Quarantine and Preshipment (QPS) Uses of Methyl Bromide in Australia and Potential for the Replacement of Methyl Bromide in QPS Uses

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Australian Government
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Glossary

AQIS	Australian Quarantine Inspection Service (see http://www.daff.gov.au/aqis)
AFAS	Australian Fumigation Accreditation Scheme operated by AQIS (see http://www.daff.gov.au/aqis/import/general-info/pre-border/afas)
AWPCS	Australian Wood Packaging Certification Scheme for Export operated by AQIS (see http://www.daff.gov.au/aqis/export/timber)
DEW	Australian Government Department of the Environment and Water Resources
IPPC	International Plant Protection Convention an international treaty to secure action to prevent the spread and introduction of pests of plants and plant products, and to promote appropriate measures for their control. It is governed by the Commission on Phytosanitary Measures (CPM) (see https://www.ippc.int/IPP/En/default.jsp)
ISPM15	'International Standards for Phytosanitary Measures Publication No. 15: Guidelines for Regulating Wood Packaging Material in International Trade' (see https://www.ippc.int/servlet/CDSServlet?status=ND0xMzM5OSY2PWVuJjMzPSomMzc9a29z)
MB	Methyl Bromide (CH_3Br) registered for use as a pesticide in Australia and commonly used as a fumigant in quarantine and pre-shipment
ODP	ozone depleting potential: ODS are measured in terms of their (ODP). The basis of comparison is CFC11 (CCl3F) which is considered as 1. ODP is then measured as a fraction of CFC11
ODS	Ozone Depleting Substance: The Montreal Protocol defines ODS according to lists in annexes to the Protocol. They include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), methyl bromide and carbon tetrachloride (a solvent once used for dry-cleaning)
PIC	Chloropicrin (CCl_3NO_2); registered for use as a pesticide in Australia and used mainly as a fumigant to control pests in soil. It can be used as a warning agent in products containing MB.
QPS	Quarantine and Pre-shipment (as defined under the Montreal Protocol on Substances that deplete the Ozone Layer – see http://ozone.unep.org/)

1. Introduction

This report provides an analysis of current methyl bromide (MB) requirements and use in Australia (as at the end of 2006 unless otherwise stated), and potential scenarios until 2020, with a particular emphasis on quarantine and pre-shipment uses of MB as defined by the Montreal Protocol[1].

The analysis included:

1. major Quarantine and Pre-shipment (QPS) uses of MB in Australia in 2005 (what commodities, pests, seasonal variations, type of fumigation, etc);
2. significant users of MB in Australia, drawing some brief comparisons from previous reports;
3. impacts of 'International Standards for Phytosanitary Measures Publication No. 15: Guidelines for Regulating Wood Packaging Material in International Trade' (ISPM15) on Australian quarantine uses of MB;
4. any mandated MB uses by our trading partners which impact our QPS regime;
5. any mandated MB uses by our trading partners or the Australian Quarantine Inspection Service (AQIS) which influence MB emissions domestically and internationally;
6. degree of take up of recapture and destruction technology, and barriers;
7. summary of research underway by industry and research institutions on alternatives domestically and internationally for the main MB uses in Australia;
8. identification of data and information gaps; and
9. development of various scenarios for MB use in Australia based on international requirements for MB staying the same or increasing, and possibility of effective alternatives coming to market.

These items are addressed in order below.

2. Scope

The survey of end users of MB for QPS in Australia covered 81 fumigators using 302 tonnes of MB in total in 2005. The survey covered 88% of the 389 tonnes of MB imported into Australia in 2005 for QPS and provided information on all expected major uses. The discrepancy between the responses to the survey and the import figure is ascribable to incomplete coverage and reporting to the survey, changes in inventory during this first year of full phase-out and some record keeping difficulties for some fumigators.

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[1] Decisions VI/11, VII/5 and XI/12 of the Montreal Protocol explain the terms "quarantine" and "pre-shipment" and how they relate to the QPS exemption under the Protocol:

"(a) 'Quarantine applications', with respect to methyl bromide, are treatments to prevent the introduction, establishment and/or spread of quarantine pests (including diseases), or to ensure their official control, where:

(i) Official control is that performed by, or authorized by, a national plant, animal or environmental protection or health authority;

(ii) Quarantine pests are pests of potential importance to the areas endangered thereby and not yet present there, or present but not widely distributed and being officially controlled;

(b) 'Pre-shipment applications' are those non-quarantine applications applied within 21 days prior to export to meet the official requirements of the importing country or existing official requirements of the exporting country. Official requirements are those which are performed by, or authorized by, a national plant, animal, environmental, health or stored product authority;"

The high coverage of 88% was somewhat greater than that covered in a previous survey, 75%, for 2000 usage (Porter 2001). It is very unlikely that there are any uses not identified by the survey in view of the range of data sources used and the diversity of fumigation business surveyed.

3. Data from Surveys

3.1 Structure of the industry using methyl bromide for QPS

Eight companies were identified with an annual use of MB for QPS purposes in 2005 exceeding 10 tonnes. Two of these companies employed their own licensed fumigators who carried out treatments on export grain and cottonseed. Other fumigations were carried out by fumigation contractors for commodity owners or handlers.

There were a substantial number of individual fumigators (11) using low total volumes of MB, less than 5.0 tonnes in 2005, that operated under the AQIS Australian Wood Packaging Certification Scheme (AWPCS) (AQIS 2006a) and only carried out treatments of wooden packaging.

