Part 3

Persistent Bioaccumulative Toxics Pollution Prevention

The Office of Environmental Assistance (OEA) is responsible for pollution prevention (P2) technical, financial and educational assistance and for evaluating state progress in P2. As data allows, this chapter of the *2002 Pollution Prevention Evaluation Report* evaluates progress and opportunities to reduce persistent bioaccumulative toxics through using P2.

Persistent, bioaccumulative toxic (PBT) chemicals are some of the most dangerous substances ever produced or released as a result of human activities. PBTs are long-lasting pollutants that are notable for their ability to be transported long distances by air or water, remain static for long periods of time in soil until disturbed, to move and partition among environmental media, and to bioaccumulate in aquatic and/or terrestrial organisms. They are particularly troublesome due to their high toxicity and persistence in the environment. PBTs may interfere with human endocrine systems, cause reproductive and developmental problems, impair the immune system, and cause cancer. Fetuses and children are at particularly high risk from PBT exposure because their rapidly developing systems can be affected by very small amounts of these substances. The symptoms of impaired development or toxicity may not be immediate; and dramatic health effects may show up in subsequent generations.

The EPA's Office of Pollution Prevention and Toxic Substances "Priority PBTs List" includes selected pesticides (aldrin/dieldrin, chlordane, DDT, DDE, DDP, mirex and toxaphene), and dioxins and furans, mercury and its compounds, benzo(a)pyrene, PCBs, hexachlorobenzene, alkyl-lead, and octachlorostyrene. The EPA has developed a national strategy to reduce these PBTs.[1] Chemicals and materials discussed in this background paper are on EPA's Priority PBTs List.

Due to the opportunities available through alternative products, P2 technologies and strong partnerships, the majority of the OEA's P2 activities to reduce PBTs are targeted for dioxins and mercury.

Dioxins

Dioxins are regarded as some of the most toxic substances known. They are not intentionally manufactured, but are created as a by-product of some manufacturing processes and through the incomplete burning of chlorine-containing materials. Once formed, dioxin molecules can persist for decades, and continuously move through air, water, soil and sediment, plants and animals alike. Due to uptake of dioxin in the environment, even burning today's wood or crop waste releases dioxin. The amounts of dioxin found in current samples of plant, soil or human tissue is many times greater than the amounts found in historical samples.[2, 3, 4]

Due to a combination of pollution prevention efforts and pollution control devices, levels of dioxin released to the environment from industrial sources have decreased 80 percent since the1980s. Although burn barrels are currently the second highest source of dioxin emissions, they will soon become the primary source as pollution control technology on incinerators improves. [5] Due to low burning temperatures, dioxin emissions from burning approximately 50-900 pounds of household waste in a burn barrel are equivalent to burning 400,000 pounds of household waste in a modern, well-controlled incinerator.[6] Assuming emission control devices are operating correctly to meet 2002 emission control limits, the majority of dioxin being formed in Minnesota will come from the incomplete burning of chlorine-containing products, principally through residential use of burn barrels and fire-pits.

P2 options for dioxins

It is expensive to purchase and maintain pollution control equipment on incinerators and difficult to control the waste disposal behavior of individual citizens. With regard to reducing precursors to dioxin, pollution prevention focuses on reducing or eliminating chlorinated compounds at the source. By using chlorine-free feedstocks and purchasing chlorine-free products, manufacturers can reduce or eliminate the chlorinated compounds, which can in turn form chlorinated organic compounds. For example, because dioxins are created as a by-product of the manufacturing process, the pesticide 2,4-D, is contaminated with dioxins.[7,8]

Progress in industry

Although the following two industries are historically high users of chlorine, in recent years they have made significant progress in reducing the amount of chlorine in their products.

P2 in the pulp and paper industry

The pulp and paper industry has made very significant progress toward reducing the potential for their manufacturing processes and products to form dioxin. In the United States, this was done through a change from the use of elemental chlorine to chlorine dioxide for bleaching purposes. As a result, the white paper products produced today by Minnesota facilities contain only 6 percent of the chlorine as compared to ten years ago. Chloroform emissions have also been reduced substantially. One hundred percent chlorine-free paper bleaching processes are available and were adopted by the majority of European paper manufacturers. However, these processes are reported to be cost-prohibitive for Minnesota facilities, given current market incentives.

