PUBLIC CONSULTATION DRAFT

Decision Document on Lead under the Process for Identifying Candidate Substances for Regional Action under the Sound Management of Chemicals Initiative

Prepared by

the Substance Selection Task Force

for the

North American Sound Management of Chemicals Working Group
of the

Commission for Environmental Cooperation

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Preface

Under the CEC *Process for Identifying Candidate Substances for Regional Action,* a substance is nominated by one or more of the North American governments and subsequently evaluated to determine if it meets criteria for trinational action and to establish whether mutual concern exists based on the issues posed by the chemical and the benefits of collective trilateral action. Following the US nomination of lead in 1998 for consideration under this process, the Substance Selection Task Force (SSTF) of the North American Working Group on the Sound Management of Chemicals, in its evaluation of lead, concluded that mutual concern exists for collective action. As a consequence, the SSTF has developed this draft *Decision Document on Lead under the Sound Management of Chemicals Initiative*, on which it is seeking public comment.

The Draft Decision Document, by way of background, and relative to our central task of examining issues in light of risk posed to humans and the environment, provides information that is indicative of achievements related to risk reduction for lead and describes current processes and products that involve use or incorporation of lead. The SSTF emphasizes that this information is not intended to be comprehensive, given the complexity of the issues involved, including the range of expertise required to provide a thorough review of the different aspects of lead (health; uses in various industrial sectors; the range and status of domestic government programs on lead; etc.). Taking the preceding into consideration, some of the issues we have identified relate to apparent gaps in information on lead. Further, we anticipate that some of the recommendations that go forward will require review by specialists within the appropriate program areas, and that their review will contribute to a possible North American Regional Action Plan (NARAP), items appearing in it, or other forms of action for collaborative work undertaken to address some of the issues raised in this document.

The SSTF emphasizes that the purpose of a decision document in the substance selection process is to recommend a course of action (as opposed to crafting responses to issues identified). The SSTF, mindful of this purpose, seeks comment and advice from the public on the following:

- feedback on those issues we have cited as potential areas for collaborative action;
- comment on whether we have overlooked issues that might be appropriate for collaborative activity; and
- the form that a NARAP might take for this substance, and/or other mechanisms that would be most appropriate to address the issues identified by the SSTF and the public.

At the conclusion of the 45-day public review period, we will make an evaluation of the comments received which will be incorporated in the final draft forwarded to the Working Group.

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Chair

Substance Selection Task Force

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1.0 Introduction

1.1 The Sound Management of Chemicals Initiative

The North American Working Group on the Sound Management of Chemicals (Working Group) is the principal body responsible for administering the Sound Management of Chemicals (SMOC) initiative. The SMOC initiative and the Working Group were established by the Commission for Environmental Cooperation (CEC) under Council Resolution 95-05, Sound Management of Chemicals.

Council Resolution 95-05 was developed under the authority of the North American Agreement on Environmental Cooperation (NAAEC) and advances many of the commitments and obligations set out therein. The Council (of Ministers) is the governing body of the CEC, which was established as part of NAAEC. The Council of the CEC approved Council Resolution 95-05 on 13 October 1995, at its second regular meeting, which was held in Oaxaca, Mexico.

A key focus of the SMOC initiative to date has been the development of North American Regional Action Plans (NARAPs) for persistent and toxic substances that the Parties agree warrant collective regional action because they pose a significant risk to human health and the North American environment. The NARAPs reflect a shared commitment by the Parties to work cooperatively to build on domestic policies and laws, improve domestic capacities, and bring a regional perspective to the implementation of international environmental commitments that are in place or being negotiated to address persistent and toxic substances.

Each NARAP is necessarily unique, as a result of the need to reflect differing circumstances for each Party, including: production, use, and disposal practices for substances; natural endowments, climatic and geographical conditions; and economic, technological and infrastructure capabilities. The sharing and transfer of information and best practices to enhance national capacity for the sound management of chemicals has been one common theme for NARAPs. It is also possible to utilize other mechanisms for coordination and implementation of trinational activities on a substance. Substance-oriented NARAPs have been developed for chlordane, DDT, mercury and PCBs, and a fifth, addressing a class of substances—dioxins and furans, and hexachlorobenzene—is under development.

1.2 Process for Identifying Candidate Substances

The SMOC Working Group established the Process for Identifying Candidate Substances for Regional Action under the Sound Management of Chemicals Initiative (Substance Selection Process) to facilitate systematic, rigorous and transparent consideration of substances to possibly be addressed by additional NARAPs. The process has three stages:

(i) The *Nomination Stage* (Stage I), involving review of a Nomination Dossier prepared by one or more of the three Parties and referred to the Substance Selection Task Force (SSTF) by the SMOC Working Group. The Nomination Dossier contains standardized information for each nominated substance. The purpose of the review is to assess whether there is justification for the nominated substance to proceed to the next stage of the Substance Selection Process. Typically, the nomination dossier includes information on the substance's physicochemical properties, risk assessment and health effects. Any citizen within North America can recommend a candidate substance to its government; however, final nomination of the substance rests with the governments.

(ii) The *Evaluation Stage* (Stage II), consisting of two parts. First, a *Screening Evaluation* to assess whether a substance deserves further attention on the basis of scientific considerations, including evidence of entrance to the environment, transboundary environmental movement, persistence, bioavailability and bioaccumulation, and that a credible risk assessment document exists. Second, a *Mutual Concern Evaluation* to determine the degree to which all Parties agree there is a problem and that there would be real benefits from collective action.

(iii)The *Decision Stage* (Stage III), in which a Draft Decision Document is prepared recommending a course of action to the Working Group for the nominated substance.

The SSTF, a subsidiary body of the SMOC Working Group, administers the review of nominated substances under the Process for Identifying Candidate Substances. Substances are nominated by one or more of the three North American governments (Canada, Mexico and the United States). The SSTF consists of two members from each of the Parties and one observer each from the NGO and industry sectors.

1.3 The SSTF Lead Review Process to Date

Stage I (Nomination Stage): The United States forwarded its nomination dossier on lead to the SMOC Working Group on 21 May 1998. The SSTF determined that the US lead nomination dossier provided the necessary rationale and background information for proceeding to Stage II, the Evaluation Stage, of the Substance Selection Process.

Stage II (Evaluation Stage): The Substance Selection Task Force members concurred that lead met the criteria for Stage II (1)—Screening Evaluation:

- Criterion (i)—the substance may enter, is entering, or has entered the North American ecosystem (emissions, media, biota). There was consensus in the SSTF that this criterion was met for all three countries.
- Criterion (ii)—available and acceptable risk assessment(s). There are Canadian, US and other international documents that meet this criterion.
- Criterion (iii)—judgment on measured/predictive databases on bioaccumulation, and bioavailability, as lead, a naturally occurring substance, is by its nature persistent. Lead and lead compounds are toxic and bioaccumulate in aquatic and terrestrial organisms. In humans, lead accumulates throughout life, with the major storage reservoir being in bone. Lead stored in animal reservoirs is gradually released over time into the blood stream. Lead is not used physiologically by any metabolic pathway in any living organism.
- Criterion (iv)—monitoring evidence of transboundary environmental transport for persistent organic pollutants (e.g., appearance in biota, or indirect evidence of transport potential, such as air persistence for more than two days, and vapour pressure<1000 Pa for POPs). The SSTF's determination that evidence exists of transboundary transport was based on an examination of lead isotope ratios found in geological formations that differ in different regions of the planet. Studies examining lead isotope ratios demonstrate that long-range transport has occurred and is continuing to occur between Eurasia and Northern Canada, the United States and Mexico, and other geographic areas.

Stage II (2)—Mutual Concern Evaluation: The SSTF determined in June 2002 that Canada, Mexico and the United States share mutual concern with respect to lead in the North American environment and that exploration of areas for trinational collaborative action on lead is warranted.

Mutual Concern under the Process for Identifying Candidate Substances for Regional Action is assessed based on three measures of concern. These measures are described below, together with the SSTF's rationale for its determinations (Hernandez 2002):

(i) *The nature, extent and significance of the hazards and risks associated with the substance(s) under consideration.* The SSTF noted in its Mutual Concern rationale that the three Parties to the CEC share concern regarding the toxicity of lead and lead compounds and the potential risk they pose to humans and wildlife.

Adverse health effects to humans include impairments/damage to the brain, kidneys, bone marrow, and other systems. Lead has been classified by the International Agency for Research on Cancer (IARC) as a "Group 2B" or probable human carcinogen. Lead and its compounds can also adversely affect reproductive performance, and high levels of lead exposure can produce coma, convulsions and death.

Children are especially vulnerable to the toxic effects of lead because of their higher gastrointestinal absorption of it and because of their behavioural patterns associated with hand-to-mouth activities (ATSDR, 1999). *In utero* development and physical and functional growth are directly affected by lead concentration in the body. Currently, the US Centers for Disease Control and Prevention (CDC) recommends that children's levels not exceed 10 micrograms of lead per deciliter of blood (µg/dL) (CDC 2003). However, evaluating appropriate blood lead levels in children is an active area of research and these levels may change. Exposure levels as low as 10 µg/dL in infants, children and pregnant women are associated with impaired cognitive function, including retardation, impairments to fetal organ development, reduced stature, impaired hearing, behavioral problems, and other neuropsychological defects. In pre-school and school-age children, downward shifts in the IQs of populations that have significant exposure to lead have been identified as a serious public health concern.

(ii) T*he nature and extent of evidence of transboundary environmental transport in North America.* The SSTF concurred that quantities of lead and the isotope ratios of the lead found in air and precipitation samples, in core samples from glaciers, and in lake sediment samples provide clear evidence of both the quantities and origins of the lead being deposited. These lead isotope ratios demonstrate that long-range transport has occurred and is continuing to occur between Eurasia and Northern Canada, the United States and Mexico, and other geographic areas. The relatively long residence time in the atmosphere of lead aerosols (about 5–10 days) can result in its dispersal over thousands of kilometers.

(iii) *The extent to which mutual and demonstrable benefits can be expected to result from trinational actions to reduce the hazards and risks associated with the substance under consideration.* Historical and recent experiences demonstrate the benefits of cooperative international effort in addressing lead so as to reduce exposure. As sources of lead become better identified, managed and controlled, the long-range transport of lead and levels of human exposure will be reduced. To some extent, health effects resulting from previous exposure can also be mitigated, and there is evidence that health effects that result from low chronic exposure can be reversible. Therefore, reducing exposure to lead can be of great benefit both for future and current generations, allowing people to improve their performance and productivity. Examples where previous cooperation has resulted in enhanced knowledge of lead and reductions in exposure include: instrument and laboratory standardization; capacity building at the local, regional and international level; industrial process control and modification; community education; patient and population risk assessment and management, including rehabilitation; crisis management; and other actions.

Stage III (Decision Stage): Upon receipt of the SSTF's memorandum, the SMOC Working Group directed the SSTF to proceed to the third and final stage of the process: discussion and then preparation of a Draft Decision Document, inclusive of recommendations of potential trinational actions that the SSTF believes might be taken on lead.

The Draft Decision Document is the main deliverable for the third stage in the review of lead under the Process for Identifying Candidate Substances. The objectives of this document are to:

- describe the results of the Substance Selection Process for lead;
- identify issues related to trinational aspects and concerns associated with lead; and
- provide a recommendation to the SMOC Working Group regarding potential trinational action on lead and possible mechanisms for implementing such action (e.g., a North American Regional Action Plan).

Following public consultation on this Draft Decision Document, the SSTF will make any revisions it deems warranted, based on comments received, and then forward a final Decision Document, inclusive of its recommendations, to the SMOC Working Group. The SMOC Working Group will, in turn, take SSTF recommendations into consideration in determining whether to forward recommendations of its own to the CEC Council.