3.2 QPS MB consumption (use) by category in Australia.

A breakdown of use of QPS MB in 2005 by tonnage is given in Table 1.

Major use categories (>5 tonnes use in 2005) were cereal grains and grain products (almost all export, preshipment); export hay; timber and sawn wood (both export and import); solid wooden packaging material, including to ISPM15 (IPPC 2006); export cottonseed and fresh fruit and vegetables (import and export). Breakdown by category of use is illustrated in Figure 1.

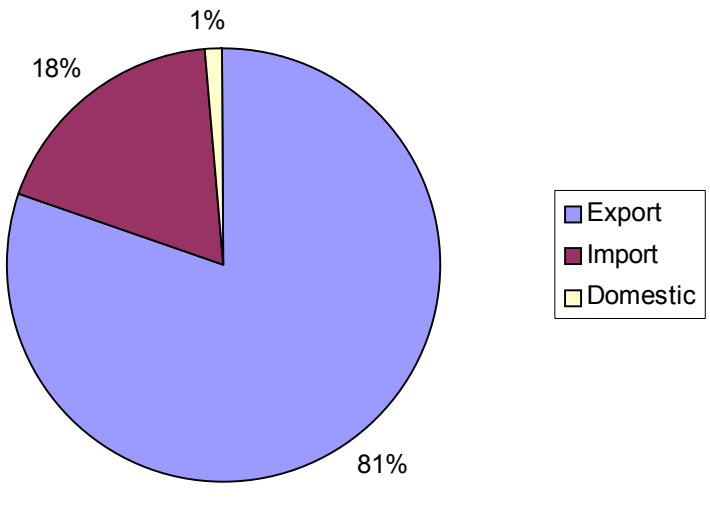

Figure 1. Estimated proportion of QPS treatments for 2005 by volume of consumption of MB.

There were a substantial number of minor uses identified by various fumigators, but these typically consumed less than 1.0 tonne in 2005 and in aggregate represented 2.0% of identified consumption.

Most MB used in Australia for QPS is 100% MB. An exception is Western Australia, where 98% MB + 2% chloropicrin is used on non-foodstuffs, including export hay. The 2% chloropicrin acts as a warning agent (potent lachrimator) easily detected by humans, in contrast to the nearly odourless MB.

Table 1. Results of the survey of MB QPS uses in 2005 by treated commodity or use, with comparison with the survey of Porter (2001) for 2000.

Treated commodity/material	Class (a)	2005 tonnes used	2005 %	2000 tonnes used	2000 %
Hay	E	72.88	22.5	131.11	33.56
Cereal grains	E	72.65	22.4	49.08	12.56
Wood Packaging	E/I	58.95	18.2	36.72	9.40
Wood and timber	E/I	48.04	14.8	13.31	3.41
Cottonseed	E	9.14	2.82	85.36	21.85
Fresh fruit and vegetables	E/I	8.18	2.52	13.34	3.41
Empty grain ships	E	4.60	1.42	5.48	1.40
Branched broomrape	D	3.20	0.99		
Tyres	I	2.96	0.91		
Equipment	I	1.62	0.50	6.81	1.74
Furniture and personal effects	I	1.35	0.42	21.22	5.43
Flours and meals	I	1.24	0.38		
Dried fruit	I	1.00	0.31		
Steel and steel scrap	I	0.84	0.26		
Flowers, bulbs and plants	I	0.75	0.23	8.14	2.08
Boats	D	0.67	0.21		
External against snail	I	0.66	0.20		
Cotton	E	0.48	0.15	1.52	0.39
Nuts	I	0.43	0.133		
Explosives	E	0.40	0.123		
Artefacts	I	0.23	0.071		
Hides	I	0.112	0.035		
Copra	I	0.046	0.014		
Peat moss	I	0.024	0.007		
Unspecified containers	E	1.39	0.43	5.19	1.33
Misc	I	2.17	0.67		
Unallocated		30.5	9.4		
Public buildings and O/S embassies				4.8	
Mills				2.68	
Tobacco				1.38	
Others (16 in total)				4.54	
Total use		**324**	87.8	**391**	75.7
Reported QPS to Ozone Secretariat		**369**		**516**	

(a) Principal class of use. E = for exports, I = for imports, D = domestic.

3.3 Relative quantities used for imports, exports and domestic quarantine.

A breakdown of MB uses between imports, exports and domestic quarantine uses was not specifically sought in the survey of end uses. However, the approximate breakdown can be estimated from the uses. Most of the MB treatment of grains, cottonseed and hay are export-related and at least 50% of timber and wooden packaging fumigation is also associated with exports. Most of the general fumigation is associated with imports, either mandatory quarantine treatment on arrival or as ordered by AQIS when pests are detected in an imported consignment. There is a small quantity of treatment associated with interstate quarantine, particularly to and from Western Australia, and control of quarantine pests within the country, including branched broomrape and drywood termites.

On this basis, the approximate breakdown of class of use is as given in Figure 1.

3.4 Technology used to apply methyl bromide

Methyl bromide has to be applied in well-sealed systems, both for efficacy and safety reasons. There are four principal modes of use for QPS in Australia:

- in silo bins, with forced recirculation;
- in ship;
- in freight containers (usually sheeted); and
- 'under sheets'.

Silo bins suitable for treatment with MB are available in many Australian grain export ports. Hay exports are typically fumigated in the freight containers that are used for the export. Timber may be fumigated in ship, on-shore under sheets or in container. All three systems are in common use, with choice dependant on local circumstances. Wood packaging, principally to comply with ISPM15 (IPPC 2006) or at direction of AQIS may be fumigated under sheets or in container, sometimes as part of the consignment. Fresh fruit and vegetables are typically treated in container or under sheets.

