however reduce the quality of export quality grapes. Additional testing was indicated to determine whether this damage could be minimized by changing the fumigation parameters.

Liu (2011) showed that fumigation of commodities surrounded by increased oxygen levels significantly increased the effectiveness of phosphine and decreased treatment time. Phosphine is a widely used fumigant, but treatment times that can be as long as 10 days prevent its widespread use as a quarantine treatment. Also, for many target pests, the effectiveness of phosphine is deficient when compared to the very high effectiveness required of quarantine treatments. Research results reported in this paper showed that these drawbacks might be circumvented with high oxygen levels and the fact that these results were consistent across four different pests indicates that this enhancement might be applicable across a wide range of pests (Liu, 2011).

Komm (2011) presented a system that relies on cycling steam and vacuum in a chamber to raise the temperature of bagged Niger seeds to 120° C for 15 minutes or longer to prevent germination of contaminating weed seeds being imported into the USA. This technique, currently being used in the USA as a quarantine treatment for commercial Niger shipments, can offer a variety of temperatures, including very high temperatures for disinfesting commodities which might contain quarantine pests.

Johnson *et al*.(2011) reported that low pressure coupled with low temperatures and regulated humidity is used to maintain product quality and prevent deterioration of some products in storage. This technique has also been suggested as a possible quarantine treatment since low pressures are known to be deleterious to insect pests. Codling moth is a major quarantine pest of fresh fruit including apples, cherries and pears as well as tree nuts such as walnuts. Tests were conducted using this insect and

showed that contrary to fumigation, the most susceptible stage of the insect was the egg stage where 100% mortality was reached. However, under the conditions of these tests, less than half of the larvae and pupae were killed. Tests are continuing to determine if altering the treatment conditions can provide better effectiveness for the larval and pupal stages or if combinations with other types of treatments will provide the required level of efficacy.

8.2.2 Update on the registration status of alternative fumigants for QPS

Registration of three fumigants, Ethanedinitrile (EDN), Ethyl formate + CO2 (Vapormate) and Carbonyl sulphide (COS) is progressing in several countries: http://www.linde-gas.com.sg/en/products_and_supply/fumigants/cosmic.html .

EDN is suitable for QPS timber fumigation, soil fumigation, grain devitalisation and possibly post-harvest fumigation of fruit fly in the future. EDN is an effective alternative to both MB and phosphine. Barrier films are used with EDN for soil fumigation to prevent the fumigant from immediately dissipating or dispersing into air. EDN degrades to release hydrogen cyanide (and gas) and is also a naturally occurring compound in the environment and present in some plants/food products. The manufacturer is expecting registration to be completed this year in Australia andNew Zealand. The registration process is also progressing in SE Asia, South Africa, Israel and being reviewed in a number of additional countries. Market acceptance tests are currently being run in many of these regions as well.

Vapormate is a rapid acting, non-residual post-harvest fumigant for the control of insects (adult, juvenile and eggs) in stored grain, oilseeds, dried fruit, nuts, fresh produce (e.g. bananas) and cut-flowers, enclosed food containers and food processing equipment.

The residues quickly from Vapormate break down to levels occurring naturally in food and in the environment. Vapormate is effective at cool temperatures and therefore does not reduce the shelf life of products. Vapormate is registered in Australia and New Zealand for a range of postharvest durable commodities as well grain & cereals. Registration is also progressing in SE Asia, South Africa and the US. BOC South Pacific Co. is continuing with industry market acceptance tests.

Carbonyl sulphide (COS) is suitable for fumigation of cereal grains for controlling typical grain pests such as wheat weevils, moths and beetles. In contrast to conventional treatment methods for stored grain, fumigation with COS offers both reduced treatment time (for example with respect to phosphine) and no known pest resistance. COS degrades rapidly allowing faster processing of grain than when traditional residual pest control agents are used. Registration is under consideration in Australia and being reviewed in additional countries. Market acceptance trials have been conducted in Australia.

8.2.3 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. The IPPC develops standards, guidelines and recommendations that are recognized as the basis for phytosanitary measures.

So far the IPPC has adopted 34 standards (IPPC, 2011b). It typically takes 4-5 years from "start to adoption" of a standard. Some of these standards include procedures that can replace or avoid the use of MB for QPS uses. There are more standards under development. In 2012 , there were 147 specifications under development by the Panels and Expert Working Groups that could lead to new or revised standards (CPM, 2011).

Standards adopted by the CPM may result in a decrease in the use of MB 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. National Plant Protection Organisations (NPPOs) are required by the IPPC to take into account a previous Commission on Phytosanitary Measures (CPM) Recommendation "*Replacement or reduction of the use of methyl bromide as a phytosanitary measure (2008)*" (IPPC, 2008).

8.2.4 SPM-15 Standard for Wood Packaging Material

The IPPC's 'Technical Panel on Phytosanitary Treatments' (TPPT) and the 'Technical Panel on Forest Quarantine' (TPFQ) are considering additional treatments for inclusion in ISPM-15 standard (IPPC, 2009), which contains phytosanitary measures for the treatment of Wood Packaging Material (WPM). This standard currently allows the use of MB, or a heat treatment consisting of 56°C for at least 30 minutes. Despite the wide spread implementation of heat treatment facilities in Article 5 and non-Article 5 countries, some of them have not installed heat treatment facilitiesand they do not have access to non-wood packaging material (TEAP, 2009). Therefore, alternatives to heat and MB in ISPM-15 are needed as soon as possible in any future revision of ISPM-15 standard.

Table 8-1 summarises additional treatments under consideration by the Panels. Dielectric heating and sulfuryl fluoride fumigation have been given the "*highest priority*" for consideration.

Table 8-1: Work being undertaken by the joint TPPT/TPFQ Panels as reported in November 2011

Priority		Projected adoption	Body	Added to work pgm	Status
1	Dielectric heat treatment of wood packaging material (WPM) using dielectric heat	2013	TPPT (TPFQ)	SC 1-5 November 2010	Draft ISPM Member comments being reviewed TPPT
1	Sulfuryl fluoride fumigation of WPM	2013	TPPT (TPFQ)	SC 1-5 November 2010	Draft ISPM being reviewed TPPT
3	HCN treatment of WPM	2014	TPPT (TPFQ)	SC 1-5 November 2010	Additional data requested from submitter
3	Methyl iodide fumigation for Bursaphelenchusxylophilus and Coleoptera: Cerambycidae of WPM	2013	TPPT (TPFQ)	SC 1-5 November 2010	Additional data requested from submitter
4	Methyl isothiocyanate and sulfuryl fluoride (Ecotwin mixture) fumigation for Bursaphelenchusxylophilus, Coleoptera: Cerambycidae, and Coleoptera: Scolytinae of WPM	2013	TPPT (TPFQ)	SC 1-5 November 2010	Additional data requested from submitter

Source: IPPC 1324300176_Report_2011_SC_Nov_2011-12-15.pdf; 1 = highest priority; 4 = lowest priority
TPPT: Technical Panel of Phytosanitary terms. TPFQ: Technical Panel on Forest Quarantine

After consideration of the proposal for the use of sulfuryl fluoride, the Standards Committee decided not to send the proposal for consultation in 2011 because it considered that the data did not support a full range of temperatures for the application of the treatment. Although there were no concerns about the science, there were concerns that the treatment would be difficult to implement in practice at the temperatures recommended in the schedule (CPM, 2012).

In contrast, the proposal on "*Dielectric heating as a phytosanitary treatment for wood packaging material*" was submitted for member consultation in June 2011. The Panel on reviewed the

comments received, which included the need for operational guidance for the proposed dielectric heat treatment. The International Forestry Quarantine Research Group reviewed some of the scientific issues supporting this phytosanitary treatment and concluded that the proposed treatment is supported by sufficient scientific research. CPM-7 will be requested in March 2012 to agree the continued development of this treatment in the knowledge that detailed operational guidance will be developed after the treatment is adopted.

The Standards Committee made several recommendations in 2011 that may enhance the prospects for additional ISPM-15 treatments being developed and accepted (IPPC 2011). Firstly, the Committee recommended that the treatment must be shown to be effective against *Bursaphelenchus xylophilis* (pinewood nematode, PWN) and *Anoplophora glabripennis* (Asian longhorned beetle, ALB). Secondly, the Committee recommended that the current list of pests should be narrowed further to individual species if possible and should also focus on organisms to be eliminated at the point of treatment i.e., the issue of infestation after treatment should not be considered. Thirdly, any new treatment was recommended to be at least as efficacious as heat and MB that are already approved for ISPM-15. As the efficacy of these two treatments might not be known, the Committee recommended that an expert judgement of their efficacy may be sufficient if exact scientific data were not available, as these data are urgently needed for the approval of new treatments. Fourthly, the International Forestry Quarantine Research Group at its meeting in September 2011 agreed that Probit-9 was impractical for many wood pests and proposed an alternative approach to treatment that did not prescribe an efficacy target (CPM, 2012). This three step testing protocol (1. Identify the Most Resistant Stage of the pest to the proposed treatment; 2) Determine the treatment conditions to obtain Probit 9 (99.667% mortality) of 30,000 to 100,000 specimens of the Most Recent Stage 3) Semi commercial tests of the treatment) was discussed at length and refinements were made for the consideration of the Technical Panel on Forest Quarantine and the Standards Committee.

8.2.4.1. Technical Panel working on the "Glossary of Phytosanitary Terms"

The Technical Panel that is working on the 'Glossary of Phytosanitary Terms' was considering revisions to 34 phytosanitary terms e.g., host susceptibility, pest freedom. One aspect of the Panel's work concerns an examination of the "*Terminology of the Montreal Protocol in relation to the Glossary of Phytosanitary Terms*". However, due to prioritization of the workload of the technical panels , the CPM-7 in March 2012 , was invited to remove this topic from the list of topics for ISPM standards (CPM, 2012).

The IPPC has proposed a draft revision to supplement 1 of ISPM-5 "*Glossary of Phytosanitary Terms*" to describe more precisely the interpretation of the concept of "*official control*" and its application in practice for quarantine pests that are present in an area as well as for regulated non-quarantine pests, and the concept of "*present but not widely distributed and under official control*" for quarantine pests. These terms are also contained in the Montreal Protocol's definitions of QPS in Decision VII/5. Interested Parties can find the details of this proposed revision by the IPPC in the documents under consideration for CPM-7[1].

8.2.4.2 Technical Panel on Phytosanitary Treatments

Other treatments under development include irradiation treatments, which may be an alternative to some QPS MB treatments. These have progressed further than the heat and cold treatments. The ISPM under development as a generic irradiation dose for all insects except lepidopteran species in the host is projected for adoption in 2013. Work on such irradiation treatments has been given high priority for development.

The Technical Panel on Phytosantary Treatment in 2011 was considering the development of an ISPM for "*treatments for soil and growing media in association with plants*". In the Montreal

[1] ACPM 2012/04/Attachment03

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 Parties (MBTOC, 2011). However, in 2012 there were no treatments under review in this category (IPPC, 2011a). Because of the high consumption of MB by some Parties 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 giving the work 'high priority' in order to be consistent other work being carried out by that body on alternatives to MB.

8.2.4.3 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*" is dependent on the results of an open-ended workshop on the international movement of grain[2]. The date and venue for this workshop have yet to be determined. In 2009, there was substantial global consumption of methyl bromide for grain disinfestation of about 12% (1,300 tonnes) annually (TEAP, 2009).

8.2.4.4 IPPC Strategic Framework 2012-2019

CPM-7 in March 2012 will be invited to discuss and tentatively agree the 8-year IPPC Strategic Framework 2012-2019, which is under development. In developing the Framework, the IPPC noted that "*…the ozone damaging effects of methyl bromide are now well known and documented, and alternative phytosanitary measures are encouraged… " (*IPPC, 2008)

The IPPC cited the measures in place for MB 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*".

MB consumption for QPS in the Montreal Protocol is currently exempt from control. However, TEAP periodically provides information to the Parties that may result in their re-evaluation of this exemption.

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 Decisionsof the Parties (Decisions XVII/15 (2005), XVIII/14 (2006) and Decision XX/6 (2008). that requested the Ozone Secretariat to strengthen cooperation and coordination with the IPPC Secretariat. Decision XXIII/5 agreed by the Parties in 2011 further reinforces this request.

8.3 Alternatives to MB for Soil Fumigation (pre-plant uses)

8.3.1 Chemical alternatives for the remaining critical uses (non Article 5 Parties).

For the CUNs being submitted in 2012, methyl bromide is being sought for only 3 uses in 2014, which amount to approximately 500 tonnes. This is significantly lower than the 16,000 tonnes applied for in the first year of CUEs in 2005. MBTOC has not specifically identified the alternatives

[2] Standards Committee Working Group Report. 9-13 May 2011. 1314198519_Report_2011_SC7_May_2011-08-24, page 78.

that have been adopted by industries previously using methyl bromide, but analysis of country information and reports shows that adoption of chemical alternatives has been the main means for many industries to replace methyl bromide in non Article 5 countries. The key chemical alternatives adopted include 1,3-D/Pic, Pic alone and to a smaller extent MI/Pic where it is registered. In some industries, eg turf , dazomet has been adopted and in others two or three way combinations of metam, chloropicrin and 1,3-D have proven effective. A new fumigant, dimethyl disulphide (DMDS) has gained registration recently in the US but to date there has been no major adoption to replace MB.

MBTOC still holds concern for the future registration of many of the chemical alternatives, including MB, as tighter restrictions and bans are restricting their use in many countries worldwide. In particular, 1,3-D is being banned completely in Europe and methyl iodide has just been withdrawn from markets in the US. Chloropicrin is also under stringent review in several countries.

Table 2 indicates the chemical alternatives that are registered or being evaluated for the three remaining CUNs – Australia strawberry runners, Canada strawberry runners and the US strawberry fruit (California). The US has completed the re-registration process for soil fumigants – including methyl bromide, chloropicrin, metam sodium and metam potassium. Additional mitigation measures such as buffer zones around treated fields have been incorporated onto product labels and must appear on all products used in the field by December 2012. Such measures will impose additional constraints on the use of these fumigants. Similar mitigation measures also apply to DMDS and methyl iodide product labels in the US.

In Australia, methyl iodide and EDN await registration decisions from APVMA. MI trials show very promising results. In Canada, the potential alternatives appear to be more limited as groundwater concerns in Prince Edward Island have constrained the use of chemical alternatives.

Table 8-2: Chemical alternatives to Methyl Bromide for current CUNs

COUNTRY	CUN CROP	MB ALTERNATIVES
USA (California)	Strawberries	1,3-D, Pic, 1,3-D+Pic, MS, 1,3-D+Pic+MS, DMDS+Pic [specialized tarp under development to deal with strong odour problem; registered federally in July 2010, registration in California still pending], MI+Pic sales suspended at present in US (registration has been retained), EDN - no federal registration request submitted to date, pebulate registration cancelled
Australia	Strawberry runners	MI and EDN registration still pending; 1,3-D+Pic results in phytotoxicity in heavy soils; pebulate not registered; soil-less production limited to foundation stock. 1,3-D+Pic+MS, MS alone or 1,3-D+Pic+dazomet not effective to the degree necessary for certification. No registration request has been submitted for DMDS
Canada (PEI)	Strawberry runners	1,3-D alone or in any combination prohibited in PEI due to risk of ground water contamination. Pic registered federally but provincial permit has not been issued. No registration request has been submitted for MI+Pic, DMDS or EDN.

8.3.2 Non-chemical alternatives for soil fumigation

8.3.2.1. Resistant cultivars

The use of cultivars with resistance to soilborne pathogens is considered among the best alternatives to MB for some specific crops such as tomatoes, peppers and eggplants. Cultivars with resistance to diseases, root-knot nematodes, bacteria, viruses and *Orobanche* spp. have been developed (Quesada-

Ocampo and Hausbeck, 2010;Christos *et al*., 2011; Jari *et al.*, 2011).Resistant cultivars in combination with grafting provide a powerful strategy for the management of plant pathogens and nematodes (King *et al.*, 2008).However, emergence of new diseases, new races of known pathogens, presence of a diverse range of nematodes and pathogens in the same field, and high pest pressures, may limit the efficacy of resistant varieties (Takken and Rep, 2010).Yield increases observed in many crops, and particularly those produced with MB, have largely been attributed to the development of new resistant and highly producing varieties. Presently, extensive vegetable cropping areas around the world that were previously fumigated with MB are grown with varieties which are resistant to one or more soil borne pathogens (Dhiham *et al.*, 2010; Jo et *al.*, 2011). Disease resistance is routinely checked before a cultivar is registered in the National and Common Catalogue of vegetable species in certain countries,for example, resistance against *Fusarium oxysporum* f. sp. *Lycopersici* race 0 and 1, *Verticillium dahliae,* Tomato mosaic virus race 0 and *Meloidogyne incognita* is recorded in Italian tomato cultivars. (Sigillo and Bravi, 2011).

8.3.2.2 Grafting

Grafting is an important component of integrated management strategies to manage pests and diseases in *solanaceous* and cucurbit crops, which has been used with great success to control a wide spectrum of diseases and nematodes (Rivard *et al* 2010; Gisbert *et al.*, 2011;Yilmaz *et al.*, 2011). In addition to reducing disease severity, this technique has been shown to enhance yield and fruit quality, while promoting growth and extending production periods and increasing crop longevity. More efficient fertilizer use, feasibility of using lower plant densities, and improved tolerances to soil salinity, low temperature and flooding have also been reported (Colla *et al*., 2010; Louws *et al*., 2010; Ricárdez-Salinas *et al.*, 2010). Optimum performances with grafted plants have been obtained when used as a component of IPM programs, which combine non-chemical and chemical alternatives (Besri, 2008; Rivard *et al.* 2010;Bogoescu *et al.*, 2010;Yilmaz *et al.*,2011).

8.3.2.3 Substrates

Substrates are widely employed worldwide mainly in protected cropping systems for growing healthy high-quality plants (Kazaz and Yilmaz, 2009). A number of countries have now developed substrate systems that are cost effective, generally by employing materials that are locally available. Substrate systems have less potential to replace MB for large-scale open field operations because of limited availability of suitable materials. Constraints on soilless culture may include high costs, vulnerability of the system to pathogen attack if not carefully managed, and difficulties with disposing the substrate when they can no longer be used.

Substrates are used alone or in combination with other alternatives. Grafted plants were shown to grow vigorously and produce higher yields when grown on substrates than on soil. (Marcic and Kacjan2010).*Trichoderma* spp. incorporated onto recycled soilless substrates controlled *Pythium ultimum* attacking cucumber seedlings. Biocontrol agents play a role in the suppression of soilborne diseases in soilless cultivation (Liu *et al* 2009).

8.3.2.4 Steaming

Steam disinfestation is an increasingly attractive alternative to control soil-borne pathogens and weeds, especially in greenhouse systems with high-value crops, such as ornamentals and vegetables (Gelsomino *et al.*, 2010). Steam alone or in combination with other methods provided control of *M. phaseolina, F. oxysporum* and weeds in strawberry production, particularly in buffer zones where fumigants cannot be used (Daugovish *et al.*, 2011; Fennimore *et al.*, 2011a-b)

8.3.1.5 Hot water

Hot water treatment is considered as an alternative to MB, particularly in organic agriculture since is regarded as a promising and eco-friendly soil disinfestations system (Uematsu *et al*., 2007). It is widely used in Japan to control soil-borne diseases of greenhouse tomato, melon, strawberry, spinach, sweet pea and carnation (Nishi, 2000). Soil irrigation with hot water (80-95 °C) can increase soil

temperatures to 55 °C. (Uematsu *et al.*, 2007;Kita, 2003, 2007)., providing control of soil-borne pathogens and at the same time improving certain soil proprieties by washing nitric acid, potassium, manganese and lime (Kita *et al*., 2007, 2010). Hot water can be applied any time throughout the year. Increased crop yields and revenue compensate for the boiler and fuel costs. Combination of hot water treatment and anaerobic soil disinfestation using low-concentration of ethanol (0.5-2%) has been developed in Japan (Kita *et al.*, unpublished) and is expected to be adopted widely by farmers after MB phase out in Japan in 2013.

8.3.2.6 Solarization

The effectiveness of soil solarization in controlling many diseases of a variety of annual crops has been shown under a diversity of conditions, soils and agricultural systems in many countries (Besri et al, 2012, Katan,1981; Stapleton, 2000). Solarization increases soil temperature by 2–15 °C under warm climate conditions. Its efficacy depends on the combination of soil temperature and duration. Control of certain soil pathogens in solarized soil was improved by combining this method with reduced dosages of fumigants (Stapleton, 2000;Chellimi and Miruso, 2006). However, failures of this technique have also been reported (Chellemi, 2002).

8.3.2.7 Biodisinfestation

Biodisinfestation is based on processes stimulating the production of volatile substances during the decomposition of organic amendments and agro-industrial residues that then act as fumigants and control pathogens (Díez-Rojo *et al*., 2011, 2012). When combined with solarization (Biosolarization) this method has been shown to be effective for regulating nematode populations, fungal pathogens and weeds (Lopez-Aranda, 2011).Spain has transitioned a significant area previously fumigated with MB to biodisinfestation and biosolarization (Bello *et al.*, 2007; Diéz-Rojo, 2012). Biosolarisation has been found to be a synergic process improving the efficacy of both biodisinfestation and solarization and thereby reducing the time required for the latter alone and of amounts of organic material required for biodisinfestation (Bello *et al*.,2007; Diez-Rojo *et al*, 2012). Pingxiang *et al*. (2010) and Martinez *et al*. (2011) showed that repeated use of biosolarization significantly reduced *Fusarium* populations, to levels that were similar or higher than those obtained with MB. A similar effect was observed for *Meloidogyne incognita*(Margarita *et al*, 2008)

8.3.3 Methyl Bromide phase out in Article 5 countries

8.3.3.1 Vegetables

Effective chemical and non-chemical alternatives have been adopted to replace MB in solanaceous and cucurbit crops in many developing countries. Grafting is one of the most popular and effective alternatives in many Article 5 countries for example China, Egypt, Lebanon, Mexico, Morocco, Romania, Tunisia and Turkey (MBTOC, 2011).Solarization alone or in combination with chemicals or other non-chemicals alternatives is extensively used in vegetable production to control soilborne pathogens and nematodes mostly in Mediterranean countries where climate conditions are favourable (MBTOC, 2011; Yilmaz *et al*., 2011).

Chemical alternatives are also widely used in developing countries (UNEP, 2010), the most common being 1,3-D/Pic, Pic, metam sodium and metam potassium used alone or in combination. In China,1,3-D provided well to moderate weed and pathogen control in tomato and ginger production (Qiao *et al*., 2010, 2012), however this fumigant is not yet registered there. In Turkey, DMDS was effective for the control of root-knot nematodes (*Meloidogyne* spp.) in greenhouse-grown vegetables (Heller *et al.*, 2010).

8.3.3.2 Ornamentals

Several chemical alternatives to methyl bromide are presently available and in use for floriculture production both in Article 5 and non- Article 5 countries. Recent research (Gerik *et al*., 2011; Kokalis-Burelle *et al.*, 2010) identifies effective alternatives such as dazomet, metam sodium and 1,3-

D, the latter often combined with chloropicrin. Methyl iodide has been successfully used in Florida, USA, for controlling nematodes (Kokallis-Burelle*et al,* 2010) and studies in California indicate that low rates of this fumigant are effective when used alone or in combination with consecutive application of other fumigants, such as metam sodium (Gerik, *et al* 2010) or metam potassium with or without VIF (Klose *et al* 2007 ab; Klose *et al* 2008ab). However, sales of methyl iodide have been stopped in the United States at present (although its registration is retained). Methyl iodide is registered in several Article 5 countries for example Mexico, Guatemala, Morocco and Turkey, with pending registration in other countries e.g. Chile (Spadafora *et al,* 2011). Recent trials conducted in California combining drip applied metam sodium with new or emerging chemicals such as 2-bromoethanol, dimethyl disulfide, furfural, propylene oxide and sodium azide are showing encouraging results, providing better control of soilborne pathogens and weeds than metam sodium alone (Gerik et al 2011).

Steam, particularly for greenhouse systems , is as efficient as methyl bromide, and although restricted by high cost, new injection techniques and combination with other options such as solarization, help to overcome this (Gerik *et al*, 2010; Rainbolt *et al,* 2010,Samtani *et al,* 2010). Steaming systems and application methods were evaluated in California and provided pest control similar to hot-gas MB (Rainbold *et al.,* 2010). Positive results have also been reported in Florida (Rosskopf, 2010). A new self-propelled machine combining steam and chemicals has been designed in Italy (Peruzzi *et al*, 2011).Steam is also in use in several Article 5 countries producing flowers, for example Uganda, Costa Rica, Colombia and Ecuador.

Other non-chemical methods, such as solarization, crop rotation and biodisinfestation are increasingly used in Europe, particularly in Spain, where biodisinfestation is showing increasing commercial adoption for flowers such as carnations and chrysanthemums (Melero-Vara *et al*, 2011; Díez-Rojo *et al*, 2011). Production of flower crops in substrates continues to increase worldwide, including many Article 5 countries. Although this system often represents higher investment than production in ground beds with methyl bromide fumigation, this is generally offset by increased yields and better quality (MBTOC, 2011).

Various alternatives to MB are adopted in Article 5 countries. In Morocco, solarisation combined with drip application of 1,3-D/Pic has proven excellent for controlling fungi (*Fusarium* spp., *Rhizoctonia* sp.) and nematodes (*Heterodera schachtii* and *Meloidogyne* spp.)(Chtaina, 2008). In Turkey, use of MB was replaced by solarization combined with alternative chemicals such as metam sodium, dazomet and 1,3-dichloropropene (Yilmaz *et al*., 2010). Roses are successfully produced in different kinds of substrates such as pumice stone in Kenya (UNIDO, 2012), rice hulls in Colombia and Ecuador, and coco peat in Brazil (MBTOC, 2011). The 'solar collector' developed in Brazil and which is successfully used to sterilize substrates used for pot plant production (Ghini, 2004, 2007), was adopted in Cuba and is now being implemented in Mexico by small-scale ornamental pot plant growers (UNIDO, 2012, pers. Com).

8.3.3.3 Strawberries

Intensive cultivation of strawberries has increased soilborne pathogen populations and in consequence the need for alternatives to MB for soil disinfestation. Several Article 5 countries have adopted alternatives for strawberry production, very often through projects financially supported by the multilateral fund of the Montreal Protocol. In Morocco, drip applied metam sodium has been used successfully to control fungi (*Rhizoctonia solani , Verticillium dahliae, Phytophthora cactorum)* and weeds (more than 40 species e.g., C*ynodon dactylon, Chenopodium sp , Amaranthus sp*). MS is injected at a dosage of 200 to 250 g /m^2 and is the single product used by the farmers in the strawberry sector for its high effectiveness, economic feasibility and without requiring any modification of the cropping system. Yields and fruit quality obtained with metam sodium were equivalent to those achieved with MB (Chtaina and Besri, 2006; Chtaina, 2008).

Soil solarization is applied with great success in many Lebanese regions. Chemical alternatives are used as well in Lebanon as are metam sodium and 1,3-D/Pic. (UNEP/MLF/MoE/UNIDO, 2004)

In Turkey, the main strawberry soil borne pathogens are *Fusarium oxysporum, Rhizoctonia solani* and *Macrophomina phseolina*. Solarisation + dazomet at a rate of 400 kg/ha was found effective for controlling diseases, nematodes and weeds attacking strawberries. For cost effectiveness purposes, it was possible to use lower doses of the fumigant. Large farmers found this combination more promising, whereas smaller producers were satisfied with the solarisation + manure option (BATEM, 2008).

In Egypt, large-scale strawberry growers have accepted that metam sodium combined with solarization and further complemented with bio-control agents is a feasible alternative for open field production (UNIDO, 2008a). For strawberry nurseries, soilless production complemented with *Trichoderma* as a bio-control agent is being trialled with success (UNIDO, pers. com, 2012). Further, various alternative fumigants, including methyl iodide and 1,3-D/Pic are also being tested for both strawberry fruit and strawberry runner production (UNIDO, pers. comm, 2012).

In Chile, previous MB users are adopting mainly chemical alternatives for strawberry fruit and strawberry runners. These include metyhyl iodide (in process of registration), metam sodium and 1,3-D/Pic. A similar situation is taking place in Mexico (UNIDO, 2008b; UNIDO, 2010; UNIDO pers.comm 2010).

8.3.3.4 Tobacco

The floating tray system for producing tobacco seedlings is widely used in many ARTICLE 5 countries such as Argentina, Brazil, China, Cuba,Kenya, Macedonia, Senegal, Malawi and Zimbabwe by both large-scale and small farmers (MBTOC, 2011). In Turkey, R&D programs are considering this technology as alternative for past MB users (Boz et al.; 2011).

In some countries mainly in Africa (Malawi, Mozambique, Zambia), problems with availability of trays and substrates has been reported (UNEP, 2011; MLF, 2012.) Research on tray disinfection by physical methods (solarization) has been conducted in Australia and was shown to be effective in reusing trays and avoiding dissemination of soilborne pathogens (Mattner*et al*., 2009).

8.3.3.5 Ginger

In China, ginger is grown in open fields, plastic tunnels and greenhouses, with about 50,000 ha in production nationwide.The main soilborne pathogens are *Erwinia chrysanthemi*, *Fusarium oxysporum* f. sp. *zingiberi*, root-knot nematodes (*Meloidogyne* spp), *Pythium spp.*, and *Ralstonia solanacearum* (Stirling, 2004;Mitsuo *et al.*,2004; Kavitha and Thomas, 2008;Tateya, 2010). MB is mainly used in fields with high incidence of *Ralstonia solanacearum* and *Pythium myriotylum.* Chloropicrin is the only chemical alternative currently registered and in use but provides insufficient control of nematodes. Further, chloropicrin applied at typically low soil temperatures present at the time of planting often leads to phytotoxity. 1,3 D has been tested with excellent results (Qiao *et al* 2012), but is not registered at present.

The main non-chemical alternative is crop rotation with low value crops, such as maize or wheat for 4 to 5 years. Due to very limited land extensions, e.g., an average of 2000 m^2 per family, rotation is not an economically feasible method for farmers.

In Japan, the main soilborne pathogen attacking ginger is *Pythium* spp. Previous MB use for controlling this pathogen has been replaced with chloropicrin, dazomet, metam sodium, 1,3-D/Pic, and methyl iodide (which was registered in 2011 for this crop). Preventive treatments with other pesticides e.g. cyazofamid, propamocarb hydrochloride and a mixture of metalaxyl M and azoxystrobin are also used to minimize incidence. Trifluralin and glufosinate are also used as

herbicide where weeds are a problem. Treatments for ginger rhizomes used as seed are now under development in Japan (Tateya, Pers.comm, 2012).

In Australia, past MB use for the control of ginger diseases has been replaced with 1,3-D/Pic (Stirling *et al.*, 2012)

8.3.3.6 Replant diseases

Perennial fruit trees and grapevines are subject to diseases in particular when they are replanted in the same site where orchards or vineyards previously stood. They are often affected with a disease complex known as "orchard replant", which has been controlled with MB in many non- Article 5 countries (for example the United States). However, MB is not used in the majority of Article 5 countries where fruit production is important (i.e. Brazil, Argentina, Morocco) for controlling orchard replant (Besri, pers.comm, 2012; Ghini, pers.comm, 2012).In Chile transition to alternatives has been reported (Reginato *et al*., 2008).Replant disease remains a major problem in fruit production in South Africa and control is achieved with MB (Van Schoor *et al.*, 2009) . However, the industry is aiming at replacing this use and using non-fumigant options in response to external market pressures (Van Schoor *et al.*,2009). Methyl iodide registration is also being sought in South Africa.

8.3.4 Additional key issues

8.3.4.1 Macrophomina crown and root disease of strawberry

Macrophomina phaseolina, a fungal root pathogen which causes crown and root rot of strawberries attacks many hosts including sunflower, maize, soybean, cotton, fruit trees, legumes, solanaceaeous crops (eggplants, tomato, potato) and others, especially in hot countries (Maas, 1998, Smith *et.al,* 1988).The pathogen has been reported in Egypt and Turkey (Yildiz *et.al*., 2010), Australia (Fang *et al*., 2011ab), Spain (Avilés *et al*.,2008, 2009), Israel (Zveibil *et al*, 2005,2009), USA (Koike, 2008), Argentina (Baino *et al*.,2011) and many other countries (Smith *et al*., 1988).

M.phaseolina was observed for the first time in Florida in 2005 (Merteley *et al*, 2005) and in California in 2006 (Koike, 2008). Koike *et al.*, (2009 ab) observed plant decline in California but the pathogens isolated from plants differed. *Fusarium* was isolated in Ventura, Camarillo and Oxnard throughout the season while *Macrophomina* was isolated from declining plants at the two Santa Maria locations and during late season decline at Ventura and different tolerances to decline caused by *Fusarium* and *Macrophomina* where observed in common strawberry varieties.

In Western Australia, Fang *et al*., (2011a,b) reported that strawberry production is severely compromised by crown and root diseases. A range of soil borne pathogens including *Fusarium oxysporum, Rhizoctonia, Cylindrocarpon destructans, Phoma exigua, Gnomonia fructicola, Phytophthora cactorum, Pythium ultimum* and *M.phaseolina*, are associated with such disease outbreaks. Studies conducted to determine and compare the virulence of these pathogens in terms of disease severity on strawberry plants showed that *F. oxysporum, Rhizoctonia* and *M. phaseolina* are the most virulent, and that the latter caused the most severe attacks when temperatures were high.

In Spain, *M.phaseolina* has been reported in Huelva. The response of the cultivars 'Camarosa' and 'Candonga' indicates differences in susceptibility to this pathogen (Avilés *et al*., 2008 ;2009).

In Israel, the most common soilborne fungi attacking strawberry are *Colletotrichum* spp., *Phytophthora* spp., *Rhizoctonia* spp., *Verticillium dahliae, Fusarium* spp. and *M.phaseolina* (Zveibil and Freeman, 2005, 2009), with the latter being the predominant pathogen isolated from wilted plants in 2005-2007.

Symptoms consist of wilting death of older leaves, stunting, and eventual collapse of plants. When plant crowns are dissected, internal vascular and cortex tissues are dark brown to orange brown. *M. phaseolina* forms sclerotia and dark brown pycnidia containing large hyaline aseptate pycnospores.

(Koike, 2008). The fungus spreads up the vascular and pith tissues of the stem finally forming numerous small sclerotia, like powdered charcoal (charcoal rot) giving the infected tissues a greyish-black colour. Sclerotia are found along the vascular elements and bordering the pith cavity. Infection by *M. phaseolina* is greatly affected by certain predisposing factors such as hot dry conditions following a period of normal growth. Attacks vary considerably from year to year, mainly according to temperature and rainfall. The number of sclerotia in soil builds up under continuous cropping and severity is related to this (Aviles *et al.*, 2008, 2009; Koike, 2008; Fang *et al*., 2011 ab).

Non Article 5 countries have now replaced MB as a fumigant for strawberry fruit production, with the exception of the USA, where a critical use is still present in California. In the USA, non-chemical and chemical alternatives have been reported (Duniway, 2000, Koike *et al*., 2009b; Daugovish, 2011). Daugovish (2011) reported that *Macrophomina* and *Fusarium* can spread from infested to non-infested areas. The most widespread non-chemical solutions are resistant varieties, soil less cultivation, crop rotations, biofumigation, and solarization (Koike *et al.*, 2009 a,b; Daugovish, 2011).The two pathogens have been efficiently controlled by mustard seed meal at 2200 kg/ha incorporated into beds and followed by solarization, mustard meal supplemented by steaming and steaming followed by solarization for 2 months (Daugovish 2011).Other important non-chemical solutions include ADS, *Tagetes spp*(Lopez-Aranda, 2012). Yildiz *et al.* (2010) have shown that soil solarization reduces significantly the viability of *M. phaseolina* particularly at 5 cm depth. Fang *et al*. (2011a,b) reported that in situations where crop rotations of 3 or more years where possible the level of plant decline/death was lower, even in the absence of fumigation.

The most common chemical alternatives are 1,3-D/Pic, Pic alone, MS and dazomet. New fumigants like MI, DMDS and others are either waiting on regulatory approval or have not been significantly adopted. 1,3-D has been banned in EC and Pic may also be banned very soon in this region. With the ban of these important and efficient fumigants, the EC will probably face difficult problems in controlling soil borne diseases of many crops and particularly of strawberry. (Lopez Aranda 2011,2012).Many Article 5 countries have completely eliminated MB in strawberry production (i.e. Lebanon, Turkey, Brazil and Morocco), while others (i.e. Mexico, Egypt and Chile) are decreasing MB use significantly (Lopez Aranda, 2011).

8.3.4.2 Nursery Issues

8.3.4.2.1 Perennial crop field nurseries

Propagation materials of many types (bulbs, cuttings, seedlings, young plants, sweet potato slips, strawberry runners, and trees) are subject to high health standards. Alternatives to MB for nurseries thus need to provide a level of pest and pathogen control sufficient to achieve an acceptable yield and quality. For propagative materials clean root system (or clean bulbs) is essential. This is critical to prevent the spread of economically important pests and pathogens from the nursery fields to the production fields. Nursery crops can remain in the ground anywhere from 9 to 26 months before being transplanted to fruiting fields. The required level of pest and pathogen control for propagative material must remain effective over this entire growing cycle, as contrasted with annual fruits or vegetables produced over a much shorter time. Nursery stock used for planting into organic production systems often comes from methyl bromide treated nursery fields

For certified nursery stock, regulations can either specify a level of control that must be achieved or use of approved soil treatments that are accepted as insuring a high level of control based on the review of available data by the regulatory body. For non-certified stock, the market sets the standard that must be met. In either case, lack of a clean root system could mean a 100% loss in marketable product for the grower. Methyl bromide has commonly been used to meet clean propagative material standards. In some cases, sufficient data and grower experience have allowed growers to transition from the 98:2 formulations of methyl bromide that were commonly used to 67:33 or 50:50 formulations depending on the pest or pathogen to be controlled and level of severity of the infestation (De Cal *et al.*, 2004; Porter *et al.*, 2007). Research trials, indicate some alternative

fumigants (such as iodomethane) and some combinations (such as 1,3-D/Pic) provide control comparable to methyl bromide under specific circumstances (Hanson *et. al.*, 2010; Schneider *et.al.*, 2008; Schneider *et al.*, 2009a; Schneider *et al.*, 2009b; Stoddard *et al.*, 2010;Walters *et al*.2009).