2.0 Physicochemical Properties of Lead

Lead (CAS number 7439-92-1) is an element originating in the earth's crust. Its atomic number is 82, and it has an atomic (molecular) weight of 207.20. Lead has a vapor pressure of 1.77 mm Hg at 1000°C, 10 mm Hg at 1162°C, 100 mm Hg at 1421°C, and 400 mm Hg at 1630°C (ATSDR 1993). Its group number is 14. It has a melting point of 327.4°C and a boiling point of 1740°C (ATSDR 1993). Its specific gravity is 11.3 (the specific gravity for water is 1.0). Its chemical abbreviation is Pb. Other names for lead include CI 77575, CI pigment metal 4, KS-4, Glover, Lead S2, Olow (Polish), plumbum, and Omaha (Nomination Dossier 1998). As lead is released to the environment, it often encounters anions, to form compounds such as lead nitrate ($Pb(NO_3)_2$) and lead acetate ($Pb(CH_3O_2)_2$). These compounds may not resemble the metallic form of lead and may have properties that differ from lead, such as the ability to burn (ATSDR 1993).

3.0 Lead in Ecosystems

3.1 Lead in the Environment

Lead is a significant environmental contaminant because it is toxic, persistent, and can be accumulated and stored in biological tissues. Lead can enter the food chain following deposition on soil, in surface waters and on plants.

The release of lead in the atmosphere by anthropogenic emissions is the primary source of lead in the environment (ATSDR 1993). Much of the lead discharged to the air is ultimately brought back to the ground or surface water through wet or dry deposition. Past and present atmospheric emissions therefore contribute to the amount of lead in soils. Areas of high traffic flow or near industrial sources are likely to have a greater concentration of lead in soils and dust than more remote areas (ATSDR 1999). Natural chemical and physical processes such as weathering, runoff and precipitation permit lead to be transferred continuously between air, water and soil (ATSDR 1993).

Once lead goes into the atmosphere, it can travel thousands of miles if the lead particles are small or if the lead compounds are volatile (ATSDR 1993). Sediment cores from Ontario and Quebec lakes remote from point sources of lead indicate that the lead burden is primarily due to long-term atmospheric deposition that began around 1850 (US EPA 1977).

Lead tends to be absorbed by soil particles and organic materials. Its uptake in plants is usually limited, although it is heightened when the soil is more acidic and when organic matter content is reduced (ATSDR 1993).

In water, lead levels are influenced by acidity and salinity. Concentrations of dissolved lead in groundwater tend to be low, as lead forms compounds such as carbonates, sulphates, and phosphates when encountering anions in the water. These compounds then tend to precipitate out of the water column. The total solubility of lead in hard water is approximately 30 µg/L, compared to approximately 500 µg/L in soft water (ATSDR 1993). High acidity generally occurs in association with human activity, such as mining activity (for example, lead that comes in contact with untreated acidic mining and industrial effluent). Some research has focused on the tendency of low-alkalinity waters to have a relatively high potential for acid deposition effects and increased bioaccumulation of lead in fish (Wiener and Stokes 1990). As a result of runoff, contaminated soil can contribute to contamination of any nearby sediments (Case et al. 1989). Lead in sediments, including lead deposited as a result of past (and, perhaps, ongoing) industrial and shipping activity, can become a concern when mobilized, for example, via heavy current or dredging, or as a result of ecosystem changes. (Environment Canada 2002a). Biomethylation of lead formerly bound to sediment has been documented (Sorensen 1991). Effects at contaminated sites range from no detectable effects to effects tens of kilometers downstream (Environment Canada 2002a). Lead solder and lead plumbing, formerly used in municipal water infrastructure systems and homes, represent a potential source of contamination of the environment via discharge waters.

Soil and sediments are important sinks of lead in the environment. Historically, atmospheric deposition of lead has been the primary source of lead in soil in the United States and Canada. Such lead generally deposits within the top 2–5 centimeters of soil. While some of the deposited lead could have originated from point sources many miles away, local sources are the major contributors of contamination within ecosystems; elimination of major localized sources of lead contamination can result in immediate reductions in concentrations of lead in the water and organisms near the sources. Most of the lead found in contaminated urban area soils is thought to come from past uses of lead in leaded gasoline formulations, landfills and leaded paint. Landfills contain waste from lead ore mining and industrial activities such as battery and information technology (IT) production and ammunition manufacturing (ATSDR 1993).

Significant environmental contamination incidents (which posed a risk to populations living in the vicinity of such contamination) have also occurred as a result of improper recycling procedures used to recover lead from products and improper disposal of lead-containing wastes.

Soil-lead tends to remain in the soil, sorbed to organic matter, until the soil is disturbed or eroded. Organic lead complexes in soil are more soluble and can leach out or be absorbed by plants more easily at a soil pH of 4–6, compared to a higher pH. The lead that plants absorb from soil is returned to the soil when the plants decay.

3.2 Effects and Pathways of Exposure in Biota

Animals high on the food chain have more opportunities to consume lead-contaminated food than other species may. Lead biomagnifies or bioaccumulates in organisms. Thus, while lead concentrations are generally highest in benthic organisms and algae (ATSDR 1993), significant amounts of lead (>1.0 mg/kg) have been found in higher organisms, for example mosquito fish, soft-shell turtles, Texas cooter turtles, bullhead minnows, crayfish, and red-eared turtles in the Trinity River in Colorado (Irwin 1988). Lead tends to accumulate over time; hence, many species tend to increase their body burdens of lead as they age (ATSDR 1993). Young animals are more sensitive than older ones, owing to developmental processes (National Library of Medicine 1996). Studies also indicate that seasonal variations can play a role in exposure to lead. For example, more than half the cases of lead poisoning in cattle studied in Scotland occurred in the spring. Similar effects have been noted for dogs (Irwin et al. 1998).

While most of the lead ingested by animals that consume contaminated plants or animals is excreted, the small amount absorbed can cause harmful effects (ATSDR 1993). In vertebrates, sub-lethal lead poisoning is characterized by neurological problems (including blockage of acetylcholine release), kidney dysfunction, enzyme inhibition, and anemia (Leland 1985).

Lead is toxic to all aquatic biota, especially fish. Organolead compounds are considered to be more toxic than inorganic lead forms and tend to bioconcentrate in aquatic biota (ATSDR 1993). In fish, lead can lead to excess mucous formation that can coat the gills and adversely affect respiration (Rompala et al. 1984). Synergistic effects of lead and cadmium and additive effects of lead, mercury, copper, zinc, and cadmium have been documented for aquatic biota (Demayo et al. 1980). Animals and wildlife encounter lead by inhaling contaminated air and by ingesting contaminated soil and plants, and, in the case of waterfowl, ingestion of lead shot and lead sinkers used to weight fishing lines. Three or four lead shots are sufficient to kill a duck; and 10 lead shots a goose. (Clarke 1981). Lead shot poisoning can also occur in bald eagles, fish and wildlife. Lead sinker or jig ingestion has accounted for 22 percent of recorded adult loon mortality in Canada (59 of 264 birds examined) in the last ten years, and is one of the leading causes of death for this species in locations where recreational angling occurs. A New England study identified lead poisoning from sinker or jig ingestion accounted for 50 percent of recorded loon mortality, the most important cause of reported mortality for adult common loons in that region. In the United States, 22 percent (138 of 654) of bald and golden eagles examined as part of an ongoing study exhibited elevated lead levels. The prevalence of lead toxicity in eagles has not changed since the 1991 ban on the use of lead shot for waterfowling in the United States; however, mean blood lead concentrations have been reduced (Hernandez 2002). Lead also poses a problem to birds in Mexico; for example, non-toxic shot zones have been established in the Yucatan to protect flamingos from lead poisoning (OECD 1999).

4.0 Human Health Effects and Principal Routes of Exposure

4.1 Health Effects

The ATSDR reports that, because lead is spread so widely throughout the environment, it can now be found in everyone's body; most people have lead levels that are in orders of magnitude greater than that of ancient times (Flegal and Smith 1992, 1995) and within an order of magnitude of levels that have resulted in adverse health effects (Budd et al. 1998).

The Centers for Disease Control Advisory Committee concluded that lead toxicity may be found at a level of 10 µg/dL and that effects may occur at levels below that (CDC 1991).

Adverse health effects to humans include impairments/damage to the brain, kidneys, bone marrow, and other systems. Lead has been classified by the International Agency for Research on Cancer (IARC) as a "Group 2B" or probable human carcinogen. Lead and its compounds can also adversely affect reproductive performance, and high levels of lead exposure can produce coma, convulsions and death. As noted in the SSTF rationale of Stage II (2), the Mutual Concern Evaluation Stage (Section 1.3), children are especially vulnerable to the toxic effects of lead because of their higher gastrointestinal absorption, especially children who have low dietary iron or calcium intakes, and because of children's behavioural patterns, i.e., hand-to-mouth activity, that may contribute to the ingestion of soil and dust (ATSDR 1999). In addition to a four-to-seven-point drop in IQ associated with every 10 µg /dL of lead (Needleman et al. 1979, 1990; Yule et al. 1981; Schroeder et al. 1985; Landsdown et al. 1986; Hawk et al. 1986; Winneke et al. 1990), there is evidence that the probability of deficits in attention and hearing impairment in children increases with increasing blood lead levels, and that these effects may begin at low, more widespread blood lead levels (at or below 10 µg /dL, in some cases), that may not be detectable upon clinical examination (ATSDR 1999).

Other than the developmental effects unique to young children, health effects in adults are similar to those experienced by children, although the thresholds are generally higher. There have been reproductive effects associated with lead exposure, although some results are controversial, especially at lower levels of exposure. Pregnant women with elevated blood-lead levels may have an increased chance of miscarriage, spontaneous abortion or stillbirth, preterm labor, and having newborns with low birth weight or neurological problems. In adults, blood-lead concentrations of 25µg/dL or higher are considered to be elevated (ATSDR 1992, revised 2000).

Lead exposure in Arctic populations has declined in parallel with the general reduction in the use of lead in gasoline. Ingestion of fowl contaminated via lead shot still poses a route of exposure. For example, mean blood lead levels in Inuit living in northern Quebec were more than twice the mean values for the general US population. Levels of lead were higher in individuals who ate waterfowl and smoked (Dewailly et al. 2001).

4.2 Principal Routes of Exposure in Humans

Higher than normal concentrations of lead are found frequently in urban areas; alongside roads (as a result of past use of lead in vehicular gasoline formulations); near mining, smelting and shipping facilities; and at industrial sites, including battery manufacturing operations (Environment Canada 1995a). Routes of exposure and the manner in which lead is metabolized and stored in the body vary among different segments of the population, including vulnerable subgroups (children, pregnant women, the elderly, and workers and their families). Socio-economic conditions are also a factor in exposure; for example, the percentage of children with elevated blood-lead concentration is generally higher for children in lower-income households and for African-American children than for those from other backgrounds (Nomination dossier 1998).

Most human exposure to lead occurs through ingestion or inhalation, with dermal absorption playing a very minor role (Moore et al. 1980). Lead exposure in the general population (including children) occurs primarily through ingestion, although inhalation also contributes to lead body burden. Almost all inhaled lead is absorbed into the body. Twenty percent to approximately 94 percent of lead in an adult's body is stored in bones and teeth, compared to 73 percent in a child's body (ATSDR, 1993). Between 40 and 70 percent of lead in an adult's blood may be attributed to mobilized bone-lead stores (Gulson et al. 1995; Smith et al. 1996). Lead absorption by the body is dependent on nutrient intake; low calcium, zinc, and iron levels have been shown to enhance lead absorption in the small intestines (Mushak and Crochetti 1996). 0

Lead stored in mineralizing tissue such as teeth and bone can later be released into the bloodstream, especially in times of calcium stress (e.g., pregnancy, lactation, osteoporosis), or calcium deficiency (ATSDR 1992, revised 2000). This is of particular concern to pregnant women, as lead mobilized from maternal bone stores can be transferred via the placenta to the unborn fetus (Nomination dossier 1998).