Treatment of branched broomrape was the sole example of quarantine use on soil identified in the survey. Application of the MB fumigant is likely to be by soil injection under tarp (see also Section 3.5).

3.5 Seasonal variation and comparison with the survey for 2000.

Table 1 summarises the results of the 2005 survey by use or treated commodity and gives a comparison with Porter (2001).

Much of the QPS MB is used on export agricultural commodities, particularly grain, hay and cottonseed. Production of these commodities is notoriously variable and dependent on rainfall. Export destinations for grain also vary with some specifying MB treatment at point of export. Some export terminals are quite small and require a fast-acting fumigant to allow loading of large cargoes without interruption. These terminals may be used for seasonal or commercial reasons. These factors give rise to substantial variation in the need/use of QPS MB in Australia. Differences in use of QPS MB for grain and cottonseed between 2000 and 2005 are attributable to changes in crop size in both cases.

Grain exports to India in 2005 were low, but much increased in 2006. India is one of the grain destinations requiring MB treatment at export from Australia.

QPS use for wood and sawn timber increased substantially for 2005 compared with that for 2000. The increase is attributable to increase in trade of both exports and imports and increased interceptions by AQIS with subsequent treatment. Part of the increase may be an artefact arising from transfer of some MB between categories used in 2000 and 2005. The reported use of MB on furniture in 2000 was very large and some of this consumption may have been better placed in the wood and sawn timber category.

Use on wood packaging is substantially higher in 2005 than 2000, presumably in response to introduction of ISPM15 compliance during 2005. However, Australia has had a longstanding quarantine against imported wood and wooden materials, predating ISPM15. Use for this may have resulted in the quite high figure of nearly 37 tonnes for this use in 2000. It can be expected that Australia's use for this category in 2006 will be significantly increased as new schedules for ISPM15 become operational (see Section 3.6)

One important new category of use, 'branched broomrape', commenced in 1998 but was not included in the 2000 survey. Branched broomrape is a parasitic plant, capable of causing severe damage and economic loss to some crops. It is restricted to the Murray Bridge area of South Australia and is the subject of a national eradication program[2].

Three categories of use that consumed >1 tonne in 2000 were not recognised in the survey in 2005 (see Table 1).

There was substantial use of MB against drywood termite infestations in Queensland in 2000. This quarantine pest has long been established in the Maryborough area of Queensland, and is subject to containment there. Occasional outbreaks occur elsewhere and the infested buildings are typically treated with MB under sheets. This can be a major operation. No such use was recorded by survey in 2005. QPS use can be expected in 2006 and later against both drywood termite and European House Borer. There are outbreaks of both these noxious pests currently in Western Australia.

The year 2005 was after the phase-out of MB for non-critical uses (ie the Montreal Protocol still allows the use of MB for critical, QPS and feedstock uses). Despite urgings of Decision XI/13(7) to reduce MB for QPS use where feasible, there was no indication of substantial reduction in QPS use compared with 2000, a year prior to full phase-out, attributable to a specific policy of MB reduction. The 25% reduction that did occur is attributable to seasonal variation of exports using MB for QPS treatment.

3.6 Impact of ISPM15 on Australian and world QPS consumption

The ISPM15 "Guidelines for Regulating Wood Packaging Material in International Trade" (IPPC 2006) have been widely adopted globally. Adoption was quite restricted in 2005 (Table 2) and its full impact is thus not evident in the 2005 survey year.

The standard has been adopted by Australia for containerised imports and is widely required by trading partners for exports. Australia has had quarantine restrictions on import of wooden packaging materials in place previously and these are still current for imported packaging other than in containers. These include fumigation where necessary, judged by quarantine risk, sometimes at a higher MB dosage rate than specified in the 2002 version of the ISPM15 standard. Estimated MB use on wooden packaging material was similar in 2000 and 2005.

During the survey several fumigators reported that their business had much increased as a result of ISPM15, although this is not reflected in the survey results, possibly because of the timing of adoption of ISPM15 by Australia and trading partners, late in 2005 or after the survey year, in 2006.

[2] As at July 2007, alternatives to MB were predominantly used

A revised MB dosage schedule was adopted for ISPM15 in 2006. Compared with the 2002 version, this did not change the initial MB concentrations needed, but raised both the exposure period and the retention of gas needed at the end of the fumigation, from 30% at 16 hours to 50% at 24 hours. While this retention is achievable with best practice, several major fumigators gave anecdotal evidence that indicated that the initial charge of MB is being increased to compensate for leakage in order to meet the final concentration requirement. This avoids the need to top up concentrations during the fumigation or to retreat if specified end concentrations are not met. Such practices were not required in 2005, prior to implementation of the revised schedule. A submission has been made by AQIS (AQIS 2006b) to reduce the required final concentration required and bring it into line with current AQIS standards.

Usage for ISPM15 for 2006 is likely to be substantially higher in Australia both as a result of this dosage practice and the more widespread implementation of ISPM15 requirements. The survey located several operators that reported no use in 2005 but were active in 2006.