Soil texture, soil temperature, and soil moisture can affect performance of methyl bromide alternatives so as to render them either suitable or unsuitable for specific conditions. Equally important to efficacy is consistency of performance of methyl bromide alternatives. Inadequate performance risks a 100% loss. As materials, or combinations of materials, meet the requirement for efficacy and consistency (as established by research results over multiple years and locations), the body of data can be reviewed by regulatory entities for incorporation into the lists of approved certified nursery soil treatments (McKenry, 2011). An example of this would be the approval by California Department of Food and Agriculture (CDFA) of the use of 1,3-D or methyl iodide as a certified nursery stock soil treatment for certain crops under specific conditions (CDFA, 2009).

An alternate approach to the use of soil treatments is the use of containerized, or soil-less substrate production systems, where this is economically feasible and an acceptable product, i.e., root system, of acceptable size and quality can be produced.

Production of high health propagative materials remains a significant challenge as Parties transition away from methyl bromide (Zasada *et. al.*, 2010). The consequences of failed treatment not only impact the propagative material, but also jeopardize the performance of methyl bromide alternatives in the fruiting fields.

8.3.4.2.2 Current Commercial Use Status

EU Member States phased out use of methyl bromide for nursery production between 1992 and 2007 (EC Management Strategy, 2009). Chemical alternatives in commercial use in the EU for control of combinations of fungi, nematodes, and weeds in nursery production systems include dazomet, metam sodium, and 1,3-D. Non-chemical alternatives include substrates, grafting, resistance, steam, and rotations. DMDS is still under development.

Japan phased out use of MB for nurseries in 2005. Alternatives in commercial use include dazomet, chloropicrin, 1,3-D, and methyl isothiocyanate (pers. comm.Tateya, 2010).

Methyl bromide is used in the United States where necessary to meet certified nursery regulations. Alternatives in commercial use in the U.S. for nurseries include both chemical (1,3-D, chloropicrin, metam sodium) and non-chemical (containerized production, substrates, resistant varieties, and steam) alternatives (CDFA, 2009). Methyl iodide has been added by CDFA to the list of certified nursery treatments, but is not yet registered in California at the rate required by the certification regulations.

In Article 5 countries, certified plant materials are produced without MB: for example, substrates are used for certified citrus and banana propagative materials in Brazil (Ghini, pers. comm., 2010); grape, pear, apple, and citrus propagative materials are produced in Argentina without MB, but information was not available on what alternatives are in commercial use (Valeiro, pers. comm., 2010). In China on the other hand, MB is used for production of certified nursery material. Chloropicrin and methyl iodide are being tested as alternatives (Cao, pers. comm., 2010).

8.3.4.3 Strawberry nurseries

As of 2012, methyl bromide is used in three non Article 5 Parties (Australia, Canada, USA) and in a number of Article 5 Parties (Argentina, Chile, China, Egypt, Mexico, Vietnam and others) for production on nursery plants (runners). Although, phase out in Article 5 countries is not required until 2015, several Article 5 countries have already phased out methyl bromide in strawberry nursery industries (e.g., Brazil, Lebanon, Morocco, Turkey) (Table 8-3).

Methyl bromide has been the fumigant of choice for over 60 years in these industries, because it provided nursery stock of high plant health to meet the requirement of the fruit growing industry. This may have been to meet the requirements of certification or standards required by export markets, and also assisted the industry avoid litigation from strawberry growers for movement of diseases. A recent review gives an excellent overview of the situation for the strawberry fruit and nursery industries worldwide (Lopez- Aranda, 2012).

Two of the three remaining applications for critical use in 2014 are for strawberry runner industries. In Australia, the northern production region fully transitioned in 2009 to mixtures of 1,3-D/Pic and Pic alone, however in the cooler southern regions in heavy soil types these alternatives are phytotoxic or ineffective and no alternatives have been adopted except for the use of substrate production of foundation stock. An application for methyl bromide is still being made for 2014 (Table 8-3). In Canada in 2008, several regions transitioned to other alternatives mainly based on use of Pic alone, however owing to its lack of registration in Prince Edward Island an application of 5.3 t is still being made for MB use in 2014.

Since a single strawberry runner grown in year one can expand to several million runners by year five, the adverse impacts of pests is of particular importance and the industries are seeking alternatives which give the same level of risk as MB or better. For this reason, only a few alternatives are suitable. MI/Pic mixtures, 1,3-D/Pic and Pic alone in some situations, substrate production of plug plants and to a lesser extent where regulations prevent the use of the above alternatives, MITC generators (metam sodium and dazomet) are the alternatives being adopted (e.g. France, Italy, Poland, Spain). In areas where bans have been imposed on MB, such as several countries within the EC, strawberry nursery growers have used improved application techniques for old fumigants, such as metam sodium and dazomet to grow runner plants (Lopez Aranda, 2012) in preference to moving to substrate production. Also in these countries, national permits are granted for emergency use of 1,3-D/Pic use annually, however the industries are uncertain of the future use of many alternatives (Lopez- Aranda, 2012).

Of the alternatives being evaluated methyl iodide is being considered by Australia as a one-to-one replacement, but registration issues are still preventing use (Mattner *et al*., 2010). Canada is awaiting an outcome for registration of Pic alone, but new studies need to validate that there are no groundwater contamination risks associated with its use. Substrate production appears suitable for at least a proportion of the runner chain production in these countries (i.e., nuclear, foundation and possibly some of the mother stock). This technique has been adopted widely in higher latitude regions as a means to produce runners for the shorter season northern markets, but the altered physiology of plug plants and cost of capital structures has been a limitation to date to the production of runner plants for performance over the long production seasons (6-8 months) presently given by existing runners produced with MB for temperate markets.

In some countries where MB has been phased out, there has also been market shifts where growers may grow their own plants (e.g.Japan) or where industries import runners produced by fumigation in other countries (e.g., Moroccan growers import runner plants from Spain and substrate plants from France). In France, Poland and other countries, metam sodium and dazomet at low rates with the use of low permeability barrier films barrier have been widely adopted (Lopez-Aranda, 2012). In Turkey, the industry presently uses solarisation and metam sodium treatment, however methyl iodide has just been registered.

Table 8-3: Status of methyl bromide phase out in strawberry nurseries in 2012 (tonnes)

MB Phased Out		MB applied under the CUE procedure in non Article 5 countries for use in 2012		MB use exempted under federal legislation as QPS (non Article 5) or not yet controlled (Article 5)	
Non Article 5		**Non Article 5**		**Non Article 5**	
Belgium	3.4	Australia	29.8	USA	>450
France	40.0	Canada	5.3		
Israel (Ghaza)	>35.0	USA	3.8	**Article 5**	
Japan	??				
New Zealand	10.0			Argentina	15.0
Poland	40.0			Chile	60.0
Spain	230.0			Egypt	33.0
UK	<80.0			Mexico	55.0
				Vietnam	5.0
Article 5	?				

* Exempted under national legislation which is interpreted to align with the Quarantine and Preshipment Exemptions of the Montreal Protocol.

In 2014, USA has indicated phase out for this sector.

8.3.4.4 Anaerobic soil disinfestation

Developed in Japan (Momma, 2008) and the Netherlands (Messiha *et al.,* 2007), anaerobic soil disinfestation (ASD), a non-chemical alternative to MB, which can control soil-borne pathogens and nematodes for example in strawberries and vegetables. In Japan, hundreds of farmers use ASD to control soil-borne pathogens (including nematodes) in strawberries and vegetables grown in greenhouses. ASD integrates principles behind solarization and flooding to control soil-borne pathogens and works by creating anaerobic soil conditions when readily available carbon-sources are incorporated into topsoil that is irrigated to saturation (not flooded) and subsequently covered with a plastic tarp. The tarp is left in place to maintain soil moisture above field capacity. Anaerobic decomposers are then able to respire using the added carbon, which results in the build-up of anaerobic by-products that are toxic to pathogens (Katase *et al.* 2009), but that are degraded rapidly once the tarp is removed or holed for planting.

In California, Shennan *et al.*, (2009, 2010) have reported that ASD can be very effective on field scale in strawberry systems in coastal CA, using 4.5 to 9 tons of rice bran and intermittently applied drip-irrigated water in bed treatment. The level of control is however not consistent across all studies and treatments. The potential for commercial application of ASD in the U.S. is extremely high given the relative ease of incorporating ASD into existing production systems (Shennan *et al.*, 2010)

In the Netherlands ASD was applied since 2004 on approximately 70 ha mainly for asparagus and strawberry runners production (Lamers *et al.*, 2010). When the asparagus crop was replanted, ASD proved to be profitable for many years by controlling *Fusarium oxysporum*. Although highly effective against soil-borne pathogens and pests ASD is not applied widely in the Netherlands due to the high costs. Apart from the costs, this technique needs special attention to prevent plastic damage. Moreover

the mechanism behind ASD is not well defined which makes recommendations for growers complex. A new and promising development in ASD is the application of defined products on a basis of mixtures of carbon hydrates and proteins (Kubo *et. al.,* 2009). Chemical soil disinfestation with fumigants is restricted more and more and a non-chemical approach of soil disinfestation like ASD is urgently needed (Lamers *et al*., 2010).

8.3.5 Remaining and emerging Challenges

8.3.5.1 Non-Article 5 Parties

The key alternatives, Pic, 1,3-D and MI are subject to regulations potentially affecting their uptake for the remaining uses of MB. MBTOC continues to urge Parties to consider review of these regulations. In some countries, Pic and MI are still not registered.

Use of methods which avoid the need for MB (e.g. substrates, soilless culture, grafting, resistant varieties, solarisation, ASD) continue to expand worldwide for growing crops once produced with MB and these technically feasible technologies become more cost effective every year. Continual review of the economics of these technologies is required to support evaluation of critical use nominations.

Nursery uses are the most significant remaining use for MB 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. There is an emergence of new or re-emergence of previously controlled pathogens in fields that have used MB alternatives for a few years. Examples include *Macrophomina* and *Fusarium* on strawberry.

8.3.5.2 Article 5 Parties

MB phase-out over the next three years is critical for developing countries as they move towards achieving the 100% phase-out by 1st January 2015 as set by the Montreal Protocol. Owing to its broad spectrum of activity, high efficacy, wide range of uses, low price and connection with food security, MB has been a difficult substance to phase-out both in non-Article 5 and Article 5 Parties. The commercial/economic viability of MB alternative technologies is critical in convincing growers to change from the MB-dependent production to alternatives.

In many Article 5 countries, MB phase out has been achieved before the 2015 deadline, mainly with support from MLF-funded investment projects. In some cases, projects have been funded directly by Article 5 and non Article 5 Parties through bilateral cooperation, and/or agricultural producers. The projects have identified many economically and technically non-chemical and chemical alternatives, which are as efficient as MB. They generally encourage the combination of alternatives (chemical and non-chemical) as a sustainable, long term approach for replacing MB. This has often implied that growers and other users change their approach to crop production or pest control including investments and training (which the projects normally support). Early phase-out of MB has proven beneficial to Article 5 Parties in many instances, by, improving production practices, increasing the competitiveness of certain agricultural products in international markets and training large numbers of growers, technical staff and other key stakeholders.

Some challenges however still persist . For example alternatives for controlling bacterial diseases affecting ginger in China are difficult at this time as described previously, and the same applies for strawberry runners in countries like Egypt, Chile and Argentina.

A recent analysis conducted by the MLF on the MB phase-out in Africa indicates concerns amongst stakeholders in that region with respect to the sustainability of the selected alternatives after the projects are finished. Factors such as the arrival of new users that were not sufficiently informed and trained on alternatives, the expansion of sectors typically using MB at a late stage, stringent quality requirements imposed by markets, inconsistent performance of some alternatives, their high cost in some instances and pressure from MB sellers were cited as putting the sustainability at risk. Clearly other factors – besides the MB phase-out – can influence the sustainability or livelihood of agricultural sectors (MLF, 2012).

8.4 Structures and Commodities Progress report

This section of the TEAP May 2012 Progress Report, contributed by the MBTOC Structures and Commodities subgroup (MBTOC SC) includes three sections:

- A regulatory news update and;
- A report of an incident causing human injury by the off-gassing of methyl bromide from fruit imported to California (United States), fumigated as a quarantine treatment and then stored. Although risk mitigation and regulatory measures are in on-going development, the report summarizes actions to date being done to ensure the safe storage of fumigated fruit;
- A short update on adoption of controlled atmosphere storage as an alternative to chemical treatment (by methyl bromide or other fumigants) in control of pests in stored commodities.

Parties continue to be interested in finding and assessing alternatives to the use of methyl bromide. Accordingly, MBTOC has prepared several reports to assist Parties to obtain the needed information.

MBTOC SC offers Parties information about alternatives tailored to specific current critical uses by addressing new research in the text boxes when we respond to Parties critical use nominations. In that way Parties can obtain the most up to date information to assist them to switch to alternatives to deal with their most pressing problems.

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.

One specific information need of Parties concerns the need to understand the function of and improve the efficacy of sulfuryl fluoride. Fumigation with SF is one of the pest control methods 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, which can be found in the TEAP Progress Report of May 2011. The report included recommendations on SF treatment parameters by pest species for the consideration of Parties and their applicants. TEAP Progress Reports can be found on the UNEP website.

8.4.1 Regulatory News

Since the last Progress Report there have been few changes in registration and other regulatory news of interest to Parties. Regulations in Australia and Canada have not changed concerning their registrations for sulfuryl fluoride (SF), for which applicants are reported to be waiting.

Specifically as pertaining to the current Australian rice CUN, the Party reports that SF is not allowed to be used on packaged rice. As concerns the Canadian mill CUN, there is no food tolerance for SF in Canada which means that all food products have to be removed from the mill if it is to be SF treated.

MBTOC notes the uncertainty caused by the 2010 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 US reported to MBTOC in CUNs that its assessment of the situation is on-going and the current registrations for sulfuryl fluoride have not changed. Accordingly, when reviewing CUNs, MBTOC did not make any assumptions about any changes in registration or us of SF which may or may not be mandated by the US regulatory authorities and only considered the current regulatory status as reported by the Party.

In Europe, accessibility of SF has been reduced recently and currently it can only be used on empty food processing structures including mills and for dried fruit. Food tolerances in commodities have been reduced to impracticable levels for pest control.

8.4.2 Special report on recapture of MB from fruit storage in California – an on-going response to an incident of human injury from methyl bromide

There has been further adoption of recapture facilities designed to reduce methyl bromide concentrations and emissions to meet local air quality and workplace standards.

Most recapture facilities have been designed for use with standard shipping containers or fumigation chambers of similar volumes, typically 100m^3 or less. Recently there have been installations in the US dealing with much larger volumes, up to 13,025m^3 (460,000 ft^3) capacity with low residual concentrations of methyl bromide. These units operate at cool room temperatures 0˚C $\pm$ 1˚ (32 - 34˚F). There use was prompted by an industrial incident attributed to methyl bromide poisoning arising from residual fumigant degassing from treated commodity.

As reported by Farnsworth (2011) to the Methyl Bromide Alternatives Organization Conference, in November 2011, a fruit inspector met with his physician complaining of dizziness and headaches. From the worker's description of his job, the physician suspected methyl bromide exposure. The inspector was found to have high bromide blood levels. Another inspector was also found to have high bromide blood levels and also neurological problems. This was reported through two Federal and two state reporting systems. The inspectors worked in cold storage facilities in California.

Following two exposure cases, US authorities, including the California Department of Pesticide Regulation (Cal DPR), and the US EPA, investigated the problem. They determined that workers in Californian cold storages which handle fumigated fruit can unknowingly be exposed to levels of methyl bromide which exceed the California Occupational Safety Health Administration (Cal – OSHA) standard 1ppm time-weighted-average (TWA). This arises from the desorption of methyl bromide gas, from fumigated produce and packaging, which occurs for some time after fumigation and during transportation and storage of products like grapes. It was shown to occur regardless of whether aeration of 4 or 9 hr duration was used. Further investigation showed where the highest MB concentrations occurred in the aeration, transportation and storage channel.

Cal DPR initiated a plan, in conjunction with industry stakeholders, for the 2011-2012 grape season to allow importation of the fruit into California, while providing safety measures for workers in the marketing channel. The importers of record were required to obtain a permit from the County Agriculture Commissioner, which only allows release of the fruit to cold storages that have a Cal DPR approved Best Management Plan (BMP). The BMP, submitted by the cold storage operators, requires notification of workers, scheduled work area monitoring, record keeping and specific mitigation measures including ventilation and/or filtration. Truckers in the transportation channel implemented ventilation procedures prior to the fruit being off loaded and entering the cold storages.

As part of this overall risk mitigation project, Nordiko, a global supplier of fumigant recapture systems, in conjunction with Cardinal Professional Products (CPP), a USA supplier in the fumigation industry, jointly worked on a solution to develop a special filter to overcome the exposure issue and

ensure the facilities comply with new California regulatory restrictions. A similar program is being voluntarily tested and implemented on the East Coast where imported fumigated fruits are stored. The regulatory authority for the East Coast is the US Environmental Protection Agency.

The purpose of the methyl bromide filter is to mitigate the levels of methyl bromide within the cold storage facilities that is resulting in an unacceptable workplace environment. Over the last few months Cardinal and Nordiko have been testing the use of carbon filtration to mitigate low-level readings of methyl bromide. Their goal is to provide a working environment in the cold storages compliant with the Cal-OSHA standard.

The filters are designed for indoor use, and operate within the cold storage warehouses to remove methyl bromide form the ambient air. The scrubbers utilize Granular Activated Carbon (CAC) as an adsorbent, to remove methyl bromide from the air through a process or adsorption. Adsorption is the adhesion of atoms, ions, biomolecules or molecules of gas, liquid or dissolved solids to a surface. This process creates a film of the adsorbate (the molecules or atoms being accumulated) on the surfact of the adsorbent. Once the filters are saturated, they undergo a special treatment process which allows the reactivation of the GAC for re-use.

To date, there are now more than twenty filter systems in operation in California, helping to provide a safer environment to those who work in cold storage facilities which handle fumigated Chilean grapes. Nordiko and CPP will continue to evaluate the success and performance of the filter throughout the remainder of the current season.

Other than these California installations, no new methyl bromide recapture installations, specifically operated for ozone layer protection, have come to notice of MBTOC during 2011.

8.4.3 Special report updating on adoption of controlled atmosphere and modified atmosphere as a pest control treatment for commodities

To date, Controlled Atmosphere (CA) and Modified Atmosphere (MA) as a means to control pests in food commodities and spaces where food is being stored is becoming a more common practice, as was also presented in the 2010 Report of the Methyl Bromide Technical Options Committee (MBTOC).

CA and MA treatments offer large commercial and small packing houses, even farmers, effective postharvest pest control options useful for most durable commodities (and even non-food commodities such as museum and historical artefacts), under a very wide range of circumstances, without using chemical fumigants. For these reasons, the technique has spread widely, quickly and there are several companies offering equipment, service, products and assistance.

The CA treatment is based on creating a low-oxygen environment within a structure (new or existing) with airflow control [airtight, gastight]. This technology provides a low-oxygen environment with oxygen levels of less than 1% causing death of pests.

During each CA treatment, the following parameters are controlled and monitored to ensure an adequate treatment:

- The temperature within the treatment environment, including inlet temperature, air temperature, product temperature. The required product temperature needs to be reached throughout the products being treated.

- The required level of oxygen needs to be maintained within the treatment environment during the entire treatment process.

- The duration of the treatment is based on the results of research on the response of target pests to CA.

- Circulation within the chambers needs to be managed to achieve an evenly distributed level of CA and temperature within the treatment environment during the treatment process.

Each insect species in the various life stages has its own optimum conditions to live and consequently its own parameters to be successfully eliminated.

Eleven new CA commercial projects were opened in 2011 and the first months of 2012 in the countries Cyprus, France, Greece, Ivory Coast, Singapore, Switzerland, United States and Vietnam by the Dutch company EcO2. Other companies such as Linde, Messer, and Air Liquide for example, also use controlled atmosphere technologies for pest control. Different commodities and related pest insects are controlled in either gastight constructed treatment rooms or prepared silo complexes by applying Controlled Atmosphere.

8.4.3.1 CA used for Quarantine Treatments

The application of CA technique in e.g., Vietnam, is also certificated by the Plant Protection Department of Vietnam as a qualified treatment practice for phytosanitary objects. This certification allows users to control insects for import of phytosanitary objects, without using any toxic chemicals. Necessary documentation such as a Phytosanitary certificate to declare that the products have been inspected and/or tested and to state that the products are considered to be free of quarantine pests is provided, based on the treatment certificate of a CA treatment.

8.4.3.2 Controlled Atmosphere (CA) or Modified Atmosphere (MA) applied in storage bags

Another application related to insect control is the use of CA or MA, for instance by GrainPro and other companies, offering CA or MA storage bags or 'bubbles' in a wide range of sizes (1 kg – 1000 kgs bags). This application is based on insect control and simultaneous quality preservation during storage of packed commodities such as nuts, coffee, cocoa beans, rice and seeds. Commodities, stored in CA/MA bags are packed under low-oxygen conditions ensuring no discoloration and ageing along with insect control and prevention of insect re-infestation.

A study by Pons *et al* (2010) established the efficacy of using CO_2 in big bags and containers to prevent pests' development. Four trials were conducted with gastight big bags (900 x 900 x 1000 or1600 cm). Two of these trials were conducted with polished rice and samples of *Sitophilus oryzae*, one trial with chamomile infested with *Lasioderma serricorne* and one trial with cocoa and samples of *Tribolium confusum* and *Ephestia kuehniella*. Initial contents of CO_2 were higher than 75%, which decreased depending on exposure time (13 to 90 d) and food product. In all four trials the insects present in the infested samples were controlled with the MA. An additional trial was conducted in a 9 m container containing dried herbs in boxes, big bags and other packaging formats. Twelve infested samples of *L. serricorne* and *Plodiainter punctella* were distributed uniformly at the bottom and top of the container. A concentration between 70% and 15% CO2 was maintained for an exposure time of 18 d. In spite of the decrease in CO_2 content, the treatment was also effective to control all insects present in the samples. The results confirmed that CO_2 could be applied to food products during the

storage in big bags and containers to control the occurrence of pests. The authors concluded that modified atmospheres (MA) based on high carbon dioxide (CO_2) offer an alternative to synthetic chemical fumigation for insect pest control in food commodities during storage and shipment processes (Pons et al, 2010)

A strong advantage of this use of CA/MA is that re-infestation after treatment is not possible (as long as the bag or bubble maintains its integrity) and goods are protected against external influences. These bags are convenient and applicable for many of the pest control needs faced by Article 5 Parties.

A recent analysis conducted by the MLF on the MB phase-out in Africa indicates concerns amongst stakeholders in that region with respect to the sustainability of the selected alternatives after the projects are finished. Factors such as the arrival of new users that were not sufficiently informed and trained on alternatives, the expansion of sectors typically using MB at a late stage, stringent quality requirements imposed by markets, inconsistent performance of some alternatives, their high cost in some instances and pressure from MB sellers were cited as putting the sustainability at risk. Clearly other factors – besides the MB phase-out – can influence the sustainability or livelihood of agricultural sectors. (MLF, 2012)

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9 2012 Evaluations of Critical Use Nominations for Methyl Bromide and Related Matters – Interim Report

9.1 Scope of the Report

This 2012 interim report provides evaluations by MBTOC of Critical Use Nominations (CUNs) submitted for methyl bromide (MB) in 2014 by three Parties (Australia, Canada, USA) 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. 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 may 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 notes that stock volumes have significantly decreased in recent years.

Standard presumptions used in the 2012 round were the same as those used in the 2011 evaluations of the CUNs. 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.

9.2 Critical Use Nominations for Methyl Bromide

9.2.1 Mandate

Under Article 2H of the Montreal Protocol, Parties not operating under Article 5(1) are required to phase-out all production and consumption (defined as production plus imports minus exports) of MB 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, Annex I of Decision XVI/2 and a number of subsequent decisions (XVI/2; XVII/9, XVIII/13, XIX/9, XX/5, XXI/11, XXII/6 and XXIII/4).

9.2.2 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

MBTOC recommended less methyl bromide that requested in a CUN when technically and economically feasible alternatives were 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. MBTOC needs annual updates of the economics information evaluating the costs of alternatives. 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.

9.2.3 Reporting of MB Consumption for Critical Use

A number of decisions (Ex.I/3(5); XVI/2(4); XVII/9(5)), XVIII/13(6), XIX/9(7), XX/5(7), XXI/11(6), XXII/6(5) and XXIII/4(4)) set out provisions which request Parties to submit by 1 Feb each year information on how criteria in IX/6(1) is met when licensing permitting or authorizing CUEs. Decision XVII/9 of the 17th MOP specifically 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). MBTOC is now able to report more information on amounts of MB permitted and/or used for CUE uses. The data are required to be reported to UNEP by Government of Parties in March of 2012 as part of the accounting framework, form 2.

For 2011 in Australia, the Meeting of the Parties authorised 4.87 tonnes of MB for rice, but 4.043 tonnes were used for that purpose. Also, Parties authorised 29.79 tonnes for strawberry runners, but 29.29 tonnes were used for strawberry runners.

For 2011 in Canada, the Meeting of the Parties authorised 2.084 tonnes for pasta manufacturing, however 0.9349 tonnes were used for pasta manufacturing. Also the Parties granted 14.106 tonnes for flour mills, but 11.495 tonnes were actually used for flour mills. The Parties granted 5.261 tonnes for strawberry runners, and that full amount was used for strawberry runners.

For 2011 in Japan, the Meeting of the Parties authorised 239.746 tonnes for a range of vegetable crops, ginger and chestnuts with 222.239 t used

For 2011 in Israel, the Meeting of the Parties authorised 290.878 tonnes for a range of vegetable and strawberry crops. The amount used is has not yet been reported as Israel has not submitted an Accounting Framework Report for 2012.

For 2011 in the United States, the Meeting of the Parties authorised 2055.2 tonnes for a wide range of commodities (Annex III and IV). In their allocation regulation for 2011 critical uses the Party reported 1,382.206 tonnes had been approved for pre-plant soil uses in 2011 and 117.794 tonnes for post harvest uses (Federal Register, September 30, 2011).

9.2.4 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 9-5, as well as Figures 9-1 and 9-2. 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 9-9 and 9.11 in particular show the amounts nominated by Parties for soil uses, and structures and commodity uses and the interim recommendations for 'Critical Use' in 2014.

Decision XVII/9 requires TEAP to show trends in the phase out of the critical uses of MB by the Parties (Figs 9-1 to 9.2, Annexes III and IV). Since 2005, there has been a progressive trend in the reduction of methyl bromide for CUNs by all Parties for soil uses and post harvest uses, although this has occurred at different rates. Figs 9-1 to 9.2 show the trends in the reduction in amounts approved/nominated by Parties for 'Critical Use' from 2005 to 2014 for all the remaining soil uses and some of the remaining structures and commodity uses. The complete trends in phase out of MB by country, as indicated by change in CUE, are shown in Annexes III and IV.

9.2.5 Disclosure of Interest

As in past reports, MBTOC members were requested to update their disclosure of interest forms relating specifically to their level of national, regional or enterprise involvement for the 2012 CUN process. Most members updated their DOI. The Disclosure of Interest declarations for 2011, updated in February 2012 can be found on the internet at http://ozone.unep.org/new_site/en/disclosure_of_interest.php?body_id=6&committee_id=6 and a list of members in Annex I, chapter 11 of this TEAP report. 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.

MBTOC co-chairs requested members to complete a Categorisation of Interest Form on the application of declarations of interest to the best extent possible. Most MBTOC members found it difficult to accurately categorise their conflicts accordingly, however they discussed these during the plenary at the start of the MBTOC meeting in Beijing and members were given the opportunity to declare there conflicts of interest. Where known, these were managed appropriately by recusal or self recusal during the relevant CUN assessment.

The co-chairs of MBTOC seek guidance from TEAP and the Parties on how to improve DOI/COI updating and management procedures and in particular to implement them for the CUN process.

9.2.6 Article 5 issues

Methyl bromide is due to be fully phased out in A5 Parties by January 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, bilateral cooperation and also national funding. Most of the remaining MB consuming A5 Parties have agreements in place with the MLF and other organisations 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 for non A5 Parties. TEAP urges Parties to consider the requirements for CUNs in due time as set out in the 'Handbook on Critical Use Nominations' which is currently being revised to meet the needs of the non A5 and A5 Critical Use Process in response to Decision XXIII/14 (see next section) . (http://ozone.unep.org/Assessment_Panels/TEAP/Reports/MBTOC/Handbook%20CUN-version5)

9.2.7 Revisions to the Handbook on Critical Use Nominations for Methyl Bromide

Decision XXIII/14 requested "…the *Technology and Economic Assessment Panel, in view of its May 2011 progress report, to consider whether the guidelines and criteria for the preparation of critical-use nominations of methyl bromide need any modification to take into account the situation of parties operating under paragraph 1 of Article 5 and to report on this issue to the Open-ended Working Group at its thirty-third meeting*".

Although not specifically mentioned in Decision XXIII/14, TEAP suggests that the "*Handbook on Critical Use Nominations for Methyl Bromide (Version 6, December 2007[1])"* http://ozone.unep.org/teap/Reports/MBTOC/MBTOC_Handbook_ver_6_Dec_07_final.pdf would be the most appropriate document to modify in order to assist A5 Parties in the preparation of CUNs for methyl bromide that will applicable to such Parties from 1 January 2015. An updated Handbook would have the advantage of a single document providing guidance to both non-A5 Parties and A5Parties.

In view of the timeline above that may see some Parties wishing to submit nominations for MBTOC's consideration in February 2013, and after consideration of Decision XXIII/14 TEAP suggests that the Parties may wish to consider an updated version of the Handbook at the 24th MOP, in order to provide timely guidance to A5 Parties that may be considering submission of CUNs in 2013.

For any revisions to the Handbook that may be necessary, MBTOC is mindful that, according to paragraph 27 of Decision XVI/4 Annex I of MOP16, the Handbook should be "… *a general reference for all those involved in the critical-use exemption process, in part owing to the convenience of using the Handbook as a general reference volume for methyl bromide decisions, as well as the critical-use nomination procedure. Therefore, the Handbook should be a comprehensive "one-stop shop" that includes information on methyl bromide decisions, working procedures and terms of reference of MBTOC, the critical-use nomination process, agreed standard presumptions and other related topics. The text should be taken as far as possible directly from decisions of the Meeting of the Parties or other language that has been approved by the Parties*".

With relevance to advice provided to the Parties on any revisions to the Handbook, TEAP suggests submitting a draft Handbook to the Parties in time for their consideration at MOP24 in November 2012.

In the course of a preliminary analysis of the current Handbook, MBTOC concluded that the following issues were important:

- The Handbook will be updated to now include deadlines and issues applying to A5 countries, additionally to what it already contains for non-A5 countries
- Forms are being simplified and a checklist of required information will be added to assist the applicant through the process.
- Trials and results from MB projects undertaken by A5 parties may provide necessary information on the performance of alternatives.
- Timelines, standard presumptions and requirements to obtain a CUN as per Decision IX/6 and others will apply to A5 countries in the same manner they apply to non A5s.

9.2.8 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 2011 and 2012 are summarized in Tables 9-1 to 9-3 below.

Parties may wish to consider this information in the light of Decision IX/6 1(b)(ii) when authorising methyl bromide for critical uses.

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. Tables 9-1 to 9.3 report the quantities of MB 'on hand' at the beginning and end respectively of 2005, 2010 and 2011 as required under Decision XVI/6. The earlier CUN reports list stocks for the other years.

Table 9-1: 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

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 9-2: 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	1.185
Israel	290.88	12.47	288.94	301.41	290.86	10.55
Japan	267.00	8.82	248.67	257.49	251.159	6.331
USA	1,956	3,063 (a)	1,955	5,018	1,955 613 (c)	1,803(b)

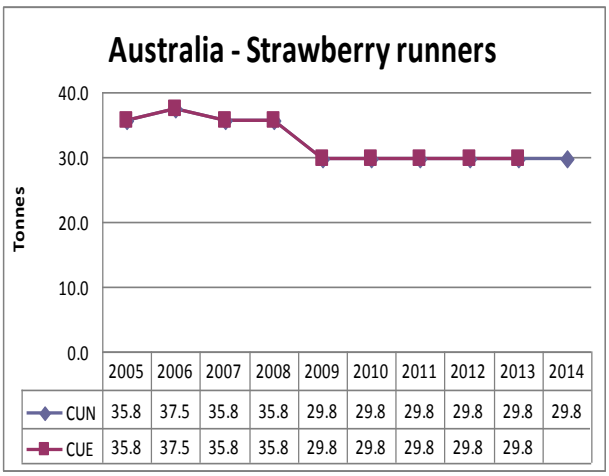
(a) Amount of pre-2005 stocks available at the start of 2010
(b) Amount of pre-2005 stocks available at the end of 2010.
(c) Stocks used for CUE uses in 2010.

Table 9-3: Quantities of MB 'on hand' at the beginning and end of 2011, as reported by Parties in 2012 under Decision XVI/6.