Even exposure to low levels of lead over an extended period of time can lead to significant accumulations of lead in the human body and toxic effects, regardless of the exposure pathway (ATSDR 2001).

The major exposure pathways for workers are inhalation and ingestion of lead-bearing dust and fumes.

Workers in the lead smelting, refining, and manufacturing industries experience the highest and most prolonged occupational exposures to lead (ATSDR 1999). Others at increased risk for lead exposure include work in brass/bronze foundries, rubber products and plastics industries, soldering, steel welding/cutting operations, battery manufacturing plants, and other manufacturing industries. Increased risk for occupational lead exposure also occurs among construction workers, bridge maintenance and repair workers, municipal waste incinerator workers, pottery/ceramics industry employees, radiator repair mechanics, and people who work with lead solder (ATSDR 1999).

Occupational exposures can also result in secondary exposure for workers' families if workers bring home lead-contaminated dust on their skin, clothes, or shoes. Children may also be exposed to occupational lead sources if their parents work in these industries and allow their children to visit them at work (ATSDR 2002).

5.0 Analysis of Major Implementation Considerations for Lead

The Stage III process for development of a Draft Decision Document lists ten considerations to be addressed for a nominated substance(s):

(i) human health or environmental measures available to reduce risk;

(ii) benefits to human health (public, occupational) or the environment from the reduced availability/elimination of a substance;

(iii) sustainability of food production;

(iv) feasibility and availability of alternatives;

(v) societal capacity for change;

(vi) implications/opportunities for trade and the economy;

(vii) costs and benefits of control measures;

(viii) national capacity to take action: expertise, technology, financing;

(ix) jurisdictional and regulatory opportunities for change; and

(x) international commitments and obligations.

These considerations are discussed in the subsections below.

5.1 Human Health or Environmental Measures Available to Reduce Risk

Pollution prevention and other risk reduction activities are the most important measures that can be taken to protect human health and the environment. Given that the primary source of anthropogenic emissions is to air, measures that address these emissions could be of particular benefit, including regarding long-range transport.

In North America, metallurgical, hazardous waste management and solvent recovery (primarily of lead-acid batteries) and electronic/electrical manufacturing and chemical processes that release or utilize lead have consistently been the most significant sources of emissions since the phase-out of lead additive gasoline formulations in public transport vehicles in the 1980s and 1990s.

Within Canada and the United States, two sources accounted for the majority of releases in 2000: the primary metals sector (40 percent), and the hazardous waste management/solvent recovery sector (26 percent). Other significant North American sources include the electronic/electrical equipment sector (12 percent); the chemicals sector (9 percent), electrical utility sector (e.g., lead as a contaminant in coal and other fossil fuels) (7 percent) and the stone/clay/glass products sector (3 percent) (CEC 2001).

Also in Canada and the United States, there were 19,772 tonnes of off-site transfers of lead for purposes of disposal in 1992–2000, as compared to 10,171 on-site releases, of which the majority (988 tonnes) were to air. (Similar information was unavailable for Mexico.)

For a breakdown of releases to the environment, see Appendix B. The appendix also includes inventory information for Canada and the United States from previous years.

The primary metals sectors (accounting for more than 18,000 tonnes of releases from Canadian and US sources in 2000, of which more than 10,000 tonnes were to the air) accounts for the highest emissions of lead to the atmosphere. National inventory data on source emissions were not available for Mexico in 2000. Reporting under Mexico's Pollutant Release and Transfer Registry should provide data on lead emissions and relative contributions from various source sectors. In 1998, those sectors with the most lead-intensive activities were metallurgy and chemical manufacturing (NRCan 2000).

The major source sectors for lead emissions could be examined to determine if there are activities beyond those already promoted domestically that could promote further reductions of emissions (e.g., development and use in processes and products of alternatives that are environmentally sound and pose less risk than lead). North American inventories of lead sources could also be examined to determine their completeness with regard to characterization of sources throughout the full life cycle, including for consumer products containing lead that are produced or imported into or within North America.

Techniques for monitoring sites, site characterization (e.g., with regard to concentrations of lead, bioavailability to the environment, location of sites relative to human populations, contamination of sources of drinking water, etc.), and remediation techniques could be shared and inventories of these sites reviewed to determine if they could be improved so that priorities could be set that protect people and the environment. Lead is listed among the 25 hazardous substances thought to pose the most significant potential threat to human health at US priority superfund sites (US DHHS and US EPA 1987). The US nomination document on lead, based on US EPA and ATSDR sources, notes that concentrations of lead in 1998 in contaminated sites were highest in the vicinity of stationary sources, such as ferrous and nonferrous smelters and battery manufacturing plants. Weathering from exterior paints that contain lead can be another source of localized lead contamination, and interior paint breakdown contributes to household dust levels. Areas where mining activities are or have been practiced may also result in lead contamination. A MiningWatch Canada document suggests that 60 percent of more than 10,000 abandoned Canadian mines have yet to be characterized as regards contaminants, and the figure is likely much higher for Mexico. The US Geological Survey, as part of its Toxic Substances Hydrology Program, in conjunction with the US departments of the Interior and Agriculture, has a pilot project underway for abandoned mines on public lands to better characterize downstream water and other types of environmental contamination. Sites where ore and concentrated lead products are loaded onto ships are potential sources of lead in the environment, due to spillage, runoff and windblown dust (Environment Canada 1995a).

Biomonitoring of lead levels in humans to establish a North American baseline would help to determine whether there are "hotspots" of contamination, sources not captured by inventories, and assist in determining strategies and priorities for action on lead.

Risk communication to the health care community within North America can promote awareness regarding the potential for lead exposure, and hence improve diagnostic ability. For example, medical staff examining children presenting with attention deficit symptoms should be aware of the importance of screening for lead if a patient's history, living conditions, etc., appear to warrant further investigation. Communicating risks to industry and manufacturing associations, sensitive populations and the general public regarding sources of lead releases can help people to make informed decisions to better protect themselves and their children against exposure.

Existing laws and policies regarding the use of lead could also be examined to determine if there are opportunities to improve their comprehensiveness and consistency with regard to risk reduction, without diminishing environmental protection that existing laws and policies offer. The OECD risk reduction strategy for lead could similarly be examined with regard to comprehensiveness of North American risk reduction activities.

Inventories could be examined to determine if there are opportunities for improving comparability of data reported and for comprehensiveness of sources, where these activities are not repetitive of those already underway (such as through the CEC's Pollutants and Health initiative, which is working to improve comparability of PRTR reporting approaches, for example, as these apply to reporting thresholds, sectors reporting and how lead and lead compounds are classified in reporting systems).

5.2 Benefits to Human Health (Public, Occupational) or the Environment from the Reduced Availability / Elimination of a Substance

Given that effects from exposure to lead can be observed at low blood levels and that these are widespread, the benefits of pollution prevention and risk reduction activities applied to products and processes and of remediation of contaminated sites include reduced occupational exposure, reduced exposure of the general population, and, in particular, of sensitive sub-populations (for example, northern aboriginal populations, pregnant women and children), and lower lead levels in the environment. Given that lead is a natural element, and consistent with Principle 15 of the 1992 Rio Declaration, the SSTF assumes that the objective for action on lead, a naturally occurring metal, is preventing or minimizing human exposure and releases of lead into the environment. As well, pollution prevention and risk reduction activities applied to processes and products can reduce/eliminate the risk of exposure to humans and ecosystem biota. Exposure to lead can occur at various stages of its life cycle. The environment (soil, sediment, water, etc.) can serve as a source of re-introduction of lead. In addition, where substitutes are employed to replace lead, care will need to be taken that the substitutes do not themselves pose significant harm, with releases to all media taken into full consideration.

5.3 Sustainability of Food Production

Plant surfaces can contain lead due to atmospheric deposition, while internal plant tissues can contain lead as a result of biological uptake from soil and leaf surfaces (Nomination dossier 1998). Such lead generally deposits within the top 2–5 centimeters of soil (US EPA 1986).

All three nations have regulations that address tolerances (limits) for lead concentrations in foods and screening for lead in imported as well as domestic foods. None of the countries permits lead solder in cans that contain food.

Almost all food contains trace amounts of lead, most of which is likely due to atmospheric fallout (FAO 1968). Lead levels in plants and animals are highest when a lead-emitting point source is located nearby.

It may be useful to conduct a literature search to determine whether there is any peer-reviewed analysis of the relationship between contaminated lands (i.e., contaminated from whatever type of source) and contamination of food subsequently grown on these lands.

Lead was used extensively in many countries from 1900 to 1950 in some insecticides (calcium and lead arsenate), after which use declined dramatically. Use of lead arsenate (also known as OrthoL40 dust and gypsine) was reported in 1968 in insecticides used to control insects chewing on fruit trees in Canada and the United States (FAO 1968). Calcium carbonate was used until about 1940 to control boll weevils and other insects. Past uses of these substances could have resulted in localized contamination of land (for example, specific locations in orchards where such pesticides were mixed), but these are more likely to pose a risk via direct contact with contaminated soil than as a food contamination issue.

In the United States, the registrations of calcium arsenate and lead arsenate for use on a variety of crops (primarily garden vegetables and fruits) was cancelled in 1988 and further sale, distribution and use were prohibited. The use of lead arsenate on citrus was voluntarily cancelled in 1987 and EPA granted use of existing stocks until all stocks were depleted. At the time of the voluntary cancellation, it was estimated that approximately 100,000 pounds of stocks existed. EPA estimated that 90,000 pounds were used in 1988 and the remaining 10,000 pounds in the spring of 1989.

In Canada, pesticides containing lead were among the first to be regulated. The Pest Management Regulatory Agency (PMRA) has finalized a document on children's health priorities that describes its approach to children's environmental health and risk assessments for pesticides, including pesticides that could be contaminated with lead (Health Canada 2002a).

Mexico has also phased out use of these pesticides.

The United Nations Committee of Experts on the Transport of Dangerous Goods has classified arsenic and most inorganic arsenic compounds, including lead arsenate, as "poisonous (toxic) substances." As such, strict regulations apply to their transportation (IPCS 1992).

The SSTF did not have sufficient information to determine whether irrigation pipes utilized in North America might contain lead soldering.

5.4 Feasibility and Availability of Alternatives

Alternatives for some products exist; others will need to be developed. For example, Mexico's federal government is supporting efforts to develop a lead-free varnish for glazed pottery products. For sophisticated technical products, producers can be encouraged to seek and develop alternatives as part of extended producer responsibility. Alternatives exist for lead in most types of batteries, for shielding applications and for vehicle wheel balancing weights. Efforts are also underway by industrial sectors, such as the electronics sector (e.g., Intel), to reduce lead in products such as computers. The OECD reports that five companies reported technology and/or product development initiatives aimed at reducing or eliminating lead emissions from their plants or in their products. Asarco has developed a lead-free alloy to replace lead in brass, bismuth tin shot to replace lead shot, and an assay-grade bismuth oxide that could be used as a non-toxic alternative to lead oxide. Hadeland Glassverk has a long-term goal of eliminating lead from its crystal. The Doe Run Company has reduced lead and zinc losses to slag through process improvements. In Mexico, the National Artisans Fund (Ceramics) and the Metallic Cans National Association developed processes that eliminate lead use in these products (OECD Environment Directorate 2000). Research into alternatives and incentives for developing such alternatives should continue to be supported. It might be useful as well to review and assess alternative technologies and products for potential applications within North America and policies aimed at ensuring alternatives are utilized where available and preferable to lead-containing products.