P2 in the plastics manufacturing industry

The use of chlorinated compounds is particularly important for the polyvinyl chloride (PVC) industry. This industry is the largest single user of chlorine in the world, accounting for 30 percent of chlorine consumption.[9] The plastics industry is developing and providing alternatives to products customarily made with PVC, such as polypropylene pipe, wire coating and food wrap; and polyethylene containers and tubing. Baxter International, one of the two largest volume makers of medical IV bags, announced it will cost effectively move to PVC-free bags in 5 to 10 years.[10] According to Environment Canada, when economies of scale are reached with current product alternatives, approximately 89 percent of current PVC resin uses could cost effectively be replaced with non-chlorine resins.[11, 12] A lack of market demand is a primary reason for limited industry investment in alternative products.

OEA P2 actions and opportunities to reduce dioxin precursors

Due to the working partnership between the OEA and Department of Administration process chlorine-free (PCF) paper is now available to purchasers that use the state contract. One hundred percent post-consumer recycled content, PCF paper is available for 12 percent above the price of 30 percent post-consumer paper. OEA will continue to promote the availability and use of PCF paper to other state agencies, and to educate consumers on the importance of purchasing PCF products and non-bleached tissue and paperboard containers.

As part of its continuing efforts to reduce dioxin precursors, the OEA will:

- research opportunities to educate office supply stores to stock and customers to ask for process chlorine-free paper.
- continue to partner with the Department of Administration to increase availability and purchase of functionally equivalent, non-chlorinated product alternatives by state agencies.
- continue to educate consumers about the availability of non-chlorinated products.
- continue to educate health care professionals about the availability of chlorine-free supplies and equipment.
- evaluate feasibility of an educational campaign, similar to what was achieved with mercury, as a means to inform the public on issues related to dioxin.

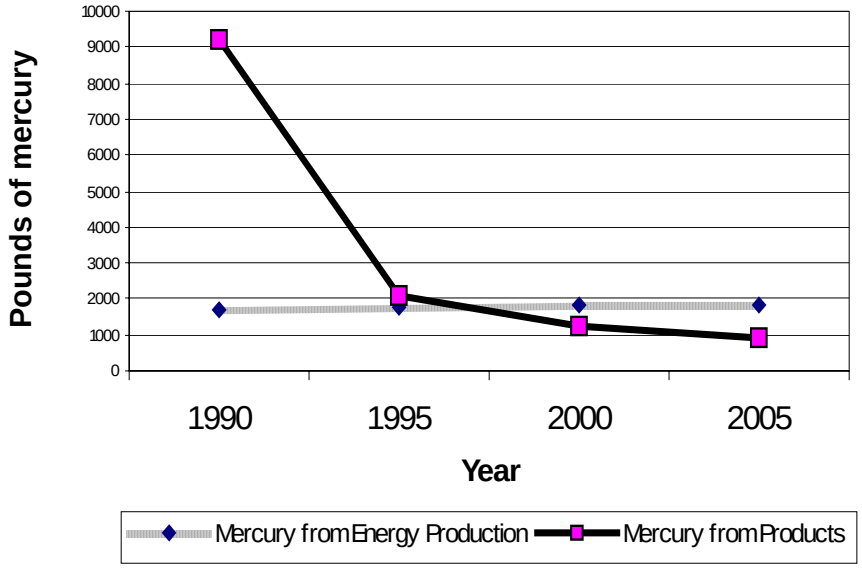
Mercury

For centuries it has been known that mercury has toxic effects on humans and wildlife. Mercury is a PBT that affects the nervous system. Children who are exposed to mercury through their mothers' consumption of fish are particularly at risk.

Coal-fired electric power plant emissions represent the single largest source of mercury released to the air.[13] Combustion of coal, which commonly has a mercury content averaging about 0.1 ppm, releases approximately 1,600 pounds in Minnesota annually.[14] Mercury is also used in a wide range of products. The highest priority of any pollution prevention program is to eliminate the use of mercury in the first place.

The following graph shows the trend of mercury emissions from primary sources in Minnesota. The large decrease in amounts of mercury released to the environment from products between 1990 and 1995 was primarily due to a ban of mercury in paint products, the elimination of mercury from most batteries, and to improvements in management and recycling. Due to an estimated 87 percent reduction in mercury from products between 1990 and 2000, emissions from energy production are now the largest sources of mercury releases in the state.