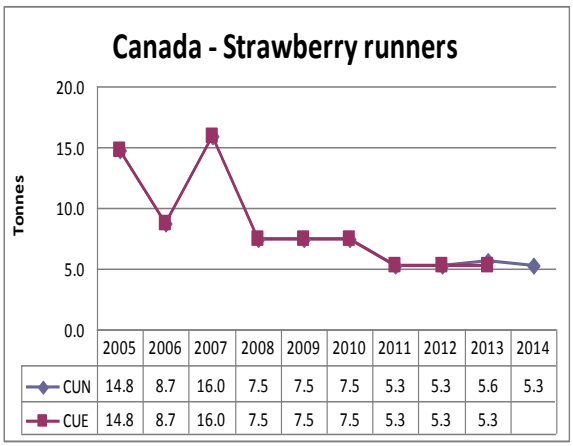
Party	Critical use exemption authorized by MOP for 2011	Quantity of MB as reported by Parties (metric tonnes)				
		Amount on hand at start of 2011	Quantity acquired for CUEs in 2011 (production +imports)	Amount available for use in 2011	Quantity used for CUEs in 2011	Amount on hand at the end of 2011
Australia	34.66	0	33.333	33.333	33.333	0
Canada	21.451	1.185	15.889	17.074	17.691	-0.617
Israel	Not yet reported					
Japan	239.746	6.413	225.552	231.965	222.239	9.726
USA	1,500 [2055 approved by MOP for CUEs]	1,803(a)	1,499	3,302	1,499 555(c)	0 1,249(b)

(a) Amount of pre-2005 stocks available at the start of 2011
(b) Amount of pre-2005 stocks available at the end of 2011
(c) Stocks used for CUE uses in 2011

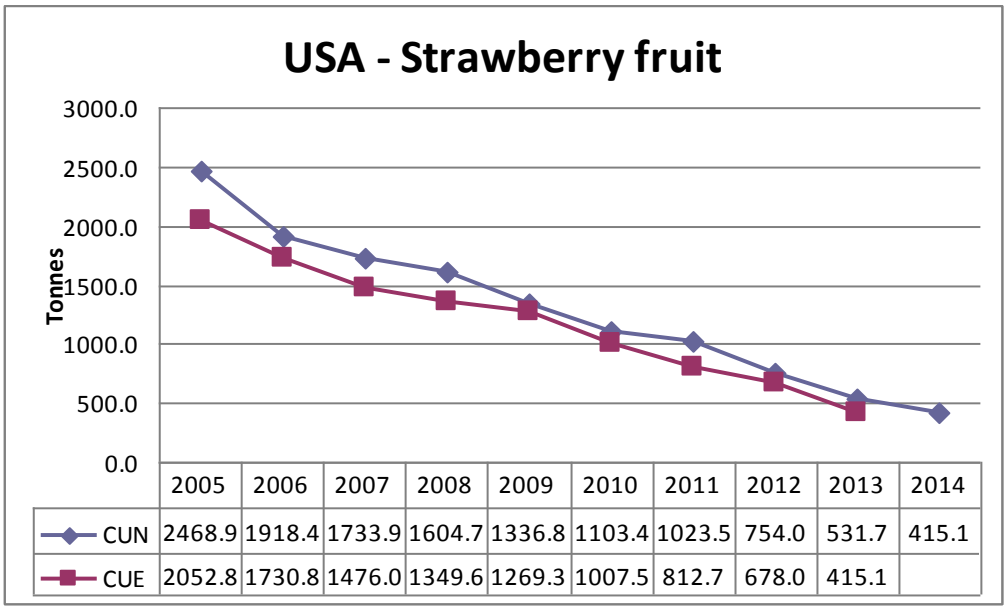
Figure 9-1: Amounts of MB nominated and exempted for CUE uses in nominated preplant soil sectors from 2005 to 2014. Blue lines indicate the trend in of CUN nominated and the red lines the amount CUE methyl bromide approved by the Parties



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CUN	35.8	37.5	35.8	35.8	29.8	29.8	29.8	29.8	29.8	29.8
CUE	35.8	37.5	35.8	35.8	29.8	29.8	29.8	29.8	29.8	

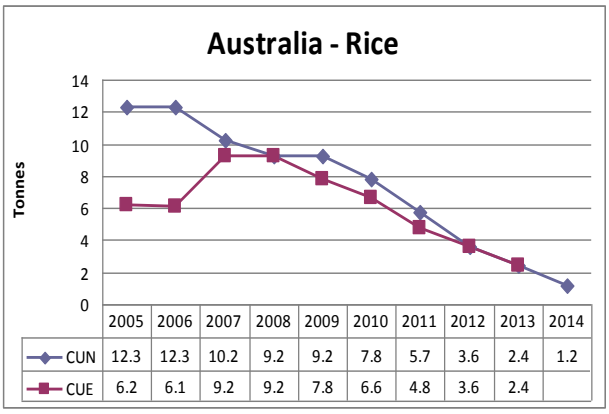


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CUN	14.8	8.7	16.0	7.5	7.5	7.5	5.3	5.3	5.6	5.3
CUE	14.8	8.7	16.0	7.5	7.5	7.5	5.3	5.3	5.3	

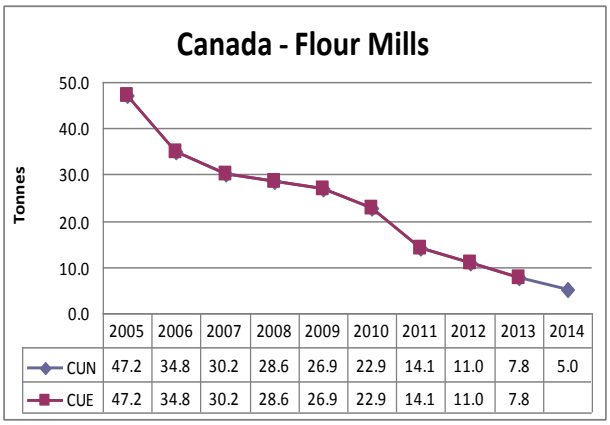


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CUN	2468.9	1918.4	1733.9	1604.7	1336.8	1103.4	1023.5	754.0	531.7	415.1
CUE	2052.8	1730.8	1476.0	1349.6	1269.3	1007.5	812.7	678.0	415.1	

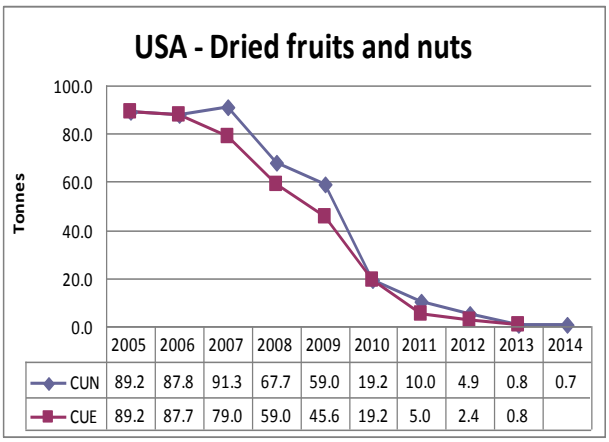
Figure 9-2: Amounts of MB nominated and exempted for CUE uses in in mills and food processing facilities and for commodities from 2008 to 2014 in nominated postharvest industries from 2005 to 2014. Blue lines indicate the trend in of CUN nominated and the red lines the amount CUE methyl bromide approved by the Parties



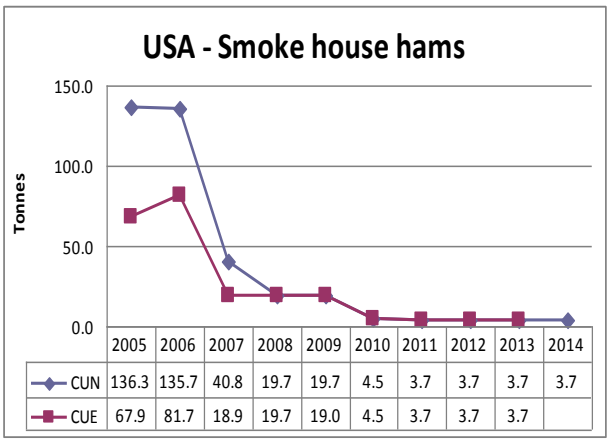
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CUN	12.3	12.3	10.2	9.2	9.2	7.8	5.7	3.6	2.4	1.2
CUE	6.2	6.1	9.2	9.2	7.8	6.6	4.8	3.6	2.4	



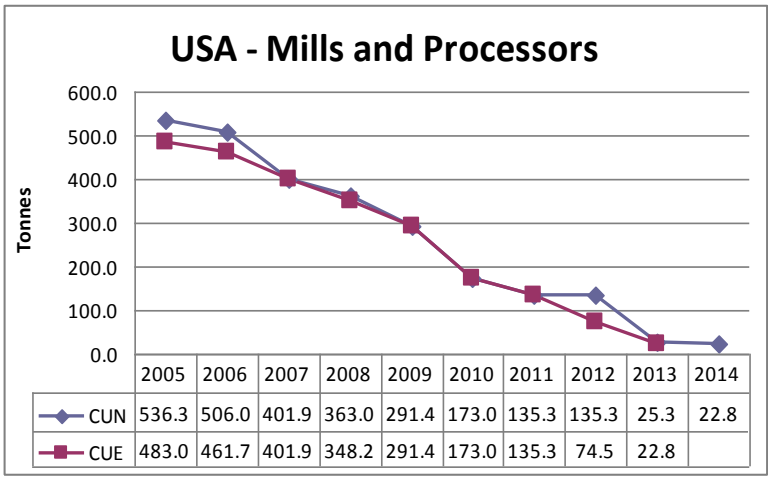
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CUN	47.2	34.8	30.2	28.6	26.9	22.9	14.1	11.0	7.8	5.0
CUE	47.2	34.8	30.2	28.6	26.9	22.9	14.1	11.0	7.8	



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CUN	89.2	87.8	91.3	67.7	59.0	19.2	10.0	4.9	0.8	0.7
CUE	89.2	87.7	79.0	59.0	45.6	19.2	5.0	2.4	0.8	



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CUN	136.3	135.7	40.8	19.7	19.7	4.5	3.7	3.7	3.7	3.7
CUE	67.9	81.7	18.9	19.7	19.0	4.5	3.7	3.7	3.7	



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CUN	536.3	506.0	401.9	363.0	291.4	173.0	135.3	135.3	25.3	22.8
CUE	483.0	461.7	401.9	348.2	291.4	173.0	135.3	74.5	22.8	

Table 9-4: Summary of Critical Use Nominations and Exemptions of Methyl Bromide (tonnes)

	Quantities Nominated										Quantities Approved									Interim Recommendation
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005 (1ExMOP and 16MOP)	2006 (16MOP+ 2ExMOP+ 17MOP)	2007 (17MOP + 18MOP)	2008 (18MOP + 19MOP)	2009 (19MOP)	2010 (20MOP + 21MOP)	2011 (21MOP)	2012 (22MOP)	2013 (23MOP)	2014
Australia	206.950	81.250	52.145	52.900	38.990	37.610	35.450	34.660	32.164	30.947	146.600	75.100	48.517	48.450	37.610	36.440	28.710	31.708	32.164	[27.971]
Canada	61.992	53.897	46.745	42.241	39.115	35.080	19.368 +3.529	16.281	13.444	10.305	61.792	53.897	52.874	36.112	39.020	30.340 +3.529	19.368	16.281	13.109	[10.094]
European Community 28	5754.361	4213.47	1239.873	245.00	0	0	0	0	0	0	4392.812	3536.755	689.142	245.146	0	0	0	0	0	0
Israel	1117.156	1081.506	1236.517	952.845	699.448	383.700	232.247	0	0	0	1089.306	880.295	966.715	860.580	610.854	290.878	0	0	0	0
Japan	748.000	741.400	651.700	589.600	508.900	288.500	249.420	221.104	3.317	0	748.000	741.400	636.172	443.775	305.380	267.000	239.746	219.609	3.317	0
New Zealand	53.085	53.085	32.573	0	0	0	0	0	0	0	50.000	42.000	18.234	0	0	0	0	0	0	0
Switzerland	8.700	7.000	0	0	0	0	0	0	0	0	8.700	7.000	0	0	0	0	0	0	0	0
USA	10753.997	9386.229	7417.999	6415.153	4958.034	3299.490	2388.128	1181.779 + 6.339	691.608	442.337	9552.879	8081.753	6749.060	5355.976	4261.974	3232.856 +2.018	2055.200	993.706	604.405	[386.307] + [3.73 Unable to Assess]
TOTALS	**18704.241**	**15617.837**	**10677.552**	**8297.739**	**6244.487**	**4044.380**	**2928.142**	**1460.163**	**740.533**	**483.589**	**16050.089**	**13418.200**	**9160.714**	**6990.039**	**5,254.838**	**3572.183**	**2343.024**	1261.304	652.976	[424.372]

* Not yet available.

28Members 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

9.3 Evaluations of CUNs – 2012 round for 2014 exemptions

MBTOC Soils and QPS met in Beijing, China, from February 27- March 2 and MBTOC Structures and Commodities met in Berlin, Germany, from February 28 - March 1 to evaluate the requests for methyl bromide and to propose recommendations on the quantity of methyl bromide eligible for critical uses, to update reports (DOI, progress reports, handbook), discuss issues of registration of alternatives and other matters.

MBTOC sincerely appreciated the welcome and hospitality of the Institute of Plant Protection (Beijing), the Chinese Academy of Agricultural Sciences and the Federal Research Centre for Cultural Plants Institute for Ecological Chemistry, Plant Analysis and Stored Product Protection in Berlin for kindly hosting our meetings.

During the meeting in Beijing, MBTOC-Soils and MBTOC QPS members held a face to face bilateral meeting with the US delegation. MBTOC-SC held a bilateral with the US delegation by Skype.

Australia, Canada, and the USA submitted nominations for critical uses of MB for either preplant soil use and/or post harvest use in 2014. These Parties have submitted nominations in previous CUN years. Eight nominations were submitted in this round (Tables 9.5 and 9.10). The total nominated amount for all countries for 2014 was 483.589 t and this represented a 35% reduction to that nominated in 2011 for 2013. The interim recommendation for 2014 was 424.372 t, ie. 88% of that nominated (Table 9.4).

For the soils CUNs, Australia and Canada submitted similar amounts to the previous rounds highlighting difficulties with phase out of MB for the strawberry runner sector. In the USA the only soil CUN submitted was for strawberry fruit; none of the other previous years' CUNs were submitted.

For postharvest CUNs, Australia, Canada and the US submitted five CUNs in total. 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 and effectiveness of alternatives. Japan did not submit a CUN for fresh chestnuts this year. MBTOC has sometimes recommended quantities of MB for 2014 which are less those nominated. The grounds used for these recommendations are given in detail in the relevant CUNs in Tables 9-9 and 9-11. The adjustments for soil uses may in part be to account for presumptions given in Tables 9-6.

In general the CUNs 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 the technical unavailability of alternatives. Additionally, MBTOC-SC notes that some Parties continue to struggle with the ability make an effort 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 9-9 and 9-11 provide this information for each CUN. This information was prepared by the MBTOC economist. MBTOC notes there was an improvement in economic information supplied in this round.

9.3.1 Critical Use Nominations Review

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. In considering the CUNs submitted in 2012, as in previous rounds, both MBTOC subcommittees applied as much as possible 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 the presence of 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. Costs for alternatives for soil or postharvest uses should be within 20% (MBTOC 2011) of the cost of using methyl bromide for it to be considered economically feasible in the context of that nomination, to the extent that could be determined.

The outcome of evaluations of CUNs for the soil and structural treatments are presented in Table 9.9 and 9.11 below.

9.3.2 Achieving Consensus

In accordance with decision XX/5(9) and similar subsequent decisions (XXI/11(4), XXII/6(4) and XXIII/4(3)) the Parties have indicated that MBTOC '*should ensure that it develops its recommendations in a consensus process that includes full discussion among all available members of the Committee and should ensure that members with relevant expertise are involved in developing its recommendations'*.

MBTOC-S had responsibility for evaluation of issues related to MB use and its alternatives for soil uses and for the preparation of a Progress Report on alternatives to methyl bromide for these uses. MBTOC-Structures and Commodities (MBTOC-SC) had responsibility for evaluation of issues related to MB use and its alternatives for structural and commodity treatments and for the preparation of a Progress Report on alternatives to methyl bromide for these uses. MBTOC QPS had 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.

In 2012, MBTOC's procedures were designed to improve members' contribution and reaching final decisions on nominations before, during and after the MBTOC meetings. This procedure ensured all members were sent information and able to discuss issues related to all nominations.

The nominations for the critical uses of methyl bromide proposed by the MBTOC-S and MBTOC-SC subcommittees were discussed in plenary by Skype. Comments made by MBTOC members were considered in the review and discussion period leading up to the meeting as well as at the meeting itself. Consensus was first reconsidered by the sub committees where all members had the relevant expertise and then again in full committee of all members attending the two meetings.

The soils and postharvest sub committees of MBTOC achieved consensus on their respective nominations. When considered by the full MBTOC committee, only one of the attending members of MBTOC disagreed with the consensus position of MBTOC-S and MBTOC-SC. Subsequent to the meeting a further member and one non-attending member also supported the minority views and these can be found in Annex II.

9.4 Interim Evaluation of CUNs: MBTOC-Soils

9.4.1 Critical Use Nominations submitted

Three CUNs were submitted for preplant soil use of MB, which is nine fewer than submitted in 2011. These included one each from Australia and Canada for the strawberry nursery industries and one from the USA for the strawberry fruit industry in California. The Australian and Canadian nominations were similar amounts to the previous years and the USA nominated 10% less than the amount approved by Parties at the 23MOP in 2011. MBTOC acknowledges substantially fewer

nominations from the USA in this round and some progress toward the phase out of MB in the strawberry fruit sector in California in this round. MBTOC notes that a range of nursery sectors are still using large quantities of MB in the USA for strawberry runners and other nursery sectors (TEAP QPS Report 2011).

9.4.2 CUN assessment for preplant soil uses

In the interim assessment by MBTOC, recommendations were made on all the preplant soils nominations.

For all three nominations submitted for use of MB in 2014, MBTOC recommended quantities of MB which are less than those nominated. The grounds used for these recommendations are given in detail in the table of interim recommendations (Table 9-9).

Table 9-5: Summary of the interim recommendations by MBTOC-S (in square brackets) for CUE's for preplant uses of MB (tonnes) submitted in 2012 for 2014

Country and Sector	Nomination by the Party for 2014	Interim Recommendation for 2014
1. **Australia** Strawberry runners	**29.760**	**[26.784]**
2. **Canada** Strawberry runners	**5.261**	**[5.050]**
3. **USA** Strawberry fruit	**415.067**	**[363.186]**
TOTAL	**450.088**	**[395.020]**

9.4.3 Issues Related to CUN Assessment for Preplant Soil Use

Key issues which influenced assessment and the need for MB for preplant soil use of MB in the 2012 round were:

i) Limitation on the uptake of a key alternative, methyl iodide (MI or iodomethane) because of issues related to its registration. In Australia, further studies have been asked for before registration can be granted, in Canada the registrant is not seeking registration at present and in the USA it has been withdrawn from sales.

ii) Changing regulations on key alternatives, particularly metham sodium and Pic used alone or in mixtures and the township caps and buffer zone regulations on 1,3-D in the US.

iii) Continued adoption of a new formulation of 1,3-D/Pic ('Pic-Clor 60') in the USA which increases the area that may be treated with 1,3-D in regions affected by township caps.

iv) Effect of restrictions on use of high rates of Pic (greater than 200 kg/ha (20 g/m^2)) in some area of the USA (ie. counties in California).

v) Ineffective disease control achieved by some alternative fumigants (1,3-D/Pic, Pic alone) when applied by drip fumigation as not all of the bed is treated.

MBTOC has noted more specific issues related to requests for CUNs below and also in the CUN text boxes (Table 9.9).

9.4.3.1 Australia

MBTOC noted that the nomination submitted by Australia for the critical use of MB for the production of strawberry runners stated that a 20% reduction in MB consumption would commence

in 2015 and reduce at 20% per year up to and including 2019. MBTOC examined only the amount requested for consumption in 2014. MBTOC strongly recommends that the Party review the 5-year reduction proposed in the nomination with a view to eliminating this small consumption in MB in one year. MBTOC notes that Australia has been undertaking trials for many years with the most likely alternative methyl iodide, which has been pending registration in Australia for several years. Only the state of Victoria uses CUEs and other States, such as Queensland used MB-CUEs in the past, but have implemented alternatives.

9.4.3.2 Canada

MBTOC noted that the nomination submitted by Canada for the critical uses of MB for the production of strawberry runners did not provide details of research that was being undertaken to identify and implement an alternative. MBTOC notes that the Parties are '.. *required to demonstrate that an appropriate effort is being made to evaluate, commercialize and secure national regulatory approval of alternatives and substitutes. Parties must demonstrate that research programmes are in place to develop and deploy alternatives and substitutes*"[29]. MBTOC notes that if the nomination were to be assessed according to the criteria agreed in decisions of the Parties MB would not be recommended. However, MBTOC acknowledges that for this particular round they have no registered alternatives and is mindful that the lack of MB authorised by the Parties due to inadequate research would result in this company on Prince Edward Island not being able to produce strawberry runners and therefore provided a recommendation. MBTOC strongly recommends that the Party consider a phase out plan to eliminate this small consumption in MB in one year.

9.4.3.3 United States

In its nomination, the US provided several reasons for the requirement for critical uses of methyl bromide for the production of strawberries in California, including:

1. Limitation on the uptake of a key alternative, methyl iodide (MI or iodomethane) because of issues related to its registration.

   After MBTOC's meeting in Beijing the manufacturer of MI suspended product sales for all formulations of methyl iodide in USA[30], although at this stage it still maintains federal registration. However, the California Department of Pesticide Registration" cancelled all products containing methyl iodide at the request of the registrant[31]". At this stage, MBTOC has not reassessed the nomination for strawberry fruit based on this outcome. The impact of this suspension on the current CUN nominations from the USA is unknown.

MBTOC noted in the nomination by the USA for the critical uses of MB for the production of strawberry fruit that a new formulation of 1,3-D/Pic ('Pic-Clor 60') in the USA increases the area that may be treated with 1,3-D in regions affected by township caps.

The most recent data show that alternatives such as 1,3-D, Pic and metham have been widely adopted in several production districts, which account for the majority of the fruit production. The area of 1,3-D use has more than tripled from 2001 ha (2003) to 6422 ha (2010), and the PIC area has more than doubled from 1021 ha (2003) to 2405 ha (2010). In addition, CSC survey data show that the organic production acreage will grow from 245 ha (2003) to an expected 790 ha (2012). MBTOC notes encouraging trends for increased uptake for Pic alone, Pic-Clor60 and 1,3D + Pic reported through 2010.

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[29] Paragraph 1(b)(iii) of Decision IX/6.

[30] Arysta. 2012. Arysta LifeScience suspends MIDAS in the USA. http://www.arystalifescience.com/release/MIDASPress3-20-12FINAL.pdf

[31] CDPR. 21 March 2012. Methyl Iodide Registration. http://www.cdpr.ca.gov/docs/registration/methyl_iodide.htm

In the 2012 round as in past rounds, 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 identifying historic use of MB within counties, particularly for the remaining strawberry fruit nomination from the USA. This information was helpful as it showed significant adoption of specific alternatives (e.g. Pic-clor 60) in California. Also, they showed that in one country in California a possible alternative, metam sodium alone and combined with other products has increased adoption.

9.4.3.4 General comments on assessment

MBTOC continues to encourage Parties to consider a 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. In this regard, MBTOC was pleased to receive information from the US on buffer zone credits that are due to take effect from 1 December 2012. Further information is provided in Section 9.4.4.

MBTOC also notes that a large proportion of MB has been nominated for uses where regulations or legislation prevent reductions of MB dosage. For several 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.

9.4.4 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".*

MBTOC considers MI a suitable technical feasible alternative for all remaining CUNs and note that it has been registered in a number of Article 5 countries and non Article 5 countries, such as New Zealand, Mexico, Turkey, Morocco 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 also 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 re-examined in the USA although this may be affected by the recent suspension of MI in the USA. 1,3-D may be subject to similar provisions when the soil fumigants are evaluated together again in 2013.

The manufacturer of methyl iodide recently announced *"... the immediate suspension of product sales for all formulations of methyl iodide in the United States ... based on a review [by the manufacturer] of the fumigant's economic viability in the US*"[32]. Even though the fumigant may remain registered, the company is not willing to sell the fumigant in the US from 20 March 2012. The suspension of sales in the US is likely to reduce the adoption of this product in the US. At the request of the registrant, the registration of methyl iodide has been cancelled by the California Department of Pesticide Regulation.

[32] Press release. 20 March 2012. Arysta LifeScience Suspends MIDAS in the United States.

The EU has further reported that registration for 1,3-D and other chemical alternatives including chloropicrin, dazomet and metham sodium are under review. A grace period for the registration of 1,3-D is presently granted in the EU for a specific time period on a yearly basis, but future registration has not been supported by the EU. Similarly, registration of chloropicrin in the EU may not continue.

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.

9.4.5 Update on rates of adoption of alternatives for preplant uses - Dec.XIX/9

From 2010 onwards, 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 9.9, Porter *et al.*, 2006, MBTOC 2011) show that technical alternatives exist for 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). In situations where a new alternative is considered suitable by MBTOC, MBTOC should request written advice from the nominating Party, which may include further information from the manufacturer of an alternative[33].

Annexes III and IV in this report show the apparent reduction rates for MB use achieved by many Parties in a number of key sectors. As noted above, the actual reduction and adoption rates may vary from the rate of change of CUN/CUE because of factors such as use of stocks (some Parties use stocks instead of 'freshly produced' methyl bromide from CUEs), and/or a transfer of MB between sectors of use, which occurs in some Parties. The CUN reviews presented in tables 9-9 and 9.11 also provide detail of some of the key alternatives that Parties have and may consider to further replace MB for the remaining uses.

In any future nominations submitted by Australia, Canada and the US should include information on expected rates of adoption of alternatives following registration, in accordance with paragraphs 34-35 of Annex 1 of the MOP16, is as this information would assist MBTOC in its evaluation of these CUNs.

9.4.6 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 fumigants in some regions of 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 chemical treatments in the short term but environmentally sustainable non-chemical alternatives where possible in 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

[33] Paragraph 34 of Annex 1A in the Report of the Sixteenth Meeting of the Parties

authorities in individual CUN regions, without reference to the sustainability of the alternative. In the past, MBTOC visited regions where successful non chemical alternatives e.g. grafting, soil less culture, solarisation, steam, biodisinfestation and anaerobic soil disinfestation, are used as sustainable alternative to MB. Several Parties have considered these techniques as viable alternatives. However, they require further consideration and in some cases additional research at the local level before they can be adopted commercially.

9.4.7 Standard presumptions used in assessment of nominated quantities.

The tables below (Tables 9-6 and 9-7) provide the standard presumptions applied by MBTOC-S for this round of CUNs for preplant soil uses. 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) in MB/Pic formulations with high Pic-containing mixtures with or without barrier films for certified nursery production, unless regulations prescribe lower or higher rates. However, MBTOC notes that studies have shown that rates of 200 kg/ha (20g/m^2) or less of MB: Pic 50:50 are effective with barrier films for production of 'certified' nursery material and urge Parties to consider regulations which permit these lower rates. MBTOC also notes that certified runner production may involve regulations which specify the mandatory use of a fumigant such as MB or an alternative, in order for the runners to be "certified runners".

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 9-6: Standard presumptions used in assessment of CUNs for preplant soil use of MB from the 2009 -2012 assessments

	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: Pathogens 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 broad acre 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 9-7: 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	**Plant 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

9.4.8 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, 33:67 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) (Porter 2006; 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 9-8).

Table 9-8: 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 (kg/ha) of MB/Pic 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 (previous CUN reports) show that a dosage of 10g/m^2 (e.g. MB/Pic 50:50 at 200kg/ha with low permeability barrier Films) is technically feasible for many situations and equivalent to the standard dosage of >20g/m^2 using standard PE films*

9.4.9 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.*, 2009). These latter technologies have not been reported or adopted widely by Parties and need to be evaluated more widely.

In southeast USA the reported use of barrier films in vegetable crops which expanded rapidly to over 20,000 hectares in 2009 has continued to increase. It is also exclusively used with the alternative MI to assist its effectiveness at low dosage rates. 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). MBTOC notes that barrier films can be used

with alternatives and this is consistently improving the performance of alternatives at lower dosage rates. Effectiveness at lower dosages can allow for greater areas to be treated with 1,3-D under township cap regulations or increase the likelihood of chloropicrin being applied at dosage rates below the 125 or 200 lb/acre restrictions presently imposed in California.

In the USA as a result of mitigation developed for the fumigants undergoing reregistration, buffer zones around treated fields will go into effect on fumigant labels as of 1 December 2012. By choosing to use certain low permeability tarps, the applicator can qualify for buffer zone reduction credits. These credits are specific for each fumigant and tarp. The most impermeable tarps to chemical fumigants results in the maximum buffer zone credit of 60%, which may allow more of the alternative to be used. Applicators of fumigants can obtain more information by going to http://www.epa.gov/pesticides/reregistration/soil_fumigants/factsheets/sfm-buffer-zones-2012.pdf. to obtain information on the appropriate buffer reduction credit. Buffer zone credits apply for soil fumigant products such as MB/Pic (but not in California), Pic, 1,3-D/Pic, iodomethane and Pic[8], and metham sodium or metham potassium.

MBTOC notes that the impact of these changes will be difficult to determine and therefore will require thorough clarification from the Party on the impact on use of alternatives in any future nominations. MBTOC is aware that the only fumigant labels that currently specify buffer zones in the US are on 1,3-D products which will not be affected by the new EPA labels and buffer zone credits as they are not part of re-registration. Buffer zones for methyl bromide are in Californian regulations. Buffer zones for metam sodium and chloropicrin are in Californian county's permit conditions. Regulations and permit conditions supersede labels if they are more stringent than the labels. In essence, the requirement for buffer zones on the MB, metam and chloropicrin labels will go into effect at the end of 2012 or in early 2013 for the first time along with the buffer zone credits so it is difficult to know the impact on use of the alternatives.

[8] Now not so relevant since sales in the US of IM were suspended by the manufacturer on 20 March 2012

Table 9-9: Final evaluations of CUNs for preplant soil use submitted in 2012 for 2014

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]	CUE for 2013[9]	CUN for 2014	MBTOC rec for 2014
Australia	Strawberry runners	35.750	37.500	35.750	35.750	29.790	29.790	29.790	29.760	29.760	**29.760**	**[26.784]**

MBTOC Recommendation for 2014:

MBTOC recommends a reduced CUE of 26.784 tonnes for use in 2014 which is 10% reduction from that nominated by the Party. According to the transition timeframe in the nomination, the anticipated quantity was proposed to be reduced by 10% in 2015. Therefore, MBTOC considers the transition timeframe for reduction could be advanced by one year and encourages the Party to consider a faster transition plan than stated in the nomination.

Nomination by the Party:

The quantity requested for this CUN is 29.760 tonnes and has remained unchanged since 2009.

Circumstances of the Nomination:

The Party states that the key pests affecting strawberry runner production are fungi (*Phytophthora, Pythium, Rhizoctonia* and *Verticillium* spp.) and weeds (*Sinapsis 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. MBTOC acknowledges the notification by the Party of the QPS issues. The Party has informed MBTOC of its intention to phase out MB for critical uses over 5 years beginning in 2015, assuming that an alternative is registered by this time.

MBTOC Review and Assessment:

MBTOC considers, and the Party demonstrated, that soil-less substrate production is technically feasible for the foundation generation and plans to commission soil-less production in the 2011/2012 season. MBTOC considers soilless substrates are also technically feasible for successive early generations of nursery runners and can be implemented for a portion of the production in the next 2 years. Therefore MBTOC recommends a 10% transition to soil-less substrates for early generation runners in 2014. Victorian Strawberry Industry certification Authority has established a commercial facility in 2011 with a capacity for producing 60,000 foundation stock plants. Methyl iodide test results have been very positive, and more data has been submitted to support the registration. However, this fumigant has not yet been registered. If methyl iodide or any other alternative is registered before the MOP 2012, MBTOC will need to reassess the nomination. 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.

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]	CUE for 2013[9]	CUN for 2014	MBTOC rec for 2014
	MBTOC Comments on Economics 2012: Economic information on the infeasibility of plug plants was insufficient to validate Australia's assertion that soilless production of runners would not be economic. Soilless production has been found economic in many countries. **Comments Requested in Dec. XX1/11 (para 9):** • **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**: On going research is being conducted in (a) supporting reduced application rates of MB/Pic, (b) supporting the registration of MI and EDN, (c) use of MB recaptured from QPS applications in combinations with chloropicrin, (d) soilless production systems. • **Dec. IX/6 b(iii) Appropriate effort**: Research effort is adequate, but commercialization of chemical alternatives is confronted with regulatory obstacles.											

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]	CUE for 2013[9]	CUN for 2014	MBTOC rec for 2014
Canada	Strawberry runners (PEI)	6.840	6.840	7.995	7.462	7.462	7.462	5.261	5.261	5.261	**5.261**	**[5.050]**

MBTOC Recommendation for 2014:

MBTOC recommends a reduced amount of 5.05 tonnes for use in 2014, which is a 4% reduction from that nominated by the Party. MBTOC considers that soil-less substrate production is technically feasible for some of the nursery production system and suitable for the stock plants where it assists with high health of nursery material. MBTOC has reduced the nomination based on transition to soil-less substrates for foundation stock in 2014 and this represents a 4% reduction of the total nominated amount. This would represent a 50% transition of the stock plants by 2014. MBTOC acknowledges that the market requires field grown bare rooted plants as a final product.

Nomination from the Party:

The Party has nominated 5.261 t of MB for use on (24.3 ha) of field grown runners and (2 ha) of stock plants. The nomination is based on a reduced rate of MB of 20 g/m² under high barrier films for the entire 26.3 ha to be fumigated.

Circumstances of the Nomination:

The Party has considered replacing MB with 1,3-D, but 1,3-D was banned for use in Prince Edward Island (PEI) in January 2003 due to potential ground water contamination. In addition, Telone C-35 was withdrawn from Canada in 2011. Chloropicrin (PIC 100) has been registered by the Pest Management Regulatory Agency (PMRA) and is used by other runner growing companies in Canada. The PEI Department of Environment is not prepared to allow the application of Pic until PMRA indicates that groundwater contamination is unlikely in PEI soil conditions. A study was conducted and submitted to PEI authorities and to PMRA for use in their re-evaluation of chloropicrin but the outcome has not yet been determined. The registration of methyl iodide has not been applied for use 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 favourably to conventional production with methyl bromide. The Party states that the producer cannot meet disease-free requirements of their buyers with organically produced runners. The Party stated that 100% of the crop is exported and therefore all plants are subject to inspection to meet phytosanitary requirements.

MBTOC Assessment:

MBTOC acknowledges the Party's reduction of the rate of methyl bromide being used by the grower in PEI in the absence of formal registration for this dosage rate. MBTOC also notes that 100% of the crop is exported and MB is used as an aid to meet phytosanitary certification standards for export. MBTOC considers that soilless culture is suitable at least for foundation stock. MBTOC notes that other Parties have adopted a number of chemical alternatives (ie. methyl iodide/chloropicrin, chloropicrin combined with herbicides and 1,3-D/Pic) for strawberry runner production, however these chemical alternatives are prevented from use because of regional regulations in PEI. MBTOC notes that dazomet, metham sodium and metham potassium are registered for use in Prince Edward

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]	CUE for 2013[9]	CUN for 2014	MBTOC rec for 2014
	Island (PEI), however under Health Canada's legislation, combinations of these products are not permitted (i.e. application at the same time). Dazomet used alone or sequential applications may warrant evaluation. It is expected that the PMRA will make a final decision on chloropicrin reevaluation in the spring of 2012 and that PEI will consider the outcomes of the PMRA decision. If the decision is to permit the use of Pic 100 following their review of the groundwater study before the MOP 2012, or any other chemical alternative is registered, MBTOC will need to reassess the nomination. MBTOC strongly recommends that the Party submit 1) a phase out plan for MB use in PEI. (2) expand its research efforts to better comply with Decision IX/6 by examining the feasibility of expanding soilless culture beyond foundation stock and the suitability of other chemical and non chemical alternatives. **MBTOC Comments on Economics 2012:** The nomination was not based on economic arguments. **Comments Requested in Dec. XX1/11 (para 9):** • **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(ii) Research Effort:** Although some research/adoption has been done in the past (ie high barrier films, biofumigation, organic varieties), MBTOC expects significant progress in accordance with Decision IX/6 with adoption of their proposed research program. • **Dec. IX/6 b(iii) Appropriate effort:** Registrants for Midas, EDN and DMDS have not submitted any registration application materials at this time. A groundwater study for chloropicrin has been submitted by the registrant to PEI and federal authorities.											

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]	CUE for 2013[9]	CUN for 2014	MBTOC rec for 2014
United States	Strawberry (field)	2052.846	1730.828	1476.019	1349.575	1269.32	1007.477	812.709	678.004	461.186	**415.067**	**[343.740]**

MBTOC recommendation for 2014:

MBTOC recommends a reduced amount of 343.740 tonnes for use in strawberry fruit in California for 2014. This is based on 170 kg/ha and 2,022 ha.

Nomination by the Party:

The Party nominated 415.067 tonnes of methyl bromide for critical uses for strawberry fruit for 2014. This was a 10% reduction of the amount approved at the MOP in 2013. The nomination is based on 2,442 ha at a dosage rate of 17.0 g/m^2 which conforms to the MBTOC standard presumptions for use with high barrier films, although high barrier films can not be used in California with MB (http://www.cdpr.ca.gov/docs/emon/methbrom/tarps.pdf.). The Party stated that this reduction was based on a composite figure encompassing all the used and available alternatives and was unable to present a specific basis tor this proposed reduction.

Circumstances of the Nomination:

The Party states that Californian growers have a critical need for methyl bromide to treat fields where the primary alternative, 1,3-D/chloropicrin, cannot be used due to township caps restricting the total amount of 1,3-D that can be used (Fennimore and Ajwa, 2011) or where diseases caused by *Macrophomina* and *Fusarium* cannot be managed effectively (Ajwa, personal communication). Methyl iodide (iodomethane, Midas®) was registered in California in December 2010. To date, it has only been used on a few acres throughout California and only 5 acres have been for strawberry production. This is likely due to cost concerns and to fear by growers that the public will perceive that the methyl iodide fumigation is unsafe and that strawberries are unsafe if they have been produced on methyl iodide-treated land.

The Party reduction of 10% is based on uptake of a range of alternatives including 1,3-D/Pic in line and shank applied, Pic alone.

The Party states that mixtures of 1,3D and Chloropicrin have regulatory constraints. The Party assumed township caps were fully used up, consistent with 2013 CUE approved by the parties. This mixture, when applied by drip, does not effectively control *Macrophomina* (Ajwa, personal communication). Additional research is underway to improve efficacy of shank application of 1,3-D /Pic. Use of shank application increases the Township Cap factor and reduces the total acreage that can be treated with 1,3-D over the acreage that can be treated if drip application is used. With successful research over the next 2 years, shank 1,3-D /Pic will be part of the 10% reduction. The CUN states that research has indicated that with the use of totally impermeable films, drip-applied 1,3-D/chloropicrin formulations (Telone C-35 with 63% 1,3-D) at 200 lb per acre (225 kg/ha) is as effective in terms of yield and weed control as a standard methyl bromide treatment (Fennimore and Ajwa, 2011). The CUN states that research has shown that this can lower the amount of 1,3-D by 33% below the rate typically used with standard films and, therefore, may result in reducing the burden of caps that restrict the overall amount of 1,3-D used in a township. Pic-Clor 60 is formulated with lower rates of 1,3-D (39% 1,3-D) and has been effective in field trials, but chloropicrin restrictions are also in place in some counties and reduce its use. These research trials did not address issues associated with *Macrophomina* or *Fusarium.*

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]	CUE for 2013[9]	CUN for 2014	MBTOC rec for 2014
	Carbonation of 1,3-D/chloropicrin formulations may help to reduce the overall use of 1,3-D by increasing its dispersal in the soil while providing yields comparable to methyl bromide (Thomas et al., 2011b). In Florida trials (Noling and Cody, 2011), most alternative fumigants evaluated produced yields which were statistically equivalent to that of methyl bromide chloropicrin 50/50 (320 lb/[treated] acre). Co-formulated fumigants such as Telone C-35, generally performed better than that of Pic-Clor 60 for maintaining strawberry crop productivity and nematode control". The nomination and subsequent responses received by MBTOC state that chloropicrin is a widely used alternative and is considered part of the reduction in 2014. Regulatory restrictions at the county level limit the maximum rate and potentially the efficacy against key pathogens. Areas with high pest pressure would likely require rates above 200 lbs/acre (224 kg/ha), requiring a permit from the County Agricultural Commissioner – which has to date seldom been granted and is given on a case-by-case basis. The CUE outcome approved by Parties in 2011 was based on methyl iodide uptake of 21% over 3 yrs, i.e. 721 ha by 2013. In 2011 only 2 ha used MI/Pic, even though a reduction of 7% (240 ha) was made for transition to methyl iodide in 2011. Anaerobic soil disinfestation (ASD) has given promising results on demonstration plots. No test data has been obtained on *Macrophominia* or *Fusarium*; only *Verticillium* in test plots. Type of organic matter, amounts, method of incorporation, keeping moisture on plots, and source of organic matter are technical issues to be determined. Further research on efficacy is required (and planned). The Party states that steam technologies are under development and look promising. While there is some commercial application of steam in flowers, there is no commercial application of steam in strawberry production other than demonstration trials (two acres in 2011). The current price of steam application is 50% higher than treatment with MB. More research is needed to increase efficiency and decrease cost. A substantial increase in organic acres would not allow a continued price premium for organic strawberries, a necessity for this industry. Moreover, any increase in organic acres will likely be insignificant relative to the net number of strawberry acres, thus having a negligible impact on the CUN. Breeders are working on development of cultivars that are tolerant or resistant to key diseases, especially *Macrophomina* and *Fusarium.* Dimethyl disulfide (DMDS) is registered for the use in strawberries at the federal level, however, it is not registered in California. Substrate use has not shown economical feasibility, but research continues to reduce costs. **MBTOC Assessment:** Review of the Californian databases by MBTOC, has shown that for the three major strawberry MB use regions in California (Oxnard, Watsonville/Salinas and Santa Maria, the fruit production areas are almost 4713 ha, 6228 ha and 3947 ha respectively (California Strawberry Commission (CSC) surveyl). The most recent PUR data (2003-2010) show that alternatives, namely 1,3-D, Pic and metham have been widely adopted in these production districts. State-wide in California, the CSC survey expects 15,535 ha strawberry fruit in 2012. The Californian Department of Pesticide Regulation – Pesticide Use Reporting (PUR) database shows that in California the area of 1,3-D use has more than tripled from 2001 ha (2003) to 6422 ha (2010), and the Pic straight area of use more than doubled from 1021 ha (2003) to 2405 ha (2010). In addition, CSC survey data show that the organic production acreage will grow from 245 ha (2003) to an expected 790 ha (2012).										