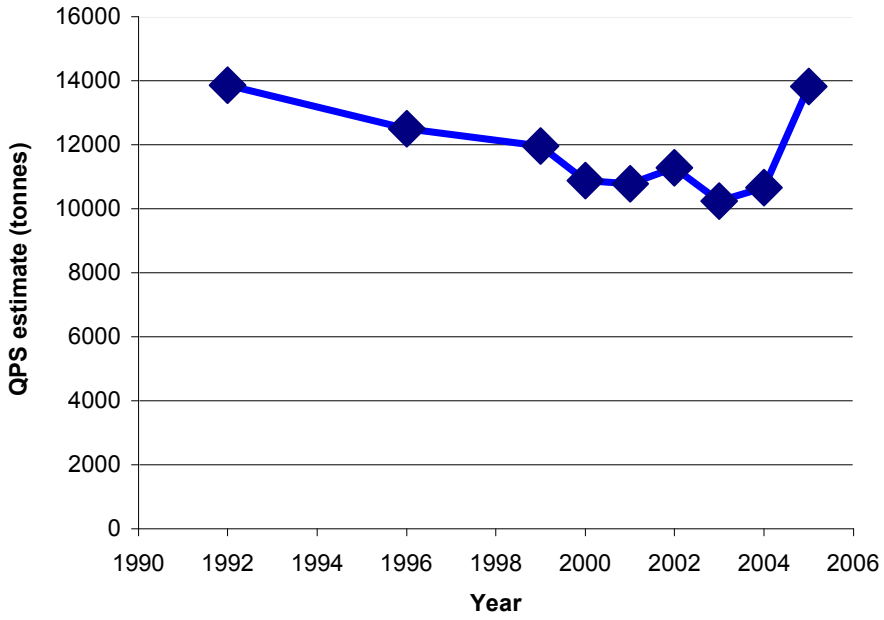

Figure 2. Global production of methyl bromide for QPS purposes (UNEP and MBTOC data). Rise in production for 2005 coincides with introduction of ISPM 15.

AQIS, as certifier for ISPM15, maintains a register of certified users of the ISPM mark showing treatment of wood carried out to ISPM15 (AQIS 2007). This register includes not only treatment providers that carry out MB fumigations to the standard, but also ones that heat treat to the standard. Particular heat treatment is specified as an alternative to MB in the standard, without any stated preference for which treatment is used.

World production figures for MB use for QPS (Figure 2) show an increase of around 30% in 2005 compared with the average for the 6 previous years. This increase is coincident with the start of widespread implementation of ISPM15.

Table 2. Adoption of ISPM15 by country, with date of enforcement or implementation.

Country	Start*	Country	Start*
Argentina	1 January 2006.	Mexico	5 July 2006
Australia	1 May 2006	New Caledonia	1 June 2006
Bolivia	24 May 2005	New Zealand	1 May 2006
Brazil	11 July 2005.	Nigeria	30 September 2004.
Bulgaria	24 January 2006.	Oman	1 December 2006
Canada	5 July 2006	Panama	17 February 2005
Chile	1 June 2005	Paraguay	28 June 2005
China	1 January 2006	Peru	1 September 2005
Colombia	15 September 2005.	Philippines	1 June 2005
Costa Rica	19 March 2006.	Rep of Korea	1 June 2005
Dominican Rep	1 July 2006.	Seychelles	1 March 2006
Ecuador	30 September 2005	South Africa	1 March 2005.
Egypt	1 October 2005	Switzerland	1 March 2005
European Union	1 March 2005	Syria	1 April 2006
Guatemala	25 January 2005	Trinidad & Tobago	15 September 2005
Honduras	25 February 2006	Turkey	1 January 2006
India	1 November 2004	Ukraine	1 October 2005
Japan	1 April 2007 (proposed).	USA	5 July 2006
Jordan	17 November 2005	Vietnam	5 June 2006
Lebanon	1 July 2006	Venezuela	2 May 2005

* For detail and full descriptions see http://www.daff.gov.au/aqis/export/timber/implementation-dates.

3.7 Consumption of methyl bromide overseas resulting from Australian regulations.

Australia is free of many highly injurious pests and diseases suffered by many other countries. It runs a rigorous quarantine to avoid introduction and establishment of new noxious pests and diseases. Methyl bromide fumigation is one weapon in the armoury of techniques used as a quarantine measure against incursions.

Where possible, the quarantine barrier is extended from point of import into Australia to point of export in the exporting country. This process has been in place for some years with overseas fumigators accredited to carry out fumigations to AQIS standards. Once certified, they may be audited. Cargoes are subject to inspection at point of import and may be retreated if infestation is detected.

During the development of the offshore fumigation scheme, it was found that a disproportionate number of ineffective MB fumigations performed offshore originated from fumigators in a relatively small number of countries. To help prevent this, a training and further certification program was developed, known as the Australian Fumigation Accreditation Scheme (AFAS) (AQIS 2007). Participating countries include Thailand, Indonesia, Malaysia and India. AQIS is working with quarantine agencies in the Philippines, China and Papua New Guinea to implement AFAS during 2008. Evaluation of the fumigation training needs of Vietnam, Cambodia and Laos will take place in 2008 with a view to training commencing in 2009. AQIS is discussing expansion of AFAS with a number of other countries including the USA, New Zealand and Chile and has received APEC funding to hold a seminar of interested parties in March 2008.

The AFAS scheme is expected to reduce the number of failed fumigations overseas and the subsequent need for multiple treatment or re-treatment onshore substantially, with consequent

savings in MB used. AQIS estimates a saving of 95 tonnes of MB has been achieved by reducing the number of unnecessary re-fumigations from Indonesia and Malaysia over the last three and two years respectively. This figure is based on the fumigation failure rate existing prior to implementation of AFAS.