5.5 Societal Capacity for Change

A number of domestic achievements related to lead demonstrate societal capacity for change. They are described in more detail by topic in this section.

5.5.1 Reduction/Elimination of Lead Additives in Motor Vehicle Formulations

The single most significant action on lead in North America has been regulatory and voluntary action to eliminate lead additives from motor vehicle gasoline formulations.

In Canada, the use of tetraethyl lead as an additive in gasoline was banned in December 1990. Concentrations of lead in the air declined significantly since the initial introduction of unleaded gasoline in Canada in 1975. Between 1973 and 1985, airborne lead concentrations fell by 76 per cent—a figure that matches almost exactly the increased use of unleaded gasoline. December 1990 data indicated that levels of lead in the air of most Canadian cities have dropped to below the detectable limit.

In Mexico, the lead content of gasoline decreased considerably between 1986 and 1992. From 1991 on, Mexican automobiles were fitted with catalytic converters, while the paragovernmental agency Pemex introduced its MagnaSin unleaded gasoline (Semarnat-INE 2001). In 1994, Mexico issued a standard (Norma 086) establishing values in gasoline with lead of 0.06-0.08 kg/m^3. Lead in gasoline values were 0.03 kg/m^3 in 1995 (i.e., below standard 086). By January 1998, Mexico had phased out leaded gasoline in the Mexican market. Primarily as a result of these activities, ambient levels of lead in Mexico that averaged 1.26 $\mu g/m^3$ in 1990 had fallen to 0.22 $\mu g/m^3$ by 1995 (OECD 2000).

In the United States, the greatest reduction in lead emissions occurred between 1970 and 1985, as a direct result of the regulated phase-out of leaded gasoline (reductions in both the lead content per gallon and the total gallons produced) (US DHHS and US EPA 1987), which enabled introduction of lead-sensitive emission control–equipped vehicles. According to the National Health and Nutrition Examination Survey (NHANES) II, nearly a 40 percent decline in average blood-lead concentration was observed between 1976 and 1980 alone, corresponding to an approximate 50 percent decrease in the use of leaded gasoline in the US (CDC 1991). The decline in average blood-lead concentration is likely due to the considerable reductions in airborne lead levels and reduced contamination of soil and food that resulted from the decline in use of leaded gasoline.

EPA regulation of the amount of lead in gasoline continued through the 1980s, until Title II of the 1990 amendments to the Clean Air Act (42 USC 7545) instituted a controlled phase-out of leaded gasoline by 31 December 1995.

5.5.2 Reduction/Elimination of Lead in Paints

In Canada, recent regulatory initiatives on lead and children's health include the Hazardous Products (Liquid Coating Materials) Regulations, that restrict the lead content in residential paints and paints for application on children's products such as toys, playpens, cribs and playground structures; and the Hazardous Products (Glazed Ceramics and Glassware) Regulations, that harmonize the leachable amounts of lead from glazed ceramic foodware with those in the US, ranging from 0.5–3.0 milligrams per liter, depending on the product.

Health Canada currently has under review a draft lead risk reduction strategy for consumer products to which children are likely to be exposed (Health Canada 2002b).

Mexico, in 1991, by means of a voluntary agreement and the subsequent introduction of a standard, eliminated the use of lead oxide and carbonate in interior paints, as well as paints used for toys and other objects with which children may come into contact. Regulations enacted in 1993 (NOM-003-SSA-1993) require labelling of paints, enamels and glazes containing lead.

In the United States, the Consumer Product Safety Commission (CPSC) ruled in 1978 that paint used for residences, toys, furniture, and public areas must not contain more than 0.06 percent lead by weight. The ruling followed voluntary manufacturer reductions to 1 percent lead by weight in the late 1950s and reductions to 0.5 percent mandated by the US Department of Housing and Urban Development (HUD) in the 1970s under the Lead-based Paint Poisoning Prevention Act. These efforts reduced the amount of lead in paint within the nation's housing stock. They did not address the presence of lead in existing paint films. In response to Title X of the Housing and Community Development Act of 1992, HUD prepared guidelines on identifying and controlling existing lead-based paint hazards, as improper control procedures can actually increase the threat of lead-based paint exposure (US HUD 1995). EPA published a final Pre-Renovation Lead Information Rule (40 CFR Part 745, Lead) under the Toxic Substances Control Act (TSCA) 406(b) on 1 June 1998, effective on 1 June 1999, stipulating requirements for hazard education prior to renovation of target housing (CDC 1991).

It may be useful to review laws and regulations within North America regarding lead content in paint, to determine if uses of lead-based paints are permitted within schools, daycare centers, offices and other public buildings, and, where such uses are permitted, to determine if these pose a risk, for example, to children, pregnant women, and workers, including during renovations.

5.5.3 Lead in Other Products and Industries

Opportunities exist to share best practices related to reducing risks of lead in products and industries. For example, introduction of new technologies, such as a low emissions smelter facility installed in 1997 in Trail, British Columbia, and upgrades to abatement equipment have resulted in a 68 percent reduction of lead emissions from that facility (Teckcominco 2000). Successful technologies could be examined to determine whether their application or adaptation in other facilities in the same sectors would lower emissions, and to examine/consider whether incentives for emissions reductions are or could be systematically applied. In the United States, legislative provisions of the US Clean Air Act (CAA) resulted in an overall decrease by two orders of magnitude in lead emissions (all forms of lead and lead compounds, including alkyl-lead) between 1970 (220,869 short tons emitted) and 1996 (3,869 short tons emitted), for a 98 percent reduction in overall airborne lead emissions (US EPA 1997). Regulatory controls for lead content in consumer products have also been implemented. For example, Canada’s Hazardous Products Act and Regulations apply to products imported, advertised and/or sold in Canada that are “designed for household, garden or personal use, for use in sports or recreational activities, as life-saving equipment, or as a toy, plaything or equipment for use by children.” Schedule I, Part I of the Act lists prohibited products, which may not be imported, advertised or sold in Canada. Schedule I, Part II lists controlled products, which may be imported, advertised or sold in Canada only if they meet certain standards of safety. Regulations developed under the Act apply to a variety of products, for example, glazed ceramics and glassware and liquid coatings. The United States Consumer Product Safety Commission (CPSC), under Regulation 16 CFR Part 1303, requires that items intended for children contain less than 0.06 percent lead by weight, or 600 mg/kg total lead (US Consumer Product Safety Commission 1977). The US Toy Manufacturers of America pledged in August 1998 that its members will help to reduce children’s exposure to hazardous lead levels by eliminating lead from their products (US Consumer Product Safety Commission 1998). A US compliance policy of 1995 established new limits for leaching of lead from lead-glazed ceramic ware. (OECD 2000).

Mexico, in 1994, issued a standard prohibiting the use of lead in pottery by 1997. A seal affixed to pottery indicates that ceramic products do not contain lead. Recently, Mexico has entered into or is promoting a number of voluntary activities aimed at reducing use of lead in products and processes. Mexico’s National Crafts Fund (Fonart) has been working since 1995 on a lead substitution program for lead oxide ceramic glazes. Some export-oriented companies have already modernized their processes but the overall increase in use of lead-free processes has not been significant. There remains a significant number of family establishments that continue to use traditional lead-based techniques and for whom the market is predominately domestic.

It may be useful to assess the effectiveness of enforcement and consumer awareness with respect to product-labeling mechanisms and prohibitions on toys and other consumer products.

There are also many voluntary industry risk reduction efforts underway that aim to reduce or eliminate lead from products. For example, Mexico has also entered into the voluntary agreements with the automobile manufacturers for installation of catalytic converters, paint manufacturers to eliminate lead compounds from certain products, and packaging manufacturers to eliminate the use of lead solder. (Lead solder is no longer used in Canada or the United States.) The National Institute of Ecology (*Instituto Nacional de Ecología*—INE), in conjunction with the Mexican Mining Industry Association (*Cámara Minera de México*—Canimex) and the International Lead Management Center (ILMC), signed an agreement for:

- laying the groundwork for cooperation on reduced exposure associated with industrial lead emissions;
- establishing lead management in production processes; and
- using and recycling of lead-containing products, and waste management, so as to bolster environmental protection, public health, and in particular, the health of workers exposed to lead.

Advances in the implementation of the agreement include compiling information for the development of an inter-institutional Web site (sponsored by INE–Canimex–ILMC) on lead in Mexico and the world and studying the re-engineering of production process at the Met-Quim plant in Celaya, Guanajuato.

A number of companies in North America, such as Intel, through its Lead Reduction Initiative, are working to find substitutes for lead in their products.

5.5.4 Lead in Drinking Water

The Canadian guideline for lead in drinking water is 0.010 mg/L. In Canada, drinking water quality is a responsibility shared between various levels of governments. Health Canada works closely with the Federal-Provincial-Territorial Committee on Drinking Water to establish the Guidelines for Canadian Drinking Water Quality. Each jurisdiction is then responsible for setting its own guidelines, objectives or enforceable regulations, usually based on the federal Guidelines for Canadian Drinking Water Quality. The Canadian National Plumbing Code prevents lead solder from being used in new plumbing or in repairs to plumbing for drinking water. Several provinces have passed legislation limiting the amount of lead in solder for drinking water supply lines.

The US EPA, in 1991, through the National Primary Drinking Water Regulations for Lead and Copper (56 FR 26460), set an action level of 15 parts per billion (ppb) for lead content in US drinking water and a maximum contaminant level goal of 0 ppb at the tap.

In Mexico, provisions that regulate safe drinking water are set forth under the Public Urban Use Provisions of the National Waters Law (*Uso Urbano Público de la Ley de Aguas Nacionales*) and the Regulation under the General Health Law (*Ley General de Salud*). Pursuant to Article 38 of the National Waters Law, the National Water Commission (*Comisión Nacional del Agua*—CNA) may establish reserve zones for the purpose of preserving drinking water sources and protect them from contamination. Minimum drinking water standards are set forth in the Regulation under the General Health Law Regarding the Sanitary Control of Activities, Facilities, Products and Services (*Reglamento de la Ley General de Salud en Materia de Control Sanitario de Actividades, Establecimientos, Productos y Servicios*). The National Water Commission and the Secretariat of the Environment and Natural Resources (*Secretaría del Medio Ambiente y Recursos Naturales*—Semarnat) have together issued NOM-001-ECOL-1996 and NOM-002-ECOL-1996, that regulate the handling and protection of water supply for human consumption (CEC 1995).

Mexico's NOM-127-SSA1-1994 of the Health Secretariat (*Secretaría del Salud*—SSA) describes quality limits and treatments required to render water potable and includes provisions for lead.

Prior to 1991, a regulation that is no longer valid required the sewage systems of residential homes in Mexico to empty into a street collector via a lead pipe connection (Romieu et al 1994).

5.6 Implications / Opportunities for Trade and the Economy

All three North American nations are important producers, suppliers and consumers of lead, within the North American market and globally.

5.6.1 Production and Supply

In Canada, the mining and metals sector as a whole accounted for 3.73 percent of the country's gross domestic production, employing 375,000 people. Lead is produced mainly as a co-product of zinc. Canada in 2001 led the world in lead production, at 154,000 metric tons (Mbendi 2001). Closure of the world's largest lead mine, the Sullivan mine, in 2002, and the Nanisivik and Polaris zinc mines in the Canadian territory of Nunavut has left the Brunswick mine, owned and operated by Noranda Mining and Exploration Inc., as the sole major producer of lead concentrates in Canada (Chevalier 2001). About 90 percent of mined lead produced in Canada goes to the export market. Recycling of lead, mainly from scrapped car batteries, is an important source of refined lead in Canada, representing nearly 50 percent of the total refined production. Nearly 90 percent of Canadian exports of refined lead are to the United States (NRCan 2003).