Figure 3-1. Estimated mercury emissions in Minnesota and projections for 2005

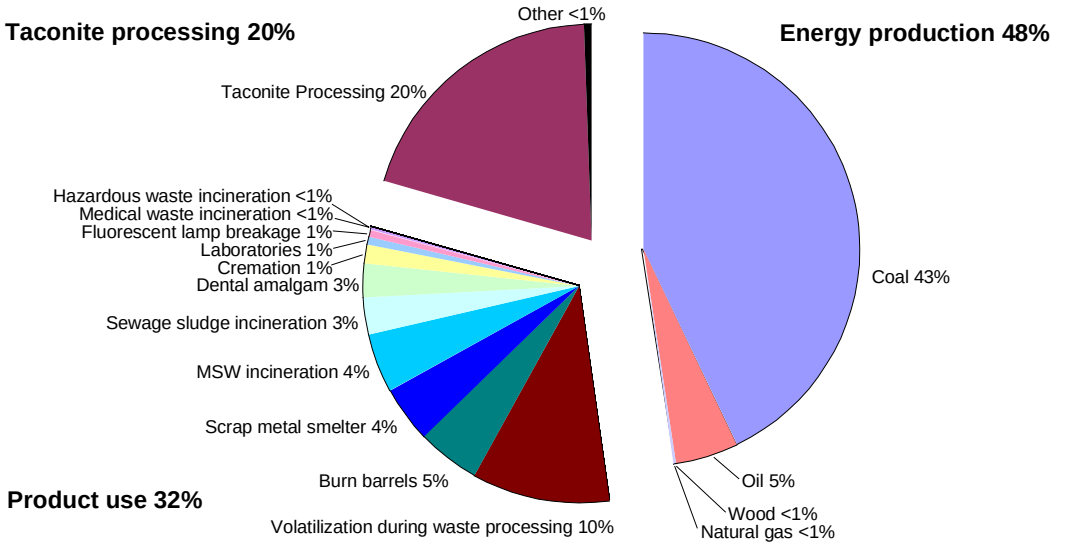


Source: MPCA, December 2001

Mercury from utilities

Fossil fuel-fired power plants currently produce 75 percent of the electricity consumed in Minnesota and are substantial contributors to mercury, lead, ozone, NOx, SOx, particulate matter and greenhouse gas pollution. Although research is underway, current technology is not available to remove the concentration of mercury found in electric utility stock gases. In 2000, Minnesota coal-fired utilities released approximately 1,600 pounds, or almost 48 percent of the total mercury emitted from primary sources. The following chart shows estimated mercury emissions from primary sources in Minnesota in 2000.

Figure 3-2. Primary sources of estimated mercury emissions in Minnesota, 2000



Source: MPCA, December 2001

Please refer to the description of P2 technologies that reduce mercury emissions due to energy production which is included in Part 5, the Greenhouse Gas and Related Toxic Chemical Pollution Prevention section of this report. This information is intentionally not duplicated here.

OEA P2 actions and opportunities regarding electric utility mercury emissions

The following activities outline OEA activities to reduce mercury emissions due to generation of electricity.

Energy conservation

Because energy conservation can reduce the amount of coal burned for electricity, the OEA will promote energy conservation as a part of its Green Building Program. The OEA will provide Internet resources to:

- promote Energy Star labeled products, which now include buildings, homes, heating and cooling equipment, high efficiency motors and air compressors, major appliances, office equipment, lighting and consumer electronics.
- promote the use of energy efficiency auditors who examine existing and recommissioned buildings to eliminate energy waste.
- promote use of energy efficiency building design assistance offered through such efforts as Xcel Energy's Energy Assets program and Energy Star Target Finder to improve architectural plans.
- promote use of the state's sales tax exemption for purchase of Energy Star lighting, photovoltaic devices, and high efficiency heat pumps, water heaters, and furnaces.
- promote use of Xcel Energy's Renewable Energy Development Fund.

The OEA's Green Building web site will also link to Minnesota Department of Commerce web site resources that promote use of energy audits for residences and the construction of super-insulated homes with air-to-air heat exchangers to assure air quality.

OEA P2 actions and opportunities regarding mercury in products

Mercury is also used in a wide range of products, including thermostats and other tilt switches, thermometers, barometers and sphygmomanometers, fluorescent and HID lamps, dental amalgam, and chemicals.