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]	CUE for 2013[9]	CUN for 2014	MBTOC rec for 2014
	MBTOC notes that regulations in California prohibit the use of low permeability (high barrier) films with MB application, and therefore discourage reduction of MB dose rates as well as emission control through use of these films (eg VIF, SIF and TIF). MBTOC acknowledges that the alternatives have been significantly adopted in all counties in the past 4 years, which indicates their technical and economic feasibility. MBTOC understands that regulatory restrictions, township caps on 1,3D and maximum rate restrictions for Pic imposed by county Ag commissioners affect their use. MBTOC notes encouraging trends for increased uptake for Pic alone, Pic-Clor60 and 1,3D + Pic reported through 2010. MBTOC acknowledges that the Party has made a 10% reduction for uptake of a range of alternatives, but has calculated that further adoption of alternatives is possible and has reduced the nomination by an additional 15% to enable transition to these alternatives in 2014. MBTOC understands that this situation may be affected by impacts of new label restrictions on fumigants that come into effect in December 2012, and legal issues regarding the availability of MI. If methyl iodide becomes unavailable, MBTOC would need to reassess this nomination. The total reduction includes a10% reduction of the 2013 CUE made by the Party and the further reduction (15.47%) made by MBTOC. The total reduction as calculated by MBTOC is based on; 1) 261 ha (or 15%) of the expected area in 2013 affected by township caps on 1,3-D mixtures being able to transition to strategies using these fumigant mixtures. These include those which use less 1,3-D dose per unit area, including uptake of Pic-Clor 60, use of barrier films to reduce dosage rates with all 1,3-D formulations and rotation with broad acre fumigant strategies to improve the effectiveness of disease control. MBTOC notes that official databases report approximately 6,500 ha of strawberry fruit production using different formulations of 1,3-D in 2010. 2) 150 ha of the total nomination being able to uptake Pic straight formulations which are not restricted by permit conditions 3) 270 ha of the total nomination being able to uptake methyl iodide 4) 10 ha of the total nomination being able to uptake new technologies of either steam, anaerobic soil disinfestation or organic production strategies. In regards to concerns about an increase of diseases caused by adoption of alternatives, reports stress that there is not enough evidence to directly support the relationship between the appearance of Macrophomina and Fusarium diseases and MB replacement (López-Aranda et al., 2009). The diseases are present in numerous crops and regions of the world independently from MB use. MBTOC, however, does accept that reports (rKoike et al. , 2010) show that there is an association of these diseases in areas where drip applied fumigants are being used and that broad acre shank treatments with fumigants (e.g. 1,3-D/Pic mixtures, Pic and metham sodium) may be required to clean up infested fields. MBTOC notes that the available literature shows promising non MB management strategies for these diseases. Disease susceptibility varies between cultivars and some of the currently used strawberry varieties show good levels of resistance although not for both pathogens (Koike et al., 2010; Daugovish et al., 2011). Fumigants applied in Californian conditions provide protection from these pathogens early and mid-season although not in late season during May-June, (Koike, 2011; Daugovish et al., 2011); in Israel research shows that metam sodium (730 l/ha) caused 90 and 95% pathogen mortality in field experiments, at the same levels of MB, indicating that fumigation may be an effective method of managing this pathogen in infested soils (Zveibil et al., 2012). Attention should also be given to efficiency in fumigant delivery and distribution to all bed areas to delay plant collapse at the most susceptible zones such as bed sides (Koike et al.,											

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]	CUE for 2013[9]	CUN for 2014	MBTOC rec for 2014
	2010; Daugovish et al., 2011). An integrated management strategy for these diseases should include: a) site selection avoiding infested fields; b) crop rotation with plant non-hosts; c) Pre-plant fumigation; d) Sanitation measures to avoid moving infested soil or contaminated equipment; e) the use of tolerant cultivars, and f) reducing plant stress mainly by maintaining optimum soil moistures and proper irrigation (Koike et al., 2010; Daugovish et al., 2011). MBTOC notes that low permeability (high barrier) films can be used on MB alternatives and that lower dose rates of 1,3-D with barrier films are effective (refs). MBTOC notes that databases show MB use for strawberry fruit in California has been higher than the exempted amount for four years since 2006. In 2010, almost 100 tonnes more MB was used than was exempted for this particular use. MBTOC also notes that in 2010, the overall average dosage used across strawberry fruit producing counties was 208 kg/ha, with a predominant formulation of 57% MB. Formulations of 67% and 98% are still used in a significant number of applications (Source: Cal DPR-PUR). MBTOC continues to encourage wider use of 50:50 formulations, which still allow for complying with regulatory restrictions on Pic use. MBTOC notes and commends the withdrawal of MB for this use in Florida and Eastern USA, where full transition to alternatives has been completed. 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 comments on Economics in 2012:** An economic analysis indicates that the gross margin (termed net revenue in the CUN) for strawberries using methyl bromide was $33,744 per hectare while that of broadcast alternatives ranged from +10% (with Pic-Clor 60 (1,3-D plus chloropicrin)) to -9% (with methyl iodide, 33:67), based primarily on the cost of the individual fumigant. These changes are not large and fall within the range of expected annual variation experienced in agriculture, with the implication that these alternatives are economically feasible. Drip alternatives also result in higher gross margins, while steam results in a small decline of 1% in the gross margin, again implying that these alternatives are economically feasible. However, in the case of steam, the costs that are presented are based on small plots (10 acres or less), so it may not yet be economically feasible on a commercial scale. **Comments Requested in Dec. XX1/11 (para 9):** • **Dec. IX/6 b(i) Emission reduction:** In California low permeability (high barrier) films are not allowed for use with MB, but are allowed and available for use with alternatives; • **Dec. IX/6 b(ii) Research program:** Yes, there is an on going research program, but specific data justifying CUN requests need to be provided. • **Dec. IX/6 b(iii) Appropriate efforts:** In California there is varying effort in the different production districts.											

[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, [9]MOP23

9.5 Interim evaluation of CUNs: Structures and Commodities

MBTOC Structures and Commodities (SC) met in Berlin, Germany February 28 – March 1, 2012 at the Julius Kuhn Institute for Cultural Plants Institute for Ecological Chemistry, Plant Analysis and Stored Product Protection and with the kind hospitality of the German Ministry of the Environment.

MBTOC SC assessed the five CUNs submitted in 2012 for 2014, prepared the Progress Report and reviewed the Handbook on Critical Use Nominations for Methyl Bromide. Prior to the meeting, a small review team of MBTOC SC members from A(5) Parties and led by an A(5) MBTOC member had prepared a draft of the changes suggested for the Handbook for review. Also during the meeting in Berlin, a bilateral meeting was held with United States electronically by Skype to discuss questions about the CUNs and to improve understanding of recent research, and to understand US regulatory matters. Finally, a Skype discussion between the two MBTOC meetings was held as a plenary session to discuss the critical use nomination recommendations and answer questions from members.

In 2012 there were five CUNs submitted by three Parties. Parties continue to make progress on CUNs, reducing most MB uses by continuing to resolve the inter-related issues of treatment logistics, costs, trade demands and effectiveness of alternatives. Japan did not submit a CUN for fresh chestnuts, having completed its planned phase out on schedule, presumably by adoption of methyl iodide which it had registered for this purpose. This was a challenging transition under the circumstances for which MBTOC acknowledges the effort by the Party.

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, however, at this time, there has been no change in the regulatory status of SF, and none was assumed by MBTOC. MBTOC will provide information to Parties if the regulatory status of SF changes.

9.5.1 Standard rate presumptions

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 gas tightness 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 worldwide. 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).

9.5.2. Details of evaluations

Parties have submitted five CUNs for the use of MB in structures and commodities in 2012. This year all CUNs were for one year – 2014.

MBTOC was unable to assess the CUN for cured pork because we are awaiting further information on the volume of the aging rooms to be treated, as explained in the text box. MBTOC notes there is currently no effective alternative for the pests which are known to sometimes infest this product during storage, and so MB is needed; but at this point, MBTOC is uncertain of the quantity of MB to recommend. The Party has been asked to supply the needed information. Therefore the final evaluation for this CUN will be found in the October MBTOC report.

The total MB volume nominated in 2012 for non-QPS post-harvest uses, was 33.501tonnes. Of the nominations in 2012 for 2014, MBTOC recommended 29.518 tonnes (Table 9.10 and 9.11). Table 9-11 provides the MBTOC-SC interim recommendations for the CUNs submitted.

Table 9-10: Summary of the interim recommendations by MBTOC SC (in square brackets) for CUE's for postharvest uses of MB (tonnes) for 2014 submitted in the 2012 round.

Country and Sector	**Nominated in 2014**	**Recommendation for 2014**
Australia. Packaged rice	**1.187**	**[1.187]**
Canada. Mills	**5.044**	**[5.044]**
USA		
1. Commodities	**0.740**	**[0.487]**
2. Mills and Food Processing Structures	**22.800**	**[22.800]**
3. Cured Pork	**3.730**	**[Unable to Assess]**[A]
USA Sub total	**27.270**	**[23.287]**
Total	**33.501**	**[29.518]**

Table 9-11: Final evaluations of CUNs for structures and commodities submitted in 2011 for 2014

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for2007[3]	CUE for2008[4]	CUE for2009[5]	CUE for2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUN for 2014	MBTOCrec. for 2014
Australia	Rice	6.150	6.150	.205	9.200	7.820	6.650	4.87	3.653	2.374	**1.187**	**[1.187]**

MBTOC Recommendation for 2014:

MBTOC recommends 1,187 kg of MB, the amount nominated by the Party, for use on packaged rice in 2014.

Nomination by the Party:

The Party nominated 1.187 tonnes, a 50% decrease of the amount of MB granted by the Parties for this use in 2013.

Circumstances of the Nomination:

The nomination is for packaged rice. The Party confirmed its phase out plan nominating in 2012 for 2014 as a final transition year with the aim that in 2015, there would be no further MB CUN nomination. The Party indicated that regardless of the volumes of rice harvested, this phase out plan would be carried out. Fifty percent of all non QPS MB use is being recaptured.

The Party indicates that the applicant is pursuing the adoption of phosphine for treatment of rice in silo bins and in fumigation chambers. They are planning to fumigate milled rice in silo and conduct chamber fumigations on packaged rice. As explained to MBTOC on previous occasions and in the current CUN, the applicant does not yet have the required facilities to deal with the lengthy exposure times required for phosphine. They are currently working through this project and the first stage of construction is going into the 2012 capital budget. It is expected that construction of the first stage will be in 2012 and the second stage in 2013 through early 2014, in line with their phase out plan.

MBTOC Review and Assessment:

MBTOC notes that these applications with phosphine will only succeed in controlling the developmental stages of Sitophilus spp. if the appropriate temperature (> 25°C) occurs during the treatments and if the treatments will last for 72-144 hours.

The Party submitted the results of a research study on the efficacy of sulfuryl fluoride (SF) to control the pests of rice. MBTOC notes, however, that the treatment of packaged rice with (SF) is not registered in Australia. In the research the temperature of the reported trials was far below the levels that are necessary for achieving complete control of all stages including the eggs of pest insects like Sitophilus spp., Tribolium spp. and Plodia spp. MBTOC recommends further experiments with SF at temperatures of 26°C or above. The Party in its response to MBTOC noted that the temperature of rice after milling is 30˚C, and so a reasonable temperature for SF effectiveness should not be difficult to achieve. MBTOC encourages the Party to continue its research effort to generate data in support of SF registration for this purpose in Australia because of the need for an alternative should resistance to phosphine occur.

To ensure the success of the adopted alternative, the Party should thoroughly conduct 1) disinfestations of raw rice prior to packaging to control especially the internally feeding Sitophilus spp. and 2) disinfestation of processed rice in packages.

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for2007[3]	CUE for2008[4]	CUE for2009[5]	CUE for2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUN for 2014	MBTOCrec. for 2014
	1) After milling of the rice, which is a control method in itself for externally feeding stored product pest insects, the fairly high temperature of 30°C should immediately be used to carry out any disinfestations measure. Internally developing Sitophilus stages do survive some milling. 2) If any holes are pinned into the packages to avoid package ballooning it must be ensured that their size remains always below a diameter of 0.1 mm to prevent young larvae of externally feeding species from invading these packages and resulting post-process re-infestation. Independently of what kind of fumigant is used for disinfestation of packages, the permeation or diffusion of the gas through the plastic laminate is a crucial factor for control. SF is even a less penetrating gas than MB and phosphine. So, the fumigation of packages will only be successful if there are enough openings. Improvements in pest control will improve rice quality and a recent report indicates that consumers may be inclined to pay more for rice when improved pest control techniques have been used (Su et al, 2012, in press) Tribolium and Plodia complaints indicate post-process reinfestation. Insect-tight packaging should be used to protect the processed rice products to prevent pest infestation while the product is in the food chain. Perforated packages will possibly allow postpackaging infestation. As part of the reason supporting its request for MB for packaged rice, the Party cites product returns costing $AU 3,440 in 2009 related to pest infestation of product. The Party notes that reducing these claims has been a focus of the rice company for the past several years and that use of MB has been part of their pest control system that has since 2002 resulted in significant reduction in claims against the company for insect contamination. The Party was unable to inform MBTOC about the species of insects involved in the claims; this information would indicate whether the insects were those that might have survived milling (Sitophilolus oryzae, for example) or those that likely entered the packaging after milling (Plodia interpunctella for example). The Australian rice company, as many other companies, punches holes in their packaging to facilitate stacking, but as the recent reviews by Athanassiou et al. (2011) and Bell (2011) detailed, these holes can easily allow larvae and even small adults of certain pest species access to infest the product after packaging. This can occur during transport or in the marketing channel. Use of MB does not prevent this type of infestation. **MBTOC Comments on Economics 2012:** The Party reports the applicant is making the necessary investments in silos and chambers to allow it to complete transition to phosphine. **Comments Requested in Dec. XX1/11 (para 9):** • Dec. IX/6 b(i) Emission control: Fifty percent of all non QPS MB use is being recaptured. • Dec. IX/6 b(iii) Research program: Research on efficacy of SF for packaged rice has not been successful, perhaps due to inappropriate temperature, but SF is not registered for packaged rice in Australia. The applicant is completing its transition to phosphine • Dec. IX/6 b(iii) 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, the selected alternative, is already registered for this use.											

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for2007[3]	CUE for2008[4]	CUE for2009[5]	CUE for2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUN for 2014	MBTOCrec. for 2014
Canada	Mills	47 (included mills and pasta)	34.774	30.167	28.650	26.913	22.878	14.107	11.020	7.848	**5.044**	**[5.044]**

MBTOC Recommendation for 2014:

MBTOC recommends 5.044 tonnes, the amount nominated by the Party, for use in mills in 2014.

Nomination by the Party:

The Party nominated 5.044 tonnes, an approximate 35% decrease of the amount granted by the Parties for this use in 2013.

Circumstances of the Nomination:

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 up to 5 of the 11 mills in the application, 6 fewer than last year's application due to transfer to alternative treatments such as heat and upgraded IPM programs. 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 listed mills are processing semolina or are very large mills with internal grain storages. Mills with internal grain storages present problems with the use of sulfuryl fluoride in the Canadian context because there is no food contact tolerance and it is not possible to completely empty internal grain storages before a fumigation.

The Party notes that mills producing semolina from durum wheat cannot use entoleters as an end process to ensure complete insect control on finished product because the process would reduce semolina size making it unsuitable for pasta production.

Barring any unexpected event, The Party notes this is the last year the Canadian National Millers Association (CNMA) intends to present an aggregated request from all flour millers. The Party notes that future nominations will be done by an individual mill on an as-needed basis.

MBTOC Review and Assessment:

Pertaining to the Party's concerns on insects in semolina as a reason for using MB, Bhuvaneswari *et al.,* 2011, indicates that specks, commonly agreed to be an indicator of low quality in finished pasta and couscous, originated in part from insect fragments. However, MBTOC considers that processes and techniques to eliminate insects in wheat and during early milling processes would have a more important impact to remove insects than mill fumigation in this instance. Insects remaining in semolina will be killed by the heat processes used to make couscous or pasta. In this and past CUNs, however, MBTOC notes and accepts that the presence of pests in mills, alive or dead, is unacceptable from viewpoints of regulatory inspection, commercial standards, consumer expectation and human health.

MBTOC notes that there has been substantial investment in upgrades in construction aspects which have significantly improved gastightness in some mills. Evaluation of alternatives to methyl bromide in progress include: heat treatments; ECO_2Fume (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/or fumigations with

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for2007[3]	CUE for2008[4]	CUE for2009[5]	CUE for2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUN for 2014	MBTOCrec. for 2014
	one of the fumigants mentioned above. Large mills have difficulty with heat treatment because of heat sinks and slow heat transfer in wood. 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 use of phosphine is a cause of concern because of the potential for corrosion of electronic components and for the likelihood of developing pest resistance when there are repeated applications of short exposures at warm temperatures which result in pest survival. The results of current trials with SF have indicated poorer than expected efficacy, it would seem because adequate temperatures of 26˚C (80˚F) or above are not being maintained and the vulnerability of concentration level maintenance in windy conditions, resulting in the survival of eggs of red flour beetle. This is significant because red flour beetle is the pest of most concern in Canadian mills. This was most recently confirmed by Hawkin *et al*, 2011. For all alternatives, the 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, with forthcoming new food safety legislation in the US, is increasing the pressure to raise the already high efficacy levels of treatments to eliminate pests. Mills in Canada have to operate according to a "Required efficacy" standard which means no live insects, including eggs, in milled grain product fractions leaving the mill for customer destinations across the continent. There is registration of SF for empty facilities but the widening of this registration originally expected in the summer of 2009 has stalled, perhaps due to concerns raised about its use because of the potential to increase fluoride to unacceptable levels where there are high natural fluoride levels in certain regions of the US. Until such problems can be resolved commercial adoption of SF will be delayed. MBTOC notes that in the EU the use of SF has been more widely accepted if mills discard the first 10 or so tonnes of flour after a SF fumigation. If a similar technical decision could be implemented in Canada it could improve prospects for wider use of SF in Canadian mills. **MBTOC Comments on Economics 2012:** **In past years, the Party has submitted economic analysis with its technical reports; the sector is proceeding with transition to alternatives in spite of higher costs. The CUN is not based on economics. Comments Requested in Dec. XX1/11 (para 9):** • **Dec. IX/6 b(i) Emission control**: Over the years the Party has reported considerable investment in mill improvements to improve sealing and decrease MB use. MB dosage rate is within standard presumptions. Mills are sealed before fumigation to ensure gastightness and ensure the standards for dosage rate are met. • **Dec. IX/6 b(iii) Research program**: 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.,). New mill research has been conducted this year. • **Dec. IX/6 b(iii) Appropriate effort:** As with all postharvest registration issues, neither the applicant nor the Party mandated with Montreal Protocol nominations has control over pesticide registration. SF is not approved for food contact in Canada. A technical decision giving an interpretation clarifying product discard after an SF treatment might encourage wider use.											

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for2007[3]	CUE for2008[4]	CUE for2009[5]	CUE for2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUN for 2014	MBTOCrec. for 2014
United States	Commodities	89.166	87.719	78.983	58.921	45.623	19.242	5.000	2.419	0.822	**0.740**	**[0.487]**

MBTOC Recommendation for 2014:

MBTOC recommends 0.487 tonnes for use in dried fruit and walnuts in 2014, a 34 % decrease of the Party's nominated amount. The recommendation is disaggregated into the following amounts: California walnuts 0.161 tonnes; dates 0.325 tonnes and dried plum board 0.001tonne. If it were to be provided, an updated phase out plan for dates and walnuts would inform MBTOC and Parties of the continued timing of its transition to alternatives.

Nomination by the Party:

The Party had requested 0.740 tonnes for use in dried fruit and walnuts, a 10% decrease of the amount granted by the Parties for this use in 2013.

Circumstances of the Nomination:

Phosphine is the primary fumigant for walnuts in storage, but fumigation takes approximately three days, therefore, when market demands fast turnaround immediately before shipping, methyl bromide vacuum treatment, a 4-6 hr treatment, is still occasionally required. SF would be efficacious, but the Party has documented temperatures at or below 50°F in San Joaquin and Sacramento Valleys of California, their main production areas and this would be incompatible with SF fumigation.

Methyl bromide is used to disinfest dried fruit in storage when the fruit is stored at processing facilities. There are concerns that the use of phosphine would eventually result in some corrosion of electrical and electronic equipment in the processing areas. Phosphine also takes longer to fumigate and would consequently shut down the processing area as well.

Currently, methyl bromide is the only treatment available to rapidly disinfest California dates at harvest time, when up to a million pounds per day are harvested within a relatively tight timeframe during the fall. These dates are harvested by hand, and growers need to get them to the marketplace in three days before fermentation begins. Although several insects may infest dates, the carob moth, *Ectomyelois ceratoniae*, is the most damaging species. The Party reports that the California Date Commission is currently testing the efficacy of sulfuryl fluoride on dates in collaboration with USDA; unfortunately, preliminary results show less than adequate egg kill, even when the amount used is twice that needed for comparable methyl bromide fumigation (Walse, 2011). Phosphine takes longer, 5 to 7 days, to fumigate dates, and during this time the dates ferment, resulting in an off-flavor and an unmarketable product. Dr. Walse's current (and future) research on dates focuses on disinfestations of insects required within hours of harvesting. The ovicidal deficiencies of SF toward several insect species endemic to California has questioned its technical merit, economic feasibility, and regulatory compliance when used in this capacity under local conditions. This critical drawback to SF can be circumvented if it is paired with a potent ovicide over the course of the fumigation process if extra heat cannot be provided. Accordingly, Dr. Walse conducts research that evaluates ovicides to use in concert with SF fumigations.

MBTOC Review and Assessment:

MBTOC believes supplemental heaters could be used to improve the efficacy of treatments with walnuts in the absence of data to the contrary. However, time might be required to gain experience with their use and resolve logistical issues. For this reason MBTOC was able to agree with the recommendation for walnuts

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for2007[3]	CUE for2008[4]	CUE for2009[5]	CUE for2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUN for 2014	MBTOCrec. for 2014
	for this year to allow for the continued transition to alternatives. However, we would expect that this transition would be completed next year since little information has been received on progress in transition. In its 2013 text box on the US dried fruit and walnut CUN, MBTOC noted that there were alternatives available dried plums saying, "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". (MBTOC Oct 2011). In May 2010 MBTOC said, "The USG reported that until viable options with the registered alternatives are further developed, the dried fruit industry has reached the maximum adoption of alternatives. But MBTOC believes there are several lines of action available with registered alternatives to almost entirely avoid the use of MB for dried fruit and nuts. For example, phosphine, cold storage after heat drying to prevent reinfestation and propylene oxide (when used to reduce bacteria and mold, insect pests will also be killed) are alternatives that could be used for the commodities in this CUN. SF is also registered for some of these commodities. In Germany carbon dioxide under pressure is used to disinfest some dried fruits. The industry acknowledges that dried plums are free of insects when they come out of the dryer and that re-infestation occurs fairly soon thereafter; the re-infestation is the reason for these stored commodity treatments. MBTOC's view is that the industry should work to prevent re-infestation and recommends this logistical problem be resolved on a priority basis. The USG said in correspondence that the industry has already transitioned to phosphine where possible, but that MB is needed if treatments need to occur around electronic and electrical equipment. MBTOC does not find this a valid reason. Commodity requiring phosphine fumigation can be moved to an appropriate location for fumigation. The Party states that the California dried fruit and nut industries continue to financially support research on methyl bromide alternatives for postharvest applications, but full reports of these tests have not been submitted to MBTOC." (MBTOC May 2010.) Additionally, new research conducted at USDA laboratories reported, "…biweekly or monthly applications of methoprene plus 1% pyrethrins or esfenvalerate eliminated *P. interpunctella* populations on raisins, as did biweekly methoprene aerosol treatments. The dried fruit and nut industries use fumigants for control of Indianmeal moths… and our simulations show that it may be possible to also use aerosol applications in sites where products are processed, bagged, and stored." (Fontenot, 2012 in press) Therefore, on the basis that there are sufficient alternatives and sufficient time has passed to transition, MBTOC recommends only a minimal 1 kg to allow for access to MB stocks under the US regulatory system. MBTOC agrees with the information provided on dates, the lack of effective alternatives which would result in a marketable product, the assessment of the research results, and the research plan. **MBTOC Comments on Economics 2012:** **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.											

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	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. **Comments Requested in Dec. XX1/11 (para 9):** • **Dec. IX/6 b(i) Emission control**: Fumigations are conducted in chambers of sufficient gastightness. • **Dec. IX/6 b(iii) Research program**: Research on dates has been focussed and ongoing, although the trials were not successful within the regulated requirements. A new research plan has been submitted which hold promise. A combination treatment of SF, carbon dioxide and propylene oxide continues to be researched as preliminary results were positive for dried fruits. • **Dec. IX/6 b(iii) Appropriate effort:** As with all postharvest registration issues, neither the applicant nor the Party mandated with Montreal Protocol nominations has control over pesticide registration. However, there are several alternatives registered for dried fruit and walnuts. Although SF is registered for dates, pest control efficacy cannot be achieved within regulatory limits.											

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for2007[3]	CUE for2008[4]	CUE for2009[5]	CUE for2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUN for 2014	MBTOCrec. for 2014
United States	Mills and processors	483.000	461.758	401.889	348.237	291.418	291.418	173.023	74.510	25.334	**22.800**	**[22.8]**

MBTOC Recommendation for 2014:

MBTOC recommends 22.8 tonnes for use in mills in 2014. The recommendation is disaggregated into the following amounts: rice milling, 2.220 t; for pet food facilities 4.199 t; for mills 16.38t. If it were to be provided, an updated phase out plan would inform MBTOC and Parties of the continued timing of its transition to alternatives

Nomination by the Party:

The Party nominated 22.8 tonnes, a 10% decrease of the amount granted by the Parties for this use in 2013

Circumstances of the Nomination:

USG is requesting methyl bromide for this sector to allow time for the industry to purchase equipment, modify structures, and/or practice using alternatives.

Pertaining to heat treatment, two companies with several mills and food processing plants have converted nearly all of their facilities, but are having difficulty with some facilities. For example, the Party reports that despite successful use of heat in other facilities, in one “problem” mill it was not possible to maintain sufficiently high temperature for an appropriate exposure period to kill all stored product pests present. The company concerned is trying to determine how to address the problem of a heat sink in that mill. Another company has encountered difficulties attributed to the failure of heat to penetrate wall voids in order to kill the pests harboring there. Treatment of some facilities has resulted in the formation of “hot spots” which damaged epoxy flooring, electronics, wood and plastic computer components in the facilities. Another mill has a corrugated sheet metal wall that is unable to maintain high enough temperatures for the length of time needed to kill the insects in the area.

Although there have been good advancements in the availability of appropriate heat treating equipment available to this sector, there are still localized problems in hot regions which do not normally need external heat equipment. So, while steam, electric or forced air gas heaters are available to this sector in most regions, two companies in California and Louisiana reported difficulty obtaining heat equipment at this time.

The Party reported that, should a facility need fumigation during cold months, SF may not be a cost-effective solution because of the requirement to use supplemental heat and additional dosage.

Pertaining to the use of sulfuryl fluoride in the sectors included in this CUN, there has been no regulatory change; SF is allowed for use in mills and rice processing but not allowed for contact of pet food and for the mixes and multiple ingredients present in many bakery products often found in some mills which produce such foods. If such foods are present, they cannot merely be tarped off during a fumigation and the Party says its applicants indicate that completely removing all products would present significant logistical challenges.

Barakat et al. (2011) described the necessary amount of SF for control of *Plodia interpunctella* eggs of different age at 27°C within one to four days stating that the ct product for these times is not constant but decreasing with longer exposures than two days. This indicates the possibility of controlling this pest at fairly low SF concentrations of 2 g/m³ by expanding the exposure to 96 hours. The Party could also refer to the MBTOC Progress Report of 2011 for the Special Report on SF Efficacy for a more thorough discussion of how to achieve efficacy in mills when using SF.

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for2007[3]	CUE for2008[4]	CUE for2009[5]	CUE for2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUN for 2014	MBTOCrec. for 2014
	Many pet food manufacturing and storage facilities have converted to alternatives; the Pet Food Institute (PFI) estimates that less than 10 percent of pet food manufacturing facilities, generally older facilities, still use methyl bromide. **MBTOC Review and Assessment:** Most of the facilities in all three of the sectors included in this nomination use alternatives, most of the time. This nomination is for those times when alternatives fail to control a pest problem and facilities must still rely on fumigation to kill insects in the processing equipment, bins, storage spaces, and even the walls of the structure. There are two primary chemical fumigants available to this industry that may accomplish these tasks: methyl bromide and sulfuryl fluoride. Heat is the other main alternative. Sulfuryl fluoride is more sensitive to temperature and is less efficacious on insect eggs than methyl bromide. Heat, a non-chemical option, is also used in this industry to disinfest facilities, but cannot be used in all situations (e.g., where there are problems with heat sinks). This nomination is for facilities, or portions of facilities, that are unsuitable for the alternatives, or where the alternatives are not economically feasible. Pertaining to the Party's reporting of problems with heat sinks, hot spots and penetration problems at a few specific mills, while MBTOC finds that heat is a widely applicable alternative in use at many mills, we also acknowledge that the problems reported are also consistent with its experience and published research. Some of these problems are surmountable, some are not. We cite noted Kansas State Professor Dr. Subramanyam who said, heat treatment is an art (but he did not say it is impossible!) (Beckett *et al*, 2007; Subramanyam *et al,* 2011) The lethal effects of sulfuryl fluoride (SF) are highly dependent upon temperature and MBTOC recommends that SF treatments occur at above 26˚C (80˚F) to ensure the treatment kills pest eggs. MBTOC noted that some companies own mills in both Canada and the United States, and that Canadian mills have adopted heat treatment to a much greater extent than American mills. MBTOC asked the Party to explain the technical or structural differences between the mills or sectors, which would affect pest control matters. The Party provided technical reasons for differences between the two milling regions with which MBTOC could agree. The geographical locations, structural components, and building configurations make each facility unique and there is no single method of pest control that works in all instances. For example, representatives of some of these types of companies reported that in the southern United States there is pest pressure year round at much higher levels than they experience in their facility in Canada. A company that has a facility in the Midwest of the United States has a problem with prevailing winds preventing them from maintaining heat for effective kill in that area; however, they have converted all their other mills to the alternatives. Phosphine, is used in combination with heat and CO_2 in some Canadian mills, but the use of phosphine can be a cause of concern because of the potential of corrosion of electronic components and the likelihood of development of pest resistance when there are repeated applications of short exposures at raised temperatures which result in survival. Research in mills has focussed lately in IPM aspects to decrease pest presence, to monitor pests so they can be controlled when localized before spreading, to control pests in warehouses and where food mixtures are present (where SF cannot be used because of lack of regulatory approval). In overview, these approaches work to prevent the need for full site fumigations, allow improved efficacy of spot treatments and allow IPM treatments to function without full site fumigations. As examples, Fontenot et al, 2012 examining the effectiveness of aerosols and insect growth regulators noted that that single applications of a contact insecticide or aerosol may not be sufficient to manage *P. interpunctella* populations over a 6-month period but some of the biweekly and monthly insecticide treatments were predicted to be effective for management of *P. interpuctella (*Fontenot *et al,* 2012 in press). Investigating whether the use of											

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	methoprene aerosols could synergistically act with heat or cold treatments to control pests, Wijayaratne and Fields (2010) found that adult *T. castaneum* exposed to methoprene were less heat tolerant, although there was no such effect on larvae nor when exposed to cold treatment. Wijayaratne et al, 2011, also found that methoprene, an aerosol whose pest control action is thought to diminish fairly quickly after application will still reduce reduce populations of *T. castaneum* by reducing their progeny production, even if adults emerge. Pet food sector has a particular problem in that SF cannot be used to disinfest pet foods because it is not labelled for that purpose. The processing of pet foods is itself a disinfestation process, but the rich nutrient content of pet foods is highly attractive to pests. A recent examination of the locations and movements of pests in a pet mill indicates that IPM improvements especially rigorous hand sweeping of the production area, rejection of poor quality incoming products, closing doors between production and warehousing areas, cleaning and monitoring resulted in decreased pest infestation (Belda *et al* 2011). Holcomb and McLean (2010) reported on an IPM approach in pet food processing plants and warehouses. The authors have had success in controlling pests in these facilities for over 5 years. They ensure outside sanitation around plants and warehouses. They also try to reduce introducing pests by inspecting incoming ingredients and goods to ensure they are "clean;" maintaining screens at windows and doors; and placing lights so that insects are not attracted to openings. Microsanitation and pest control access are stressed in Holcomb and McLean's (2010) IPM approach. Holcomb mentioned during his MBAO presentation that companies need to hire a sanitation team to ensure that the facility and all equipment could be thoroughly cleaned every 30 days to break the life cycle of stored product pests (which is typically about 45 days). (Holcomb and McLean, 2010). Additionally, it is known that heat treatment either full site or spot heat treatment of rooms or equipment has been efficient in most pet food establishments. With the new, clear details provided on the IPM approaches that are effective in pet food establishments indicated in the research reported above, and the use of heat, MBTOC signals that unless significant new, specific and detailed data is provided showing that IPM and heat is not effective for the remaining pet food establishments, it would not support a recommendation for pet food for 2015. **MBTOC Comments on Economics 2012:** Improved financial information was provided, verified from third party sources. In both alternatives examined costs of treatment increase. However, this increase is only a miniscule fraction of gross margins. In the case of postharvest CUNs one would also want to look at the proportionate change in costs. In both these cases this is however also small. In summary, the nomination is not based on economic grounds, and it would be difficult to recommend an exemption on economic grounds. **Comments Requested in Dec. XX1/11 (para 9):** • **Dec. IX/6 b(i) Emission control**: Mills are sealed before fumigation to ensure gastightness and ensure the standards for dosage rate are met. • **Dec. IX/6 b(iii) Research program**: Extensive research program. USDA research for mills is focussed on IPM aspects such as monitoring pests, use of volatiles and pest modelling. A USDA-NIFA Methyl Bromide Transition Grant is supporting an investigation of the major pests in the rice mills, and the spatial and temporal distribution of those pests within the rice mill. • **Dec. IX/6 b(iii) Appropriate effort:** As with all postharvest registration issues, neither the applicant nor the Party mandated with Montreal Protocol nominations has control over pesticide registration.											

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for2007[3]	CUE for2008[4]	CUE for2009[5]	CUE for2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUN for 2014	MBTOCrec. for 2014
United States	Cured pork	67.907	40.854	18.998	19.669	18.998	4.465	3.73	3.730	3.730	**3.730**	**[U]**

MBTOC Recommendation for 2014:

MBTOC expects to be able to recommend MB for use in dry cured pork in 2014, but is currently unable to determine the correct volume of MB to recommend.

Nomination by the Party:

The Party nominated 3.73 tonnes, the same amount as was granted by the Parties for this use in 2013.

Circumstances of the Nomination:

Currently there are no viable alternatives to methyl bromide for Southern dry cure pork, a regional traditional product; heat would alter the product, and phosphine has failed to control mites, a major pest. Sulfuryl fluoride received federal registration and has been tested for efficacy against the mites and other pests of cured meat products. Although mortality of the red-legged ham beetle (*Necrobia rufipes*) occurred at levels below maximum rates of sulfuryl fluoride, control of the ham mites took three times the legal limits of sulfuryl fluoride (Phillips, et al., 2008). At the time of this nomination, there are no known registered alternatives for use on hams in the U.S. that provide the same level of mite control as methyl bromide. Research is still ongoing with phosphine, but more research and commercial applications need to be conducted before any treatment can be considered an alternative to methyl bromide for treatment of ham (mold) mites.

There is an ongoing multi-university, multi-state research program which is focused on improving meat processing sanitation, IPM and pest control. So, for example, the Party reports, Processors are now trying to steam clean, bleach, or both to sanitize and their aging facilities when the hams are gone and before new hams are introduced. In addition, some changes to a few facilities have taken place, such as cement floors that they can power wash with steam and bleach. While this has not eliminated the pests, it does take longer before hams are infested with mites, ham beetles and/or ham skippers.

In addition, prior to the phase-out of methyl bromide this industry tended to fumigate on a monthly basis. Plus processors brought in new hams into aging houses that had contaminated old hams. This is no longer the case. Processors keep new hams away from the older hams, many have subdivided their aging house space. Processors are only fumigating when the pests, or signs of the pests, are present.