Mexico—with 156,000 tons in mine production, or five percent of world output—ranked fifth globally in mine production in 2000. Mining activities overall accounted for just 1.2 percent of Mexico's GDP in 2001 (*The Economist* 2003). Production of nonferrous metals was valued at MexP$12.3 billion, with lead, copper and zinc as main contributors, at 96 percent (*Secretaría de Economía* 2003).

United States mine production output of 468,000 in metric tons of lead in 2000, or 18 percent of global production, placed it third (after Australia and China) in world production. The value of domestic recoverable mined lead in 2000 was about $404 million, while US lead mines employed an estimated 1,100 people. Secondary lead, derived primarily from lead-acid batteries, accounted for 77 percent of refined lead production in the United States. Lead consumption in the United States in 2000 was estimated at 1.7 million tons, occurring at 140 manufacturing plants. The US transportation industries are the country's principal user of lead (for batteries, fuel tanks, solder, seals, bearings, wheel weights, etc.). The United States exported $42.6 million in lead ore and concentrates in 2000 (USGS 2000). In addition to production of lead, the United States imports lead in concentrates. Canada and Mexico, during 1997–2000, were the major sources of imports of lead in its metal form, at 61 percent and 15 percent respectively (USGS *Minerals Yearbook* 2000).

5.6.2 Lead in Products

The largest single use of lead in products today, including within North America, is for lead-acid storage batteries used in automobiles. There are two general types of lead-acid batteries: starting, lighting and ignition (SLI), and industrial. SLI batteries are sold as both original equipment and replacement batteries for use in the automotive market. According to Environment Canada, six million used lead-acid batteries were taken out of service every year in Canada up through 1995. This amounts to 100,000 tonnes of batteries, which contain about 50,000 tonnes of lead. Approximately 40 percent of these batteries were manufactured in Canada. Environment Canada noted that it is difficult to estimate the proportion of used lead-acid-batteries that become available for recycling and those that are actually recycled. One reason is that large numbers of lead-acid batteries, both new and used, are both imported from and exported to the United States. Environment Canada estimates that Canada's recycling rate for used lead-acid batteries is about 90 percent, and in some years has exceeded 100 percent as stockpiled batteries are recycled). In Canada in 1999, lead-acid batteries and battery oxides accounted for the largest quantity of lead used (16,741 tons of primary lead and 20,024 of recycled lead) (Environment Canada 1995b).

Mexico notes that lead-acid batteries are a major source of lead, in terms of product inputs (Semarnat/INE communication to CEC 2001).

The United States Geological Service (USGS) similarly reported in 2000 that, in the United States, the demand for lead in both SLI-type and non-SLI battery applications increased. Total demand for lead in all types of lead-acid storage batteries represented 88 percent of apparent US lead consumption (USGS 2002). Non-SLI battery applications in the United States include motive power sources for industrial forklifts, airport ground equipment, mining equipment, and a variety of non-road utility vehicles, as well as stationary sources of power in uninterruptible electric power systems for hospitals, computer and telecommunications networks, and load-levelling equipment for electric utility companies.

Industrial batteries can be either "traction," which power such diverse products as forklifts, golf carts, scrubber sweepers and submarines, or "stationary," used for emergency lighting and uninterruptible power supplies.

There are several emerging markets for lead-acid batteries. These include remote area power supply (RAPS) and uninterruptible power systems (UPS) used in electric grid connections, phone systems and computer banks to provide protection against power failure.

There are three major types of lead oxide: battery oxide, used in lead storage batteries; lead monoxide, used in the production of television tubes, electronic glass, auto ignition and fuel injection systems, and radiation shielding; and red lead, used in the production of positive battery plates, telescope and camera lenses, incandescent lights and computer monitors.

Lead-acid batteries are also used at the domestic level for photovoltaic solar panels and wind generators.

Natural Resources Canada (NRCan) reports that the second-largest use of lead globally is in pigments and compounds, which accounted for 8.8 percent of western world demand in 2000. The principal uses are in PVC plastic stabilizers, which prevent degradation during processing or from ultraviolet radiation; in colour pigments; and in the manufacture of glass, including crystal, light bulbs, insulators and television/computer screens.

Other uses of lead in North America include manufacture of explosives, nuclear and X-ray shielding devices, cable coverings in the power and communication industries, lead sheet for roofing, restoration of old buildings and chemically resistant linings, noise control materials, electrical and electronic equipment, motor vehicles and other transportation equipment, and as a bearing metal. It is used in brass and bronze alloys, casting metals, glass making, ceramic glazes, exterior paints, pipes, traps and bends and other extruded products for building construction, fuel and storage tanks, process vessels, and in some solders. Minor uses include products such as wheel weights, yacht keels, ornamental items and stained glass.

In the United States, the most significant sources of lead, after lead-acid batteries, included ammunition (3 percent), oxides in glass and ceramics (3 percent), casting metals (2 percent), and sheet lead (1 percent). The remainder was consumed in solders, bearing metals, brass and bronze billets, covering for cable, caulking lead, and extruded products (USGS 2002).

Use of lead in roofing, piping and caulking is declining in Canada and the United States, but Natural Resources Canada notes that lead use has increased in sheeting as a partition sound barrier in office buildings, schools and multiple dwellings.

Lead and lead compounds also appear in dyes, asbestos, brake linings, insecticides and rodenticides, ointments and other products and are used as catalysts, cathode material, and flame retardant.

It would be useful to have a comprehensive update of North American trade in lead as this could assist in predicting trends in future lead production and consumption and inform risk reduction strategies.

Products containing lead at some juncture in their life cycle can pose risks of exposure to populations and releases to the environment. Products containing lead are traded within North America and exported elsewhere. Occasionally, despite vigilance applied to imports, products containing lead, for example in solder in cans, are discovered in shipments from other nations to North America.

Concerted North American action on lead will help publicize concerns with lead in products internationally and can serve as one additional means, along with legal and regulatory provisions, for communicating risk to exporters as well as North American resolve to protect populations from exposure to lead.

Elimination or reduction of lead exposure through measures such as product re-design and "take-back" programs for products for which safe substitutes do not exist will improve confidence for North American products, both continentally and globally. Mexico's work now underway to develop a substitute for lead-glazed pottery and a system for certifying pottery lead-free is a point in case. Such efforts help to ensure that an industry, in this case operated at a small scale but broadly, is not harmed by lack of confidence. Such measures can also help to expand on the export market for this industry. Hence, improvements to products have linkages to prevention of poverty.

Laws and regulations exist in the three countries that address hazardous lead content in products. These laws could be reviewed for their comprehensiveness and consistency. Another issue is the need for improved tracking of sales of products. Manufacturers generally are aware of inappropriate uses subsequent to sale, such as the extraction of the product's lead for its incorporation in other products, or unintended use of the product. Where sales cannot be tracked, this is further impetus for extended producer-responsibility for products containing lead. International law and policies could also be reviewed to determine the implications of international obligations in domestic efforts, such as those aimed at promotion of "green" or sustainable trade. For example, under Article XX(b) of the provisions of the General Agreement on Tariffs and Trade incorporated into the World Trade Organization Agreement of 1994, a WTO member may apply an import ban or another type of trade restriction if the application is "necessary to protect human, animal, or plant life or health," subject to the restriction that such measures are not "applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade." (WTO web site).

5.7 Costs and Benefits of Control Measures

Unifying actions across North America include:

- ensuring a level playing field for producers, manufacturers and recyclers of lead;
- making opportunities for "green" industries, as regards development of potential alternative products and approaches;

- helping reduce the costs of health care and educational resources associated with adverse health effects, in particular in vulnerable populations; and
- avoiding additional future costs that could be required for remediation of environmental contaminated sites.

5.8 National Capacity to Take Action: Expertise, Technology, Financing

All three countries have demonstrated capacity to take action (see Section 5.5). In the interests of expanding and perhaps accelerating lead risk reduction activities, opportunities could be explored whereby expertise could be identified and made available among the countries, with respect to pollution prevention, waste minimization and other risk reduction activities (e.g., expertise in identifying lead paint and dust hazards in cities; in blood lead surveillance and with respect to access to data generally; via industry-to-industry partnering exchanges). Financing mechanisms could be reviewed, particularly with respect to capacity building activities, for example in Mexico, to determine whether these are adequate.

The recent incorporation of lead into national PRTRs and the expansion of reporting to a broader range of sectors (e.g., via the lowered threshold for reporting on lead in the US TRI) will provide information that should help to inform priorities and strategies for action on lead.

5.9 Jurisdictional and Regulatory Opportunities for Change

Continuing public concern over lead, particularly in relation to child health (for example, as expressed by the environment ministers of the three countries in their Final Communiqué of the Ninth Regular Session of the CEC Council), creates an opportunity for the governments to promote voluntary activities, such as challenge programs, to work together to promote and protect public interests with respect to the environment, health and security; to contribute to innovation and economic growth; and to reduce the administrative burden on business.

Each country has recourse to a range of regulatory and voluntary approaches to the sound management of lead. An overview of legislative and regulatory provisions pertaining to lead is provided in Appendix A to this document.

Examples of current activities underway include the following:

Great Lakes Binational Toxics Strategy: Canada–United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes (Binational Strategy, or BNS), 1997. The Strategy builds on existing Canadian and US regulatory programs for targeted substances, including lead, and affirms each country's commitment to virtually eliminate releases of these substances to the Great Lakes basin. A cornerstone of the strategy is its reliance on voluntary measures to dramatically reduce pollutant discharges to the Great Lakes basin. It outlines a framework by which the countries can work together to achieve virtual elimination objectives.

As part of the strategy, alkylated lead compounds (or alkyl-lead) have been identified as a "Level I" substance. Therefore, the virtual elimination of alkyl-lead within the basin, through pollution prevention and other incentive-based actions, is considered an immediate priority for both governments.

The Strategy sets reduction goals for Canada and the United States to virtually eliminate persistent toxic substances, including alkyl-lead, in the Great Lakes.

The two governments have accepted the following challenges as significant milestones on the path toward virtual elimination of alkyl-lead emissions:

US Challenge: *Confirm, by 1998, that there is no longer use of alkyl-lead in automotive gasoline. Support and encourage stakeholder efforts to reduce alkyl-lead releases from other sources.*

Canadian Challenge: *Seek, by 2000, a 90-percent reduction in use, generation, or release of alkyl-lead, consistent with the 1994 Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA).*

5.10 International Commitments and Obligations

The United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution, 1979 and the **1998 Åarhus Protocol on Heavy Metals**. The Heavy Metals Protocol addresses lead, cadmium and mercury. The Protocol Objective deals with the control of emissions of heavy metals caused by anthropogenic activities that are subject to long-range transboundary atmospheric transport. In 1998, Canada became the first country to ratify the Protocol. The United States ratified the Protocol in 2001. A total of sixteen ratifications are required for the Protocol to enter into force. As of June 2003, 14 countries had ratified the Protocol. Mexico is not a member of the United Nations Economic Commission for Europe. A recently formed Heavy Metals Expert Group under the Convention could be a forum to share with UNECE colleagues North American activities and findings of relevance to the Heavy Metals Protocol.