No estimate was obtained of the total quantity of MB used off-shore as a result of Australian quarantine requirements, including implementation of ISPM15.

The transfer of MB QPS treatments to off-shore may be a good strategy for quarantine, but it will also reduce the Australian QPS consumption on shore without reduction in emissions in total attributable to Australian activities. The QPS MB used off-shore will accrue to the using country's MB consumption. Much of this consumption will occur in Article 5 countries[3].

3.8 Mandated MB use by trading partners on Australian exports

Australia has a number of pests that occur in particular production areas of the continent (including Tasmania) that are of quarantine concern to particular importing countries. These may be endemic species, such as Queensland fruit fly, or exotics that have become established here, such as Mediterranean fruit fly in parts of Western Australia. National Plant Protection Organisations of some countries specify MB treatment as a condition of accepting particular export commodities from Australia. In most cases, such specification is against recognised quarantine pests and often MB is the only bilaterally acceptable treatment. The requirement may be restricted to produce from particular regions while other regions may be exempted under area-freedom arrangements or, alternatively, prohibited from export to that trading partner at all.

Prominent QPS MB uses, without established alternatives, include:

- Treatment of apples and cherries against codling moth from Tasmania to Japan; and
- Treatment of cottonseed against a race of *Fusarium* fungus from NSW and Queensland to west coast USA.

Further examples may be found in the AQIS 'PHYTO" database of requirements for quarantine treatments by importing countries by export destinations (see http://www.aqis.gov.au/phyto/asp/ex_search.asp).

Some trading partners purchasing export cereal grain, principally wheat, insist on MB fumigation of the exports despite alternatives of similar performance being available.

Malaysia specifies MB fumigation of export timber from Australia.

3.9 Emissions resulting from mandated MB use associated with exports and imports

The rate of MB emission from a treatment varies widely with the commodity treated and the situation and its environment. In Australia, many fumigations still result in more than half the initial charge lost through leakage during the exposure period. Typically at present the residual fumigant, from both technically good and bad treatments, is vented to atmosphere after fumigation. A fraction of the charge will react with constituents of the commodity to produce non-volatile residues. It is only the latter part of the added MB that is not emissive – the remainder is released to atmosphere and so has potential to reach and destroy the ozone layer.

[3] Under the Montreal Protocol on Substances that Deplete the Ozone Layer, Article 5 provides for developing countries (for full text see ozone.unep.org/Publications/MP_Handbook/Section_1.1_The_Montreal_Protocol/Article_5.shtml)

The proportion of MB reacting is dependent on the commodity and its state, particularly its temperature and moisture content. As a global approximation, MBTOC (2007) estimated about 82% (range 76 – 88%) of the added MB was lost to atmosphere for fumigation of commodities, including timber.

Given this estimate of loss, and that Australian on-shore use of MB for QPS purposes in 2005 was 369 tonnes, then this would have resulted in around 300 metric tonnes of MB emitted to the atmosphere (ie 0.82 X 360 tonnes = 303 tonnes).

3.10 Availability and uptake of emission control and recapture technology

With one exception, QPS MB fumigations within Australia are all currently carried out in contained systems of some sort. The contained systems must be well sealed to minimise leakage and unintentional loss of fumigant, for both efficiency and safety reasons. The fumigation enclosures range from large grain stores of several thousand tonnes to domestic houses, sheeted stacks of goods and loaded or empty freight containers. The exception is the sole QPS use involving soil fumigation – treatment against branched broomrape. Contained systems potentially can be adapted to allow efficient recapture of the added MB at the end of the treatment. There are installations that recapture MB from fumigations in commercial operation in several places around the world, with Australia (as at May 2007) having the most in number and total capacity.

3.10.1 Available technology for recapture of methyl bromide

As at 1 May 2007, the only commercially available and installed MB recapture units are those supplied by Nordiko Quarantine Systems and Desclean België NV, based in Sydney, Australia and Antwerp, Belgium respectively. Desclean België NV announced in January 2007 that they had received approval from the Belgian regulatory authorities for use of their system to meet recently introduced regulations for MB fumigations in Belgium. A similar approval was obtained by Nordiko at the same time. The Desclean België NV system is now being actively promoted but no details are available as to whether there are commercially functioning units installed. Various versions of the Nordiko system has been installed in Australia (see Section 3.10.2) and overseas.

Custom-designed systems (MBTOC 2007) are installed at several locations in the US, and also in Poland and the Netherlands. There does not appear to be any marketing effort by the makers of these installations to promote their use more widely.

All these units are based on capture of MB gas on active carbon, but their subsequent treatment of the loaded carbon varies. The unit in Poland not only recaptures the MB, but the MB is reclaimed from the carbon absorbent and reused giving a net saving of about 75% in new MB. The Desclean België NV system claims to be able to store the loaded carbon and then release the MB for reuse as required. The other systems use a variety of disposal methods (reaction with thiosulphate, Nordiko; combustion, US; reaction with ozone, US; deep burial, Netherlands). One US system uses condensation as a means of recapturing some of the MB for reuse.

There have been numerous other suggestions and prototypes for MB recapture, described in MBTOC (2007). None of these are currently in use or being offered for routine commercial application. The recapture system based on zeolite (Halozone system) that was installed in some large facilities in the US, is no longer available.

At this time, the two systems in commercial use, Nordiko and Desclean België NV, are both limited to recapture of small quantities of MB, 20 kg or less, such as might be available from fumigations of freight containers or enclosures of 200 m^3 or less.