Reducing mercury in health care products

OEA will continue to work with representatives from the Minnesota health care community to promote pollution prevention within the health care sector. The Healthcare Environmental Awareness and Resource Reduction Team (HEARRT) meets quarterly. OEA and Minnesota Technical Assistance Program (MnTAP) staff, with additional help from health care professionals and Health Care Without Harm, conducted training programs in three Minnesota locations for hospital staff during June of 2001 to address the goals of the Hospitals for a Healthy Environment (H2E) project. H2E's goals include eliminating mercury in health care facilities by 2005, reducing the generation of PBTs, and reducing overall waste by 33 percent by 2005 and 50 percent by 2010. The training staff plan to reach additional hospitals and clinics throughout Minnesota during 2002 through technical assistance, training and product demonstrations.

HealthSystems Minnesota mercury reduction intern

The Minnesota Technical Assistance Program funded a summer 2000 intern project at HealthSystems Minnesota to identify all mercury-containing materials and develop a Mercury Elimination Plan. The final intern project report is an excellent model for other health care facilities and organizations.

Health Care Environmental Purchasing Tool

Under a grant awarded to the OEA by the Great Lakes Protection Fund, a "Health Care Environmental Purchasing Tool" has been developed for health care facilities. The tool, developed under a collaborative project of four Great Lakes states and the American Hospital Association, facilitates purchasing medical supplies that do not contain persistent bioaccumulative toxics, including mercury. [15]

Mercury in vehicles

OEA, MPCA and the nonprofit group INFORM partnered with the Department of Administration–Materials Management Division to include a mercury component disclosure requirement in the 2002 Vehicle Request for Bids. The state intends to require vehicles to be mercury-free in future model years and will use this year's information disclosure to develop future bid specifications.

Travel Management Division (TMD), OEA and MPCA are cooperating on a pilot project to change out mercury switches in TMD vehicles that are being withdrawn from state service. TMD intends to make this a permanent program, with switch changeout occurring when vehicles are serviced at the St. Paul TMD facility. Mercury convenience lighting switches, containing about 0.8 gram of mercury, were phased out by Ford, GM and Chrysler between the 1999 and 2002 model years. Foreign manufacturers phased out the use of mercury switches in the early 1990s. Use of mercury-containing four wheel drive ABS sensors, used only by Ford and DaimlerChrysler, will be fully discontinued for the 2003 model year.

Use of mercury-containing HID headlights, navigational displays, and entertainment units is increasing in both domestic and foreign vehicles. An estimated 150 to 200 tons of mercury remain in vehicles currently in use nationwide.

Mercury thermometer sales ban

The Office of Environmental Assistance developed a 2001 session legislative proposal to prohibit the sale of most mercury thermometers in Minnesota. Two legislators also introduced mercury thermometer sales prohibitions. The Legislature passed the most comprehensive language from these proposals. With a few narrow exemptions to cover legally required uses, products with no available alternative, and primary calibration standards, the sales prohibition became effective January 1, 2002. There are no reliable estimates of the total amount of mercury contained in thermometers sold annually in Minnesota. Fever thermometers contain slightly less than a gram of mercury; typical school laboratory thermometers contain 1 to 3 grams of mercury.

Mercury detecting dog and Mercury-free Zone

The OEA has provided a grant to the Institute for a Sustainable Future to provide project management support for this project, matching Xcel Energy's contribution. The project was kicked off statewide on October 19, 2001, with the introduction of a mercury sniffing dog at the Minnesota Science Teachers' Association Fall Conference at North St. Paul High School. The goal of the Mercury-free Zone Project is to eliminate mercury use in K-12 schools, find any remaining hidden and spilled mercury, and educate students and teachers about mercury. To date, an average of three pounds of mercury has been found and removed from each participating school.

Binational Toxics Reduction Strategy

The OEA represents Minnesota in the Binational Toxics Reduction Strategy (BNS) Mercury Workgroup, and works with the MPCA to coordinate mercury management and reduction activities with governments, businesses, institutions, nongovernmental organizations, and citizens within Minnesota and on a national basis. The OEA has been actively involved in BNS Mercury Workgroup activities and has developed and implemented programs in Minnesota addressing, for example, mercury in schools, mercury in health care, motor vehicle mercury switches (management and government procurement), and mercury thermometer education and phaseouts.