Basel Convention, 1989. The purpose of this convention, which entered into force 19 May 1994, is to regulate transboundary movements of hazardous materials and wastes. Lead is listed in Annex I of the Convention as a hazardous substance. Annex VII, which characterizes the wastes listed, was adopted in 1995 but has not yet entered into force. Under its provisions, lead wastes include wastes having lead as constituents or contaminants, waste electrical and electronic assemblies or scrap, to the extent that they meet the characteristics set out in Annex III (corrosivity, toxicity and ecotoxicity; etc.); waste lead-acid batteries, whole or crushed; waste zinc residue containing lead in quantities sufficient to meet Annex III conditions; lead in wastes that are principally organic but which contain, consist or are contaminated with lead anti-knock compound sludges. Mexico is a signatory to the convention. Canada ratified the Convention on 28 August 1992; Mexico ratified the Convention on 22 February 1991. The United States signed the Convention on 22 March 1989, but has not ratified the Convention.

Declaration on Risk Reduction for Lead, 1996. Under this declaration, the Organization for Economic Cooperation and Development (OECD) pledges its support to continue cooperation among member countries on risk reduction efforts, to monitor the environment for lead levels, to work with industry in implementing voluntary risk reduction activities, to share information on lead exposure among all countries, and to continue to raise the issue of lead exposure at an international level. Canada, Mexico and the United States are all OECD members.

OECD Council Decisions. Various council decisions, which are binding on OECD member nations, have applicability to lead, such as the OECD Council Acts on Transfrontier Movement of Wastes (Council Decision C(98)202/FINAL), which applies to lead wastes and scrap, including waste containing metals such as electronic assemblies, vehicles and vessels ; and with regard to a notification system on consumer safety measures. Canada, Mexico and the United States are OECD members (OECD 1999).

The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, adopted 10 September 1998, but not yet ratified, provides for a notification system for banned or discontinued substances. A process has been initiated for listing tetraethyl and tetramethyl lead gasoline additives under the convention. (Secretariat web site 2003).

United Nations Environment Programme (UNEP) Governing Council decisions include decisions that pertain to lead, such as phase-out of lead in gasoline and as regards global assessments of persistent toxic substances. (Developing countries that still use lead can request assistance in their phase-out activities from developed nations.)

The World Summit on Sustainable Development (WSSD) Implementation Plan calls, in Paragraph 23, for a renewed commitment, "as advanced in Agenda 21, to sound management of chemicals throughout their life cycle and of hazardous wastes for sustainable development as well as for the protection of human health and the environment, *inter alia*, aiming to achieve, by 2020, that chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment, using transparent science-based risk assessment procedures and science-based risk management procedures, taking into account the precautionary approach, as set out in Principle 15 of the Rio Declaration on Environment and Development, and support developing countries in strengthening their capacity for the sound management of chemicals and hazardous wastes by providing technical and financial assistance." The plan promotes reduction of the risks posed by heavy metals that are harmful to human health and the environment.

The Miami Declaration, whereby, in 1997, the (G7/G8) Environment Leaders of the Eight, which includes Canada and the United States, committed to fulfill and promote the OECD declaration on an international level, includes, among its commitments regarding lead, agreement by each of the member countries to develop and share individual country actions to accomplish the goals of the OECD Declaration on Lead. It calls for "further actions that will result in reducing blood lead levels in children to below 10 micrograms per decilitre. Where this blood lead level is exceeded, further action is required." The declaration also cites the importance to child health of maternal exposure to lead and agrees to reduce maternal exposure. The Eight will establish principal points of contact and a mechanism for sharing timely information regarding lead hazards in toys and other products to which children might be exposed, including imported products, and will consider other joint actions as appropriate. As well, they have agreed to provide access, on a timely basis, to new technological developments on blood lead-level testing (Environment Ministers Meeting 2002).

6.0 Rationale for Trinational Action

The major reasons to take trinational action to reduce lead concentrations in the environment include the following:

- All three countries operate lead smelters and utilize lead in some products, such as lead-acid batteries and information technology equipment, and in a range of other uses;
- The three countries trade with one another (and with other nations) in products and wastes containing lead. (The scope and repercussions of such trade could use more research into the significance of concerns related to human health and the environment).
- Eliminating and/or reducing lead in products for which safe substitutes exist and eliminating lead-containing products for unacceptable uses, such as in children's toys and garments, and in lead-glazed pottery, will eliminate sources of exposure to lead while also maintaining and/or

increasing trade opportunities among the countries. Locating acceptable substitutes in artisanal products (lead-glazed pottery, etc.) is important to maintaining economic well being.

- There is stable isotopic evidence that lead is subject to long-range atmospheric transport to remote regions of North America.
- Countries would benefit from information exchange on best practices and experience for reducing and/or eliminating exposures to lead.

7.0 Gaps and Uncertainties

Trinational action on lead would help to address areas where gaps and uncertainties exist and, in addressing them, enable nations to set priorities for action. The SSTF has identified areas that could be considered for action. They include:

- monitoring environmental exposure and sources of lead;
- identification of environmental contamination or "hotspots" that would enable setting priorities for their remediation based on risk of exposure posed to humans and other organisms and degree of or risk of further significant environmental degradation;
- public information, awareness and education;
- an examination of the commercial use of lead to determine if there are risk-related and waste minimization opportunities and opportunities to improve access to and implementation of best practices for life cycle management of lead throughout North America;
- an examination of agricultural sustainable development practices to determine if there are any concerns related to lead;
- identification of potential capacity building activities (e.g., PRTRs);
- an examination of research regarding significance of secondary sources to exposure in vulnerable populations; and
- comparison of data collected by each country under its respective inventories to determine if there are gaps pertaining to lead and whether opportunities exist to improve comparison or comparability of data gathered and publicly reported.

Some of the gaps and uncertainties noted here are elaborated upon in the following discussion.

7.1 Inventory Mechanisms

Information could be shared on national inventories in which information on lead has been and is currently collected. (i.e., what information is collected and the approaches taken to collection; source sectors; threshold for reporting; etc.) to determine if there are opportunities for enhancing comparisons of data and to assist in determining if there may be gaps in national inventories with regard to sources.

CANADA

Under the authority of the Canadian Environmental Protection Act, 1999, owners or operators of facilities that manufacture, process or otherwise use one or more substances listed in CEPA under ministerial order must report to the National Pollutant and Release Inventory (NPRI). Established in 1992, the NPRI is Canada's primary inventory for toxic air pollutant emissions. Its mandate is to provide information to the public on toxic pollutants released into the environment or transported from the site of their generation to the site for their treatment or disposal.

Facilities that manufacture, process or otherwise use more than 10 tonnes annually of any designated substance and which have the equivalent of 10 full-time employees must report.

Environment Canada publishes the *Criteria Air Contaminants (CAC) Emissions Inventory* every five years. Data on lead was first gathered in 1995, following Canada's signature and ratification of the 1998 UN ECE Åarhus Protocol on Heavy Metals, which includes annual reporting requirements.

Under the CAC there are no mandatory federal or provincial reporting requirements for facilities, although provinces may include reporting requirements in permits issued to individual facilities or in regulations. Ontario has a mandatory reporting of air emissions, under its EPA Regulation 127, which came into effect in 2002, that includes lead and its compounds. Most information supplied is provided by individual companies to provincial environment agencies and by the provinces voluntarily to the federal government.

The most recent inventory, published in 1997, includes figures for 1990–1995. Approximately 4,600 sources were included in this inventory, some of which are also included in the NPRI. In general, sources emitting more than 100 metric tons of one criteria contaminant are captured in the inventory, although in practice, many provinces collect information from sources below this level.

As of 2003, lead and its compounds will be collected in the NPRI not as a CAC, but as "Elements and their Compounds" (Environment Canada 1998). The National Emissions Inventory and Projections Task Group (NEIPTG) of the federal/provincial National Air Issues Coordinating Committee (NAICC) coordinates information received for the provinces. The Pollution Data Branch of Environment Canada estimates emissions from remaining sources (such as minor industrial, transportation, and natural sources). The final inventory provides national, provincial and sectoral breakdowns of emissions of these pollutants, but, unlike the National Pollutant Release Inventory, does not provide facility-specific information.

MEXICO

Mexico passed enabling legislation in late 2001 for development of regulations pertaining to Mexico's Registry of Emissions and Contaminants Transference (*Registro de Emisiones y Transferencia de Contaminantes*). For 1999, on a voluntary basis, 117 facilities reported releases of listed chemicals. More information is needed to determine if lead is one of the substances for which reporting will be encouraged or required. As of the release of this Draft Decision Document, Mexico does not require mandatory reporting to the registry.

UNITED STATES

The National Toxics Inventory (NTI), compiled by the EPA, is the principal inventory of air toxics emissions used in the United States. It utilizes data developed by the states and the EPA for almost all of the 188 hazardous air pollutants listed in the 1990 Clean Air Act. It includes emissions from more than 900 stationary, area and mobile source categories in all states, Puerto Rico and the Virgin Islands. These emissions are published annually in EPA's Emissions Trends Report.

The Toxics Release Inventory, or TRI, provides an overview of toxic chemical pollution from larger manufacturing facilities in the United States. It does not cover smaller point or area sources, or mobile sources. The TRI reporting threshold for lead is 100 pounds. Collection methodologies for release data are not uniform under the TRI, nor does it indicate whether emissions occurred over the course of the year or were emitted in larger, intermittent bursts. TRI data cannot be used for either health effects or risk analyses.

The National Toxics Inventory suggests that the TRI alone represents less than half of the total emissions from point sources. The National Toxics Inventory uses Toxics Release Inventory reports along with toxic pollutant emissions data to supplement toxic emissions information.

The EPA compiles, on an annual basis, the National Emissions Trends (NET) inventory of criteria pollutants and pollutant precursors, and includes lead. The nation-wide inventory comprises data supplied by the states.

7.2 Lead in Products and Potential Exposure Issues

Lead in products can pose a potential source of occupational exposure and, if improperly disposed of, for example in landfills, of environmental contamination.

Some of the sources that the OECD lists as the most likely contributors to lead exposure in many countries have been largely addressed in North America; for example, as noted in this discussion paper, gasoline in leaded fuels used in motor vehicles. The same is true for many products that formerly contained lead, such as interior paints, solder used in canned goods and in water distribution systems, and lead shot and sinkers used in hunting and fishing activities. However, the continued existence of these sources—in particular, lead-based paint in older homes, and lead solder or lead pipes in older homes/communities—continues to present a domestic source of exposure. Sharing information on measures that exist to protect and inform consumers about lead exposure and best practices for safe removal, handling and disposal of lead from older homes could be a potential cooperative activity.

Examples of other possible opportunities to enhance knowledge of the potential harm that lead in products poses to human health and the environment, and opportunities with regard to risk reduction are noted below in this section.

7.2.1 Lead-acid Storage Batteries

Environmental concerns associated with lead-acid batteries have included occupational exposure during manufacture and recycling, and the potential for exposure of populations living in the vicinity of manufacturing or recycling facilities. Given that lead-acid batteries represent two-thirds of all lead usage in the western world, and consumption of such batteries accounts for the majority of the two percent per year increase in lead consumption in the western hemisphere, this product may merit special attention to determine if best practices are widely applied within North America with respect to handling, recycling and disposal, including in small and medium-sized enterprises.

7.2.2 Other Products

Other prominent uses of lead in products (as regards content and/or potential for exposure of people or the environment) could be explored, to determine whether risk reduction measures would be warranted and are feasible, or whether use reductions might apply. Examples include lead in information technology and telecommunication products and in exterior paints, and uses of exterior paints (such as for schools and daycare centers).

Information technology products known to contain lead include printed circuit boards used in PCs and computer monitors. Lead oxide used in the cathode ray tubes (CRTs) of computer monitors is of particular concern because it is in a soluble form. One study estimates that 1,356 tonnes of lead was contained in the PCs and monitors disposed of in 1999 in Canada and that, based on a prediction that 47,821 tonnes of PCs and monitors will be disposed of in 2005 and an assumption that the lead content will remain the same that year, the weight of lead that will be disposed of with this stream in 2005 will increase to 3,012 tonnes (Environment Canada 2000c).