There has been no recent demonstration of recapture of large quantities of MB, a tonne or more, such as might be available from a typical QPS treatment of export cottonseed or grain. The discontinued Halozone system was apparently capable of recapture and recycling of large quantities of MB. The VR Technologies system, under development and involving liquid scrubbing with ammonium thiosulphate, looks as though it can be scaled up quite easily but there will be substantial effluent disposal problems.

3.10.2 Recapture units in operation in Australia.

As informed by Nordiko Quarantine Services (February 2007), there are 8 recapture installations in Australia (Table 3). All these use the Nordiko system.

Table 3. Installations of MB recapture in Australia for fumigation concentrations at February 2007.

Operator	Location	Reason for recapture	Commodity treated
P&O Trans Australia Pty Ltd	Port Botany	OH&S, local regulations	General cargo
Sunrice (Ricegrowers Cooperative Ltd)	Leeton	?ozone protection	Packaged, milled rice
Tasports Pty Ltd	Hobart	State regulations	Export apples and cherries
Morris Pest Control	Launceston	State regulations	General cargo, ISPM15
Smith Pest Control	Burnie	State regulations	General cargo, ISPM15
H&D Timber	Raymond Terrace	OH&S, local regulations	ISPM15
Fumilink (Worldlink)	Perth Airport	Local air quality	AQIS orders on imports
Top Class Fruit Supply (Sydney Markets - Flemington)	Sydney Markets	Local air quality	Fruit and vegetables, mainly interstate quarantine

Note: a site may have more than one recapture unit installed.

3.10.3 Impediments to uptake of recapture and recycling

Some current QPS MB uses do not have immediately applicable alternatives, nor prospect of availability of economically feasible alternatives in the near future. These include fumigation of export cottonseed, fumigation of some particular export and import fruit and vegetables and many minor uses that cannot economically support development of alternatives.

In situations where MB use is permitted and may persist in absence of alternatives, recapture systems appear a potential option for decreasing emissions to atmosphere, as well as addressing various OH&S issues associated with MB fumigations. Recycling and reuse of MB is also a potential option in substantially reducing both net MB consumption and emissions, and also reducing the need for further production.

Despite these advantages, recapture is little implemented worldwide and recycling still less so. There are several impediments to more widespread adoption in situations where it is not

mandatory. These include cost and competitive disadvantages, inconvenience, disposal of waste products and acceptability of recycled material for reuse as a fumigant.

Costs: Installation and use of recapture equipment by the Australian fumigation industry is currently seen as an additional cost to the price of a fumigation treatment. There is reticence to adopting this measure by individual companies because it may add to the costs of a treatment compared with those of a competitor that has not taken up recapture, with consequent loss of business. At present the Australian market for recapture equipment is serviced only by Nordiko Pty Ltd., though it can be expected that Desclean België NV may provide some competition soon.

Inconvenience: Simple MB fumigations for QPS purposes, such as in freight containers or under tarps, require very little infrastructure and may be conducted easily on virtually any site, provided it can be made safe. Current versions of recapture equipment are not easily transportable, but are better installed at fixed fumigation sites.

Waste products: The Nordiko system currently relies on regeneration of the carbon absorption bed by flushing with aqueous thiosulphate solution. This reacts with the captured MB on the bed, producing relatively non-toxic products. The waste solution requires disposal. The Desclean België NV system includes a storage and reuse option for captured MB, thus avoiding the problem of waste disposal. It may be that Australian registration authorities will not allow reuse or impose conditions on its reuse.

Recycling: At this time it is unclear what restrictions, if any, would be imposed by Australian registration authorities on reuse of recaptured MB as a fumigant. In USA this is not permitted, while in Poland recaptured MB is used as a fumigant on the same commodity that was previously treated, with top up with new fumigant as needed.

The disadvantages of recapture should be set against improvements in fumigation, worker and bystander safety, reduced emissions and compliance with Decisions of the Montreal Protocol that can be gained from recapture.

4. Availability of alternatives for Australian QPS uses

4.1 Existing alternatives for major uses by volume.

There are a number of QPS uses, worldwide and within Australia, for which there are existing, registered and approved non-MB alternatives. A summary of these has recently been published (MBTOC 2007).

Quarantine alternatives have to be bilaterally approved (importer and exporter), a process that is time-consuming, expensive and uncertain. Preshipment alternatives may be restricted by the choices of the importing country.

Despite these restrictions some major Australian QPS uses have current and near-market alternatives. Alternatives for these major uses are summarised in Tables 4.

Table 4. Non-MB alternatives for major Australian QPS uses.

Major QPS use	Category [a]	Existing alternative	Restrictions	Near market alternatives [b]	Comments
Export cereal grains	P	Phosphine fumigation, dichlorvos treatment	Importing country may not accept treatment, some export terminals too small to accumulate shipment in time	Carbonyl sulphide, heat disinfestation, sulphuryl fluoride	
Hay	?P	CO2, phosphine	Does not meet shipping schedule	Sulphuryl fluoride	
Wood and timber	Q	-		Sulphuryl fluoride, phosphine in transit, cyanogen	Phosphine in transit in use in NZ/China trade
Wood Packaging (ISPM15)	Q	Heat treatment	More expensive, facilities lacking	Sulphuryl fluoride with or without methyl isothiocyanate	Sulphuryl fluoride likely to be approved within 2 years for ISPM15.
Cottonseed	Q	-		-	No alternatives identified and no prospective ones under research
Fresh fruit and vegetables	Q	Heat, chemical dips, systems approach, pest-free areas	Markets may not accept chemical dips, damage to product.	Numerous alternatives in research	Alternatives very dependent on particular produce treated and market acceptability
Empty grain ships	P	Phosphine	Slow action with demurrage costs	Hydrogen cyanide, sulphuryl fluoride, cyanogen	Hydrogen cyanide in use in Singapore and NZ

(a) Q = Quarantine, P = Pre-shipment, ?P = probably Pre-shipment
(b) Expected registration for this purpose within 3 years, or already in use in the Asian region

4.2 Existing alternatives for minor uses by volume

Several of the minor uses could be treated for quarantine purposes by non-MB systems and there will be further scope for this as new fumigants such as sulfuryl fluoride are recognised and registered for these uses.