MBTOC Review and Assessment:

MBTOC has closely followed the research in this difficult pest control problem and agrees that no pest control has proven effective at this time. However, although MBTOC intends to make a recommendation for MB use for cured pork in 2014, we are unable to recommend a volume. MBTOC requires the Party to supply the following information: a total true volume of the aging rooms which are fumigated in each facility, irrespective of the number of fumigations. In other words, if one of the applicants' aging rooms is fumigated 3x/yr we do not want them to multiply the volume of their aging room 3x and then report that as the volume. We then need to know the average of how often each aging room is fumigated annually by each applicant.

For any future nomination for this sector, MBTOC would like actual MB use data; we believe there are only a few MB applicators working in this sector. We would like an explanation for the variation in the dosage rate used by the applicants and what actions are being taken to decrease the dosage rates through facility improvements and improvements in gastightness. We have read with interest the advances being made in sanitation and IPM but we wonder why this has not

Country	Industry	CUE for 2005[1]	CUE for 2006[2]	CUE for2007[3]	CUE for2008[4]	CUE for2009[5]	CUE for2010[6]	CUE for 2011[7]	CUE for 2012[8]	CUE for 2013[9]	CUN for 2014	MBTOCrec. for 2014
	resulted in a decrease in MB use over time; the CUN in this sector has requested the same amount for several years. MBTOC is concerned about the number of repeat fumigation in some facilities, but we do not know enough about the ability of sanitation methods to minimise mite and other pest numbers from ham aging rooms. Have the meat scientists involved in the multi-university research study fully examined the USDA-approved disinfectants available for their insecticidal and acaricidal properties? MBTOC members, knowing that the Party and its research scientists are grappling with a difficult challenge, would like to report that it can propose some other alternatives which work with similar cured meat products in Europe. (Although we acknowledge that each country's cured meat products have variations which may affect infestation issues.). Different types of Ham products are produced in Spain (in the south - Jabugo, in the Pyrenees – Serrano), France (Bayonne), Italy (Parma). Similar mites problems but no MB is used in these areas. In the EU the use of any pesticide is not approved on hams. Procedure to avoid mite problems rely on sanitation, modernization of structures, fumigation of empty structures with PH3 and other authorized pesticides, dipping the hams in olive oil and lard at 90ºC (control of superficial mites), strict control of the RH during the process (initial 75 % to allow salt penetration and afterwards gradually decrease to 65%), control of moulds in the ham surface. Update the old ham houses to modernize them into modern meat processing facilities would assist to avoid pest infestations. In the next phase of the research planned in the US, we could recommend to increase the temperature to at least 30ºC in order to achieve control of eggs effectively. Also they could try double PH3 fumigation with the timing done to catch the growth cycle. This has been demonstrated with other species. Physical exclusion by means of fine mesh or air blowing out of the curing chamber could help avoid mite infestation. Lehmset *al* (2012, in press) showed that nets of 30 µm were sufficient to keep out all stages of the mite *Tyrophagus putrescentiae*. This needs to be confirmed in commercial process. Also, the mesh could be used to form a shroud over the hanging shelves of hams to keep mites infesting the aging room from attacking the clean hams. **MBTOC Comments on Economics 2012:** The CUN is not based on economics. **Comments Requested in Dec. XX1/11 (para 9)** • **Dec. IX/6 b(i) Emission control**: 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. Producers have modified their buildings both to make them more gas-tight and to exclude pests. • **Dec. IX/6 b(iii) Research program**: . 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. • **Dec. IX/6 b(iii) 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.											

[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, [9]MOP23

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ANNEX 1 TO CHAPTER 9: 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 9: MINORITY REPORT ON THE ASSESSMENT OF THE CRITICAL USE NOMINATIONS FOR METHYL BROMIDE

- Minority Report Sections 1-8 signed by Tom Batchelor and Antonio Bello
- Minority Report Section 1 signed by Janny Vos on "*Procedures used by MBTOC for the assessment of nominations for critical uses of MB*"

The Parties have requested MBTOC to determine if a proposed use of MB qualifies for a critical use exemption, in the light of specific criteria contained in Decision IX/6 and other relevant Decisions. In Decision XVI/4, the Parties adopted *"Working procedures of the Methyl Bromide Technical Options Committee relating to the evaluation of nominations for critical uses of methyl bromide"* that stated:

"*Decision IX/6 is the basis for the assessment of critical-use exemptions by MBTOC.*

While the burden of proof remains with the nominating Party to justify the request for a critical-use exemption, MBTOC in its report should indicate whether the nominating Party has provided the information in order for MBTOC to determine that the Party has met the applicable criteria set out in decision IX/6 and related decisions.

Exemptions must fully comply with Dec IX/6 and other relevant decisions, and are intended to be limited to the levels needed for critical-use exemptions, temporary derogations from the phase-out of methyl bromide in that they are to apply only until there are technically and economically feasible alternatives that otherwise meet the criteria in decision IX/6. MBTOC should take a precise and transparent approach to the application of the criteria"[34].

"MBTOC is requested to summarise in the table on its recommendations for each nomination information on adherence with each criterion set out in decision IX/6(1)(a)(ii) and (b)(i) and (b)(iii) and other relevant decisions of the Parties" [35].

Decision IX/6 "*Requests the TEAP to review nominations and make recommendations based on the criteria established in paragraphs 1 (a)(ii) and 1(b) of Decision IX/6*":

Decision IX/6 1(a)(ii): "*That a use of methyl bromide should qualify as "critical" only if the nominating Party determines that 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.*"

Decision IX/6 1(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 minimize 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*;

[34] Paragraphs 30 to 32 of **Annex IA of the 16th Meeting of the Parties:** Working procedures of the Methyl Bromide Technical Options Committee relating to the evaluation of nominations for critical uses of methyl bromide **: P79.**

[35] Dec XXI/11(9): Critical uses of methyl bromide.

iii) *It is demonstrated that an appropriate effort is being made to evaluate, commercialize and secure national regulatory approval of alternatives and substitutes …. Non-Article 5 Parties must demonstrate that research programmes are in place to develop and deploy alternatives and substitutes*".

The minority report is also submitted in accordance with the TEAP Terms of Reference states that '*…reports must reflect any minority views appropriately*'[36].

1. Procedures used by MBTOC for the assessment of nominations for critical uses of MB

1) Some MBTOC members did not complete and sign an updated "*Declaration of Interest"* (DOI) Form for 2012. In addition, many members did not sign MBTOC's "*Categorisation of Interest Form*" (COI) which aims to identify members who may need to be excluded from discussions on specific CUNs. A simplified and clearer *COI Form* needs to be developed. To avoid a conflict of interest in the assessment of CUNs, both the *DOI* and *COI Forms* need to be completed and signed so that any potential conflicts are clearly identified and managed.

2) MBTOC did not take *'… a precise and transparent approach to the application of the criteria…*' and did not *'… limit the recommendations of MB to the levels needed for critical-use exemptions*'[37]. The meeting had insufficient time to align MBTOC's assessment procedures with the criteria in Decision IX/6 and other relevant decisions. This Minority Report (Sections 2-7) provides examples of MBTOC interim recommendations for CUNs that did not meet the criteria in Decision IX/6.

3) MBTOC was unable to develop "*… its recommendations in a consensus process that includes full discussion among all available Committee members and should ensure that members with relevant expertise are involved in developing its recommendations*"[38] for several reasons:

- The 'Structural & Commodities (SC)' subcommittee of MBTOC met in Berlin (Germany, 8 members) while MBTOC convened at the same time in Beijing (China, 18 members);
- The SC meeting finished one day earlier than MBTOC's meeting in Beijing, thereby making it impossible for plenary discussions by Skype on the final day of the meeting in Beijing; and
- The draft SC text boxes assessing each postharvest CUN were not available for review and discussion during MBTOC's plenary meeting in Beijing.

The Parties may wish to consider clarifying the minimum number of members necessary for a quorum for agreeing recommendations by consensus, as 17 MBTOC members[39] meeting in Berlin were fewer than 24 members required for a quorum[40].

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[37] Paragraphs 30 to 32 of **Annex IA of the 16th Meeting of the Parties:** *Working procedures of the Methyl Bromide Technical Options Committee relating to the evaluation of nominations for critical uses of methyl bromide***, p79.**

[38] Paragraph 4 of Decision XXII/6.

[39] One member left prior to the plenary review of the nominations

[40] TEAP Terms of Reference, paragraph 3.3 says: *'The rules of procedures of the Montreal Protocol will be followed in conducting meetings of the … TOCs…'* Source: Handbook 2009 Eighth edition, p477. The Montreal Protocol's *Conduct of Business* Rule 30 says: *'… any decision taken when representatives of at least two-thirds of the [Members] are present*'. Source: Handbook 2009 Eighth edition, p553. MBTOC has 35 members in March 2012 and therefore a quorum of two-thirds would be 24 members.

Consensus was not achieved by MBTOC in plenary for MBTOC interim recommendations affecting seven of the nominations.

2. Nomination submitted by USA for the critical use of MB for strawberry fruit in California in 2014

MBTOC recommended 343,740 kg of MB as "*critical*" in 2014 for uses where it considered these 1,3-D/PIC, PIC alone, metam sodium (alone or with PIC or with 1,3-D/PIC), and methyl iodide alternatives could not be used due to regulatory restrictions on their use e.g., township caps, buffer zones. However, in its calculations MBTOC failed to give sufficient consideration to three key "*MB substitutes*": 1) Non-chemical alternatives 2) Buffer-zone reduction credits 3) Metam sodium alone.

Non-chemical alternatives: The California Strawberry Commission survey data showed that organic production increased from 245 ha in 2003 to 790 ha in 2012. This equates to an average increase of 60 ha per year of organic production over the past 9 years. MBTOC considered a small increase of 10 ha in 2014 for a number of non-chemical alternatives, including organic production. The area of non-chemical alternatives needs to be re-calculated and considered in MBTOC's interim recommendation for critical uses of methyl bromide.

Buffer zone reduction credits: Any regulatory action that reduces the buffer zone area presents an opportunity to increase the use of chemical alternatives and thereby reduce MB. Recently, the EPA provided notification of "*Buffer zone reduction credits*" that will go into effect on fumigant labels from 1 December 2012. Currently, there are 20 commercially-available and EPA-approved barrier films that, when used with 1,3-D/PIC (the most commonly used alternative) for example, would qualify for the maximum 60% buffer zone reduction credit, as they were rated as having the lowest permeability to fumigants. The buffer zone area around the area where alternatives are used needs to be re-calculated and considered in MBTOC's interim recommendation.

Metam sodium alone not considered: MBTOC calculated the area of metam sodium applied in combination with other chemical products, which is how the product is typically used in California. However, MBTOC did not calculate the area of metam sodium used with non-chemical cultivation practices as this was assumed to be a minor use. However, MBTOC acknowledged that "*… in the most recent PUR data (2003-2010) … alternatives namely 1,3-D, Pic and metam have been widely adopted in the [Oxnard, Watsonville/Salinas and Santa Maria] production districts*"[41]. MBTOC needs to examine the PUR database to determine the area of metam sodium used with other non-chemical cultivation practices that could replace methyl bromide, and to reduce its recommended amount for the critical uses of methyl bromide accordingly.

Suspension of methyl iodide sales: In the range of alternatives available for 2014, MBTOC assumed in its calculations that methyl iodide would replace a significant proportion of the MB. Methyl iodide was assumed to be about 30% of the alternatives used in 2014 for strawberry production in California. MBTOC agreed in Beijing that, following a discussion on that extent of the future use of methyl iodide in California, it would need to "*re-assess the nomination if methyl iodide becomes unavailable*"[42]. This outcome has eventuated. Almost three weeks after MBTOC's meeting concluded, the manufacturer of methyl iodide announced *"… the immediate suspension of product sales for all formulations of methyl iodide in the United States … based on a review [by the manufacturer] of the fumigant's economic viability in the US*"[43]. Even though the fumigant may remain registered, the company is not willing to sell the fumigant in the US from 20 March 2012 and therefore it is most unlikely to be available in 2014 in California.

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41 MBTOC. 2012. MBTOC Assessment: Text Box for US Strawberries.

42 MBTOC. 2012. MBTOC Assessment: Text Box for US Strawberries.

43 Press release. 20 March 2012. Arysta LifeScience Suspends MIDAS in the United States.

MBTOC will need to recalculate the amount of MB that can be replaced with alternatives, based on its new assumption that methyl iodide will not be available in 2014 in California.

Conclusion: The interim recommendation by MBTOC was not agreed by consensus. MBTOC's recommended quantity of methyl bromide for critical uses does not consider non-chemical alternatives, buffer zone credits and the use of metam sodium alone. The interim recommendation does not demonstrate that use and emissions have been minimised in accordance with Decision IX/6(1)(b) and Decision XXI/11(9). MBTOC agreed to re-assess the nomination if methyl iodide becomes unavailable. For these reasons, TEAP is invited to re-categorise the nomination as "*unable to assess*" in this TEAP Progress Report pending re-calculation of MBTOC's interim recommendation.

3. Nomination submitted by Canada for the critical use of MB for strawberry runners on Prince Edward Island in 2014

The amount of MB requested for strawberry runner production on 65 acres of land on Prince Edward Island has remained the same for the last four annual nominations. Chemical alternatives permitted for use in Canada are not permitted by local authorities because of concerns with groundwater contamination which limits the options to replace methyl bromide.

Strawberry runner certification: Globally, most strawberry nurseries produce strawberry runners according to regulations that mandate the use of soil fumigants for 'certified' material (Porter *et al.* 2006[44]). Runners exported from these programmes have two certificates – one for compliance with 'certification' pertaining to fumigants used on the land on which the runners are grown, plus a general phytosanitary certificate that is issued if plant material is exported.

The nomination did not describe any regulation in Canada that mandates the use of methyl bromide for runner production on Prince Edward Island. The Party confirmed that strawberry runner plants for export were issued with a general phytosanitary certificate, which would be issued for any plant material exported from Canada. Furthermore, the dosage of MB to produce uncertified runners should comply with MBTOC's Standard Presumption for nursery plant material of "*no more than 15 gm^{-2} with barrier film*"[45]. MBTOC's Standard Presumptions have been approved by the Parties[46]. MBTOC's interim recommendation was based on a dosage rate of 20 gm^{-2} with film, as MBTOC assumed regulations required the nursery land to be fumigated with methyl bromide which is not the case. MBTOC's interim recommendation for 25% more methyl bromide for critical uses does not demonstrate that all steps have been taken to minimise MB dosage and emissions, as required by Decision IX/6(1)(b) and Decision XXI/11(9).

Amount nominated not consistent with grower proposed use: The amount nominated by Canada was also not consistent with the dosages proposed by the company that uses MB for strawberry runner production. In practice, fewer acres may be treated with MB in order to retain sufficient MB for treatment of the stock plants at the higher dosage rate.

Insufficient information to make a recommendation: The Prince Edward Island Department of the Environment is not prepared to allow the application of chloropicrin, which is the chemical alternative most likely to replace MB, until Canada's Pest Management Regulatory Agency (PMRA, a federal agency) *"…indicates that groundwater contamination is unlikely in PEI soil conditions*". According to the nomination, "*…the PMRA is expected to publish the final re-evaluation decision for chloropicrin in spring 2012*". As the outcome of the PMRA re-

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[44] Porter, IJ, Mattner, SW, Mann RC, and RK Gounder. 2006. Strawberry nurseries: Summaries of alternatives and trials in different geographic regions. Acta Hortulturae 708, 187-192.

[45] TEAP. 2011. Maximum dosage rates for pre-plant soil uses of MB by sector used in the 2009 and later assessments (standard presumptions). Table 3-5 (page 19) shows a maximum MB dosage rate of 15 gm-2 with barrier film for nursery material to control pathogens.

[46] Annex 1(A) of MOP16; Also in the CUN Handbook, Section 2.1, p13.

evaluation is due shortly and well before the OEWG meeting of the Parties in Bangkok in July 2012, and since this outcome will determine the necessity of MB for critical uses only if chloropicrin is deemed to be unsuitable, MBTOC is required to "… *categorise the nomination as 'unable to assess' if there is insufficient information to make an assessment, and clearly explain what information was missing*"**Error! Bookmark not defined.**.

No demonstration of research programme: According to Decision IX/6(1)(b)(iii), critical uses should be permitted only if a Party '…*demonstrates that an appropriate effort is being made to evaluate, commercialize and secure national regulatory approval of alternatives and substitutes*'. A Party must also demonstrate that '… *research programmes are in place to develop and deploy alternatives and substitutes*'. Canada reported that discussions were underway, but its nomination did not demonstrate that a research programme was in place to develop and deploy alternatives and substitutes. The Party has therefore not complied with the criteria contained in Decision IX/6(1)(b)(iii) that qualify the proposed use for critical uses of methyl bromide.

Conclusion: The interim recommendation by MBTOC was not agreed by consensus. MBTOC recommended 25% more methyl bromide than MBTOC's Standard Presumption for nursery material. MBTOC therefore did not assess the nomination in the light of the criteria contained in Decision IX/6. TEAP is invited to re-categorise the nomination as "*unable to assess*" in the TEAP Progress Report until such time that the MBTOC is informed of the results of the PMRA publication on the re-evaluation decision for chloropicrin; the total amount requested by the Party is consistent with the proposed dosage and area to be treated by the company; and information is provided on a research programme that is in place to develop and deploy alternatives and substitutes.

4. Nomination submitted by Australia for the critical use of MB in rice in 2014

Australia reported that eight chemical alternatives are registered and available for rice disinfestation: Phosphine (ECO2Fume (2% CO2, 98% phosphine); Vaporphos (99% phosphine)); sulfuryl fluoride; pesticides of low volatility e.g., organophosphates insect growth regulators, botanicals; pyrethroids; and carbonyl sulphide. In addition, the nomination listed four non-chemical treatments (heat, inert dust, irradiation, vacuum treatment) that are available and can be used. The nomination stated that "*Phosphine is still considered as the primary alternative to methyl bromide as it is the only alternative demonstrated to be technically and, in the longer term, economically feasible*".

Delays in implementation of available alternative: There have been long delays in the implementation of an alternative. The first cost estimate for the implementation of phosphine was made in 2001, and the most recent estimate was based on costs for 2008. A Transition plan was proposed in 2008 for phosphine to replace all of the MB in 2010. The company has said that financial hardship over many years has prevented investment in an alternative to MB. However, CUN12 in 2010 stated that "*Profits were normal in 2009 (CUN12, page 7)*". The nomination provided no explanation for phosphine not being installed in 2010 or earlier.

No information on gas tightness: The rice company closed parts of its facilities over the past 6 years because of financial hardship. Because of changes to the operation of the rice facilities over time, MBTOC was not able to confirm the fumigation facilities that would be used with any MB for critical uses, their gas tightness and emissions, and the MB dosage that is planned for 2014. The nomination did not demonstrate for 2014 that all technically and economically feasible steps have been taken to minimise the use (dosage) and emissions of MB, as required by paragraph 1(b) of Decision IX/6 for critical uses.

Conclusion: The interim recommendation by MBTOC was not agreed by consensus. MBTOC did not assess the nomination in the light of the criteria contained in Decision IX/6. TEAP is invited to re-categorise the nomination as "*Not Recommended*" in the TEAP Progress Report until such time that the Party demonstrates for 2014 that alternatives are not available, and that

all technically and economically feasible steps have been taken to minimise the use (dosage) and emissions of MB, as required by paragraph 1(b) of Decision IX/6 for critical uses.

5. Nomination submitted by Canada for the critical use of MB for structures in 2014

The nomination submitted by the Party provided information on seven alternatives to MB that are registered, available or being used for the disinfestation of structures: Sulfuryl fluoride (for empty mills, since April 2006), CO2, phosphine, phosphine and CO2, diatomaceous earth, heat (no registration needed) and IPM (registration required for components that are pest control products). The nomination reported that heat treatments, and combinations of phosphine + CO2 + Heat, have successfully replaced MB in mills.

The nomination reported that three of the five mills that produce durum semolina, and two particularly large mills, are the remaining MB users in the re-nomination for 2014. The nomination reported that the use of an entoleter[47] was not practical for the disinfestation of durum semolina in these mills, but provided no reason for the lack of an alternative in the two large mills. Two mills were reported to have undergone "*significant modernisation*" or experimented with heat treatments in 2011, and the results are due to be reported in 2012.

Insufficient information to make a recommendation: In a letter to the Party[48], MBTOC questioned "*…if there had been work on alternatives to MB control of pests where the use of an entoleter is not practical, specifically giving examples of what techniques have worked or not worked over these three years*". The Party has not yet responded. MBTOC is required to *"... categorise the nomination as 'unable to assess' if there is insufficient information to make an assessment, and clearly explain what information was missing*"**Error! Bookmark not defined.**.

Availability of alternatives: The Canadian National Millers Association reported in 2007 that there "*…were 32 wheat mills producing wheat flour, semolina, good grade brand and by products*"[49]. More than 90% of the mills producing durum semolina have therefore implemented procedures that no longer depend on MB. The Party has therefore not demonstrated that an alternative is not available, as required by Decision IX/6.

The Party informed MBTOC in 2008 that "*Although suppliers of semolina (wheat millers) themselves have IPM programs and periodically conduct whole facility fumigation or heat treatment, semolina can be manufactured without successfully destroying all egg stages of insect pests. Mills advertently allow eggs to pass through the final sifting process as eggs are smaller than semolina granules. Mills that produce semolina for pasta manufacturing seek to avoid this through high levels of sanitation and one or two MB fumigations annually. These mills are evaluating alternatives to MB including SF*"[50]. Based on this information provided by the Party, at least heat treatment and sulfuryl fluoride are alternatives that are available to disinfest durum semolina, which is the basis of the nomination for 2014.

No information on gas tightness: In a letter to the Party**Error! Bookmark not defined.**, MBTOC stated that *"Although previously reported in earlier CUNs, we believe that facilities may well have improved over time. Please report the gas tightness of each mill facility, using the format from the nomination for fixed facilities*". Gas tightness information for the five facilities that are requesting MB in CUN14 could not be found in nominations submitted by the Party from 2005 to 20012, which is necessary to demonstrate that all steps have been taken to minimise MB

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47 An "Entoleter" destroys insect life stages remaining in sifted flour by throwing them against the lugs and case of a rotor revolving at high speed.

48 Marcotte, M. 12 Feb 2011. Questions addressed to Mr Marco Gonzalez, Dr Martin Sirois and Team Canada on the Mill CUN.

49 CNMA. 2007. Comparative evaluation of IPM, Heat Treatments and fumigants as alternatives to MB for control of stored product pests in Canadian Flour mills. P3

50 CPMA. 2008. Evaluation of alternatives to MB in Canadian Pasta Manufacturing Facilities in 2007 and 2008. Interim Report. P3.

use and emissions, as required by Decision IX/6. The Party has not yet responded to MBTOC's question.

Conclusion: The interim recommendation by MBTOC for 5.044 tonnes of MB for critical uses was not agreed by consensus. An analysis of the number of mills not using MB shows that the vast majority of them have implemented MB-free disinfestation procedures. The Canadian Pasta Manufacturers Association reported in 2008 that heat treatment combined with integrated pest management programmes (sanitation) is an option for wheat millers producing semolina. Sulfuryl treatment of empty facilities is permitted by the Party and is a technically and economically feasible alternative. TEAP (2012) opines that SF would be more widely used in Canada if millers accepted the European practice of discarding relatively small quantities of product at start up after SF fumigation[51].

The Party has not demonstrated that there are no technically and economically feasible alternatives or substitutes available to the user disinfestation of durum semolina treatment, in accordance with Decision IX/6(1)(a)(ii). The Party is not able to demonstrate that it has taken all technically and economically feasible steps to minimise the use and emissions of MB for each of the five facilities, as gas tightness information that is required under paragraph 1(b) of Decision IX/6 has not been provided. For these reasons, TEAP is invited to re-categorise the nomination as "*Not Recommended*" in the TEAP Progress Report.

6. Nomination submitted by USA for the critical use of MB for commodities in 2014

The nomination submitted by the Party reported that a range of chemical and non-chemical alternatives are registered. They are technically and economically feasible, available and include: Phosphine, sulfuryl fluoride and propylene oxide; heat, IPM/sanitation and pheromone traps, electrocution traps, and light traps to monitor insect pest populations.

Technically and economically feasible alternatives available: The nomination reported that mill owners would be financially better off adopting alternatives to MB. MBTOC found that alternatives for this use have been implemented in other countries and regions in circumstances similar to the nomination, such as Canada where phosphine is combined with CO2, heat and IPM.

Analysis of the data provided in the nomination showed that 99.2% of the MB used for critical uses for commodities had been phased out since 2005. This strongly suggested that technically and economically feasible alternatives had already been implemented commercially.

No information on gas tightness: CUN07 submitted in 2005 stated that "*no information is available as to the type of construction, age, volume, number of facilities, and gas tightness of the diverse types of facilities in this sector*". Since that time and up to this latest submission (CUN14), the Party has not provided information on gas tightness in each facility that proposes to use MB.

Conclusions: The interim recommendation by MBTOC was not agreed by consensus. The nomination reported that a range of chemical and non-chemical alternatives are registered, they are technically and economically feasible, and they have been commercially implemented for the treatment of these commodities. The Party has not demonstrated that there are no technically and economically feasible alternatives or substitutes available to the user in the circumstances of the nomination, in accordance with Decision IX/6(1)(a)(ii). The Party has not demonstrated that it has taken all steps to minimise MB use and emissions in 2014, as required by Decision IX/6(1)(b) and Dec XXI/11(9). For these reasons, TEAP is invited to re-categorise the nomination as "*not recommended*" in the TEAP Progress Report.

[51] TEAP. 2012. Canada / Mills. Draft text box for TEAP Progress Report. In prep.

7. Nomination submitted by USA for the critical use of MB for cured pork in 2014

MB is used in relatively few cured pork facilities in the USA to control pests such as beetles and mites "… *that infest and feed on meat, especially deep inside the meat along the bone, as it cures and ages. Food commodities that exceed the US Food and Drug Administration's maximum limits for live or dead insects or insect parts that may be present in stored food products are considered adulterated and unfit for human consumption.*"[52] The nomination submitted by the Party stated that "…*This industry currently has no viable chemical or non-chemical alternative available … and MB remains critical for the industry*"[53].

Technically and economically feasible alternatives available: The current nomination requested MB for 30 facilities, which is about 3.5% (30/850) of the facilities that previously required this fumigant. Therefore, more than 96.5% of the cured pork facilities in 2014 will not use methyl bromide. The reduction in MB use was attributed by the Party to modifications to the curing facilities and their surroundings[54], sanitation improvements and IPM measures[55]. The nomination did not provide information on the infeasibility of the implementation of non-chemical alternatives in about 3.5% of the cured pork facilities. A chemical alternative, while potentially useful, is therefore not necessary to replace methyl bromide as according to the nomination methyl bromide is not used in more than 96.5% of the facilities. MBTOC recently questioned whether the Party has fully examined the USDA-approved disinfectants available for this use**Error! Bookmark not defined.**, suggesting that the range of alternatives is wider than investigated so far by the Party.

Therefore, the Party did not provide information in 2012 to demonstrate that there are no technically and feasible alternatives or substitutes available to the user that are acceptable from the standpoint of environment and health and that are suitable to the circumstances of the nomination, as required by paragraph 1(a) of Decision IX/6.

Comparative performance of MB and alternatives: The Handbook on MB Nominations states that Parties should '*… provide information on the comparative performance of MB and alternatives, including control of target pests in research and commercial scale up studies*'[56]. Comparative data on phosphine and MB fumigation of mite mortality have not been provided. These data are important as the nomination reported that phosphine was 99.8% effective on mites and 100% effective on beetles. The data may show that the performance of phosphine is equivalent to MB and can be used to replace MB without further trials.

No information on gas tightness: The nomination did not provide sufficient information on the gas tightness of the cured pork facilities in 2012 (or earlier nominations). When considering the use of potential alternatives in existing facilities, the nomination stated that "…*structures are not air tight*" (which would also apply to the use of methyl bromide) and that "*several companies have modified their buildings to make them more gas-tight*". The nomination stated that the gas loss "… in *the majority of the aging housing lose less than 25% in 24 hours, but about a quarter of the structures lose approximately 25-50% in 24 hours*". This indicates that the gas loss is unacceptably large. The volume of the facilities requiring MB has not been defined sufficiently and MBTOC has recently requested the Party provide a more precise figure[57]. The Party did not demonstrate that all technically and economically feasible steps have been taken to minimise the use (dosage) and emissions (gas tightness) of critical uses of MB, as required by paragraph 1(b) of Decision IX/6.

Methyl bromide not recommended for use on a product containing fat: The US reported

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52 ExI/4(3): The US National Management Strategy (2009). Page 13
53 2012 Nomination as CUN14
54 2008 Nomination, page 9
55 2008 Nomination page 7; 2011 nomination page 4
56 TEAP-MBTOC. 2007. Handbook on Critical Use Nominations for Methyl Bromide. Version 6. P57
57 Marcotte, M. 3 March 2012. Letter to Mr Gonzalez and Dr San Martini.

that cured pork is fumigated with MB one to five times per year depending on pest pressure in the cured pork facility[58]. In general MB is readily absorbed by lipid materials and care should be taken to avoid contamination of high fat content foods such as butter, cheese, margarine and meat[59]. The US does not recommend MB fumigation of products containing butter, lard or fats[60]. Residual MB normally desorbs relatively quickly from non-fat products, but it is not readily desorbed from fat products. Previous research showed that MB can be detected up to 3 months after fumigation in refrigerated storage[61]. MB is an alkylating and mutagenic agent. India has banned the use of MB on butter, lard or fats[62]. The use of MB should not be recommended by MBTOC and TEAP for use on cured pork, which is a product that contains fat and therefore MBTOC's interim recommendation is inconsistent with national and international recommendations.

Information missing for an assessment: MBTOC recommended the Cured Pork CUN be categorised as "*unable to assess*", pending further information on the *'…true volume of the aging rooms…*' from the Party. MBTOC reports other information is also required to make a recommendation, but states that this information should be provided "… *for any future nomination*". This other information includes "… *actual MB use data*…", "… *an explanation for the variation in dosage rate*…", "… *actions being taken to decrease the dosage rate* …", " … *why sanitation has not decreased MB use* …", and reasons for " … *repeat fumigations* …"[63].

The authors of this Minority Report are not aware of any criteria in Decision IX/6 that permits MBTOC to defer the provision of information necessary to make an assessment. MBTOC has no basis on which to request *partial information* to make a decision, while listing and then ignoring significant other informational items that are necessary to make an assessment. Information on dosage rate, for example, is required under Decision IX/6 in order for MBTOC to be in a position to assess whether a nomination has minimised methyl bromide emissions and dose.

Moreover, the SC co-chair correspondence to the Party on behalf of MBTOC stated "*Rest assured that there is some correct volume of MB which will eventually be recommended for this CUN*"**Error! Bookmark not defined.**. Such reassurance does not comply with procedures agreed by the Parties that require MBTOC to receive and assess any further information provided by a Party before making a recommendation. MBTOC is required to "… *categorise the nomination as 'unable to assess' if there is insufficient information to make an assessment, and clearly explain what information was missing*"**Error! Bookmark not defined.**.

Conclusions: The interim recommendation by MBTOC was not agreed by consensus. Insufficient information provided by the Party prevented the nomination being assessed by MBTOC according to the criteria contained in Decision IX/6 and other relevant decisions of the Parties. TEAP is requested to retain the categorisation of "*Unable to Assess*" until such time that *all information* necessary to make a recommendation is provided in 2012 for MBTOC to make a final assessment[64].

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58 2007 Nomination, page 18

59 Bond. 1984. Manual of fumigation for insect control. FAO Plant Production and Protection Paper No 54. FAO Website.

60 US. 2010. USDA-PPQ-Treatment Manual. 2-9 Chemical Treatment--Fumigants--Methyl Bromide--Closed-door Container Fumigation

61 Rhodes et al. 1975. Exposure of meat to methyl bromide during refrigerated-store pest control; residues in beef and lamb and effect on quality. J. Food Sci. of Food and Agric., 26(9): 1375-1380.

62 Government of India. 2005. Quarantine treatment and application procedures: I. Methyl bromide fumigation. NSPM 11. Fumigation Forbidden commodities. Pp18-19.

63 TEAP 2012 May Progress Report. Cured pork Text Box. In publication.

64 Annex to Decision XVI/4 (Annex 1 of the Report of MOP16)

8. Nomination submitted by USA for the critical use of MB for structures in 2014

The Party reported that MB is required in 2014 "*…to allow time for the industry to purchase equipment, modify structures, and/or gain experience using alternatives"*[65]. The Party has cited difficulties with the implementation of heat treatments in some situations.

The nomination submitted by the Party reported that at least six technically and economical feasible alternatives are registered, available or can be used singularly or in combination: Sulfuryl fluoride, heat, heat with sulfuryl fluoride, phosphine (pure, and other formulations with and without CO2), and IPM.

Technically and economically feasible alternatives available: Compared to MB, the nomination reports that alternatives are cost effective and sometimes less expensive, safer and more convenient to use. The nomination stated that "*the most critical strategy implemented is integrated pest management (IPM), especially sanitation and equipment design modifications to enable cleaning and inspection in all areas of a facility. SF [is used] to kill pests in the processing equipment, bins, storage spaces and walls. SF remains registered in the US for the uses described in this nomination chapter, and this nomination considers it to be a viable, available alternative. SF and MB treatments of flour mills were not significantly different (Hartzer et al 2010)".*

The Party nominated a fumigation volume of 18,950 m^3 for treatment with MB in 2014. This volume is about 94% less than the amount requested for this use in 2008 by the Party, which indicates that alternatives have been implemented in commercial practice.

The Party therefore reported many alternatives that are available and can be used. MBTOC notes that problems reported by Party, such as corrosion of electrical equipment by phosphine and the impracticality of using sulfuryl fluoride, have been solved in the US and other countries.

The Party has therefore not demonstrated that technically and economically feasible alternatives or substitutes are not available to the users that are acceptable from the standpoint of environment and health and are suitable to the crops and circumstances of the nomination.

No information on gas tightness: As the nomination did not identify the facilities that would use MB in 2014, it was not possible for the nomination to include information on their gas tightness. The number of facilities in each sector (pet food, rice, flour mills) was not provided. The frequency of fumigation of each facility in each sector was not provided. The nomination did not demonstrate that all steps have been taken to minimise MB use and emissions, as required by Decision IX/6(1)(b) and Decision XXI/11(9).

Conclusions: The interim recommendation by MBTOC was not agreed by consensus. TEAP is requested to categorise the nomination as "*Not Recommended*" as the Party did not demonstrate that technically and economically feasible alternatives were not available in the circumstances of the nomination, as required by Decision IX/6. MB requested for this purpose should therefore not be considered as 'critical' as its proposed use does not comply with the criteria that have been defined by the Parties for the 'critical uses of methyl bromide'.

[65] San Martini, F. 25 Feb 2012. Response to MBTOC questions.

ANNEX III TO CHAPTER 9: TEAP COMMENTS ON METHYL BROMIDE MINORITY REPORT

During its annual meeting in Berlin at the end of March 2012, TEAP was briefed on and reviewed the process used to reach recommendations with respect to the Critical Use Nominations (CUNs) submitted for 2014 and beyond. As part of this review, the TEAP took account of a draft Minority Report which had been submitted by two MBTOC members and supported in part by a third.

Firstly, it should be noted that TEAP took careful account of the processes adopted by the MBTOC in reaching its recommendations – respecting the fact that time-scales were tight from the submission of nominations by Parties to the presentation of MBTOC recommendations to TEAP. This was exacerbated by the fact that the TEAP meeting was being held earlier than in previous years. It was also noted that logistics and funding of experts from non-Article 5 Parties for the various sub-committees was particularly challenging, with two MBTOC subcommittees meeting in Beijing and the third in Berlin. Nevertheless, even under these circumstances TEAP is fully satisfied that due process was followed by the co-chairs and their respective sub-committees under difficult conditions.

In initially assessing the Minority Report submitted, TEAP felt that it did not align with the requirements of such a Report as set out in the 2007 TEAP Progress Report – namely:

"TEAP has instructed MBTOC and all TOCs that, when consensus cannot be reached, experts not in agreement with the technical and economic findings of the majority are to be invited to submit signed minority reports substantiating the technical or economic basis of their judgement."

It was noted that this Minority Report strayed into areas of criticism of MBTOC members and also into matters of procedure. These items do not belong in a minority report, and should have been addressed directly to TEAP in the form of a bilateral letter or parallel communication, thereby leaving the 'technical and economical' aspects as the focus of the minority report for publication. At the beginning of its meeting, a TEAP co-chair initiated a dialogue with one of the authors of the submitted draft Minority Report and, over the duration, succeeded in agreeing the removal of a number of comments that fell into the criticism and procedural categories. Since the TEAP annual meeting, the authors of this Minority Report have withdrawn the report and provided a new Minority Report that is contained in Annex II to Chapter 9 of this report.

The Minority Report makes specific requests on TEAP, which are believed to be more appropriately placed in bilateral correspondence and to which TEAP feels no obligation to respond despite the public nature of the request. TEAP's role is one of facilitating consensus amongst the MBTOC co-chairs and it should not be asked to unilaterally over-ride the conclusions of the MBTOC or its sub-committees. However, if TEAP was asked by the MBTOC co-chairs to intervene because they could not reach consensus it would assist as appropriate to resolve any problems. Also, if TEAP had concerns about the technical and economic findings of MBTOC, it would ask for reconsideration by the MBTOC co-chairs.

In respect of procedures relating specifically to recusal, TEAP notes that these are currently under review in response to Decision XXIII/10 and that further guidance may be forthcoming once the Parties have considered TEAP's input into that discussion. Nevertheless, TEAP is satisfied that all MBTOC members revised their Declaration of Interest forms prior to the sessions and that decisions of recusal were appropriately guided by the co-chairs in this respect.