7.2.3 Leaded Gasoline

Remaining uses of lead in gasoline formulations could be examined to determine if these uses should be reduced or phased out. Leaded gasoline (containing alkyl-lead) continues to be used in all three North American nations, predominantly in the general aviation (piston engine) industry, for safety reasons. It is also used in a variety of non-road gasoline formulations, including those for competition race vehicles, construction equipment, farm machinery, and marine vessels. Leaded gasoline used for aircraft and for non-road vehicles and engines, primarily farm equipment, is exempt from regulation in Canada and the United States.

The amount of leaded fuel (all of which is imported) used by competition vehicles in Canada has risen about 37 percent since 1998. However, use of leaded fuels for this purpose comprises a small percentage of the total gasoline consumption in Canada. Data collected by Environment Canada in 1997 from several sources indicated approximately one million liters of leaded racing fuel were imported into Canada in 2001. This compares to Canada's overall gasoline consumption (mostly unleaded) of 36 billion liters annually.

In the summer of 1997, Environment Canada carried out two monitoring programs that measure ambient air and soil concentrations of lead at the racetrack sites. Based on analysis of the data by Health Canada, which showed that the estimated lead intake for sensitive segments of the population (toddlers, adolescents and pregnant women) was less than 50 percent of the World Health Organization's (WHO) provisional tolerable weekly intake (PTWI) amount, Health Canada concluded that there was no increased risk from leaded racing fuels at that time. Accordingly, Environment Canada amended the Gasoline Regulations in March 1998, extending a previous exemption until 31 December 2002. The new amendments imposed more stringent record-keeping and reporting requirements (Environmental Canada 2002).

The US EPA notes that current overall production and use rates of alkyl-lead in gasoline in the United States, particularly for non-road motor vehicles, are difficult to determine, due to the fact that the US Department of Energy discontinued the tracking of leaded gasoline in 1990. Most of the available information on alkyl-lead use in gasoline is limited to older data on sales, imports, exports and throughput at bulk distribution plants (US EPA 1999).

The EPA TSCA Chemical Inventory Chemical Update System indicates that alkyl-lead was not manufactured domestically as of 1994. However, the US Department of Commerce Web site documents that, in 1998, the quantity of anti-knock preparations imported into the US was approximately 14.4 million pounds per year (based on TEL or TEL/TML mixtures), and the quantity exported was 7.07 million pounds per year (based on lead compounds). A draft US EPA report observes that it is therefore reasonable to assume most of the 7 million pound difference between imports and exports was used for the production of leaded gas (US EPA 1999).

7.3 Monitoring Levels in the Environment

Monitoring for lead in the environment is not currently done with consistency in North America and there are a number of significant gaps for which a trinational effort could provide focus. Examples of monitoring programs currently in place in North America include the following:

CANADA

The 1996 Assessment of the Aquatic Effects of Mining in Canada (Aquamin), undertaken to examine the effectiveness of Canada's Metal Mining Liquid Effluent regulations, notes that for lead and other contaminants no nationally consistent monitoring framework exists in Canada. The report observes that most monitoring programs assessed were adequate to identify changes, but not all were adequate to describe all changes quantitatively. As well, methods and study designs were noted to be inconsistent, the degree of quality assurance/quality control variable, although improved, and baseline studies not all adequate. A key recommendation of the report resulting from the assessment was that a cooperative national environmental protection framework be implemented inclusive of revisions to the legislation, site-specific requirements and environmental effects monitoring (Environment Canada 2002b). Canada monitors lead and other metals and toxic substances via its National Air Pollution Surveillance (NAPS) network, established in 1969. Monitoring of lead was initiated in 1984. The network is used to identify long-term air quality trends, provide basic data on human health effects and assess control compliance. The network operates more than 200 monitoring sites across the country, including rural sites.

As previously noted, Environment Canada in 1997 measured ambient air and soil concentrations of lead at the racetrack sites.

In Mexico, lead is measured in ambient air in the major metropolitan areas of Mexico, including Mexico City, Guadalajara, Monterrey, Toluca, Mexicali, Tijuana and Ciudad Juárez.

In the United States, environmental lead monitoring is undertaken via the following mechanisms:

- The Great Lakes Regional Air Toxic Emissions Inventory Project
- The CAA §112(m) Atmospheric Deposition to Great Lakes and Coastal Waters Program

7.4 Research Efforts

Research efforts on lead could be examined to determine if there are gaps or areas which might be further promoted, for example, as regards commercialization. Examples of research efforts underway in North America include the Great Lakes Regional Air Toxic Emissions Inventory Project, the CAA §112(m) Atmospheric Deposition to Great Lakes and Coastal Waters Program, the US EPA Cumulative Exposure Project (lead compounds), and the monitoring of children's blood lead levels in the National Health and Nutrition Examination Survey (NHANES) conducted by the Centers for Disease Control (CDC).

The US EPA maintains a database on body burdens of pesticides and persistent bioaccumulative toxics (PBTs), including lead. Studies already completed include the Total Exposure Assessment Methodology studies and the National Human Exposure Assessment Study (Nhexas). Online database application will be linked to the Environmental Information Management System (EIMS), managed by the Office of Research and Development's National Center of Environmental Assessment, where bibliographic information on all the studies (authors, years, key words and descriptors, abstracts, etc.) is to be permanently stored. The database will offer "one-stop shopping" for scientific data on lead and other substances.

The US EPA *Draft Report on Alkyl-Lead: Sources, Regulations and Options* observes that there is insufficient information to assess whether the remaining uses of leaded gasoline result in adverse environmental or health effects. Most notably, there is no information to determine whether there is increased risk of lead exposure to at-risk populations (especially children) living in the vicinity of race tracks or general aviation airports, spectators at racing events or air shows, and fuel handlers (aviation or racing crews).

The US automobile racing industry, via the National Association for Stock Car Racing (Nascar), is evaluating and testing the use of unleaded racing gasoline (e.g., in the Busch Grand Nationals series) and has indicated to the US EPA that it may be receptive to participating in a voluntary unleaded phase-in partnership/program. Specifically, representatives from Tosco Company, Nascar's "Fuel 76" supplier and partner have expressed interest in partnering with EPA to develop an unleaded fuel for Nascar use.

An industry group called the Coordinating Research Council (CRC) has formed a task force for the purpose of finding a no-lead gasoline substitute. Working cooperatively with the CRC, the FAA has initiated the Unleaded Fuels Research Program. Under this program, engine and fuel testing (e.g., engine performance, emissions, fuel consumption changes, etc.) at the FAA's small-engine and fuel test facilities began in 1994. Data from this testing will aid the FAA in replacement fuel certification for 100-octane low-lead gasoline, as well as in developing fuel specifications with the American Society of Testing and Materials. Currently, FAA has certified a new 85 percent ethanol-based fuel for use in at least one plane (EERC 1999). However, considering all of the testing that must be conducted (different conditions, different engine/airframe combinations, toxicity, etc.) as well as the approvals from FAA and the acceptance by the aviation industry, petroleum companies, and gasoline distributors that must be obtained, the time frame for widespread implementation of an unleaded high-octane aviation gasoline is projected to be 8–10 years.

A US EPA Great Lakes Binational Toxics Strategy report on alkyl-lead notes that "Other than aviation gasoline, very little data exist on current levels of leaded gasoline use. Since 1991, the Department of Energy (DOE) stopped tracking information on the production of leaded gasoline for non-aviation uses. Consequently, there is no readily accessible information on how much leaded gasoline is being produced for the continued, legal use of alkyl-lead in racing cars, off-road, non-road vehicles, etc. However, it may be possible to derive upper bound estimates for these uses from other available information (US EPA 2000)."

8.0 Capacity Building Opportunities

The SSTF notes that the following capacity building opportunities exist for trinational cooperative efforts:

1. Information exchange on best practices, including for waste handling and disposal at factories/recycling operations for recovered lead, smelter operations, and stockpiles, including defense stockpiles, and for remediation of contaminated sites (those that have received mine tailings, mining effluent, etc.).

2. Information sharing on results of research on human health effects, especially reproductive, genotoxic and neurobehavioral effects. Current exposure levels are still estimated to be several orders of magnitude above pre-historic background levels of lead experienced by early man and its ubiquity virtually precludes carrying out studies on health effects where "true" control (unexposed) values can be identified in humans or experimental animals.

3. Development/sharing of risk communications/outreach/stakeholder consultation strategies that identify target audiences at risk, and of outreach tools, especially taking into account medical professionals, women, children, the poor, those who are known to use lead in processes and factory workers/people living near smelters or known contaminated sites. This would include emphasis on exposure pathways and measures that can be taken by individuals to protect them, as well as fact sheets of government efforts to reduce risk to health/environment.

4. Best practices training sessions (capacity building), with specific sectors and focusing on environmental management systems, and regulatory and voluntary risk reduction options for domestic consideration.

5. Partnership exchanges/awareness raising, including promotion of partnerships/challenge programs as regards pollution prevention for products containing lead, such as use of less risky alternatives and take-back commitments/provisions for wastes (e.g., computer screens containing lead, and other electronics waste).

6. Product certification systems for North America, taking into account WTO obligations.

7. Capacity building/training on inventory source characterization.

8. Source characterization/inventories:

    - SMOC exercise to compare national inventories as a starting point to determine if gaps exist in major sources and whether these are currently being addressed (lead in specialty fuels, etc.); and
    - second-tier sources: strategy for identification/characterization of micro-industry/recycling operations, including timetable for development.

9. Monitoring and tracking lead in the environment:

    - assess current monitoring activities and their adequacy, the manner in which data is collected, and accessibility of data to the public;
    - determine if uniform assessment procedures for North America would be beneficial;
    - develop a strategy for determining levels in the environment/ambient monitoring in coordination with the steering committee for the environmental monitoring and assessment NARAP;
    - develop a strategy for biomonitoring (building on existing national and regional efforts, including the planned CEC blood-monitoring project as it moves toward implementation);
    - work with municipalities and/or appropriate jurisdictions regarding water supply to public places;
    - identify and determine significance of currently unidentified secondary sources of exposure for children, such as those related to the child's hygiene and food-related behaviors;

- identify North American lead "hotspots," determine their significance as regards exposure and, where warranted and feasible, mechanisms for funding remediation;
- include lead-acid battery production and recycling facilities in monitoring efforts;
- conduct information exchange on Pb-isotope tracking and laboratory analysis training; and
- cooperate in tracking cross-boundary movement of wastes containing lead.

10. Support for research on safer alternatives to lead in products, in particular, lead-acid batteries and electronic/electrical products.
11. Pilot projects: It may be of benefit to explore new models of partnership among the NAFTA partners and to assess overall capacity at the pre-regulatory development stages to ensure capacity exists to follow through with monitoring and/or, if applicable, inspection and enforcement.

    Examples might include the following:

    - Communicate risk with artisanal users of lead in the three nations.
    - Co-operate on regulation to facilitate (a) exchanges of information on respective regulatory policies and provide opportunities for collaboration (e.g., research projects) towards protecting public interests (health, the environment and security) with respect to the use of lead; (b) tri-lateral trade, thus increasing consumer choice and the government's fiscal opportunities; (c) the possibility to move towards more performance-based regulation such as the Canadian initiative with the United States regarding the Smart Border Action Plan. This would enable the three countries to move towards regulatory equivalency in the North American context.
    - Demonstrate the identification/reduction of risk through a US/Mexico border project.
    - Compare legislative provisions of the three countries to determine if judicial gaps exist.