Long-term storage/retirement of surplus mercury

As demand for mercury drops and mercury recovery increases, the United States will generate a mercury surplus, which must be managed in some manner. The OEA and MPCA have been active since 1993 in the national and international discussions about how to manage surplus mercury to prevent its release to the environment. OEA led an effort to raise awareness about possible stockpile sales in 1995 to 1996 and its efforts resulted in 30 to 40 letters from governments and nongovernment organizations, and passage of an Environmental Council of States resolution opposing mercury stockpile sales. Department of Defense initiated an Environmental Impact Statement on stockpile disposition in early 1999; and OEA is monitoring that process. OEA is representing the state on the steering committee for an EPA conference on long-term management of mercury that will be held in Boston in May 2002.

Other PBTs

Other than research, the OEA currently has no P2 projects for the following PBTs.

Banned pesticides (DDT, DDD, DDE, chlordane, mirex, aldrin/dieldrin, toxaphene)

These pesticides are classified as PBTs and are banned from use in the United States, although some may still be manufactured here for sale to other countries. Although pollution prevention opportunities exist for pesticides that are approved for use, P2 opportunities for PBT pesticides consist of using alternative pesticides or banning all of these PBTs from manufacture.

Benzo(a)pyrene [B(a)P]

B(a)P is a probable human carcinogen. With long-term exposure, B(a)P may cause developmental and reproductive problems. Short-term health effects may include red blood cell damage, suppression of the immune system and anemia. B(a)P is a member of a class of compounds known as polycyclic aromatic hydrocarbons (PAHs) which generally occur as complex mixtures and not as single compounds.

PAHs are primarily by-products of incomplete combustion. These combustion sources are numerous, including fuels used in transportation, fuel production, industrial processes, food preparation, smoking tobacco, disposal activities such as open trash burning and natural sources such as wildfires. In a collaborative project with the nonprofit group INFORM and E4, the Minnesota Department of Natural Resources is piloting use of bio-based two-cycle engine oils and other lubricants in chainsaws and outboard motors as a means to reduce PAHs.

Data collected from the Great Lakes states, including Minnesota, indicate that about 90 percent of B(a)P emissions in the Great Lakes Basin come from two sources: residential wood combustion (46%) and petroleum

refining (42%). The airborne emissions of B(a)P to the Great Lakes Basin are estimated to be about 122,000 pounds annually.

Polychlorinated biphenyls (PCBs)

PCBs were originally used in insulation for electrical cables and wires, as an additive for lubricants, in epoxy, caulk, plasticizers, and in electrical condensers and transformers. PCBs have been shown to inhibit postnatal and infant mental and motor development.[16] PCBs have been banned from production and use in the United States since 1975.

In May 2001, the United States signed the international Persistent Organic Pollutants (POPs) treaty that will allow countries to work together to restrict or ban the production of PCBs.[17] This is significant because even though this material is banned for use and production in the United States, like other PBTs, it is readily transported long distances by air and water, resulting in contaminated areas throughout the globe.

Hexachlorobenzene (HCB)

HCB is a highly persistent environmental toxin that until the late 1970s was manufactured for use as a fungicide on grain seeds such as wheat. The last registered use as a pesticide was voluntarily canceled in 1984. However, HCB is currently formed as an inadvertent by-product in the production of silicone products, metal cans, pesticides, chlorine, and other chlorination processes. It is also released from water treatment plants, commercial refuse systems, and petroleum refineries. A significant source of HCB is the application of surface coatings to metal cans.

Alkyl-lead

Alkyl-lead compounds are man-made compounds in which a carbon atom of one or more organic molecules is bound to a lead atom. Tetraethyllead (TEL) and tetramethyllead (TML) compounds are the most common alkyl-lead compounds. Alkyl-lead compounds are used as a fuel additive. Although the alkyl-lead problem in the United States has largely been solved, there are still some limited uses of alkyl-lead containing fuels that can lead to direct human exposure, including piston driven aircraft gasoline, auto racing gasoline, and recreational marine gasoline.

In the human body, alkyl-lead compounds are distributed through the blood to soft tissues, particularly the liver, kidneys, muscles and brain. Alkyl-lead is a dominant type of organic lead compound, and is much more bioavailable and toxic than inorganic lead. Exposures to humans can result in lead poisoning. Lead poisoning can also result from the ingestion or inhalation of inorganic lead compounds emitted as exhaust through the combustion process as a direct result of the use of alkyl-lead in gasoline.

