Order Code RS20863
Updated December 15, 2004

Stratospheric Ozone Depletion and Regulation of Methyl Bromide

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Summary

In the mid-1980s, some scientists became concerned that emissions of methyl bromide (MBr), a pesticide widely used in agriculture, could become a major source of bromine and thus could contribute to depleting the Earth's stratospheric ozone layer. The ozone layer shields the Earth's surface from harmful forms of ultraviolet radiation. MBr plays an important role in U.S. agricultural commerce because of its effectiveness in killing insects and plant pathogens. It is used extensively for pre-planting, post-harvest, quarantine, and pre-shipping treatments. Production, consumption, and trade of MBr is regulated globally under the 1987 Montreal Protocol (on Substances That Deplete the Ozone Layer), amended in 1992 and adjusted in 1997, and domestically under Title VI of the U.S. Clean Air Act, amended in 1993 and in 1998. This report discusses regulation of MBr as an ozone-depleting substance and addresses possible concerns for Congress such as (1) the timing of a production phaseout, (2) "critical use" allowances, and (3) the search for alternatives. It will be updated as warranted.

About 76,000 metric tons of methyl bromide (MBr) were manufactured globally in 1991 for agricultural uses. MBr is effective at killing molds, other fungi, insects, and worm (nematode) infestations of crops. About 80% of that tonnage is used as a fumigant to treat soils prior to planting. Another 20% is used to treat post-harvested commodities such as fruits, vegetables, dried foodstuffs, stored grains, cut flowers, and timber. Quarantine and pre-shipment (QPS) treatments for import/export account for about 1% of total tonnage produced. The profile of emissions differs for the various uses. About 50% of MBr is emitted into the atmosphere during pre-planting applications, while 80% can be emitted from QPS and post-harvest applications, if not in a contained environment.

U.S. consumers of methyl bromide have petitioned Congress to amend the Clean Air Act (CAA) and extend its production phaseout from January 1, 2005, to January 1, 2015. They foresee higher costs, diminished supplies, lack of viable alternatives, and possible future restrictions on trade of U.S. agricultural products, if those cannot be treated with MBr. Congress extended the phaseout date once before. Acting under the authority of §604 of the CAA, on December 10, 1993, the U.S. Environmental Protection Agency (EPA) issued a final rule, freezing domestic production and consumption of MBr at 1991

levels (about 62,000 metric tons), and ceasing its manufacture by January 1, 2001. In 1999, Congress extended U.S. production allowances until January 1, 2005 (§764(a) of P.L. 105-277). Since then, prompted by H.R. 4125 and S. 2504, introduced in the 106th Congress, the EPA issued a notice of proposed rulemaking to ban all domestic *uses* of MBr by January 1, 2015.[1] The rule would also halt manufacture by 2005, except for small quantities for export to Article 5(1) countries,[2] and for what they anticipated would eventually be approved for "critical uses" under the Montreal Protocol on Substances That Deplete the Ozone Layer.[3] Presently, the CAA comports with international regulations of MBr under the 1987 Montreal Protocol, as amended in 1992 and adjusted in 1997.

At a March 2004 meeting of Montreal Protocol parties, conflicts arose between European Union negotiators, committed to a January 1, 2005, phaseout of MBr production, and 13 industrialized countries that had requested allowances to produce tonnage of it for "critical uses" after 2004. The United States requested the largest allowances, including 39% (of 1991 production levels) for 2005, and 34% for 2006.[4] Domestic concerns about regulating MBr as an ozone-depleting substance (ODS) have included whether there is a need for stronger *or* less stringent controls of MBr emissions; why production cutbacks scheduled under P.L. 105-277 were not met; and when, if ever, effective alternatives for "critical uses" of MBr will be developed cost-effectively for U.S. agricultural producers. Common questions have included:

- Do the economic benefits of MBr for U.S. produce growers outweigh its potential danger to the ozone layer and health of humans and the environment?
- Is scientific evidence about MBr and stratospheric ozone depletion compelling enough to justify stronger regulation, or any regulation at all?
- Were phaseout schedules under the CAA realistic, given the time it could take to develop, approve, and market feasible alternatives?
- Can suitable chemical substitutes or alternative treatments be found for *all* of its applications?
- Will it be necessary for farmers to stockpile MBr for "critical uses," in case Montreal Protocol parties cease allowances after 2006?
- Are there policy actions that can be taken now to reduce MBr emissions that would minimize their potential depleting effects on the ozone layer?

Over the past two decades, the United Nations Environmental Program (UNEP) and the U.N. World Meteorological Organization (WMO) have co-sponsored scientific, technical, and economic studies containing in-depth analysis relating to the costs and benefits of using MBr as an agricultural pesticide. These studies have attempted to

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[1] "Protection of Stratospheric Ozone: Incorporation of CAA Amendments for reduction in Class-I, Group IV Substances (Environmental Protection Agency, 40 CFR Part 82)," *Federal Register*, v. 65 (Nov. 28, 2000), 70795-70804.