5. Research into MB alternatives

5.1 Research in Australia on QPS methyl bromide alternatives

There is no active program in Australia at this time (May 2007) specifically targeted at replacement of MB in particular or general areas of QPS. Most related research, such as carried out by WA Dept of Agriculture or Queensland Department of Primary Industries, has other aims but may incidentally lead to replacement of MB treatments with other technologies/systems. Former research groups active in strategic research to develop alternative pest control processes have become refocussed or disbanded. The realities of research funding, such as from Horticulture Australia, have required that research has to be closely defined by particular problems.

There is no current public sector research activity in Australia specifically aimed at replacing MB in the major Australian QPS MB uses: timber, sawn wood or solid wooden packaging, grain, hay or export cotton seed. However, it is well-recognised that MB is an ozone-depleting substance and subject to control for uses other than QPS.

The Plant Health Committee, the peak organisation of state and federal bodies concerned with plant health including pest control on exports and imports, is currently seeking information on MB alternatives research in Australia.

A number of companies and public sector research organisations are, or have been, involved in QPS and development of alternatives to MB. For example:

- the Plant Biosecurity CRC (http://www.crcplantbiosecurity.com.au) has within its charter of activities areas of research that could possibly also involve MB alternatives for QPS;

- three alternatives to MB pioneered or rediscovered in Australia under the CSIRO's Stored Grain Research Laboratory's new fumigant program are being progressed through the registration system[4] – they are ethyl formate, cyanogen (also known as ethane dinitrile) and carbonyl sulphide;
- propylene oxide is being investigated for treatment of horticultural products (and soils)[5];
- registration was obtained for sulphuryl fluoride in Australia on 28 November 2007 after successful registration elsewhere for use on grains and mills (e.g. USA, Europe)[6];
- trials have been carried out by CSIRO Stored Grain Research Laboratory and WA Department of Agriculture to demonstrate alternatives to MB for hay exports, including carbon dioxide, phosphine and carbonyl sulphide – of these only carbonyl sulphide has a similar speed of action to MB while application of either CO2 or phosphine[7] would need to be in transit and necessitate changed export inspection arrangements or disinfestation prior to container stuffing to meet current logistic requirements.

There is no QPS MB alternatives research for import/export timber (logs), sawn timber or solid wood packaging at this time in Australia. The recent forum (CSIRO 2006) showcased progress that has been made on MB and alternatives. The only identified ongoing research was by Ensis (http://www.csiro.au/csiro/content/standard/psq3.html#2), a joint Australian-New Zealand research grouping. This group is involved with the continuing development of in-transit phosphine treatment as an alternative to on-shore or in-ship MB, particularly for trade with pine logs from New Zealand to China. There is collaborative research (Australia-China-USA) on control of forest pests infesting wood in trade in progress, including use of the potential alternatives, cyanogen and sulphuryl fluoride. This is carried out mainly in China but includes collaborative work and input by Drs Ren Yonglin (CSIRO, Australia) and Al Barak (USA).

There are no efforts currently under way to replace the large, but specialised use of MB on export cottonseed to the US. This unusual treatment is against a particular race of the *Fusarium* fungus, not apparently present in the US.

5.2 Research overseas in QPS methyl bromide alternatives

There is active research in several countries into alternatives to MB, including for QPS, which may have outcomes directly relevant to QPS treatments in Australia. Much of the work is associated with market access, but there are three prominent research groups that have a wider mandate – in China, Japan and USA.

- China – Wang Yuejin, Institute of New Technology and Equipment, Chinese Academy of Inspection and Quarantine Service, Beijing. Collaborative research into alternatives for timber attacked by Asian pests.
- Japan – Takashi Misumi, Quarantine Disinfestation Laboratory of the Research Division, Yokohama Plant Protection Station, MAFF.
- USA – there has been a 5-year program of research in the US on MB alternatives, now in its assessment phase. The program, ARS National Program 308, Methyl Bromide Alternatives, did not distinguish between QPS and non-QPS uses.

[4] All are now licensed to BOC, recently taken over by Linde Gases.

[5] Licensee is R A Dibbs & Co

[6] Licensee is Dow AgroSciences Pty Ltd

[7] Hay exports from USA to Japan are treated with phosphine against hessian fly, a quarantine pest.

At the international level, some of the IPPC initiatives relating to pest control and plant health that allow the continued use of MB (eg in new standards) contrast with trying to further limit the emission of MB under the Montreal Protocol (albeit recognising that the Protocol exempts the use of MB for QPS purposes). Nevertheless, there is an active relationship between the Montreal Protocol and IPPC to try and overcome this (see below).

The very widespread implementation of ISPM15 has led to an increase in MB use, and recent (2006) changes to the Standard are likely to further increase use. The IPPC (www.ippc.int) now has an expert working group under its Technical Panel on Phytosanitary Treatments (TPPT), tasked with drawing up a standard for MB alternatives in QPS application, but this has not yet reported.