In conclusion, this latest experience has confirmed a need to re-define the means by which minority views are expressed in the future. As with the procedures relating to recusal, TEAP notes that this topic is under review by the Task Force preparing the response to Decision XXIII/10.

In accordance with the current TEAP Terms of Reference, following its review of the final MBTOC report, the TEAP is forwarding the report, without modification by TEAP, to the Meeting of the Parties.

ANNEX IV TO CHAPTER 9 - Part A: Trend in MB Preplant Soil Nominations and Exemptions

List of nominated (2005 – 2014) and exempted (2005 – 2013) amounts of MB granted by Parties under the CUE process for each crop.

Party	Industry	Total CUN MB Quantities										Total CUE Quantities								
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
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	**29.760**	35.750	37.500	35.750	35.750	29.790	29.790	23.840+ 5.95	29.760	**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								
Belgium	Lettuce(&	42.250	22.425									25.190								

Party	Industry	Total CUN MB Quantities										Total CUE Quantities								
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
	endive)																			
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	**5.261**	(a)14.792	6.840	7.995	7.462	7.462	7.462	5.261	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	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
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 solanaceo us)	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						

Party	Industry	Total CUN MB Quantities										Total CUE Quantities								
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
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			
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						

Party	Industry	Total CUN MB Quantities										Total CUE Quantities								
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
Italy	Pepper (protected)	220.000	160.000	67.000								160.000	130.000	67.000						
Italy	Strawberry Fruit (Protected)	510.000	400.000	35.000								407.000	320.000							
Italy	Strawberry Runners	100.000	120.000	35.000								120.000	120.000	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						

Party	Industry	Total CUN MB Quantities										Total CUE Quantities								
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
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							
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	

Party	Industry	Total CUN MB Quantities										Total CUE Quantities								
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
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							
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	**415.067**	2052.846	1730.828	1476.019	1349.575	1269.321	1007.477	812.709	678.004	**415.067**
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								2.768	2.768										

ANNEX V TO CHAPTER 9 – Part B: Trends in MB Structural and Commodity Nominations and Exemptions

List of nominated (2005- 2014) and exempted (2005 - 2013) amounts of MB granted by Parties under the CUE process for each commodity.

Party	Industry	Total CUN MB Quantities										Total CUE MB Quantities								
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
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	**1.187**	6.150	6.150	9.205	9.200	7.820	6.650	4.870	3.653	**1.187**
Belgium	Artefacts and structures	0.600	0.307									0.590	0.307							
Belgium	Antique structure & furniture	0.750	0.199									0.319	0.199							
Belgium	Churches, monuments and ships' quarters	0.150	0.059									0.150	0.059							
Belgium	Electronic equipment	0.100	0.035									0.100	0.035							
Belgium	Empty silo	0.050	0.043									0.050	0.043							
Belgium	Flour mill see mills below	0.125	0.072									See mills below	0.072							
Belgium	Flour mills	10.000	4.170									9.515	4.170							
Belgium	Mills	0.200	0.200									0.200	0.200							
Belgium	Food processing facilities	0.300	0.300									0.300	0.300							
Belgium	Food Processing premises	0.030	0.030									0.030	0.030							

Party	Industry	Total CUN MB Quantities										Total CUE MB Quantities								
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
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	Woodworking 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	5.044	(a)47	34.774	30.167	28.65	26.913	22.878	14.107	11.020	5.044
Canada	Pasta manufacturing 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							
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						

Party	Industry	Total CUN MB Quantities										Total CUE MB Quantities								
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
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								160.000	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							
Switzerland	Mills & Processors	8.700	7.000									8.700	7.000							
UK	Aircraft			0.165										0.165						

Party	Industry	Total CUN MB Quantities										Total CUE MB Quantities								
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
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						
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								

Party	Industry	Total CUN MB Quantities										Total CUE MB Quantities								
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005	2006	2007	2008	2009	2010	2011	2012	2013
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	**0.740**	89.166	87.719	78.983	58.921	45.623	19.242	5.000	2.419	**0.740**
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		
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	**3.730**	67.907	81.708	18.998	19.699	18.998	4.465	3.730	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	**22.800**	483.000	461.758	401.889	348.237	291.418	173.023	135.299	74.510	**22.800**
USA	Research								0.159	0.159										

10 Quarantine and Pre-Shipment uses of methyl bromide – response to Decision XXIII/5

10.1 Introduction

10.1.1 Mandate and scope

Decision XXIII/5 requests the Technology and Economic Assessment Panel (TEAP) and its Methyl Bromide Technical Options Committee (MBTOC), to prepare a report to be considered by the 32nd meeting of the Open-Ended Working Group (OEWG) that:

> *(a) Summarizes data submitted under article 7 of the Montreal Protocol on a regional basis, providing analysis of trends in that data;*
>
> *(b) Provides guidance on procedures and methods for data collection on methyl bromide use for quarantine and pre-shipment for parties that have not yet established such procedures and methods or wish to improve existing ones;*

10.2 Origin and intent of the QPS exemption

At the 1992 Meeting of the Parties in Copenhagen that established methyl bromide as a controlled Ozone Depleting Substance, Article 2H of the Protocol specifically excluded QPS from control measures when it stated, *inter alia*:

> *'The calculated levels of consumption and production …shall not include the amounts used by the Party for quarantine and pre-shipment applications'*

This was the first time that QPS was mentioned in the Protocol documentation. It is notable that in the report of this Meeting of the Parties there was no attempt to define 'quarantine' or 'pre-shipment' (UNEP/Ozl.Pro.4/15), but rather to defer this task to a later meeting.

At the time that Article 2H was documented in Copenhagen in 1992, the Parties understood that there were no alternatives to MB for a diverse range of treatments carried out with MB for QPS. The Parties recognised that although QPS consumption was about 10% of global MB consumption at the time, this volume was nevertheless very significant in allowing inter- and intra-country trade in commodities treated with MB *in the absence of site-specific alternatives*.

10.2.1. Definitions of Quarantine and Pre-shipment

The scope of the QPS exemption set out in Article 2H para. 6 has been clarified in Decisions VII/5 and XI/12 of the Protocol relating to the terms 'Quarantine' and 'Pre-shipment'. TEAP (2002) provided some discussion and examples of cases that might or might not fall within the QPS exemption. There is also discussion of the scope of the exemption from control under the Protocol for QPS uses of methyl bromide in TEAP (1999) and the UNEP/IPPC (2008) publication 'Methyl Bromide: Quarantine and Pre-shipment Uses'.

Differences in interpretation of the scope and application of the QPS exemption by individual Parties have led to some differences in the uses that are reported as QPS (TEAP 2009; 2010). Specifically, the Seventh Meeting of the Parties decided in Decision VII/5 that:

a) *"Quarantine applications", with respect to methyl bromide, are treatments to prevent the introduction, establishment and/or spread of quarantine pests (including diseases), or to ensure their official control, where:*

i. *Official control is that performed by, or authorised by, a national plant, animal or environmental protection or health authority;*

ii. *Quarantine pests are pests of potential importance to the areas endangered thereby and not yet present there, or present but not widely distributed and being officially controlled*

b) *"Pre-shipment applications" are those treatments applied directly preceding and in relation to export, to meet the phytosanitary or sanitary requirements of the importing country or existing phytosanitary or sanitary requirements of the exporting country;*

The definition of 'Pre-shipment' is unique to the Montreal Protocol and it has no equivalent in the International Plant Protection Convention (IPPC) that aims to protect cultivated and wild plants by preventing the introduction and spread of pests. It is given and elaborated in Decisions VII/5 and XI/12 in the Montreal Protocol. The Eleventh Meeting of the Parties decided in Decision XI/12 that pre-shipment applications are *"those non-quarantine applications applied within 21 days prior to export to meet the official requirements of the importing country or existing official requirements of the exporting country"*.

Pursuant to Decision VII/5, official requirements are those, which are "*performed by, or authorised by a national plant, animal, environmental, health or stored product authority*".

The Montreal Protocol's definition covers environmental and other pests that might endanger a region without direct quantifiable economic loss. An interpretation of Decision VII/7 is that the use of methyl bromide as a quarantine treatment may only be for pests that are officially recognised as quarantine pests and must be officially authorised by a competent authority. QPS treatments under the Montreal Protocol relate not only to official phytosanitary treatments, but may also apply to 'sanitary' treatments, e.g., against human or animal pathogens and vectors (e.g. mosquitoes), covered by International Agreements (IAs, multilateral agreements) such as the World Animal Health Organisation (OIE) and World Health Organization (WHO).

Pre-shipment treatments target non-quarantine pests that may be present in both the exporting and importing country. These pests are usually ones that affect storage or end-use quality of the exported commodities, and are outside the direct scope of the IPPC. However, the model Phytosanitary certificate from Guidelines for Phytosanitary Certificates provided in ISPM 12 contains the following clause: "They are deemed to be practically free from other pests.* (optional)". This relates to Preshipment uses where a certification is needed to meet commodity shipping requirements.

10.2.2 Organisation of work

MBTOC-QPS met in Beijing, China, from 27 February to 2 March 2012 to prepare this report. The meeting took place at the same time as that of MBTOC-soils.

The opportunity was further used to visit the Quarantine and Inspection Service at Tanggu, where Chinese officials kindly shared information on QPS issues and showed MBTOC interesting trials on alternatives to MB for quarantine treatments such as vacuum. Recapture was also observed, as well as commercial heat treatment of wood packaging material to satisfy ISPM-15 requirements.

10.3. Consumption and Production of MB for QPS uses

10.3.1 Mandate

Paragraph 5(a) of Decision XXIII/10 requests MBTOC to prepare a concise report that

(a) Summarizes data submitted under article 7 of the Montreal Protocol on a regional basis, providing analysis of trends in that data.

10.3.2 Source of data and analysis

The data on MB-QPS consumption and production in this report were obtained exclusively from the Ozone Secretariat's Data Centre[1] which had compiled data contained in official reports on ODS consumption that had been submitted to the Secretariat by the Parties to the Montreal Protocol. Article 7 of the Montreal Protocol mandates Parties to report data on ODS consumption and production annually, including the consumption and production of MB for QPS.

The Beijing Amendment of 1999 required Parties to report QPS data under Article 7 as follows:

> *'Each Party shall provide to the Secretariat statistical data on the annual amount of the controlled substance listed in Annex E used for quarantine and pre-shipment applications.'*

The Beijing Amendment came into force from 2002 onwards. By June 2008, 142 Parties had ratified the Amendment[2]. By January 2012 (current data) this had increased to 172 Parties. The QPS reporting requirement has therefore applied to the majority of Parties for several years.

Since 1997 the official Article 7 ODS data reporting forms have included a requirement for Parties to report on the total quantity of methyl bromide produced, imported and exported for all purposes (including QPS and feedstock) and, separately, *the quantity produced or imported for use as QPS*, and feedstock. Decision IX/28(3) of 1997 adopted revised forms[3] and instructions for Parties to use when reporting national ODS data under Article 7. Paragraph 6 of Decision IX/28 also clarified QPS reporting as follows:

> *'…for the purpose of the data-collection only, when reporting data on the consumption of methyl bromide for quarantine and pre-shipment applications, the Parties shall report the amount consumed (i.e., import plus production minus export) and not actual "use".'*

Decision IX/28 provides the following guidance to Parties when completing the import forms for Article 7 reports:

> *'When calculating a Party's* [controlled] *consumption the Montreal Protocol does not include quantities of methyl bromide, which is used for quarantine and pre-shipment. In Data Form 1, quantities of methyl bromide imported for quarantine and pre-shipment applications should be entered separately in Column 6 …'*

Similar guidance is provided for methyl bromide produced or exported for QPS. The Secretariat then calculated a Party's QPS consumption using the submitted data.

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[1] http://ozone.unep.org/new_site/en/ozone_data_tools_access.php
[2] http://ozone.unep.org/new_site/en/treaty_ratification_status.php?treaty_id=8&country_id=&srchcrit=1&input=Display
[3] The forms are shown in annex VII of MOP-9 meeting report.

Several Decisions have also encouraged or reminded Parties to submit QPS data, for example Decisions X/11 (1998), and XI/13 (2001) and XX/6 (2008).

The ODS data that is submitted by Parties pursuant to Article 7 of the Montreal Protocol has been added by the Ozone Secretariat to an on-line database called the Data Centre[4]. According to the Secretariat, "…*a blank* [in the Article 7 Reporting Form submitted by a Party] *is non-available or non-reported data and zero means that a Party reported quantities that result in zero calculated consumption or production*". On the basis of this explanation, MBTOC did not assume that any blanks in the Secretariat's database indicated zero consumption by the Party, unless the database indicated that zero consumption was specifically reported.

The analysis used the same Regional Groups of Parties as used by the Ozone Secretariat in the Data Centre. The Asia group contains 56 countries; the "Western Europe and others" group (WEO) contains 29 mainly European countries as well as Australia, Canada and the USA; Eastern Europe consists of 25 countries the Russian Federation and countries in Central Asia, and includes the data from 12 Parties that joined the EU after 2004 EU; Africa contains 53 countries; Latin America and the Caribbean (LAC) consists of 33 countries. The total number of countries in these groups is 196 countries, which is one fewer than the number of Parties that have ratified the Montreal Protocol (197).

10.3.3 Production of Methyl Bromide for QPS uses

10.3.3.1 Global production

The quantities of methyl bromide for QPS produced by two A5 Parties and five non-A5 Parties that were reported to the Ozone Secretariat are shown in Figs 1-3 for the period 1999 to 2010. According to the reports submitted by Parties pursuant to Article 7, there was no QPS-MB production in France, Ukraine and India in 2003, 2003 and 2006 respectively. MB for QPS is currently produced in 3 non-A5 Parties (USA, Israel, Japan) and one A5 Party (China), as described below.

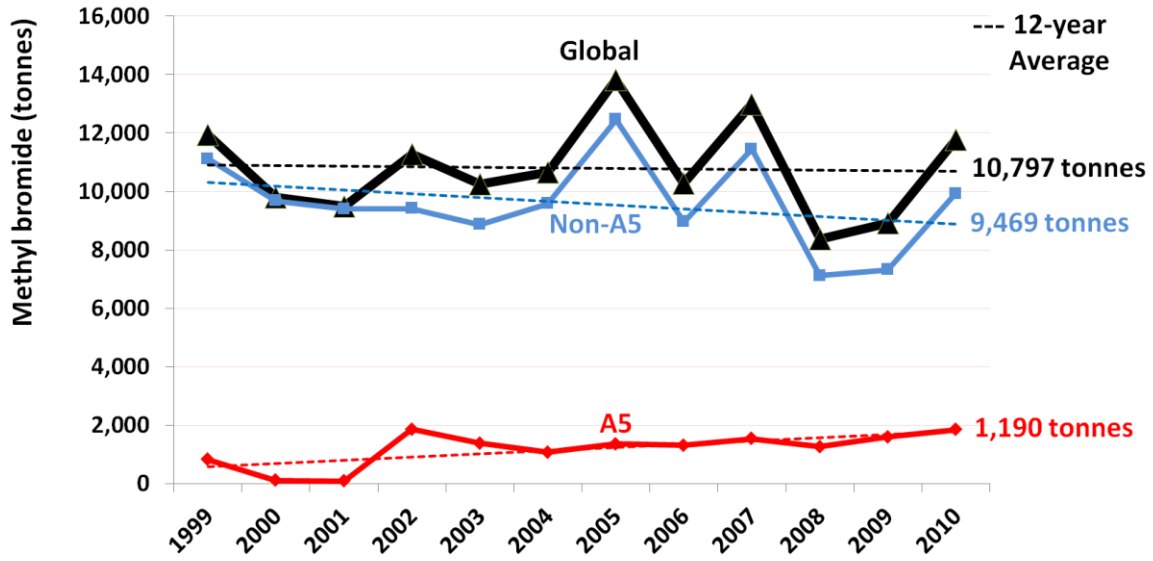
Global production of methyl bromide for QPS in 2010 was reported as 11,477 metric tonnes. Production in 2010 was about 32% higher than for 2009, when global production was reported as 8,922 tonnes. Average production (A5 + non-A5) over the past 12 years (1999-2010) was 10,797 tonnes.

10.3.2.2 Production in non-Article 5 Parties

Compared to 2009, the quantity of QPS methyl bromide produced in 2010 increased significantly in the USA (Fig. 10-2 below), and shows some increase in Israel and a decrease in Japan. Japan continues to show a consistent reduction trend since 2003, whilst the USA and Israel show relatively large fluctuations over several years, as shown in Fig 10-2. The increase in the period 2004 – 2006 in the United could reflect recategorisation of some soils uses from CUEs to QPS.

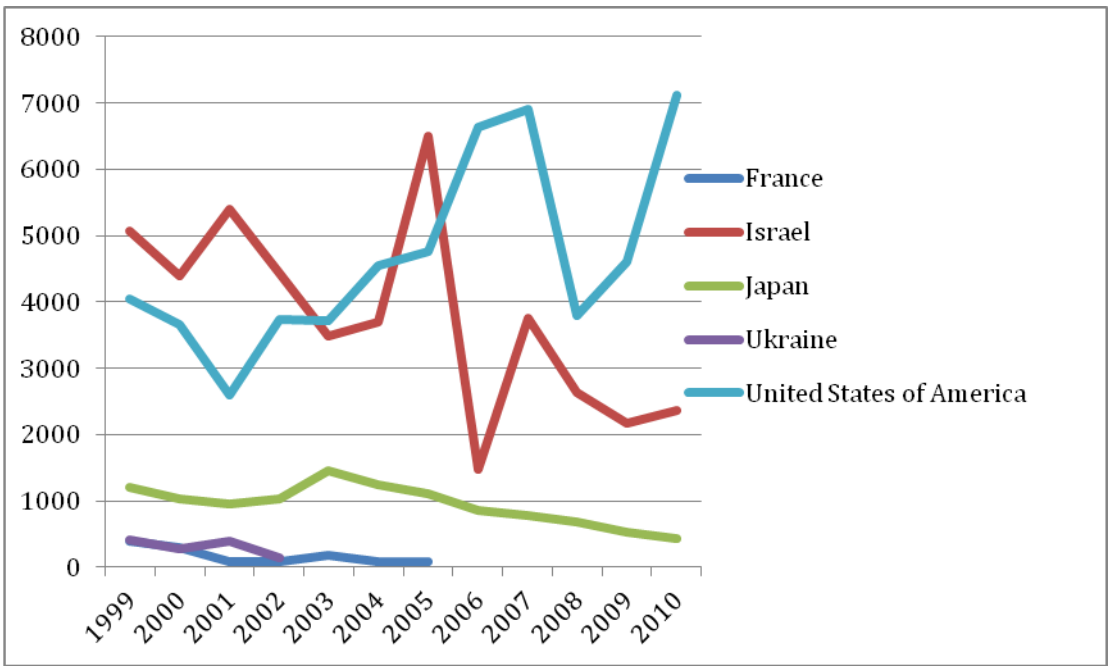
[4] http://ozone.unep.org/new_site/en/ozone_data_tools_access.php

Figure 10-1: Global production of Methyl Bromide for QPS uses 1999 – 2010



Source: Official reports submitted by Parties in accordance with Article 7 of the Montreal Protocol; data in the report stored in the Ozone Secretariat Data Centre, February 2012

Figure 10-2: Production of MB for QPS uses in non-A5 countries 2002-2010



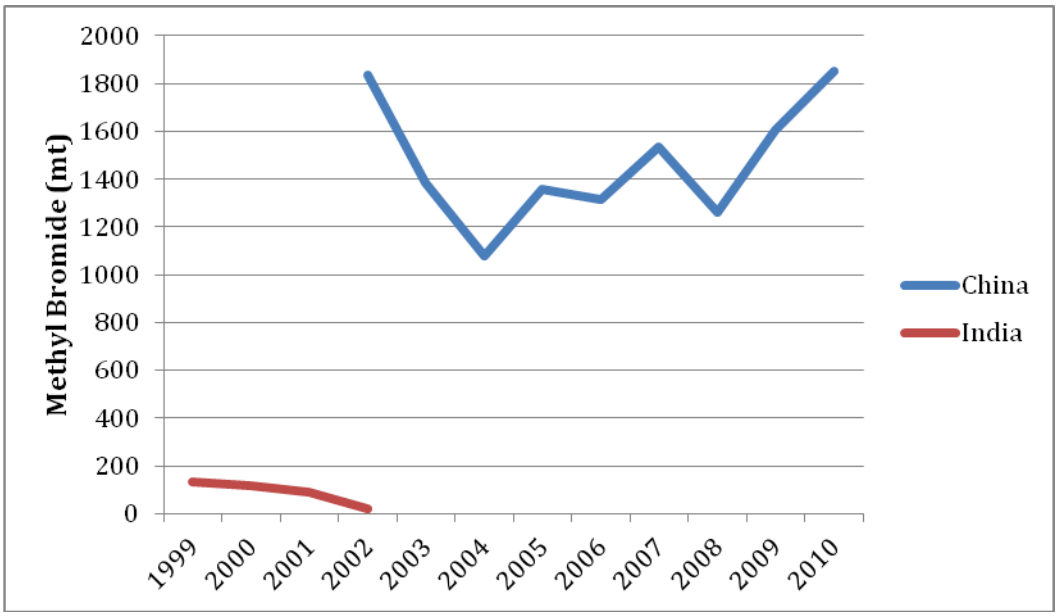
Source: Official reports submitted by Parties in accordance with Article 7 of the Montreal Protocol; data in the report stored in the Ozone Secretariat Data Centre, February 2012

10.3.2.3 Production in Article 5 Parties

Two Article 5 countries reported production of methyl bromide for QPS since 1999: India and China. India last reported QPS production in 2002 and has not reported any production since that time. China's production each year has ranged from 700 tonnes in 1999 to to 1,853 tonnes in 2010. China's production of MB for QPS shows a generally increasing trend since 2004 (Figure 10-3). India was

believed to have ceased production in 2003 (Ozone Secretariat Data Access Centre; Pak Chun Il, 1999, *pers. comm.*; S.K. Mukerjee, 2006, *pers. comm.*). However, several companies in India indicate on their websites that they manufacture MB (for QPS, non-QPS and/or feedstock uses)[5].

Figure 10-3: Production of MB for QPS uses in A5 countries 1999-2010



Source: Official reports submitted by Parties in accordance with Article 7 of the Montreal Protocol; data in the report stored in the Ozone Secretariat Data Centre, February 2012

10.3.4 Consumption of Methyl Bromide for QPS uses

MBTOC examined the data reported by Parties to the Ozone Secretariat on the amount of MB-QPS produced and consumed. Production and consumption of methyl bromide for QPS purposes fluctuate from year to year. In 2009, global QPS consumption exceeded global QPS production by 2,334 tonnes, whilst in 2010 the inverse occurred, with production being larger than consumption by 864 tonnes, a situation that has happened on several occasions since 1999.

10.3.4.1 Global consumption

The overall trend in QPS consumption for non-A 5 and A 5 Parties that reported methyl bromide consumption for QPS is shown in Figure 4, which shows a general increase over the past 12 years in MB consumed for QPS in 5 Parties (blue line), and a general decrease over the same period in non-A 5 Parties (red line), although with a recent increase. The consumption of MB for QPS in 2010 was similar in Article 5 Parties (5,558 tonnes) and non-Article 5 Parties (5,355 tonnes).

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[5] Websites for Indian companies:

Tata Chemicals: www.tatachemicals.net

Intech Pharma: http://www.ippl.co.in/company.html

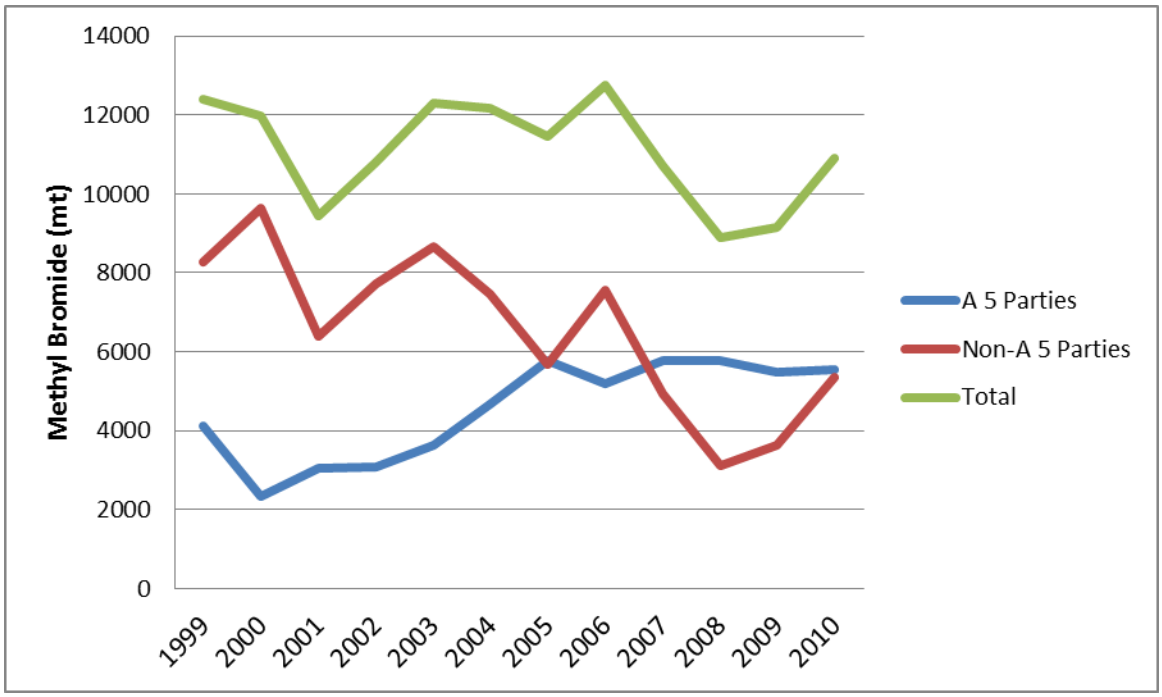
Sarti Chem Ltd: http://sarthichem.com/ and http://sarthichem.com/product.html

Sang Froid Chemicals: http://trade.indiamart.com/search.mp?search=methyl+bromide and http://trade.indiamart.com/details.mp?offer=1505970

Chemtron Science Laboratories: www.chemtronscience.com and http://trade.indiamart.com/details.mp?offer=1819445033

The global consumption (green line) showed an increase in methyl bromide consumed for QPS in 2010 compared to 2008 and 2009, due to an increased consumption in non-Article 5 Parties. Consumption in Article 5 Parties has trended upward whilst non-Article 5 consumption has trended downwards over the past 10 years, with fluctuations. Overall global consumption therefore has been relatively stable and has averaged 11,268 tonnes over the past 12 years.

Figure 10-4: Global consumption of Methyl Bromide for QPS uses 1999 – 2010

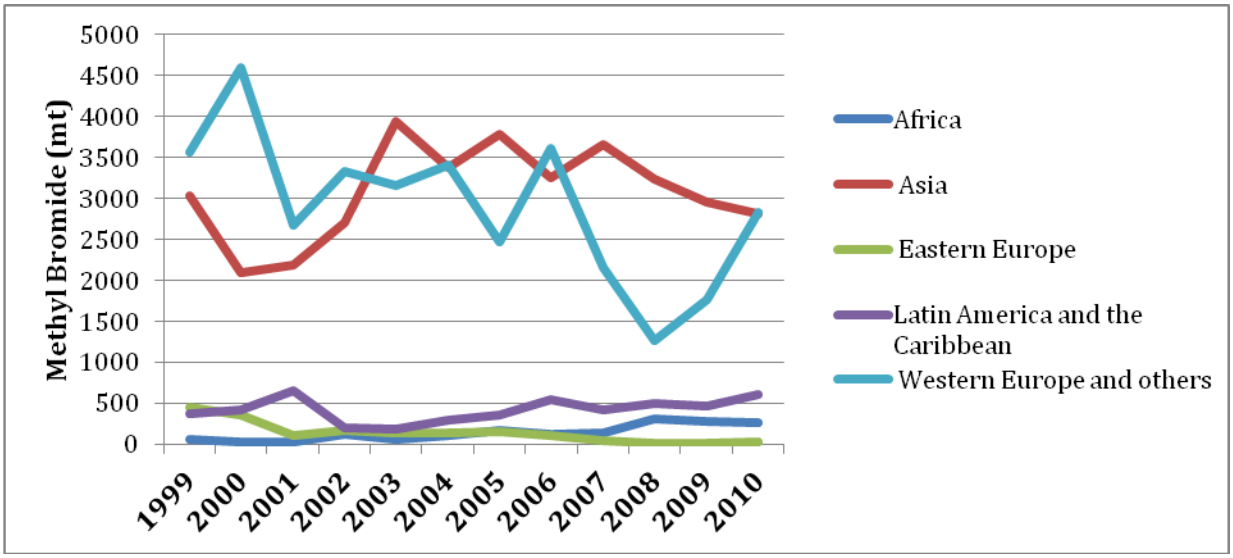


Source: Official reports submitted by Parties in accordance with Article 7 of the Montreal Protocol; data in the report stored in the Ozone Secretariat Data Centre, February 2012

10.3.4.2 Regional consumption

Regional consumption of methyl bromide for QPS was examined according to regional groups of countries established by the Ozone Secretariat and described previously. The overall increase in Article 5 consumption was due to increases in the group "Western Europe and others", which now holds a global share that is equal to that of Asia. This is a change from 2009 when the Asia region accounted for 54% of global QPS consumption (Fig 10-6).

Figure 10-5: Regional Methyl Bromide consumption for QPS uses 1999-2010



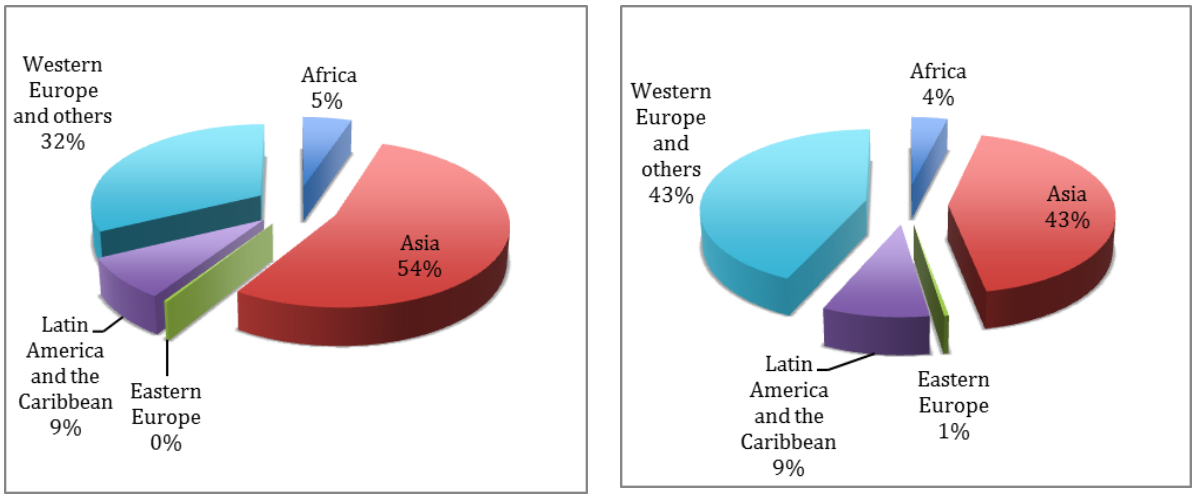
Source: Official reports submitted by Parties in accordance with Article 7 of the Montreal Protocol; data in the report stored in the Ozone Secretariat Data Centre, February 2012.

As explained above, 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 in 2009 with respect to 2008 and a further 83% in 2010 with respect to 2009 (Fig. 5). Similarly, New Zealand reported a 50% increase in MB consumed for QPS in 2010 compared to 2009; and Australia reported a 39% increase in MB consumed for QPS in 2008 compared to 2007.

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, however this was reduced by about 19% in 2010 with respect to 2009. Israel had initially reported a 15-fold increase in its 2009 consumption with respect to 2008 but this information has been corrected, showing large reductions in consumption for both 2009 (7.8 tonnes) and 2010 (8.5 tonnes) compared to 2003-2006 of 275-500 tonnes. China had reported a 13% decrease in QPS consumption in 2009 (1,074 tonnes) with respect to 2008 (1,236 tonnes), but reports an increase of 17% in 2010 (1,259 tonnes) compared to 2009.

Between 2009 and 2010 there was a significant shift in the proportion of MB consumed for QPS in global regional consumption, as shown in Figure 6. Whilst in 2009 54% of the consumption occurred in Asia, the recent increase in consumption in the group "Western Europe and others" now show these two regions as about equal with respect to consumption. Latin America and Africa show a generally stable trend, with some variations. QPS consumption in these regions was comparatively low.

Figure 10-6: Regional consumption of MB for QPS uses in 2009 and 2010



2009 **2010**

Source: Official reports submitted by Parties in accordance with Article 7 of the Montreal Protocol; data in the report stored in the Ozone Secretariat Data Centre, February 2012.

10.3.4.3 Consumption in non-A5 Parties

Non-Article 5 consumption of methyl bromide for QPS uses is presently concentrated in five countries: Australia, Israel, Japan, New Zealand and the United States. The European Union, which reported substantial consumption in the past, banned all uses of methyl bromide, including QPS since 2010.

For the purpose of this analysis MBTOC considered those Parties reporting consumption equal or larger than 100 metric tonnes in 2010 (Table 10-1; Figure 10-7).

Table 10-1: Largest consumers of MB for QPS uses in 2010 by non-Article 5 Parties (tonnes)*

Party	2002	2003	2004	2005	2006	2007	2008	2009	2010
USA	4,127	3,722	4,116	2,931	5,089	2,930	1,212	2,099	3,844
Japan	1,525	2,845	1,277	1,166	1,105	1,107	849	697	604
Australia	415	440	388	358	355	288	401	502	472
New Zealand	100	141	205	126	215	170	289	271	406

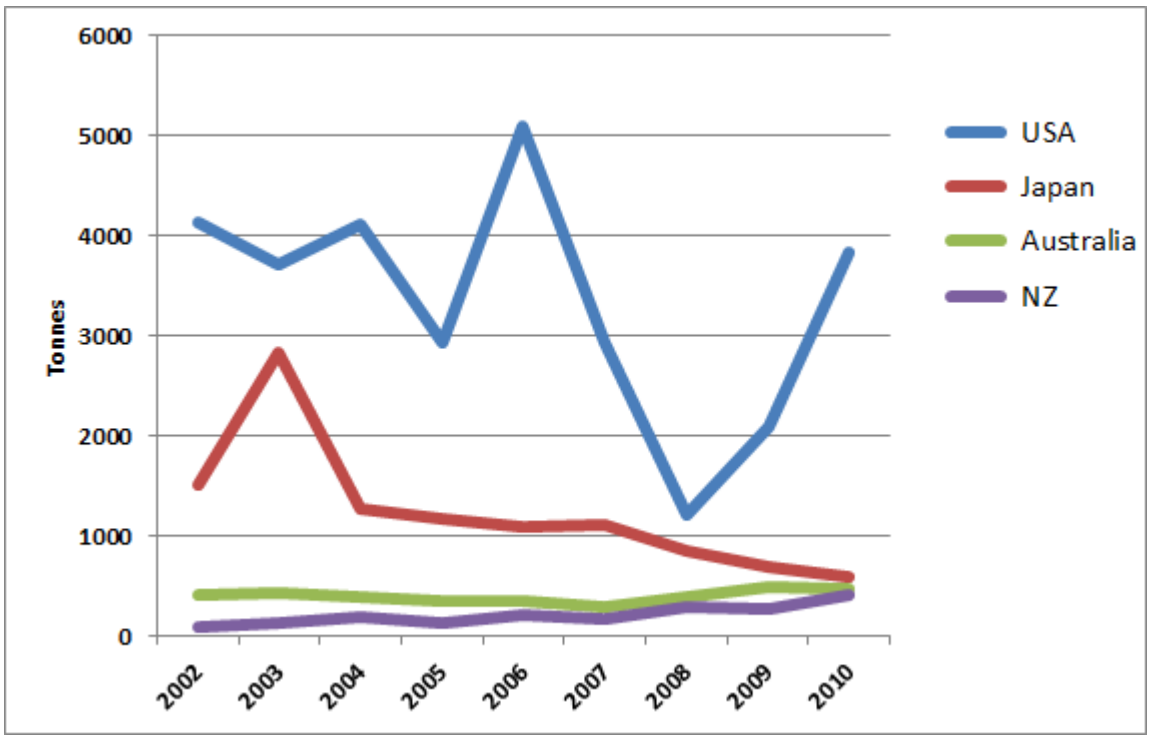
Official reports submitted by Parties in accordance with Article 7 of the Montreal Protocol; data in the report stored in the Ozone Secretariat Data Centre, February 2012.

* Large volume users have reported QPS consumption of >100 tonnes a year in 2010.

** Israel corrected its consumption data as submitted previously for 2009

Australia, New Zealand and the United States reported a significant increase in MB-QPS consumption in 2010 compared to 2008. The consumption of MB by the United States in 2010 was more than twice the consumption of all other Parties combined in 2010.

Figure 10-7: Largest* consumers of MB for QPS uses in 2010 by non-Article 5 Parties (tonnes)



* Parties that consumed more than 100 tonnes in 2010; Official reports submitted by Parties in accordance with Article 7 of the Montreal Protocol; data in the report stored in the Ozone Secretariat Data Centre, February 2012.

10.3.4.4 Consumption in A5 Parties

There were 11 Article 5 Parties that reported MB-QPS consumption of more than 100 tonnes in 2010 (Table 10-2; Figure 10-8). Eight of these Parties consumed less than 500 tonnes, two consumed 500 – 800 tonnes (Republic of Korea and Vietnam) and one consumed more than 1000 tonnes (China). There were almost as many Parties that reported consumption of more than 100 tonnes of MB-QPS in Article 5 Parties than non-Article 5 Parties.