[2] Article 5(1) refers to developing countries that consume less than 0.3 kg of ozone-depleting substances per capita. Non-Article 5(1) countries are industrialized or developed countries. *Consumption* equals tonnage for domestic uses plus imports of MBr, minus exports.

[3] For a definition of critical uses, see U.N. Environmental Program Ozone Secretariat, Draft Decision IX/1, "Further adjustments and amendments to the Montreal Protocol," and Decision IX/2: "Critical-use exemptions for methyl bromide" (UNEP/OzL.Pro.9/6, June 10, 1997).

[4] Juliet Eilperin, "U.S. Gets Another Reprieve on Use of Pesticide by Farms," *Washington Post*, Nov. 27, 2004, p. A10.

answer the questions above, and have been conducted at the request of Montreal Protocol parties. Global government officials, science and agricultural agencies, chemical industry producers of MBr, and agricultural consumers have advised such studies.

Scientific Research. Many scientists believe that diminishing ozone in Earth's stratosphere that traps UV-B radiation could increase incidences of skin cancer in humans and animals, and produce genetic damage in terrestrial plants and marine phytoplankton, possibly disrupting the natural food chains.[5] Laboratory experiments conducted since the discovery of the Antarctic Ozone Hole in the early 1980s showed that chlorine molecules released from CFCs (chlorofluorocarbons), found in some industrial solvents and refrigerants, and bromine molecules released from some fire extinguishing agents (halons) were extremely effective at breaking down ozone molecules. They deduced that those chemical reactions have serious implications for Earth's stratospheric ozone layer.

On January 1, 1996, most manufacture and trade of CFCs and halons were banned globally; however, CFC emissions are believed to remain in the atmosphere for 70-150 years, accounting for their high cumulative ozone depleting potential (ODP). Long before then, scientists had turned their attention to methyl bromide, because of its suspected high ODP.[6] Research on MBr's chemical reaction in the stratosphere was first reported outside of the professional scientific literature in the UNEP *1991 Scientific Assessment of Ozone Depletion*. Some scientists cautioned that eventually MBr could become as significant an environmental threat as CFCs and halons. Montreal Protocol parties and the EPA accepted scientists' estimates that MBr had a particularly strong ODP of 0.7.[7] The *1994 Scientific Assessment of Ozone Depletion* urged more stringent control on MBr emissions. Although scientists had reported that the maximum ozone-depleting effects from breakdown of a single MBr molecule occurred within two years, and had re-estimated its ODP to fall within a range of 0.3-0.6, it continued to be regulated as a Class-I ODS.[8]

Four years later, UNEP's *1998 Scientific Assessment of Ozone Depletion* reported about the findings of some scientists who suggested possible environmental benefits (e.g., quicker recovery of pre-ozone hole condition and lesser long-term exposure to UV-B radiation) if concentrations of *all* ODSs in the stratosphere could be stabilized at 1999 levels. Reaping those benefits, UNEP noted, would require expeditious implementation of the1997 "adjustments" to the Montreal Protocol, which included a more ambitious phaseout schedule for MBr than in previous regulations. Under previous international agreements, maximum ozone loss from *all* man-made ODSs emitted into the atmosphere was projected to peak around 2030, and then slowly decline. However, by 1998, some scientists observed concentrations of ozone in the upper stratosphere begin to increase,

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[5] "Surface UV Radiation," *Global Ozone Research and Monitoring Project — Report No. 37, Scientific Assessment of Ozone Depletion: 1994* (WMO: Geneva, Feb. 1995), p. 9.1.

[6] Class-I ozone-depleting substances have an ODP greater than 0.2, vis-a-vis CFC-11, which has an ODP of 1.0.

[7] Susan Solomon, A. R. Ravishankara, et al., "Atmospheric lifetimes and ozone depletion potentials of methyl bromide (CH3Br) and Dibromoethane (CH2Br2)," *Geophysical Research Letters* (19), Oct. 23, 1992, pp. 2059-2062.

[8] "ODPs, GWPs and Cl-Br Loading," UNEP/WMO *Scientific Assessment of Ozone Depletion: 1994*, p. 13.17.

which many attributed to the 1996 global ban of CFCs and halons under the Montreal Protocol. Many UNEP scientists were optimistic that concentrations of ODSs in the stratosphere might actually peak as early as 2010, and pre-ozone hole conditions return by 2050. Also, they theorized that if man-made emissions of MBr could cease, full recovery could possibly occur 10 years sooner. Those findings had inspired some Montreal Protocol parties to seek even more stringent regulations of MBr. Nevertheless, the adjusted treaty would allow Article 5(1) countries to *consume* small quantities of MBr until 2015. The possibility of an earlier peak of maximum depletion and evidence of a recovering stratospheric ozone layer was viewed in some circles as evidence that the Montreal Protocol (and CAA) was working.