6. Analysis and prognosis

Excepting for the OH&S issues that accompany MB fumigation and associated regulatory constraints, there is currently little incentive to change to non-ODS technologies, locally and internationally. In the absence of such incentives and continued good performance by MB for QPS current uses, MB fumigations will continue to be a favoured choice in many of the current uses. Indeed, it may be expected that there will be increased MB use for QPS with expansion of trade and continued biosecurity concerns, particularly those associated with timber and wood in trade.

It is very difficult to get new quarantine measures accepted. Typically quarantine arrangements are subject to bilateral agreement, often developed over several years and requiring extensive laboratory and trial work. The market for the measure can be quite small, costs of registration high and uncertain. As a result there are few new quarantine measures.

The CSIRO-developed new fumigants, cyanogen and carbonyl sulphide, are progressing slowly through the registration systems in various countries but may offer some alternatives for MB replacements in some QPS situations.

If MB emissions from QPS treatments are to be minimised, it is likely to be best achieved by two parallel strategies – development and adoption of alternatives in some situations with enhanced retention and recapture in others where alternatives are not feasible.

7. Scenarios for QPS methyl bromide control in Australia

At the Montreal Protocol level, it is now clear that reduction in MB emissions has had a dramatic effect on the effective tropospheric bromine loading. This will lead to a similar drop in stratospheric loading. The effect of MB reduction in the stratosphere is larger than was previously expected.

The recently published Science Assessment Panel Report (UNEP/WMO 2006) concluded that:

- There has been a 10% decline in effective atmospheric bromine since its peak in the mid-1990s, MB alone is responsible for 40% of this decline.MB decline has been larger than expected, suggesting that fumigation-based MB emissions have a stronger influence than was estimated in previous Assessments.Bromine is 60 times more effective than chlorine in causing ozone depletion. Thus the Ozone Depletion Potentials (ODPs) of all bromine containing chemicals, including MB, have increased by 33% over previous estimates.

It appears likely that at some time soon, there will be moves in the Montreal Protocol to try to restrict QPS uses and emissions, above those exhortations already in place (Dec. XI/13(7) and VII/5(c)). The EU has already capped QPS MB use and one Member State, Belgium, has

required recapture of MB from 1 July 2007. Some other Member States, notably Netherlands, severely restrict QPS use. These actions place the EU in a position to lead any proposals for additional restrictions on QPS MB.

The IPPC community has recognised the use of MB in quarantine applications and that some of its standards and recommendations involve emissions of this gas that is recognised as an ozone-depleting substance. Recently (March 2007), the Commission on Phytosanitary Measures (CPM) agreed to update its guidance on use of MB in the context of its ozone-depleting properties. A standard is under development that will provide listings of MB alternatives for quarantine treatments.

MB use in its present form is under increased scrutiny from regulatory authorities concerned with worker safety, potential for bystander exposure and local air quality. Revised requirements for MB use, emissions and environmental concentrations are at an advanced level of consideration in the US (http://www.epa.gov/fedrgstr/EPA-PEST/2006/August/Day-09/p12898.htm) and also in Europe. When finalised, the US regulations are expected to lead to substantial tightening of allowable use patterns, and reduced acceptable exposure limits and boundaries. In Belgium use of recapture equipment on quarantine treatments will be mandatory from 1 July 2007.

Against this background, the following hypothetical scenarios for control of QPS MB emissions in Australia can be developed:

1. Further international controls agreed at Montreal Protocol within the next 3 years to restrict MB emissions from QPS treatments. Likely measures include stronger measures to adopt alternatives where feasible and adoption of recapture where not so. These agreed measures would then be adopted within Australia at Federal level.
2. IPPC approves replacement fumigant(s) for ISPM15 treatments within the next 2 years. The most likely approved replacement is sulphuryl fluoride, though this fumigant is poorly active at low temperatures and requires high dosages for effective control of some developmental stages of pests. There are other candidate replacements, including cyanogen. Approval of an alternative at IPPC level would substantially reduce need for QPS MB in Australia, and worldwide. Removal of a large part of QPS MB use would result in loss of incentive to adopt further restrictions on such use in the Montreal Protocol.
3. Allowable workspace concentrations for MB reduced to 1ppm v/v or less, following developments in US and Europe, within the next 2 years. Allowable environmental/air quality levels also reduced substantially. Regulations on full airing of containers and fumigation enclosures to these reduced workspace concentrations enforced by State Workcover authorities leading to reduced convenience and increased costs of MB treatment, with incentive to adopt increased alternatives. Recapture adopted to meet the standards, without need for additional regulation.
4. Several versions of recapture equipment become commercially available in Australia within 2 years. Recycling developed. Price of MB on world marketplace doubles as a result of reduced supply. State regulatory authorities, in collaboration with federal authorities, mandate use of recapture and destruction or recycling of MB to achieve set maximum workspace and environmental levels. Use of recycled MB of appropriate purity approved by registration agency for non-foodstuff use and for use on the same foodstuff as was initially treated. Use of MB for several QPS purposes prolonged, but with substantially reduced net emissions.
5. Following successful reduction of Australian emissions of MB from QPS use as a result of several factors, there is an incursion of a quarantine pest. It becomes established in a

small, well defined area, and it is decided to attempt eradication. Use of MB is suggested as the main measure, involving more than 100 tonnes of MB, if it is a soil pest. Environment protection and regulatory authorities do not allow MB use, and alternatives are used effectively, but at increased cost.

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