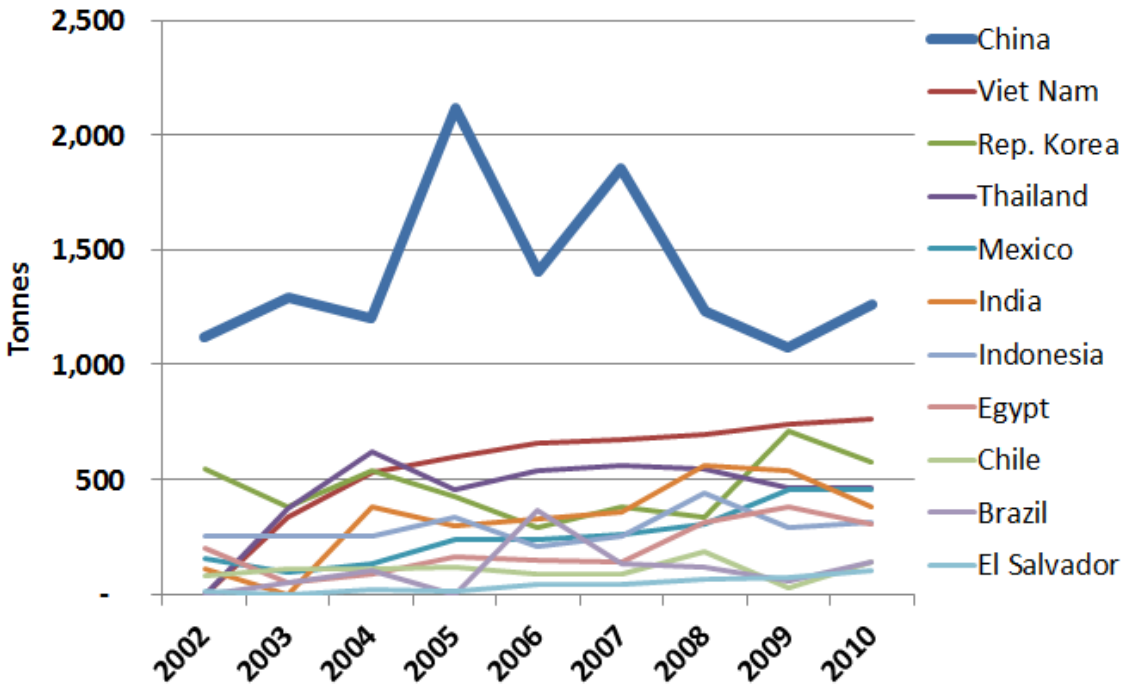
Table 10-2: Large volume* Article 5 consumers of methyl bromide for QPS (tonnes)

Party	2002	2003	2004	2005	2006	2007	2008	2009	2010
China	1,118.0	1,290.5	1,202.0	2,121.0	1,405.0	1,854.5	1,235.8	1,073.5	1,258.8
Vietnam	-	336.0	530.0	598.5	656.0	677.0	696.0	739.0	761.0
Rep. Korea	543.0	377.0	536.0	425.0	288.0	381.0	338.5	708.0	574.2
Thailand	-	375.0	619.8	454.7	538.8	558.3	545.7	465.2	466.8
Mexico	155.0	96.3	135.3	240.0	238.5	260.0	306.5	458.0	453.0

Party	2002	2003	2004	2005	2006	2007	2008	2009	2010
India	114.0	-	381.8	301.0	330.3	360.5	562.0	540.3	379.2
Indonesia	252.0	252.0	252.0	337.0	211.0	250.2	439.2	288.0	313.3
Egypt	200.0	53.5	89.0	160.0	150.0	138.0	312.0	379.0	309.0
Chile	77.2	114.3	109.5	114.8	89.0	85.7	189.2	25.8	143.8
Brazil	-	51.5	106.7	-	368.0	133.3	121.8	61.3	137.2
El Salvador	13.8	-	22.8	12.7	45.7	45.8	63.8	70.2	106.8

Source: Official reports submitted by Parties in accordance with Article 7 of the Montreal Protocol; data in the report stored in the Ozone Secretariat Data Centre, February 2012.

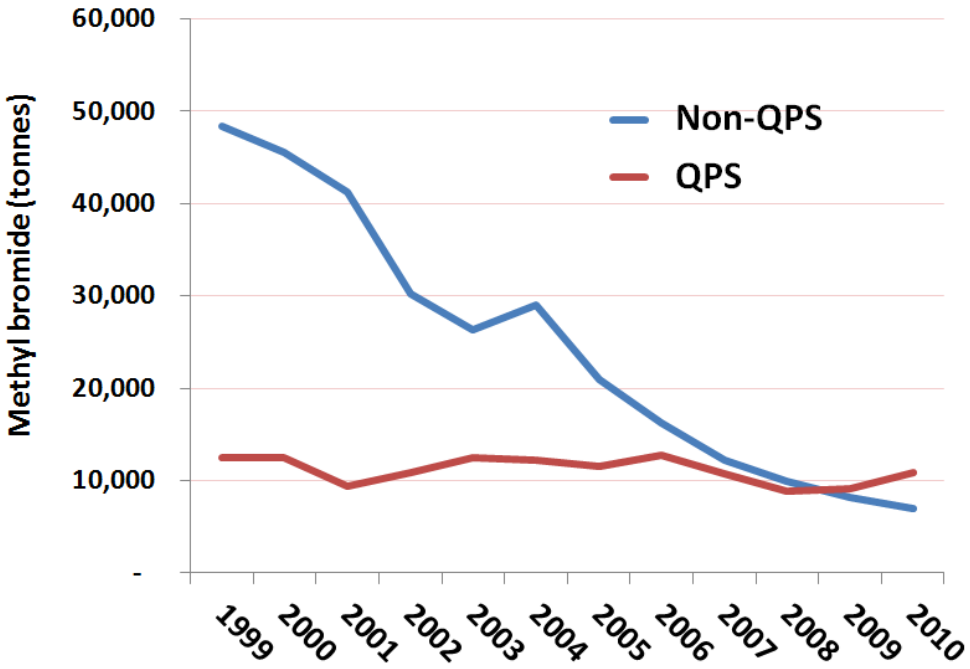
Figure 10-8: Largest* consumers of MB for QPS uses in 2010 by Article 5 Parties (tonnes)



* Article 5 Parties that consumed more than 100 tonnes in 2010; Official reports submitted by Parties in accordance with Article 7 of the Montreal Protocol; data in the report stored in the Ozone Secretariat Data Centre, February 2012.

Reported global consumption of methyl bromide for QPS uses was greater than consumption for controlled (non-QPS) uses for the first time in 2008. This trend, which is related to progress made in phasing out methyl bromide for controlled uses globally, has continued since that year as seen in Fig 10-9.

Figure 10-9: Comparison of non-QPS and QPS global consumption from 1999 to 2010 (tonnes)

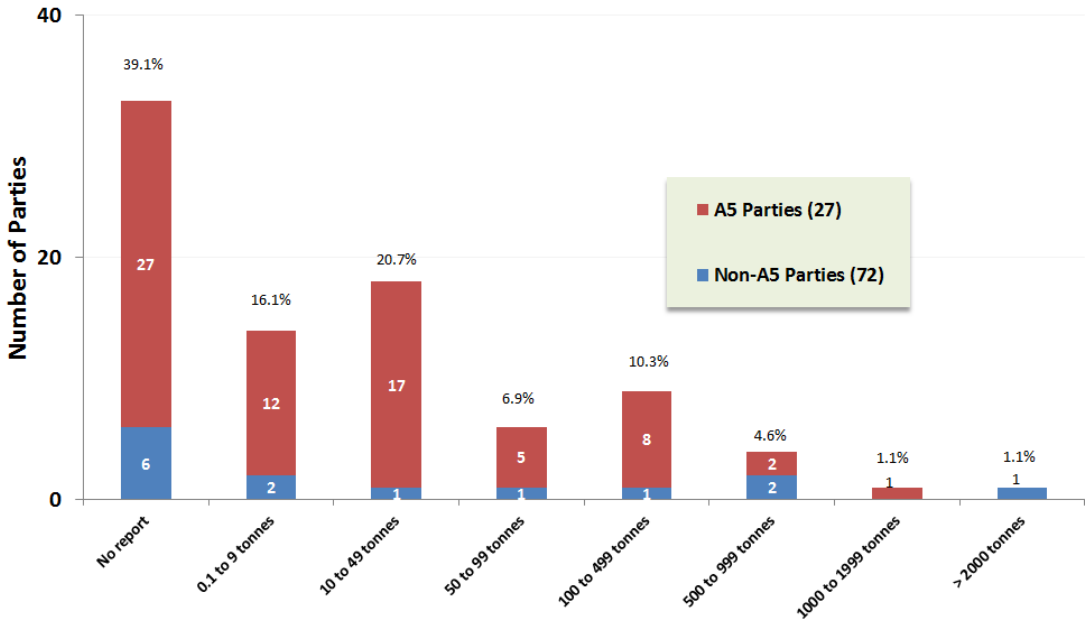


Official reports submitted by Parties in accordance with Article 7 of the Montreal Protocol; data in the report stored in the Ozone Secretariat Data Centre, February 2012.

The QPS data reported in 2010 to the Ozone Secretariat were categorized into "No report" for Parties that did not report, and one of 7 consumption bands (Figure 10-10). An analysis of the data shows that:

- There were 86 Parties (72 Article 5, 14 non-Article 5) that have reported MB for QPS at least once since 1999 and that reported in 2010;
- The 14 Non-Article 5 Parties excludes Member States as the EU reported on their behalf when they joined the EU; and Switzerland that has not reported MB-QPS since 1998;
- Forty-seven or about 55% of the Parties either did not report in 2010 (39%, 27 Article 5 plus 6 non-Article 5) or reported consumption of less than 10 tonnes in 2010 (16%, 12 A5, 2 non-A5);
- Fifteen or about 17% of the Parties (11 Article 5, 4 non-Article 5) that reported MB-QPS consumption in 2010 consumed 100 tonnes or more.

Figure 10-10: Article 5 and non-Article 5 Parties categorized according to "No Report" or a consumption band



10.4. Procedures and methods for data collection on MB use for QPS purposes

10.4.1 Mandate

Paragraph 5(b) of Decision XXIII/10 requests TEAP and its MBTOC to prepare a report that:

> *(b) Provides guidance on procedures and methods for data collection on methyl bromide use for quarantine and pre-shipment for parties that have not yet established such procedures and methods or wish to improve existing ones;*

This section focuses on providing examples of methods of data collection of MB use for QPS. In general, the most common method of data collection was found to be the use of Form, supported by policy or measures that require users of MB to complete the forms and to submit them to a central agency for analysis and reporting.

Some Parties have developed procedures and methods for data collection on MB-QPS in response to Decision XI/13 in 1999 that "*... urged Parties to implement procedures (using a form shown in the Panel's April 1999 report, if necessary) to monitor the uses of methyl bromide by commodity and quantity for quarantine and pre-shipment uses in order:*

(a) To target the efficient use of resources for undertaking research to develop and implement technically and economically feasible alternatives;

(b) To encourage early identification of technically and economically feasible alternatives to methyl bromide for quarantine and pre-shipment where such alternatives exist.

The Form that was developed by TEAP (1999) is contained in Annex 1 of this report, together with examples of Forms used in countries to collect data on MB used for QPS.

10.4.2 Data collection forms

Many quarantine treatments are 'post-entry'. This is where a treatment is required either if inspection finds a quarantine organism in the shipment at the port of entry or quarantine or other treatments have been insufficient to adequately manage the risk of importing quarantine pests in sufficient numbers to be a quarantine threat. Many countries prohibit imports of particular cargoes where the risk of carrying quarantine pests is unacceptable and there is no system or treatment available to manage this risk to an adequate level. In effect, this avoids the need for post-entry quarantine measures, including methyl bromide fumigation.

Typically, treatment options are more restricted practically for post-entry quarantine treatments than for treatment before shipment. In many post-entry situations, methyl bromide fumigation is the only technically and economically available and approved process to meet quarantine standards to allow importation. The cargos are often containerized and removal from the container is uneconomic. Methyl bromide fumigation may be ordered before the commodity can be released for distribution. Rejection or destruction of the cargo remains the default option if the treatment is not carried out.

National Plant Protection Organisations may publish listings of approved treatments for imports, with specifications varying according to phytosanitary requirements of receiving countries and pest risk. In many cases, methyl bromide fumigation may be specified as a quarantine treatment, but often there are also approved alternative treatments or processes given.

Examples of manuals of approved quarantine treatments for international trade, which include information on data collection when performing methyl bromide treatments include:

USA - APHIS PPQ manuals – http://www.aphis.usda.gov/import_export/plants/manuals/index.shtml

Australia – AQIS Import Conditions database
http://www.aqis.gov.au/icon32/asp/ex_querycontent.asp

New Zealand - Approved Biosecurity Treatments for Risk Goods Directed for Treatment - http://www.biosecurity.govt.nz/files/regs/stds/bnz-std-abtrt.pdf

Japan - Theory and Practice of Plant Quarantine Treatments (revised edition 2002) (JFTA 2002)

Examples of Forms used to record QPS treatments using Methyl bromide was well as alternatives to methyl bromide are shown in Annex 1 for:

- TEAP Form (1999)
- The United States
- The European Union (for 27 countries)
- Australia
- Japan
- India

The Forms provided as examples in this report were developed and used as "hardcopy" documents. Parties that are considering developing methods for data collection may wish to develop electronic or web-based systems. This could include, for example, input of data by a fumigator to a hand held device that transmits the information by radio frequency to a central location for storage and analysis. Alternatively, a Party may wish to develop an on-line system where the user can log onto a "Reporting Platform" and complete data entry via a series of windows. Compared with hardcopy systems, on-line systems have the advantage of data entry screening and rapid transmission, ease of analysis with "real time" reports and feedback to the users.

10.4.2.1 Australia

AQIS has a Form for recording MB fumigations (see Annex 3). The AQIS website refers to it as 'example of a methyl bromide record of fumigation'. The form appears under the heading Quarantine Treatments and Fumigants, but it is not clear when the form should be completed.

The Department of Environment has a '*Methyl bromide record of all use form*'(see Annex 3), which must be completed by each MB user for both QPS and non-QPS uses. The website asks '*Anyone who uses methyl bromide must keep a record of the details of every fumigation performed using a Record of all use form. These records must be kept for five years. A separate form is available for non-QPS and QPS use. For feedstock users of methyl bromide please see the section below for reporting requirements*".

The Department of Environment also has a 'Summary record of all methyl bromide use form' (see Annex 3), which must be completed by each MB user for both QPS and non-QPS uses.

The website says: '*In addition to the records for each fumigation performed, end users must keep a separate summary record, on a Summary record of all use form. A separate form is available for non-QPS and QPS use. The forms record a summary of methyl bromide use over a six month period from 1 January and 1 July of each year during which the person uses methyl bromide for a QPS or non-QPS application. The summary record must be kept for five years.*' QPS users are not required to report to the department about their use, but must retain records or summary records and the must provide them on request'.

10.4.2.2 Malaysia

The Malaysian Dept Agriculture, Plant Quarantine Service has a Form for 'Application for Permits & Licenses' that may be required for a permit before fumigation or as a record after fumigation (Annex 4). The 'Recording of Treatment and Use of WPM' form appears to a record form. Form PQ21 on 'Methyl bromide fumigation operation' indicates that this is a permit form for requesting the use of MB for a fumigation operation. Form PQ14 relates to '*Notification of fumigation under certified fumigation scheme*'. There is also a Form for '*Recording of treatment and use of wood packaging materials*'. The Department of Agriculture provides 'Instructions' for submission of the forms.

10.4.2.3 United States

Forms used in the United States to record treatments with MB for QPS uses can be found in Annex 2 of this chapter.

10.4.2.3.1 APHIS

Treatments on imports are performed under the supervision of a USDA -APHIS officer. A special form (429 Fumigation) needs to be filled, in which many fields used to track commodities types, methyl bromide usage, origin countries and others. Treatments with MB undertaken when exporting commodities are not recorded in the same way.

The Treatment Quality Assurance Unit (TQAU) website https://treatments.cphst.org/tqau/ provides useful information on this respect.

10.4.2.3.2 EPA

The US EPA list 12 Methyl Bromide reporting forms, of which two are relevant to QPS :

1. Distributor of QPS Methyl Bromide Quarterly Report
2. Certification of Order/Purchase of QPS Methyl Bromide Report

The US EPA provides assistance on which form to use at this site: Helpful Hints for Completing EPA's Methyl Bromide Reporting Forms. Form No 2 above relating to QPS is shown in Annex 2.

10.4.2.4 India

MB is permitted for QPS purposes in India, including its use under ISPM-15. India published "*Guidelines for Assessment, Audit and Accreditation of Fumigation Agencies for Undertaking Methyl Bromide Fumigation*"[6]. According to India, the guidelines provide guidance on the assessment, audit and accreditation of fumigation operators for undertaking effective fumigation operations as per provisions of the standard on '***Quarantine Treatments and Application Procedures: I. Methyl bromide fumigation'.*** This standard has been revised in view of technological advancements and recent experiences. The standard came into force from 1 September 2011.

The fumigation agency must ensure that a standard operational procedure is documented in line with the provisions of the MB standard established by the Directorate of Plant Protection, Quarantine & Storage. The fumigation agency must ensure that the following records and documents relating to supervising, monitoring and testing of compliance with the procedures are maintained in prescribed format and kept up to date:

- Fumigation Record;
- Check sheet of fumigation;
- Calibration records;
- Stock register of fumigants should cover the volume of fumigation on daily basis;
- Record of Servicing of Equipment & Replacement of Accessories;
- Test Report of sheet permeability provided by the manufacturer;
- Personal Health Record of Fumigation Operators & Co-workers;
- Record of Accredited Fumigation Operators; and
- Fumigation Certificate.

The Forms provided by India that are most relevant for monitoring MB used for QPS are shown in Annex **. The fumigation agency must report to the Directorate of Plant Protection, Quarantine & Storage / In-charge of NPQS/RPQS on monthly basis regarding the stock/use of methyl bromide fumigant and the details of all the fumigation operations carried out using the correct forms.

10.4.3. Policies and measures requiring data collection on the use of methyl bromide for QPS

10.4.3.1 European Union

The European Union banned the use of methyl bromide for all uses including QPS in March 2010, in accordance with Regulation (EC) No 1005/2009 that came into force on 1 January 2010. Member States that consumed MB for QPS prior to the prohibition were required to report to the European Commission by 30 June each year on:

[6] India. 2011. *Guidelines for Assessment, Audit and Accreditation of Fumigation Agencies for Undertaking Methyl Bromide Fumigation.* Directorate of Plant Protection, Quarantine & Storage. 39pp.

- Quantities of methyl bromide authorized for different treatments for QPS purposes;
- Purposes for which methyl bromide was used;
- Progress in evaluating and using alternatives[7].

Legislation that was in force prior to the Regulation (EC) No 1005/2009 contained very similar use and reporting requirements for users of MB for QPS, which were applicable for the period 1 January 2000 until 31 December 2009[8].

10.4.3.2 International Plant Protection Convention

The IPPC recommended policies and measures that countries could implement to replace and reduce the use of MB as a phytosanitary measure[9].

The IPPC recommended measuring progress in the use of MB by encouraging officers in National Plant Protection Organisations (NPPOs) to accurately record and collate data on current usage and to share these data with their country's National Ozone Unit. The IPPC recommended that information exchanged on methyl bromide use for phytosanitary measures should contain:

- Quantities of methyl bromide used in kilograms;
- Description of the articles fumigated where appropriate;
- Whether the use was on import or export commodities;
- Target pests.

The IPPC recommendation also encouraged officers to undertake a range of activities to replace methyl bromide with alternatives, where practical, as a result of these guidelines to NPPOs:

1) Review and consider how to change phytosanitary policies (e.g. phytosanitary import requirements) to replace and/or reduce methyl bromide where it is required and where an equivalent, technically feasible, practical and economically viable alternative exists. This may also require review and revision of bilateral agreements between countries.

2) Ensure that methyl bromide fumigation is used only for quarantine pests and that it is authorized or performed by the NPPO, including fumigation as emergency action for pests not previously assessed (as described in section 5.1.6.2 of ISPM No. 20: Guidelines for a phytosanitary import regulatory system).

3) Provide guidance to those responsible for methyl bromide fumigations for quarantine purposes on the importance of pursuing feasible alternative phytosanitary measures.

4) Develop and utilize phytosanitary measures that are equivalent, viable and feasible alternatives to methyl bromide.

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[7] Article 26(i) in Regulation (EC) No 1005/2009 on "Substances that Deplete the Ozone Layer". Official Journal of the European Union, L286/16. 31.10.2009.

[8] Article 4(2)(iii) in Regulation (EC) No 2037/2000 on "Substances that Deplete the Ozone Layer".

[9] IPPC. 2008. Recommendation for the implementation of the IPPC: Replacement of methyl bromide as a phytosanitary measure. CPM-3/Report: Appendix 6.
https://www.ippc.int/file_uploaded/1249888979969_CPM3_English_Final.pdf

5) Communicate to other NPPOs where there are viable alternatives to methyl bromide use.

6) Submit phytosanitary treatments that are effective, efficacious, documented, feasible and applicable alternatives to the use of methyl bromide to the IPPC Secretariat using the guidelines in ISPM No. 28 (Phytosanitary treatments for regulated pests).

7) Give highest priority to the development of alternative treatments for those commodities for which methyl bromide usage is high.

8) Liaise with research groups and funding bodies to develop alternative treatments as appropriate.

9) Coordinate with the National Ozone Unit [in the Montreal Protocol] as appropriate, **to facilitate the annual collection and reporting of methyl bromide usage data**.

10) Post or link details of NPPO-approved alternatives for methyl bromide treatment on the International Phytosanitary Portal (https://www.ippc.int) for exchange of information.

11) Cooperate with the National Ozone Unit to implement a strategy to replace and reduce methyl bromide usage.

12) Exchange information on alternatives to methyl bromide usage between the NPPO and the National Ozone Unit.

13) Identify current treatments where methyl bromide is the only option, and provide sufficient information to the appropriate IPPC body for consideration in the development of potential viable alternatives (e.g. identify the commodity, pests associated with it for which methyl bromide is used, required efficacy).

14) Evaluate or re-evaluate pest risk (via pest risk analysis) to determine if the treatment prescription is appropriate and whether less rigorous treatment or alternative measures may be used.

The IPPC provided a list of articles fumigated with MB in order to facilitate the annual collection and reporting of methyl bromide usage data:

List of articles fumigated	**Kg**
Commodities	
Bulbs, corms, tubers and rhizomes (intended for planting)	
Cut flowers and branches (including foliage)	
Fresh fruit and vegetables	
Grain, cereals and oil seeds for consumption including rice (not intended for planting)	
Dried foodstuffs (including herbs, dried fruit, coffee, cocoa)	
Nursery stock (plants intended for planting other than seed), and associated soil and other growing media	
Seeds (intended for planting)	
Wood packaging materials	
Wood (including round wood, sawn wood, wood chips)	

List of articles fumigated	Kg
Whole logs (with or without bark)	
Hay, straw, thatch grass, dried animal fodder (other than grains and cereals listed above)	
Cotton and other fibre crops and products	
Tree nuts (almonds, walnuts, hazelnuts etc.)	
Structures and equipment	
Buildings with quarantine pests (including elevators, dwellings, factories, storage facilities)	
Equipment (including used agricultural machinery and vehicles), empty shipping containers and reused packaging	
Other items	
Personal effects, furniture, crafts, artefacts, hides, fur and skins	

Source: IPPC. 2008. Recommendation for the implementation of the IPPC: Replacement of methyl bromide as a phytosanitary measure. CPM-3/Report: Appendix 6.

MBTOC recommends that Parties that have not yet established procedures and methods for the data collection on MB for QPS, or that have a Form but wish to improve it, consider the list of articles in the above Table, with appropriate modifications for their national circumstances.

10.4.3.3 Japan

The department of Ministry of Agriculture, Forestry and Fisheries in charge of plant quarantine has prescribed a rule to record fumigation details on plant quarantine process. The fumigation facility owner is requested to make and keep a fumigation record using "form 3" (see Annex I, the outline for the designation of fumigation facilities (Feb. 6, 1971 Director notice 45 Nou-sei No. 2628[last revised Jun. 30, 2003]),from Plant Protection Station website[in Japanese], http://www.pps.go.jp/law_active/Notification/basis/8/66/html/66.html).

When quarantine insect pest is found in item imported, plant quarantine officer orders fumigation, and observes its termination. Fumigation records are usually provided by fumigators at the fumigation every time, and they hands an original and a copy of fumigation record sheet (form 3) to quarantine officer and fumigation facility owner, respectively.

10.4.4 Suggested form that Parties may wish to consider

MBTOC reviewed the forms that were submitted by Parties and found that there are common elements that the Parties may wish to use in order to harmonise as much as possible the collection of data on the use of MB for QPS.

To assist the Parties in this process, MBTOC has asterisked (*) the elements or criteria in a form that it considers essential. Parties could use the asterisked elements as a minimum and add as many other elements that the Party considers relevant for their national circumstances. Use of the asterisked elements on a Form would help to harmonise procedures globally for monitoring and reporting on how MB is used for QPS.

MBTOC sees value in two separate forms, with a common heading: 1) Articles 2) Soils. The key elements in each Form are shown below.

- Headings common to the Postharvest and Soils Forms
  - * Date
  - * Location
  - * Authorising Authority
- Articles
  - * Target pest(s) for MB treatment
  - * Reason for fumigation [import requirement, export requirement, other]
  - * Origin of product (Domestic, country where product was imported from)
  - * Destination of product (For export, for domestic market)
  - * Import, export or domestic market
  - * Item fumigated: Commodity [consider IPPC list for guidance and for collation of results] or Pest-infested structure
  - * Quantity of MB (kg, 0000 no commas or points)
  - Treatment conditions
    - Enclosure type
    - Volume of enclosure fumigated (m3)
    - * Dosage
    - Formulation e.g. pure MB or mixture
    - Temperature of commodity
    - Treatment duration
- Soils
  - * Crop (name of crop) or soil
  - * Area treated (ha)
  - Open field, protected agriculture (tunnel house, glasshouse, other)
  - Cultivation method
  - Frequency of treatment
  - * Quantity of MB (kg)
  - * Target pest(s) (Genus and species; common name(s))
  - * Reason for treatment (e.g., certification requirement, pest control / eradication programme, other)
  - Destination of crop, if known/relevant (domestic, export (name of country or countries))
  - Treatment conditions
    - Air temperature, if relevant
    - Soil temperature, if relevant
    - * Dosage applied (kg/ha or gm-2)
    - * Formulation of MB (e.g., Pure, Mixture with chloropicrin)
    - Emission control (e.g., barrier film)

- Application method (e.g., broadcast, strip, shank, hot gas other)
- Depth of application

The Parties may wish to ask the Ozone Secretariat to upload examples of Forms that use these elements so that Parties that do not have procedures in place, or who may wish to improve existing procedures, may wish to develop a form using one or more Forms that meets their requirements. MBTOC remains ready to assist the Parties in their endeavor to improve procedures for monitoring and reporting on the use of MB for QPS.

ANNEX 1: DRAFT METHYL BROMIDE RECORD SHEETS FOR RECORDING QUARANTINE AND/OR PRE-SHIPMENT USES

Source: TEAP (1999), APPENDIX A3, page 101-104

This document is intended as an aid to Parties for gaining information about quarantine and pre-shipment (QPS) consumption of methyl bromide (MB) at a national level. Those involved in monitoring and reporting QPS should amend the requirements of this form to suit their needs. Parties wishing to make use of this or similar form would need to ensure that a system is in place for licensing companies and individuals carrying our MB fumigations.

Applications to be completed by licensed applicators of methyl bromide for quarantine and pre-shipment purposes. Please read instructions and definitions before completing the application form.

Instructions

You are required to provide information to the government of (specific name of country requesting information) if your company was involved with the use of methyl bromide for quarantine and pre-shipment applications. This form must be filled out on an annual basis and submitted by (specific day, month, year) for quarantine and pre-shipment uses (QPS) during the period of (day, month, year) to (day, month, year).

Definitions

Quarantine applications with respect to methyl bromide, are treatments to prevent the introduction, establishment and/or spread of quarantine pests (including diseases), or to ensure their official control.

Official control of a pest is that which is performed by, or authorised by, a national plant, animal or environmental protection or health authority.

Quarantine pests are pests of potential importance to the areas endangered thereby and not yet present there, or present but not widely distributed and being officially controlled.

Pre-shipment applications are those treatments applied directly preceding and in relation to export, to meet the phytosanitary or sanitary requirements of the importing country or existing phytosanitary or sanitary requirements of the exporting country.

- Please refer to the 'QPS Logic Diagram' (see Section 3.2.5, Figure 3.1 in the TEAP 1999 Report) for assistance in classifying methyl bromide uses as quarantine or pre-shipment.

Complete and return this form to: _____

Government Department: _____

Address: _____

_____

Contact Person _____

Telephone _____

Fax _____

Section A

Information respecting your company's activities:

1. Dates of reporting period: Start: _____ Finish: _____

2. Name of your company: _____

3. Address: _____

_____

Telephone: _____ Fax: _____

4. Contact person: _____

5. Company's Activities:

(a) State the total quantity of methyl bromide applied or otherwise used by your company for quarantine and/or pre-shipment purposes during the reporting period:

_____ kg

(b) Please complete Section B for quarantine treatments. Please complete Sections C & D for pre-shipment treatments.

Section B

Complete the following table for each use of methyl bromide for **quarantine** purposes **only.** Attach **official proof** of these quarantine treatments i.e., document from official authority which performed or authorised the treatment for each fumigation.

e.g., 10-09-00	Apples	15,000 boxes	Codling moth	Japan	227 kg
					Total Amount Used

Section C

Pre-shipment treatments required by official authorities in the **importing** country.

Complete the following table for each use of methyl bromide used for phytosanitary or sanitary purposes to meet the official requirements of countries importing the commodities or items.

Attach **official proof** that these methyl bromide fumigation(s) were required by official or national authorities in the importing country e.g. document from the national authority which performed or authorised the treatment for each fumigation.

10-10-00	15-10-00	Wooden pallets	10 containers	[National] Grain Board	Kenya	27 kg
						Total Amount Used

Section D

Pre-shipment treatments required by official authorities in the **exporting** country.

Complete the following table for each use of methyl bromide used for phytosanitary or sanitary purposes to meet the official requirements of countries exporting the commodities or items.

Attach **official proof** that these methyl bromide fumigation(s) were required by official authorities in the exporting country e.g. document from the national authority which performed or authorised the treatment for each fumigation.

10-10-00	15-10-00	Ship	3 holds	Canadian Plant Protection Division #76-9	1 tonne
					Total Amount Used

List of articles fumigated	
Commodities	**kg**
Bulbs, corms, tubers and rhizomes (intended for planting)	
Cut flowers and branches (including foliage)	
Fresh fruit and vegetables	
Grain, cereals and oil seeds for consumption including rice (not intended for planting)	
Dried foodstuffs (including herbs, dried fruit, coffee, cocoa)	
Nursery stock (plants intended for planting other than seed), and associated soil and other growing media	
Seeds (intended for planting)	
Wood packaging materials[1]	
Wood (including round wood, sawn wood, wood chips)	
Whole logs (with or without bark)	
Hay, straw, thatch grass, dried animal fodder (other than grains and cereals listed above)	
Cotton and other fibre crops and products	
Tree nuts (almonds, walnuts, hazelnuts etc.)	
Structures and equipment	
Buildings with quarantine pests (including elevators, dwellings, factories, storage facilities)	
Equipment (including used agricultural machinery and vehicles), empty shipping containers and reused packaging	
Other items	
Personal effects, furniture, crafts, artefacts, hides, fur and skins	

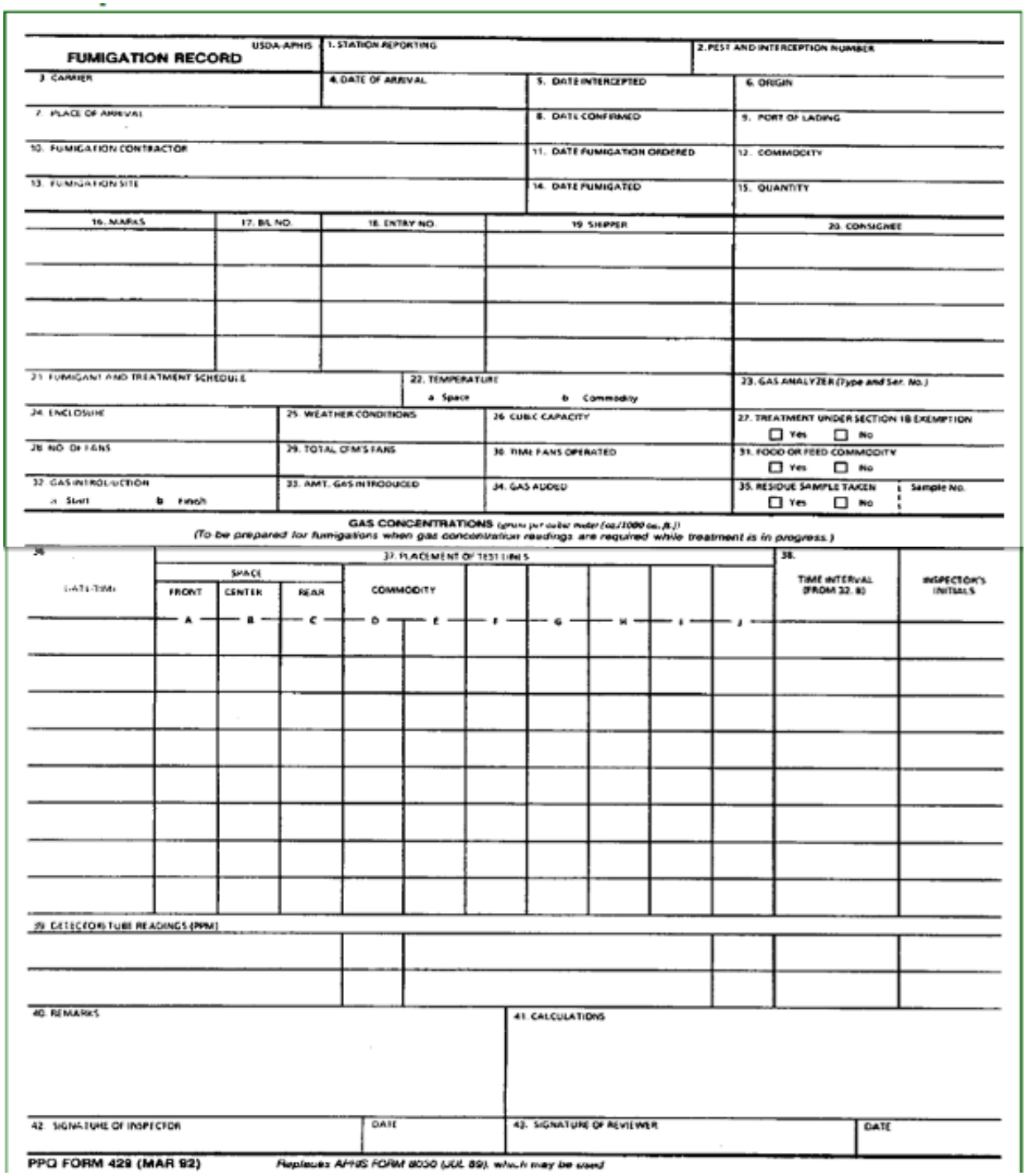
[1] It is noted that ISPM No. 15 (*Guidelines for regulating wood packaging material in international trade*) is the only ISPM currently listing approved treatments for wood packaging material. Wood packaging material is the only commodity for which specific treatments are currently described in an ISPM.

ANNEX 2: UNITED STATES (APHIS)

Form required by US APHIS for each quarantine fumigation (PPQ Form 429, Fumigation Record)

Source: USDA APHIS (2009) *Treatment Manual*, Plant Protection and Quarantine, Animal and Plant Health Inspection Service, United States Department of Agriculture, version 10/2009-38, October 19 2009, Appendix A Forms, page A-1-9, Fumigation Record, PPQ Form 429. http://www.aphis.usda.gov/import_export/plants/manuals/ports/treatment.shtml

One form is used for recording each quarantine fumigation, whether MB or another fumigant.



USDA-APHIS

FUMIGATION RECORD

1. STATION REPORTING			2. PEST AND INTERCEPTION NUMBER
3. CARRIER	4. DATE OF ARRIVAL	5. DATE INTERCEPTED	6. ORIGIN
7. PLACE OF ARRIVAL		8. DATE CONFIRMED	9. PORT OF LADING
10. FUMIGATION CONTRACTOR		11. DATE FUMIGATION ORDERED	12. COMMODITY
13. FUMIGATION SITE		14. DATE FUMIGATED	15. QUANTITY

16. MARKS	17. B/L NO.	18. ENTRY NO.	19. SHIPPER	20. CONSIGNEE

21. FUMIGANT AND TREATMENT SCHEDULE	22. TEMPERATURE a. Space b. Commodity		23. GAS ANALYZER (Type and Ser. No.)
24. ENCLOSURE	25. WEATHER CONDITIONS	26. CUBIC CAPACITY	27. TREATMENT UNDER SECTION 18 EXEMPTION ☐ Yes ☐ No
28. NO. OF FANS	29. TOTAL CFM'S FANS	30. TIME FANS OPERATED	31. FOOD OR FEED COMMODITY ☐ Yes ☐ No
32. GAS INTRODUCTION a. Start b. Finish	33. AMT. GAS INTRODUCED	34. GAS ADDED	35. RESIDUE SAMPLE TAKEN ☐ Yes ☐ No — Sample No.