In the *2002 UNEP Assessment*, scientists reported difficulties in fully accounting for all man-made and natural sources of and sinks of MBr emissions. They found that actual quantities and apportionment of MBr in the environment were difficult to estimate, because long-term measurements at probable sources were limited, or did not exist. However, UNEP continued to sanction *1994 Assessment* estimates that global agricultural use accounted for nearly a third of *all* MBr emissions; other human-induced sources of MBr, including biomass burning and automobile exhaust, might account for another third; and out-gassing from the ocean was responsible to a lesser extent. Also, UNEP scientists projected that by 2010, bromine released from MBr would constitute 30%-60% of ODSs in the stratosphere; and, as concentrations of chlorine from CFCs and bromine from halons declined, that of bromine release from MBr would increase 3% annually.

Economics and MBr Alternatives Studies. In 1994, the Montreal Protocol's Methyl Bromide Technical Options Committee released *MBTOC-1*, a report examining possible alternatives for MBr in a number of different uses.[9] That study mainly focused on agricultural applications. It has since informed international negotiations regulating emissions of manufactured MBr by suggesting possible options for global policy makers to comply with the 1992 amendments to the Montreal Protocol that govern MBr emissions. In addition, *MBTOC-1* reviewed ongoing experimental studies of chemical substitutes and alternative agricultural practices for its different applications. *MBTOC-1* assumed that Montreal protocol parties would seek a *rapid* production phaseout, but also considered possible exemptions for "emergency uses" of MBr, and recommended that QPS treatments be exempted from regulation, pending longer-term studies of substitutes.

In 1998, *MBTOC-2* was released. It urged Montreal Protocol parties to (1) identify future critical uses of MBr; (2) inventory the quantities of MBr produced and consumed globally; and (3) aggressively research alternatives for MBr's use as a "soil fumigant, a fumigant of durable commodities and structures ... and of perishable commodities." Also, it featured Article 5(1) country perspectives about a MBr phaseout; cited non-uniform responses of pathogens to alternative treatments, geographically; and suggested possible courses of action policy makers might take in the near term to reduce emissions, including conservation and control measures, user fees, and research funding.[10]

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[9] U.S. interests on MBTOC are represented through such agencies as EPA, the National Oceanic and Atmospheric Administration, the National Institute for Standards and Technology, the National Aeronautics and Space Administration, and the USDA Agricultural Research Service.

[10] EPA lists a range of substitutes for a variety of uses of methyl bromide on its website at (continued...)

MBr Regulations

Scientific findings about MBr's possible potent ODP, presented in the UNEP's *1991 Scientific Assessment of Ozone Depletion*, spurred on the Natural Resources Defense Council, Environmental Defense Fund, and Friends of the Earth to jointly petition EPA to regulate MBr as a Class-I ODS under the CAA. (See "Scientific Research," above.) In March 1993, the EPA issued a notice of proposed rulemaking to add MBr to the CAA's lists of Class-I, under a new "schedule H," created for MBr, which would require regulation of its production and use.[11] The EPA proposed to cap U.S. production of MBr at 1991 levels by January 1, 1994, and to cease its manufacture December 31, 2000.[12]

In December 1995, parties to the 1985 U.N. Vienna Convention on Protection of the Stratospheric Ozone Layer, the progenitor of the 1987 Montreal Protocol, convened for the 10th meeting of Vienna Convention parties. Many were encouraged by news that the atmospheric lifetime of MBr might be as short as two years, making it an easy target for eradicating some ODSs in the stratosphere. They evaluated MBr's existing phaseout schedule and considered what actions would be necessary to stabilize concentrations of MBr in the atmosphere.[13] Over the following two years, Montreal Protocol parties negotiated treaty text to "adjust" international regulations of MBr and expedite phaseout of its production and use, globally. In September 1997, at the ninth meeting of Montreal Protocol parties, a "final treaty text" was adopted whose terms obligated industrialized countries to phase out production of MBr by January 1, 2005 — except for "critical uses" under the MBTOC's study. Interim reductions, based on 1991 production levels, were scheduled for 25% by 1999, 50% by 2001, and 70% by 2003. Also, Article 5(1) countries were obligated to cut 20% of average 1995-1998 *consumption*, beginning in 2005, and cease its use by 2015.

Many U.S. produce growers and some U.S. lawmakers became concerned about different phaseout requirements for MBr in industrialized and developing countries under the adjusted Montreal Protocol, and under the CAA. Of particular concern were consumption allowances for developing countries (some of which compete directly with U.S. produce markets) that were granted until 2015, while domestic supplies declined. Congress amended Title VI of the CAA in 1998, and extended the U.S. production deadline for MBr to January 1, 2005, thereby securing parity with other industrialized Montreal Protocol parties. In addition, it granted production allowances to U.S.