Octachlorostyrene

Octachlorostyrene (OCS) has never been deliberately produced as a commercial product and its release is essentially unmonitored.[18] OCS has been reported in Great Lakes fish, birds, and sediments. Potential sources of OCS are chlorinated solvent production, production of graphite electrodes, semiconductor manufacturing, production of aluminum, magnesium, and synthetic graphite. Flame retardant and waste incineration are also potential sources. Because a number of processes create OCS as a by-product, the EPA recommends that "the four-step analytic process for OCS set forth under the Binational Toxics Strategy (be used to locate the sources)...continued assessment of potential sources, consideration of reduction methods if current sources are identified, and evaluation of environmental progress."[18] OEA will continue to monitor the EPA's findings and work towards OCS reduction once sources are more clearly identified.

Other pollution prevention projects for persistent toxics

Toxics in products/listed metals

In 1991, the Minnesota Legislature passed a law (Minn. Stat. §115A.9651) requiring the reduction of four heavy metals (mercury, lead, cadmium, and hexavalent chromium) in specified products. This statute was amended several times and in 1997 became known as "Listed Metals in Specified Products." As a result of that legislation, the MPCA facilitated the Listed Metals Advisory Group which reviewed 229 products,[19] of which 22 products containing lead and hexavalent chromium are now banned from use and production in Minnesota. Activities under the program ceased in 2000. A component of this program was to have manufacturers report to the MPCA amounts of these toxic chemicals in their products. Annually 65,882 pounds of lead and 15,899 pounds of hexavalent chromium will no longer be put into the environment due to a permanent ban of these products by a State of Minnesota rule.[19]

The OEA is presently engaged in several product stewardship activities designed to collect and recycle products that are difficult to manage and/or contain hazardous and toxic components. The OEA product stewardship policy statement places a priority on reducing or eliminating the toxic and hazardous constituents of products and product components and reducing the toxicity and amount of waste that results from the manufacture, use and disposal of products. The OEA has worked for many years to prevent pollution in the manufacture of products. One successful element of P2 has been the public disclosure of chemical release and generation data submitted by manufacturers and then published in documents such as the *P2 Evaluation Report* or in an annual summary of TRI data published by the Emergency Response Commission.

Over the next two years, the OEA will consider developing incentives to encourage manufacturers to remove toxic constituents from their products in the design and redesign stages. It is much more efficient in the long term to eliminate hazardous and toxic materials before they are placed into a product rather than managing hazardous and toxic materials at end of the product's useful life.

Toxics in packaging

Since 1991, Minnesota has had statutory restrictions on the level of certain toxic metals in packaging. The Toxics in Packaging legislation (Minn. Stat. §115A.965) is based upon model legislation developed by the Coalition of Northeast Governors (CONEG) which is currently in place in 18 states. The law states that the toxic metals lead, cadmium, mercury and hexavalent chromium must not exceed 100 ppm in total by weight in packaging. Manufacturers and distributors must provide a Certificate of Compliance to the MPCA certifying that they have either met the requirements of the law or are claiming an exemption allowed in the statute.

As part of implementing this statute, Minnesota has been participating in the multi-state Toxics in Packaging clearinghouse, formerly based in CONEG and currently based in the Council of State Governments. This clearinghouse allows member states to exchange ideas on toxics in packaging issues and to coordinate laws and regulations to ensure uniformity. The clearinghouse meets a few times a year and maintains contact by monthly conference calls.

This legislation has its roots in pollution prevention: Reduce the toxic chemicals that are in a product and you reduce the environmental impacts throughout the product's life cycle. The potential exists for further pollution prevention and toxicity reduction in packaging and other nondurable products. The OEA plans to assist the MPCA in this program by participating in clearinghouse activities. The MPCA will retain its statutory authority in this area.

Over the next year, the OEA and MPCA will examine how the statute and this program could be modified to have a greater emphasis on pollution prevention and toxicity reduction. The OEA is currently highlighting PBT chemicals in its toxicity reduction activities.

[1] U.S. EPA, Strategy to Reduce Persistent, Bioaccumulative Toxics. http://epa.gov/pbt/pbtstrat.htm.

[2] EPA's dioxin source inventory estimated that more than 99% of all dioxin in the U.S. comes from industrial sources. *The Inventory of Sources of Dioxin in the United States.* U.S. EPA Office of Research and Development EPA/600/P-98-002a, 1998a. Part I and II, http://www.epa.gov/ncea/pdfs/dioxin/part1and2.htm. "Temporal Trends," Part III, http://www.epa.gov/ncea/pdfs/dioxin/dioxreass.htm. Due to federal regulation and industry efforts, known industrial sources of dioxin are down 90% from 1980 levels.