GAS CONCENTRATIONS (grams per cubic meter (oz./1000 cu. ft.))

(To be prepared for fumigations when gas concentration readings are required while treatment is in progress.)

36. DATE-TIME	37. PLACEMENT OF TEST TUBES: SPACE FRONT A	CENTER B	REAR C	COMMODITY D	E	F	G	H	I	J	38. TIME INTERVAL (FROM 32. B)	INSPECTOR'S INITIALS

39. DRAEGER TUBE READINGS (PPM)

40. REMARKS	41. CALCULATIONS

42. SIGNATURE OF INSPECTOR	DATE	43. SIGNATURE OF REVIEWER	DATE

PPQ FORM 429 (MAR 92) *Replaces APHIS FORM 8030 (JUL 89), which may be used*

TARPAULIN FUMIGATION

NOTE: *In preparation for the fumigation and prior to site selection the officer should have determined (1) the immediate pest risk associated with the infested commodity, (2) the temperature requirements for the fumigation, and (3) the permeability of the packaging.*

CHECKLIST OF MATERIALS AND PROCEDURES *(Consider each of the listed items when performing a fumigation.)*

MATERIALS

FUMIGATOR

- ☐ Tarpaulin
- ☐ Sand Snakes
- ☐ Water Snakes
- ☐ Loose Sand
- ☐ Burlap / Padding
- ☐ Masking Tape
- ☐ Pesticide & Spray Equipment
- ☐ Tarpaulin Supports
- ☐ Fans
- ☐ Extension Cords
- ☐ 2-3 Prong Plug Adapters
- ☐ Fumigant
- ☐ Gas Introduction Line
- ☐ T/C Gas Analyzer
- ☐ Volatilizer
- ☐ Heat Supply
- ☐ Exhaust Fans
- ☐ Sampling Tubes
- ☐ Scale
- ☐ Fumigation Placards
- ☐ SCBA - Self Contained Breathing Apparatus

PPO

- ☐ Gas Analazer
- ☐ Drierite
- ☐
- ☐ Self Contained (SCBA) Breathing Apparatus
- ☐ Halide Detector
- ☐ Tape Measure
- ☐ Thermometer
- ☐ Gas Detector Kit and Detector Tubes

PROCEDURES *(SECTION III TREATMENT MANUAL)*

PREPARATION

1. **SITE SELECTION**
   - ☐ Ventilated Area
   - ☐ Sheltered Area
   - ☐ Impervious Surface
   - ☐ Non-work Area
   - ☐ Proximity to Electrical Source
   - ☐ Proximity to Commodity
2. **ARRANGEMENT OF COMMODITY & EQUIPMENT**
   - ☐ Stack Size Limitation
   - ☐ Air Space, Below and Between Load
   - ☐ Placement of Tarp. Supports
   - ☐ Placement of Padding
   - ☐ Placement of Fans
   - ☐ Placement of Gas Introduction Line(s)
   - ☐ Placement of Sampling Lines
3. **TARPAULIN ENCLOSURE**
   - A. **COVER**
     - ☐ Condition
     - ☐ Air Space, Above Load
     - ☐ Floor Area 30 cm (12") Space Around Load
     - ☐ Overlap 45 cm (18") Border
   - B. **SNAKES**
     - ☐ Contact Along Sides
     - ☐ Contact Around Corners
     - ☐ Overlap 15 cm (6") Minimum
   - C. **SAND**
     - ☐ Perimeter
   - D. **ADHESIVE**
     - ☐ Perimeter

FUMIGATION

4. **TREATMENT SCHEDULE DETERMINATION**
   - ☐ Plant Pest
   - ☐ Commodity Temperature
   - ☐ Space Temperature
   - ☐ Volume Determination
   - ☐ Sorptive Commodity
   - ☐ Amount of Fumigant
5. **FUMIGANT INTRODUCTION**
   - ☐ Area Clear of Unauthroized Personnel
   - ☐ Cover condition
   - ☐ Fan Operation
   - ☐ Contaminant Gases
   - ☐ Fumigant Cylinder Weight
   - ☐ Gas Line Connections
   - ☐ Volatilizer Heated
   - ☐ Introduction Rate
   - ☐ Check for Leaks
6. **SAFETY**
   - ☐ Gas Detection Tests
7. **CONCENTRATION READINGS**
   - ☐ T/C Gas Analyzer Standardization
   - ☐ Time Intervals
   - ☐ Gas Distribution
   - ☐ Maximum / Minimum
8. **AERATION (MULTIPLE STACKS)**
   - ☐ Exhaust Fan(s)
   - ☐ Exhaust Tube(s)
   - ☐ Exhausted in a Non-fumigation Area
   - ☐ Negligible Gas Readings Before Tarpaulin Removal
   - ☐ Halide or Other Detector Tests

PPQ FORM 429 (Reverse)

☆ U.S. GOVERNMENT PRINTING OFFICE: 1997 417-294/60024

Detailed instructions for completing the form are also provided in the APHIS Treatment Manual.

For many years, the APHIS Treatment Manual has instructed APHIS officials to send one copy of each [completed] form to a central body. The January 2009 version of the Manual, for example, stated the following:

> 'Purpose
>
> This form is to be used as a station record for all treatments conducted in approved chambers or in temporary enclosures(tarpaulin, in containers, truck vans, railroad cars, ships, warehouses, or other enclosures). Treatments conducted under temporary enclosures require minimum gas concentration readings be reported. ….
>
> Distribution
>
> Give the original and one copy to your supervisor for review. The supervisor should keep the original for port files and send one copy to:
>
> USDA, APHIS, PPQ, CPHST
> Treatment Quality Assurance Unit
> 1730 Varsity Drive, Suite 400
> Raleigh, NC 27606'

The current version of the APHIS Treatment Manual (dated May 2010) indicates that APHIS has set up an elecronic reporting system which augments the paper submission:

> 'The PPQ Form 429 is to be used as a station record for all treatments conducted in approved chambers or in temporary enclosures (tarpaulin, in containers, truck vans, railroad cars, ships, warehouses, or other enclosures). Treatments conducted under temporary enclosures require minimum gas concentration readings be reported. CPHST TQAU tracks MB fumigant usage in an electronic 429 database. Contact CPHST TQAU for username and password.' ….
>
> '**Distribution**
>
> Give the original and one copy to your supervisor for review. The supervisor should keep the original for port files and send one copy to:
>
> USDA, APHIS, PPQ, CPHST
> Treatment Quality Assurance Unit
> 1730 Varsity Drive, Suite 400
> Raleigh, NC 27606

ANNEX 2a: UNITED STATES (EPA) QPS FORM

OMB Control Number: 2060-0170
Expiration Date: 4/30/12

EPA U.S. Environmental Protection Agency

STRATOSPHERIC OZONE PROTECTION PROGRAM

CLASS I CONTROLLED SUBSTANCE

DISTRIBUTOR OF QPS
METHYL BROMIDE QUARTERLY REPORT
(Sec 82.13)

SECTION 1 DISTRIBUTOR IDENTIFICATION

1.1 Date of Submission

1.2 Total Quantity of Methyl Bromide Delivered for Use in Certified QPS Applications (kg)

1.3 ☐ **Original Submittal** ☐ **Re-submittal**

1.4 Quarter and Year to Which This Report Applies ☐ 1st ☐ 2nd ☐ 3rd ☐ 4th Year ____

1.5 Distributor Information

Company Name		
Street Address		
City	State	Zip Code

1.6 Distributor Contact Identification

Reporting Distributor Contact Person	Phone Number	Fax Number
E-mail Address		

1.7 Supplier Identification

Supplier Name

1.8 Signature of Reporting Distributor Representative

I certify that the total quantity of methyl bromide listed in this form was exclusively sold for use in quarantine & preshipment applications, and not sold/ transferred to another person.

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Name _____

Title _____

Signature _____ Date _____

SEND COMPLETED FORMS TO:

For U.S. Postal Service:

Tracking System Program Manager
Stratospheric Protection Division
U.S. EPA (6205J)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

For Private Courier:

Tracking System Program Manager
Stratospheric Protection Division
U.S. EPA – (6205J)
1310 L Street, NW; 10th Floor
Washington, DC 20005

Information in reports submitted in compliance with the final rule may be claimed as confidential. A company may assert a claim of confidentiality for information submitted by clearly marking that information as confidential. Such information shall be treated in accordance with EPA's procedures for information claimed as confidential at 40 CFR Part 2, Subpart B, and will only be disclosed by the means set forth in the subpart. If no claim of confidentiality accompanies the report when it is received by EPA, it may be made public without further notice to the company (40 CFR 2.203).

The public reporting and recordkeeping burden for this collection of information is estimated to average 2.4 hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

EPA Form # 5900-155, Revised 04/09

ANNEX 3: AUSTRALIA

Australian Government

Department of the Environment, Water, Heritage and the Arts

Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995

RECORD OF ALL USE OF METHYL BROMIDE

10251663360251664384251666432

Name: _____

Address: _____

P'code: _____

Date of Use	**Total Quantity Used (kg)**	**If Non-QPS application:**					**If QPS application:**		
		Crop or commodity for which treatment conducted	Dosage Rate kg/ha or kg/m³	MeBr:Pic Mix Used	No. of Hectares/ No. and volume of Containers Treated	Name & Address of Exempt Person for whom the fumigation was carried out	Type of QPS application	Commodity/ Pest fumigated	Reference number (Commonwealth; State/Territory)

Signed: _____ **Print Name:** _____

Last Updated: 7 April 2010

Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995

SUMMARY RECORD OF ALL USE OF METHYL BROMIDE

This record is a summary only of the total quantity of methyl bromide your company uses each day. This record should be kept and maintained in conjunction with your own record keeping system of recording the particulars for each individual fumigation as outlined in the *Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995*, and on the Department's website at www.environment.gov.au/atmosphere/ozone.

Company Name: _____ ABN: _____

Date	Total Quantity Used (kg)

Total quantity for this page: _____kg

Signed: _____

Australia / Methyl Bromide - Record of Fumigation

Job Details			
Job Identification	Customer Name	Start Date of Fumigation	Location
Description of Consignment			
Target of Fumigation		Container Numbers / Consignment Identification	

Fumigation Details			
The consignment complies with the following requirements of the Standard: Adequate free airspace, no impervious surfaces or wrapping, maximum timber thickness & spacing ☐ Yes ☐ No			
☐ Sheeted Containers Size: Qty: ☐ Pressure Tested Container Decay Time = seconds		☐ Sheeted Stack ☐ Chamber	Enclosure Dimensions L H W Volume = m^3
Specified Dosage Rate g/m^3	Exposure Period hrs	Forecast Minimum Temp °C	Dosage Rate Used g/m^3
Calculated Dosage g	Chloropicrin ☐ N/A % g	Actual Dosage Applied g	Time Dosing Finished

Concentration Readings									
Phase	Time of Reading	Standard g/m^3	Monitor Line Readings by Location 1:	2:	3:	4:	5:	Equilibrium Calculation	Top-up Dose
Start								%	
								%	
During									
End									

Comments			

Ventilation			
Initial TLV ppm	Date & Time Taken	2nd TLV Reading ppm	Date & Time Taken

Fumigator in Charge		Quarantine Officer (if supervised)	
Name	Signature	Name	Signature

ANNEX 4: METHYL BROMIDE FUMIGATION LOGBOOKS USED IN THE EUROPEAN UNION UNTIL METHYL BROMIDE WAS BANNED IN 2010

Logbook used by EC countries for recording the quantities and uses of MB for QPS treatments

The logbook below was used for recording each MB fumigation for QPS in all 27 EU countries until MB was banned. The logbooks were used for annual reports on the quantities of MB authorised for QPS and the purposes for which MB was used, under Regulation (EC) 2037/2000, Article 4(2)(iii).

Please carefully read the instructions at the bottom of the logbook table.
Add more rows if needed.
Indication of authorising authority is mandatory, but indication of demanding authority is voluntary.

Date and purpose of the treatment …										**After fumigation, the consignments were …**			**Authorising authority in EU Member State**		**Demanding authority in country of destination**
Date or period of treatment	**Number of treatments;**	**Name and location of fumigation company;**	**Location of fumigation**	**Fumigation in …**	**Volume of space treated**	**Identifier of Commodity treated**	**Quarantine Pest / Disease target (indicate as precise as possible)**	**Total metric kg of MB used for this commodity – treatment**	**Total metric kg of MB recaptured (if recapture techniques available)**	**Shipped within EU to these Member States …**	**Exported out of the EU to these countries …**	**Placed on the local market in your territory (Y/N)**	**Name of Authority**	**Location of Authority**	**Name / Location**
☒	☒					☒	☒	☒		☒	☒	☒	☒	☒	
A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**

The following explanations shall help to fill in the logbook table above correctly.

☒" indicates that information in this column is mandatory under Regulation (EC) No. 2037/2000.

Column A: Date or period of treatment

Please indicate the date (e.g. 23/07/2005 for 23 July 2005) or period (e.g. 23-28 July 2005) when the treatment(s) has (have) taken place.

Column B: Number of treatments

If you report on several treatments on the same commodity within the specified period, please indicate the number of individual treatments within this period.

Column C: Name and Location of fumigation company *(Voluntary information)*

Please indicate the name and the location of the office of the fumigation company.

Column D: Location of fumigation *(Voluntary information)*

Please indicate the type of location where the fumigation took place. Only write the corresponding Identifying letter into this column:

P	Port area
A	Airport
O	Fumigation place within the country other than Ports and airports (please specify)

Column E: Fumigation in … *(Voluntary information)*

Please indicate the type of place where the fumigation took place. Only write the corresponding Identifying letter into this column:

T	Under tarpaulin
S	On board a ship
P	In an aircraft
C	In a shipping container
F	In a fumigation facility
O	Other (please specify)

Column F: Volume of space treated *(Voluntary information)*

Please indicate the volume of the treated space according to the following groups. Not the volume of the commodity is relevant here, but the volume of the fumigation facility in which the commodity is treated. Only write the corresponding identifying letter into this column:

S	Small: 0 – 49 m^3
M	Medium: 50 – 99 m^3
L	Large: 100 – 499 m^3
XL	Extra-large: 500 – 999 m^3
XXL	Extra-extra large: 1000 m^3 and larger

Column G: Identifier of Commodity treated

Select the identifier of only one of the following target categories and put this letter into the column "Identifier of Commodity treated":

A	Bulbs, corms, tubers and rhizomes
B	Cut flowers and branches
C	Fresh fruit and fresh vegetables
D	Grain and cereals for consumption
E	Dried foodstuffs
F	Nursery stock
G	Seeds and seedlings for planting
H	Wooden packaging materials, pallets, dunnage, other packaging
I	Processed wood (furniture etc.)
K	Whole logs with bark
L	Whole logs without bark
M	Hay, stray, dried animal fodder
N	Cotton and fibre
O	Equipment
P	Personal effects
Q	Other (please specify)

Igrox other uses: Manhole covers, chemicals, yacht, chemicals, cricket bats, slate, detergent, healthcare products, books, glassware, construction materials, cable, scaffolding, steel plates, claywear, plastic, paper, valves, pvc compound, insulation, metal. [Note that the Biocides Directive does not permit the use of MB for biocidal applications after 1 September 2006]

Column H: Pest to be treated

Please indicate the pest as precisely as possible, preferably with its scientific name. This information is legally required to justify any Quarantine treatment. It will allow the Commission to separate the Quarantine-treatments from the Preshipment-treatments. Without a specific pest name, the treatment will be assumed to be against a non-quarantine pest.

Column I: Total kg of MB used for this commodity / treatment

Please indicate the total amount of methyl bromide in metric kg that was used for this commodity / treatment.

Column K: Total kg of MB recaptured (if recapture techniques available) *(Voluntary information)*

Please indicate the amount of methyl bromide (metric kg) that was recaptured if a recapture technology is installed.

Column L: Shipped within EU to these Member States

Please indicate those Member States within the EU (not third countries) to which the consignments treated with MB have been shipped.

Column M: Exported out of the EU to these Countries

Please indicate those third countries (not Member States of the EU!) to which the consignments treated with MB have been exported.

Please note: Transport of goods between Member States of the EU is not considered to be export, but shipment. Only transport of goods to countries outside the EU is considered export.

Column O and P: Authorising Authority

Please indicate the name and location (city) where the agency that authorised the particular treatment is located.

Note that the authorising agency must be located within the EU.

According to the Montreal Protocol, "authorised" refers to specific instructions only provided by a national plant, animal, environmental protection of health authority. Any other authority is not considered to be entitled to give authorisation to QPS treatments with Methyl bromide.

Column Q: Demanding Authority *(Voluntary information)*

You may wish to provide the name and location (country) of the authority that has demanded this treatment. Note that the demanding authority is usually located in the country of destination, i.e. outside the EU.

Forms used by EU countries for annual reports on progress in QPS alternatives

The forms below are used by EU countries for their annual reports on the progress in evaluating and using alternatives for QPS under Regulation (EC) 2037/2000 on substances that deplete the ozone layer Article 4(2)(iii).

ANNEX 4A: FORM FOR REPORTING ON PROGRESS IN USING ALTERNATIVES FOR QPS

You may wish to attach supplementary information where appropriate, but summarise the key parts of the supplementary information into the relevant part(s) of the Form. Please indicate a future implementation date for an action or event that has yet to be implemented.

Where legislation or a programme is mentioned, please state national code for the legislation.

List the alternatives to methyl bromide being used for QPS in the reporting calendar year, e.g. 2008.

No.	**Name of Alternative**	**Commodity**	**Pest target**	**Disease target**	**Date when treatment with this alternative commenced**	**Kg per year of methyl bromide replaced by the alternative (estimates)**	**Comments: duration of treatments, estimated cost of facility, estimated cost per treatment, estimated amount of fumigant used etc.**
1							
2							
3							
4							
5							
6							

QPS uses of methyl bromide for which you have no alternatives yet:				
Commodity	**Pest target**	**Disease target**	**Expected date of research**	**Comments**

One row is used for recording each MB fumigation carried out. More rows can be added as needed

Date when fumigation started	Quantity of methyl bromide used (kg)	Item fumigated	Destination country	Target pest species	Address of government authority which required this fumigation
Example: *31/02/2010*	*300 kg*	*Fresh grapes*	*xxx*	*Chilean spider mite (Brevipalpus chilensis)*	*Quarantine office, Port Town 3210*

ANNEX 5: JAPAN

Form 3 (original: Japanese)

Fumigation record sheet

Company name:

Name of cargo vessel	Plant items	Quantity (tones)	Application No. of plant inspection

Name of fumigation warehouse (chamber):			Fumigation warehouse No.:		
Chamber volume (m^3)		Rate of items loading (Tonnes/ m^3)		Chamber class (gas tightness)	
Name of fumigant :			Amount of dose (kg):		
			Dosage rate (g/m^3):		
Use of circulation apparatus :		Yes No	Use of forced ventilation:		Yes No
Dose application	Year/ Month/ Day :		Chamber space temperature :		∘ C
	Time:		Items temperature :		∘ C

Name of persons in the presence at the dose application	Facility owner:	Chief fumigator:	Fumigation workers:

Termination of fumigation	Year / Month / Day:	Chamber temperature :	∘ C
	Time::	Items temperature :	∘ C

Name of persons in the presence at the termination of fumigation	Facility owner:	Chief fumigator:	Fumigation workers:

*Remaining gas concentration at the fumigation termination: mg / l	*Test insect alive Dead	*Fumigation result Success Failure

※Remarks		*Chief plant quarantine officer name:	
		*Associate-chief plant quarantine officer name:	
		*Name of officer in presence at the dose application:	
		*Name of officer in presence of termination of the fumigation	

Note

1. It is expected to describe every item except for the parts marked with "*" and to submit a copy to the plant quarantine officer at the termination of fumigation.

2. For items in the fumigation chamber which are fumigated with main items simultaneously, respective names of plant items and their quantities are shown.

3. In the columns of name of persons in presence at dose application and the termination of fumigation, all persons names must be described who are engaged in the fumigation and are in presence at the fumigation.

4. This is an English version provisionally translated.

One row is used for recording each MB fumigation carried out. More rows can be added as needed

Date when fumigation started	Quantity of methyl bromide used (kg)	Item fumigated	Destination country	Target pest species	Address of government authority which required this fumigation
Example: *31/02/2010*	*300 kg*	*Fresh grapes*	*xxx*	*Chilean spider mite (Brevipalpus chilensis)*	*Quarantine office, Port Town 3210*

ANNEX 6: MALAYSIA

JABATAN PERTANIAN MALAYSIA
(PERKHIDMATAN KUARANTIN TUMBUHAN)
DEPARTMENT OF AGRICULTURE
(PLANT QUARANTINE SERVICE)

PQ 21

No :

PENGESAHAN OPERASI PEWASAPAN MENGGUNAKAN METHYL BROMIDE

Tempat: ..... Tarikh: .....
Nama Pemilik Konsainan & Alamat: .....

BIL.	PERALATAN	TARPAULIN	KONTENA	CATATAN
1.	Topeng Keselamatan			
	a. Fullface Mask & Canister Filter			
	b. Peralatan SCBA/CABA			
2.	Tarpaulin kalis gas - cover sheet (0.2-0.7mm)			
3.	Tarpaulin kalis gas - floor sheet (0.2-0.7mm)			
4.	Rangka atau Struktur			
5.	Muatan komoditi dalam enclosure 80% atau kurang			
6.	Kontena - kalis gas (pressure test)			
7.	Tangga			
8.	Lampu Suluh			
9.	Guni/Getah/Foam/Kertas (alas sudut)			
10.	Sand snake atau Water snake (5 - 7 cm garispusat & panjang 1 - 1.5 meter)			
11.	Masking Tape atau Loytape jenis kalis gas			
12.	Sealant/Glue/Epoxy/Tar (untuk menampal)			
13.	Tali Pengukur (panjang 30 meter)			
14.	Saluran Tiub Gas (introducing line) - reinforced with wire mesh (eg. Teflon)			
15.	Kedudukan Tiub Persampelan:			
	a. Tengah			
	b. Atas			
	c. Bawah			
	d. Dalam Komoditi			
	e. Lain-lain (nyatakan)			
16.	Gas Methyl Bromide:			
	a. Selinder			
	b. Canister			
17.	Vapouriser/Volatilizer (alat penguwap gas)			
18.	Dapur atau Alat Pemanas			
19.	Guni atau Bekas Tadahan			
20.	Dispenser Gas			
21.	Penimbang (weighing scale)			
22.	Kipas Angin - blade 16-24in diameter - 1,840-5,000 cfm			
23.	Alat Mengesan Kebocoran:			
	a. Halide Detector Lamp			
	b. Reiken-kiki Electronic Detector			
24.	Alat Mengukur Kepekatan Gas:			
	a. Kitigawa/Draeger/Auer Pump			
	b. Fumiscope (thermal conductivity meter)			
25.	Pita Amaran merah puteh (perimeter tape)			
26.	Poster Amaran			
27.	Peti Pertolongan Cemas (First Aid Kit)			

BIL	LOKASI RAWATAN	YA	TIDAK	CATATAN
1.	Kesesuaian Lokasi/Tapak			

BIL	OPERATOR/PEKERJA	YA	TIDAK	CATATAN
1.	Operasi dijalankan oleh Operator/Pekerja terlatih			

BIL	PROSES KERJA	TARPAULIN	KONTENA	CATATAN
1.	Pengiraan Dosej (kepekatan gas)			
2.	Guna & semak carta kepekatan gas/masa			
3.	Pengudaraan (aeration/ventilation)			

KEPUTUSAN PEMERIKSAAN

☐ Pewasapan dibenarkan.
☐ Pewasapan tidak dibenarkan:
Catatan: .....

Syarikat Pewasapan	Pegawai Penyelia:
Tandatangan:	Tandatangan: .....
Nama Operator/Fumigator*:	Nama: .....
Nama & Alamat Syarikat:	Jawatan: .....
Tarikh:	Tarikh: .....

Sila tanda (/) dalam ruangan berkenaan.

JABATAN PERTANIAN SEMENANJUNG MALAYSIA
SKIM PERAKUAN PENSIJILAN PEWASAPAN

PQ14

PEMBERITAHUAN MELAKSANAKAN PEWASAPAN OLEH SYARIKAT PEWASAPAN

Pejabat Kuarantin Tumbuhan: _____

Nama Syarikat Pewasapan: _____

Nama Pemegang Lesen Pewasapan: _____

Maklumat Kerja-kerja Pewasapan yang akan dilaksanakan _____

TARIKH RAWATAN	MASA	NO RUJUKAN	JENIS KOMODITY			PEMILIK/PENGKESPORT/PENGIMPORT	TEMPAT RAWATAN	DISTINASI
			PALLET	CRATE	LAIN			

Perakuan Syarikat Pewasapan;

Saya mengaku bahawa semua maklumat di atas adalah benar, dan saya akan mematuhi semua syarat yang dikenakan oleh Jabatan Pertanian, dan akan melaksanakan pada masa yang tersebut dan sekiranya terdapat apa-apa perubahan tarikh, waktu dan tempat rawatan, saya akan memaklumkan notis yang baru 2 jam sebelum kerja-kerja dijalankan.

Tarikh:	***Tandatangan Pemegang Lesen Pewasapan:***	***Cop Syarikat:***

Borang ini hendaklah dikemukakan kepada Pejabat Kuarantin Tumbuhan 48 jam sebelum melaksanakan kerja-kerja pewasapan

REKOD RAWATAN DAN PENGGUNAAN "WOOD PACKAGING MATERIAL"

BULAN :

RAWATAN					PENERIMA BEKALAN					
TARIKH	BIL UNIT	UNIT DIGUNAKAN (DISPOSAL)	BAKI	PENGESAHAN (PEGAWAI SYARIKAT)	TARIKH	NAMA SYARIKAT PEMBELI	JUMLAH	PENGESAHAN (PEGAWAI SYARIKAT)	PENGESAHAN (PEGAWAI KUARANTIN)	CATATAN

ANNEX 7: INDIA

Fumigation Record (India)						
Fumigation Company/Branch				**Regd. Number:**		
				Date:		
Description of Goods fumigated						
Commodity	**Quantity**	**No of Packages**	**Mode of Packing**	**Shipping marks**	**Container Number (s)**	**Place of Fumigation**
Shipment Particulars						
Vessel Name	**Port of loading**	**Country of Export**	**Foreign port of shipment**	**Name of the Exporter**	**Name of the Importer**	
Details of Fumigation Treatment						
Fumigant	**Dosage (g/m^3)**	**Date/Time of Starting Fumigation**	**Date/Time of Ending Fumigation**	**Temp in ^0C**	**Quantity Of fumigant**	**Volume/Type of Fumigation enclosure**
If Containers are not sheeted, the pressure decay (gas-tightness) value for 200-100 Pascals (in. seconds).						
Record of Monitoring gas concentration				**Gas Monitor type Used:**		

Date/Time	Time Interval	Readings of Sampling lines						Monitored by
		S1	S2	S3	S4	S5	S6	
	0.5 hr							
	1.0 hr							
	2.0 hrs							
	4.0 hrs							
	12.0 hrs							
	24.0 hrs							
	48.0 hrs							

Particulars of top up of fumigant at the end point of fumigation, if any undertaken	
Name & Signature of accredited Fumigation Operator with date/Accreditation Number	
Supervised by Specified Officer of Dte PPQS (Applicable in case of non-accredited agency)	

Fumigation Certificate (India)	
(Company letter head)	**Treatment Certificate Number**
	Date of Issue
This is to certify that the goods described below were treated in accordance with the fumigation treatment requirements of importing country (_____) and declared that the consignment has been verified free of impervious surfaces/layers such as plastic wrapping or laminated plastic films, lacquered or painted surfaces, aluminium foil, tarred or waxed paper etc. that may adversely effect the penetration of the fumigant, prior to fumigation	
Details of Treatment	
Name of Fumigant	
Date of fumigation	
Place of fumigation	
Dosage of Fumigant (g/m^3)	
Duration of Fumigation (hours)	
Average ambient temperature during fumigation ^{0}	
Fumigation performed under gastight sheets	**Yes/No**
If containers are not fumigated under gas-tight sheets, pressure decay value (from 200-100	
Description of Goods	
Container Number (or numerical link)./Seal	
Name & Address of exporter	
Name & Address of consignee	
Type and description of cargo	
Quantity (MTs)/ No of packages/No of pieces	
Description of packaging material	
Shipping mark or brand	
Name & Signature of Accredited Fumigation Operator with seal & date/ Accreditation	
Endorsed by Specified Officer of Dte of PPQS(**Applicable only in case of non-accredited fumigation agency**)	

Reporting of Stock and Use of Methyl Bromide (India)				
Name of Fumigation Company/Branch:			**Month of Reporting:**	
Opening stock	**Qty purchased**	**Total Qty**	**Qty used**	**Closing Balance**

Particulars of Fumigations carried out

IMPORTS			**EXPORTS**		
Commodity	**Origin**	**Qty of**	**Commodity**	**Exported**	**Quantity**
Total			**Total**		

Name & Signature of Accredited Fumigation Operator with date	**Name & Signature of GM/BM of Fumigation Agency with date**

11 TEAP and TOC Organisation Issues

11.1 Current TEAP and TOC membership

Currently TEAP has 22 members; this number includes, the TEAP co-chairs, the TOC co-chairs, Senior Expert members and one temporary member serving as co-chair of a Task Force. Of the 22 members, 7 are from Article 5 Parties, 1 from a former Country with Economy in Transition (CEIT) and 14 are from non-Article 5 Parties.

The total membership of the TEAP and its six TOCs is about 150 members with a third from Article 5 Parties and two thirds from non-Article 5 Parties (which includes a small number of experts from non-A5 former CEITs in Eastern Europe and Central Asia). Full lists of the TEAP and TOC members are contained in the Annex to this report. The latest collection of disclosures of the interests of TEAP, TOC and Task Force members is posted on the Ozone Secretariat website.

11.2 Future TEAP Membership

Paragraph 9 of Decision XXIII/10 of the Twenty-Third Meeting of the Parties to the Montreal Protocol (Updating the nomination and operational processes of the Technology and Economic Assessment Panel and its subsidiary bodies) specifies: "*That the terms of all the members of the Panel and its technical options committees shall otherwise expire at the end of 2013 and 2014, respectively, in the absence of reappointment by the parties prior to that time, except for those experts that have already been nominated for four-year periods in past decisions;" subject to paragraph 10 of Decision XXIII/10: "That parties may revisit the status of the Panel and its technical options committee membership at the Twenty-Fifth and Twenty-Sixth Meetings of the Parties respectively if more time is needed by the parties to submit nominations;*

In 2011, Parties approved the appointment of Keiichi Ohnishi as Co-Chair of the CTOC and the appointment of Masaaki Yamabe as Senior Expert Member for four-year terms ending in 2015.

11.3 TOC and Task Force Membership

Alistair McGlone (UK) is the only member of a TEAP Task Force in 2012 not previously a member of TEAP or its TOCs. Keiichi Ohnishi is the only new permanent member of TEAP, as mentioned above.

The TOCs are still in the process of finalising their memberships for the 2014 Assessment, and will report on the revised memberships in the next 2013 progress report (particularly on departing and new members). Overall, the TOC memberships status May 2012 are about the same as in 2011.

11.4 Financial Constraints and Challenges

TEAP is grateful for the continuing support of governmental and non-governmental organizations, industries and academic institutions that finance time and expenses for the participation of experts in the TEAP, TOCs and Task Forces. Each TEAP, TOC and Task Force member annually reports the source of their funding (but not the specific details) in their individual Disclosure of Interest, which are posted on the Ozone Secretariat website. Sponsorship funds are paid as reimbursements to employees, as payment for independent contractors (consultants), and in some cases via the Ozone Secretariat from special contributions from industry associations and Parties. In many cases, consultants to industry associations and Parties are paid for their time in addition or expenses or are granted a lump

sum payment for both time and expenses. The Montreal Protocol Trust Fund continues to fund the travel of Article 5 members and a limited number of non-Article 5 experts on a case-by-case basis to the relevant meetings of the TEAP and TOCs.

In 2011 and 2012, the governments of Australia, Canada, the Czech Republic, Germany, Japan, Spain, Sweden, United Kingdom, and the United States as well as the European Commission sponsored the expenses of one or more TEAP and/or TOC members. However, it has become increasingly difficult for many non-Article 5 experts to find funding for travel and miscellaneous meeting expenses. As a result, the TEAP and TOC operations are becoming ever more difficult.

TEAP and its TOCs have the disadvantage of only being able to recruit non-Article 5 experts whose time and expenses of working on TEAP, TOCs and Task Forces are financed by governments, employers, trade associations or from their own personal savings. Many experts from both Article 5 and non-Article 5 Parties make significant unpaid and unreimbursed contributions through their participation.

The funding-starved environment strains attendance at meetings, jeopardizing the ability of TEAP and its TOCs to maintain the quality and consensus of its many reports. In 2012, one MBTOC subcommittee chose to meet in a different location than the other two MBTOC subcommittees because many of its non-Article 5 members were unable to finance their travel, and the MTOC committee met without many of its non-Article 5 members owing to funding constraints on their travel. Other TOCs and Task Forces met with partial membership, met by Internet, or compromised the scheduling of TOC meetings to take advantage of professional meetings that some of the members were attending. For example, the FTOC met after the 2012 TEAP meeting at the location of a professional meeting, potentially complicating the completion of the TEAP Progress Report. The Task Force on Decision XXIII/10 proposes that the TEAP operating procedures be modified, on an on-going basis, to allow virtual meetings using available and emerging communication technology.

Inadequate funding for TEAP and its TOCs has the risk of biasing the membership to the views of organizations with enough policy, financial, or technical interest to sponsor participation. Parties may wish to consider financing for travel and other expenses, as needed, for both Article 5 members and non-Article 5 members.

11.5 Minority Reports

Since the 2011 TEAP Progress Report, TEAP has had two additional minority reports, both from members of MBTOC. These minority reports reflect differences in professional judgement, which are the traditional basis of disagreement on facts and findings. In addition, these minority reports have questioned 1) the burden of proof (must Parties prove that identified alternatives and substitutes are not suitable for uses nominated for Critical Use Exemptions (CUEs) or must MBTOC identify alternatives and substitutes that make CUEs unnecessary); 2) whether Decisions of Parties should be strictly enforced regarding an appropriate level of research effort, that every effort has been implemented to reduce methyl bromide use and emissions, and that annual progress must be demonstrated in phaseout; and 3) whether MBTOC subcommittees must all meet in the same location at the same time, and that agendas be organized to allow every MBTOC member to participate in the discussion and findings of each Critical Use Nomination (CUN).

The TEAP Task Force reported elsewhere in this report is putting forward recommendations to Parties on the way forward. TEAP welcomes guidance from Parties on all aspects of its operations.

ANNEX I TO CHAPTER 11: TEAP TOC Membership List Status April 2012

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
Masaaki Yamabe	National Inst. Advanced Industrial Science and Technology	Japan
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 V. 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
Keiichi Ohnishi	Asahi Glass	Japan
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	Energy International Australia	Australia
Daniel P. Verdonik	Hughes Associates	USA
Ashley Woodcock	University Hospital of South Manchester	UK

Task Force Co-chair	Affiliation	Country
Alistair McGlone	DEFRA	UK

TEAP Chemicals Technical Options Committee (CTOC)

Co-chairs	Affiliation	Country
Biao Jiang	Shanghai Institute of Organic Chemistry	China
Keiichi Ohnishi	Asahi Glass	Japan
Ian D. Rae	University of Melbourne	Australia

Members	Affiliation	Country
D. D. Arora	The Energy and Research Institute	India
Joan Bartelt	DuPont	USA
Steven Bernhardt	Honeywell	USA
Olga Blinova	Russian Scientific Center for Applied Chemistry	Russia
Jianxin Hu	College of Environmental Sciences & Engineering, Peking University	China
Abid Merchant	Consultant	USA
Koichi Mizuno	National Inst. Advanced Industrial Science and Technology	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
Adam Chattaway	Kidde Graviner Ltd.	UK
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
John J. O'Sullivan	Bureau Veriitas	UK
Emma Palumbo	Safety Hi-tech srl	Italy
Erik Pedersen	Consultant – World Bank	Denmark
Donald Thomson	Mantoba Hydro & MOPIA	Canada
Filippo Tomasello	European Aviation Safety Agency	Italy
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
David Liddy	United Kingdom Ministry of Defence	UK
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
Emmanuel Addo-Yobo	Kwame Nkrumah University of Science and Technology	Ghana
Paul Atkins	Oriel Therapeutics Inc.	USA
Sidney Braman	Mount Sinai School of Medicine	USA
Nick Campbell	Arkema SA	France
Hisbello Campos	Instituto Fernandes Figueira, FIOCRUZ, 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	Boehringer Ingelheim Pharmaceuticals 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	Professor ad Honorem	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
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	Honorary Professor	Germany
Jordi Riudavets	IRTA – Department of Plant Protection	Spain
John Sansone	SCC Products	USA
Sally Schneider	US Department of Agriculture	USA
JL Staphorst	Consultant	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)

Co-chair	Affiliation	Country
Lambert Kuijpers	Technical University Eindhoven	Netherlands
Roberto de A. Peixoto	Maua Institute, IMT, Sao Paulo	Brazil

Members	Affiliation	Country
Radhey S. Agarwal	IIT New Delhi	India
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
Martien Janssen	Re/genT	Netherlands
Makoto Kaibara	Panasonic, Research and Technology	Japan
Michael Kauffeld	Fachhochschule Karlsruhe	Germany
Fred Keller	Consultant	USA
Jürgen Köhler	University of Braunschweig	Germany
Holger König	Consulatant	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
Paulo Vodianitskaia	Consultant	Brazil
Sulkan Suladze	Consultant	Georgia