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[10] (...continued)
[http://www.epa.gov/docs/ozone/mbr/casestudies/index.html], visited on Dec. 13, 2004. The Agricultural Research Service has its research results on alternatives for MBr on its website at [http://www.ars.usda.gov/is/np/mba/apr04/], visited on Dec. 13, 2004.

[11] "Protection of Stratospheric Ozone: Notice of Proposed Rule Making (Environmental Protection Agency, 40 CFR Part 82)," *Federal Register*, v. 58 (Mar. 18, 1993), 15014-15038.

[12] "Protection of Stratospheric Ozone, Final Rule Making (Environmental Protection Agency, 40 CFR Part 82)," *Federal Register*, v. 58 (Dec. 30, 1993), 69235-69238.

[13] The original MBr regulations envisioned by Vienna Convention parties were not implemented. For a summary of original terms, see "Statement by Nicholars Burns, Spokesman," U.S. Department of State, Office of the Spokesman, *Press Release* (Washington, DC: Dec. 7, 1995).

manufacturers of MBr of up to 15% annually for export to Article 5(1) countries through 2015, thereby domestically implementing terms U.S. negotiators agreed to under the 1997 "adjustments" to the Montreal Protocol. Those regulatory changes discouraged environmental groups that wanted an expeditious ban of MBr globally.

On January 3, 2003, EPA issued a final rule exempting quantities of MBr produced for QPS treatment of agricultural commodities from regulation until January 1, 2005.[14] In March 2003, the EPA solicited comments on a proposed rule to establish exemptions for farmers' "critical uses" of MBr beyond 2004.[15] EPA initiated its "nomination of critical uses" (NCU) in May 2003, having received 57 petitions from domestic consumers who anticipated no economically feasible replacements for MBr by 2005. EPA either approved, returned for additional information, or rejected them outright.[16] It concluded that about 23,000 lbs. of MBr would need to be manufactured for "critical uses" in the 2005 growing season alone.[17] In November 2003, EPA submitted its final NCUs to Montreal Protocol parties, requesting production allowances of 39% of 1991 tonnage for 2005 and 36% for 2006; decisions on NCUs were deferred until March 2004, however.

Uncertain about approval of its NCUs, some U.S. lawmakers threatened to withdraw from the international treaty,[18] when some parties questioned whether "what was being sought was truly essential."[19] In June 2003, the House Science Energy and Air Quality Subcommittee held a hearing on H.R. 3403, to amend the CAA and allow production of MBr for "critical uses" after 2004, at EPA-approved levels, and extend 2005 allowances annually through 2015.[20] The bill saw no further action. In November 2004, Montreal Protocol parties exempted 13 industrial countries from a 2005 MBr production ban. Final U.S. allowances were 37% of 1991 tonnage; however, some parties warned that those could be reduced to 27% in 2006, or the equivalent of 17,000 lbs.

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[14] "Process for Exempting Quarantine and Pre-Shipment Applications of Methyl Bromide: Interim Final Rule." *Federal Register*, v. 66 (Jul. 19, 2001), 37752-37769; *Federal Register*, v. 68 (Jan. 2, 2003), 237-254.

[15] "Process for Exempting Critical Uses of Methyl Bromide ... Proposed Rule," *Federal Register*, v. 69(Aug. 25, 2004), 52366-52402.

[16] "U.S. Government Nominates Critical Use Exemptions for Methyl Bromide," *Environmental News*, Feb. 7, 2003, at [http://www.epa.gov/spdpublc/mbr/], visited Dec. 10, 2004.

[17] BNA, Inc., "Methyl Bromide Production for Export Can Continue Until 2005 under EPA Rule," *Daily Environmental Report*, vol. 82 (Apr. 29, 2002), p. A-6.

[18] The Senate Committee on Foreign Relations considered Treaty Doc. 106-32, which restricted international trade of MBr among Montreal Protocol parties by requiring a license for exporting and importing, and approved that provision Oct. 2, 2002. U.S. withdrawal from the treaty would result in loss of exporting privileges to other industrialized and Article 5(1) parties.

[19] Andrew Revkin,"U.S. Seeks Exemptions for Pesticide, European Union Leads Critics as Ozone Talks Open in Nairobi," *New York Times* (Nov. 11, 2003), p. 3.

[20] U.S. House Committee on Science, Subcommittee on Energy and Air Quality, *Status of Methyl Bromide under the Clean Air Act and the Montreal Protocol*, hearing, June 3, 2003, available at [http://energycommerce.house.gov], visited Dec. 10, 2004.