[3] *Biological Basis for Risk Assessment of Dioxins and Related Compounds.* Banbury Report 35:169-214, 1991. Dioxin levels in ancient human tissues were no more than 1 to 2% of the amount in today's humans.

[4] *Estimating Exposures to Dioxin-like Compounds, Volumes 1-3.* U.S. EPA Office of Research and Development, EPA/600/6-88-005, 1994b. The theory that much of today's body burden of dioxin could be due to natural sources has been largely discounted by the testing of ancient human tissues.

[5] In 1999, about 20% of dioxin was from burn barrels. EPA burn barrel emissions data http://www.epa.gov/ttn/catc/dir1/barlbrn1.pdf.

[6] "Burn Barrels" *New York State Solid Waste Examiner,* Spring Edition 2001. Joint U.S. EPA and NY State Dept. of Health and Environmental Conservation study reports that dioxin emissions from burning 50 to 900 pounds of household waste in burn barrels are equivalent to those from burning 400,000 pounds in a modern incinerator.

[7] "Pesticides and You," Vol. 6, No. 4, October 1986. *ChemicalWATCH Factsheet: 2,4-D*. National Coalition Against Misuse of Pesticides, Washington, DC.

"2,4-D: Toxicology, Part 2." *Journal of Pesticide Reform,* V. 19, No. 2, Summer 1999. pp 17-18. Northwest Coalition for Alternatives to Pesticides, Eugene, Oregon.

[9] Leder A., E. Linak, R. Holmes, and T. Sasano. *CEH Marketing Research Report: Chlorine/Sodium Hydroxide*, Palo Alto: SRI International, 1994.

[10] Toloken, Steve. "Baxter Advances Toward PVC-free Bags," *Plastic News,* December 2001.

[11] Hickling Corporation. "Economic Instruments for the Virtual Elimination of Persistent Toxic Substance in the Great Lakes Basin." Windsor, Ontario: International Joint Commission, 1993, presentation text. 82nd Annual Meeting of the Air and Waste Management Association, Anaheim, California, June 1989. Cost-effective substitutes are available for 26% of PVC products, based on current market price for alternatives and does not include installation costs, capital costs to produce larger quantities of the alternatives, or cost reduction of alternatives due to economy of scale.

[12] CHEMinfo Services for Environment Canada. *A Technical and Socio-economic Comparison of Options to Products derived from the Chlor-alkali Industry.* November 1997. The article notes that 65% of the alternatives are slightly or moderately more expensive, 9% of current PVC products are quite expensive to phase out, 89% of PVC could be replaced for a total of $13 million at a net savings of 2 cents per kilogram. Current cost increase is 0.04% for a non-PVC home. Environment Canada estimates that phase out of PVC would create 87% more jobs per dollar per sales than does PVC and would create over 200,000 new jobs. http://www.on.ec.gc.ca/glimr/data/chlor-alkali/.

[13] EPA's PBT Initiative: Strategy and Action Plans–Mercury. www.epa.gov/pbt/hgaction.htm.

[14] Minnesota Pollution Control Agency, *2001 Air Quality Report,* Appendix G; Reported 1999 mercury emissions from non-exempt electrical production facilities in Minnesota. Updated with 2000 data. December 2001. http://www.pca.state.mn.us/hot/legislature/reports/2001/airquality.html.

[15] *The "Health Care Environmental Purchasing" tool is located on the American Hospital web page at http://www.ahrmm.org/HCEPT/index.html.*

[16] Walkowiak, J., J. Wiener, A. Fastabend, B. Heinzow, U. Krämer, E. Schmidt, H. Steingrüber, S. Wundram, and G. Winneke. "Environmental exposure to polychlorinated biphenyls and quality of the home environment: effects on psychodevelopment in early childhood." *Lancet* 358: 1602–07. 2001.

[17] U.S. signs POPs Treaty, http://www.state.gov/g/oes/env/rls/index.cfm?docid=3015.

[18] U.S. EPA information on Octachlorostyrene, http://www.epa.gov/glnpo/bnsdocs/98summ/ocsresp.html.

[19] MPCA's Listed Metals web site, http://www.pca.state.mn.us/waste/listedmetals.html.