12. In addition to the above, the following more specific activities could be undertaken as regards waste handling and storage and disposal of lead products:

    - Waste handling and storage practices and extent of remediation measures for mine tailings and mine effluent containing lead could be examined to determine whether they represent current best practices and to determine if improvements are warranted.
    - Selected landfill sites within each country could be monitored in conjunction with this effort to determine if improper disposal of lead products presents a significant source of environmental contamination and pathway of exposure to people living near landfill sites, and to determine the origin of the lead-based products found in the landfills.
    - Given the significance of current and emerging trade in products containing lead, both globally, and between Canada and the United States, there may be reason to further coordinate North American efforts for environmentally sound hazardous waste disposal and recycling of hazardous recyclables.
    - The mercury NARAP provides the rationale that mercury in products will one day be released into the environment, hence views recycling as an interim measure only. A CEC effort could determine whether the same concerns are applicable to recycling of products containing lead or recycling of lead.

- As an initial step, monitoring of occupational and environmental contamination at lead-acid battery manufacturing and recycling facilities (both larger facilities and small and medium-sized facilities) could be undertaken to determine whether this growth sector entails exposure concerns, either to workers, or to those living near such facilities, including children.
- A study could be undertaken to determine if manufacturing and recycling of lead-acid batteries, electronic lead-containing products, etc., occur primarily in larger facilities or in small and medium-sized enterprises within each country, as this could affect approaches to implementing best practices and policies applicable to the recycling industry, and as regards implications for occupational exposure and exposure of people living in the vicinity of such facilities.
- If it is not already documented, it could be useful to determine the significance of trade in lead-containing products between Mexico and Canada and Mexico and the United States as regards take-back provisions for wastes within North America and globally. The removal of lead-acid batteries for recovery from automobiles might present an exposure issue, in particular where such recovery is done from scrap yards by individuals without knowledge of proper exposure and storage issues.
- Policies for promoting extended producer responsibility as it applies to recycling and proper waste handling and disposal practices both within North America and abroad could be examined, should environmental and biomonitoring indicate risk of exposure is a concern.
- A single uniform "best practice" approach to waste handling could be explored, together with effective mechanisms for promoting industry stewardship and compliance in this area. Standards could be considered for handling, disposal and recycling of lead in discarded products (such as lead-acid batteries/electronic equipment), in particular with respect to the mining, electronic/electric, battery and chemicals sectors.
- Best practices regarding avoidance of and containment of spills and contamination of airports could be examined, given the use of lead additive fuels in the aviation industry.
- Mechanisms could be developed for tracking sales of lead-containing products, with the aim of preventing inappropriate uses or disposal practices of such products.

9.0 Recommendations to the Working Group on the Scope of the North American Regional Action Plan for Lead

Despite the many activities underway in all three countries to reduce the use and exposure to humans and biota to lead (described in preceding sections), the Substance Selection Task Force believes there are remaining problems that would benefit from a range of collective North American actions. To this effect, the SSTF makes the following preliminary recommendations regarding areas of activity in which Canada, Mexico and the United States could collaborate:

- Trinational efforts on lead should focus on vulnerable populations; monitoring, so as to establish baselines and gauge progress; and risk reduction and pollution prevention.
- As regards children's health, should the Parties undertake a longitudinal study that includes lead, they are urged to consider including looking at children, in terms of a cohort study.

- Monitoring efforts should focus initially, as priority areas, on point sources, trends in blood lead in the general population—determining how quickly blood levels decline once exposure to sources is addressed—and a contaminated-site inventory.
- Risk reduction/pollution prevention (P2) activities should emphasize information sharing and technology transfer (processes, alternatives, etc); product design; contamination site remediation; and risk communications (education to prevent exposure, such as how to identify lead in paint in older homes/renovation procedures).
- Risk reduction and pollution prevention activities should focus initially on batteries, information technology (IT) scrap, and lead-glazed pottery.
- Exchange of information on respective regulatory policies should be advanced. This could enable the three countries to move towards regulatory equivalency in the North American context.
- The three countries could compare and consider how to jointly develop information and strategies related to air emissions and long-range atmospheric transport of lead, taking into account existing initiatives.
- Industry and consumers of lead should be engaged in public participation at the national level to promote and facilitate public information, awareness, and educational outreach on lead issues as they pertain to reducing risk of exposure to humans and the environment.

10.0 Frameworks for Action Implementation

The Substance Selection Task Force will review suggestions from the public consultation process before considering whether it recommends to the North American Working Group on the Sound Management of Chemicals that a North American Regional Action Plan (NARAP) on lead be developed and what focus it suggests for the group charged with developing such action. Bearing in mind that the purpose of a NARAP is to add value to activities already underway on lead and that actions proposed within a NARAP should be aligned with existing domestic programs, the SSTF interpretation is that a NARAP offers considerable flexibility as to the range of issues that could be addressed and the mechanisms utilized to implement them. A NARAP could include a comprehensive list of actions; target actions in specific areas, such as inventories, trade and health; and/or advocate support for integration of recommendations within existing programs (CEC and other programs, as appropriate).

The SSTF strongly believes that any trinational cooperation on lead must take the full populations of the three countries into account, while also taking care to ensure that vulnerable populations are fully considered as activities are developed and implemented.

The SSTF recommends that any task force or advisory group formed to provide oversight or to craft the development of an action plan to implement any trinational activities undertaken on lead either include or consult with representatives of the healthcare community (with specific expertise on children and lead exposure), municipal associations, given that these often bear the burden of oversight as regards disposal activities, and industry (inclusive of the mining, electrical/electronic, and lead-acid battery recycling associations.) As well, consultation should be sought with any groups known to be particularly at risk from specific activities that warrant investigation. The SSTF recognizes that such consultation is consistent with current SMOC practices for NARAPs.

The SSTF believes that the SMOC initiative within the CEC is best suited to oversee trinational cooperative activity on lead, given the expertise of its members in their countries' actions, legislation and voluntary provisions pertaining to lead. This should include links to the various activities being planned as part of the environmental monitoring and assessment NARAP. The SSTF also suggests that all SMOC discussions on lead include the participation of a representative from each of the CEC initiatives on children's health and the environment, the PRTR, and various JPAC linkages.

The Substance Selection Task Force recommends to the North American Working Group on the Sound Management of Chemicals that trinational activities on lead pertaining to monitoring and research should be coordinated with the CEC Standing Committee created under the CEC's environmental monitoring and assessment NARAP.

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Appendix A: North American Regulatory and Voluntary Activities Pertaining to Lead

NOTE: *The following overview is not comprehensive. One activity that the three countries might undertake as a prelude in conjunction with other activities on lead is a comprehensive status report for each country on its lead accomplishments, administrative mechanisms and current activities. However, cooperative actions would not be contingent upon development of such reports, which, by their nature, would require periodic updating.*

CANADA

Canadian legislation, including the Canadian Environmental Protection Act (1999), the Food and Drugs Act, the Pest Control Products Act and the Hazardous Products Act, takes account of the potential effects of environmental impacts of toxic substances, including lead, on human health.

Lead is listed in the Schedule 1 List of Toxic Substances of Canada's Environmental Protection Act, 1999. In developing proposed regulations or instruments respecting preventive or control actions in relation to substances specified on the List of Toxic Substances in Schedule 1, the Ministers shall give priority to pollution prevention actions. The Minister of Environment may, at any time, publish in the *Canada Gazette* and in any other manner that the Minister considers appropriate a notice requiring any person or class of persons described in the notice to prepare and implement a pollution prevention plan in respect of a substance or group of Schedule 1 substances.

The National Office of Pollution Prevention is responsible under CEPA for the administration of regulations pertaining to secondary lead smelter release, gasoline and contaminated fuel, and persistence and bioaccumulation. As well, under the Canadian Fisheries Act, it administers regulations pertaining to metal mining effluent and liquid mining effluent.

In Canada, starting 1 January 1991, it became illegal, under the Gasoline Regulations of the Canadian Environmental Protection Act (CEPA) to sell, import or use gasoline that contained lead at a concentration greater than 5 mg/L.

Canada does not have national guidelines for occupational exposure to lead; the current allowable limits on blood lead are determined by each individual province. The allowable limit for occupational exposure varies from province to province; however, the average limit seems to be 50 µg/dL of blood lead. Some provinces, such as British Columbia, exceed this level (Lead Environmental Awareness and Detection).

Canada's Fisheries Act takes into account environmental effects of pollutants, including metals. Canada's Metal Mining Liquid Effluent Regulations (MMLER) were promulgated in 1977 as part of the Fisheries Act. These regulations were developed on the basis of effluent treatment technologies available at that time. MMLER regulates the maximum effluent concentrations of seven "detrimental" substances: As, Pb, Cu, Zn, Ni, 226Ra, and total suspended matter, as well as the acceptable pH range. The regulations apply to metal mines opening, re-opening or expanding since 1977. The regulations do not apply to older metal mines, or to gold mines using cyanide treatment of ore.

Included in Canada's Green Plan (1990) was a commitment by Environment Canada to re-examine MMLER. In 1992, Environment Canada sponsored a workshop to discuss the MMLER revision process, and to seek guidance on this process from representatives of all groups with a stake in mining and the environment. A key recommendation of participants in this workshop was that prior to revising MMLER, the effectiveness of the current regulations should be evaluated through an assessment of the impacts of mining on aquatic ecosystems in Canada. The workshop has led to the initiation of two separate but parallel initiatives: the Assessment of the Aquatic Effects of Mining in Canada (Aquamin); and the Aquatic Effects Technology Evaluation (AETE) Program.

The Hazardous Products Act contains a duty of care to protect children's health and has regulatory provisions for a few types of children's products, including toys, sleepwear, cribs and cradles, carriages, strollers, and pacifiers. The Food and Drugs Act contains zero tolerance for non-essential food additives, which includes lead, in infant formula.

The Pest Management Regulatory Agency (PMRA) has finalized a document on Children's Health Priorities that describes its approach to children's environmental health and risk assessments for pesticides (available at: <http://www.hc-sc.gc.ca/pmra-arla/eng-lish/pdf/spn/spn2002-01-e.pdf>).

Lead can be a contaminant in some pesticides. Additionally, the Government of Canada has recently tabled a new Pest Control Products Act. The new bill would require the special consideration of children's sensitivities, which are already being incorporated into PMRA's risk assessment processes.

MEXICO

Existing regulations, presented according to the agencies responsible for developing and implementing them, include the following:

Ministry of the Environment and Natural Resources (Semarnat)

- NOM-001-ECOL 1996. Establishing the maximum contaminant limits for wastewater discharges into national bodies of water and property.
- NOM-002-ECOL-1996. Establishing the maximum contaminant limits for wastewater discharges into urban or municipal sewer systems.
- NOM-052-ECOL-1993. Establishing the characteristics of hazardous waste, the list thereof and the thresholds above which a waste is considered hazardous due to its toxicity in the environment.
- NOM-086-ECOL-1994. Air pollution. Environmental protection specifications for liquid and gas fossil fuels used in fixed and mobile sources.

Ministry of Health (SSA)

- NOM-002-SSA1-1993. Environmental health. Goods and services. Metal packaging of food and beverages. Seam specifications. Public health requirements.
- NOM-003-SSA1-1993. Environmental health. Public health requirements on the labeling of paints, dyes, varnishes, lacquers, enamels and glazes.
- NOM-004-SSA1-1993. Environmental health. Public health limitations and requirements for the use of lead monoxide (litharge), red lead oxide (minium) and basic lead carbonate (ceruse).
- NOM-005-SSA1-1993. Environmental health. Lead chromate and lead chromate molybdate pigments. Extraction and determination of soluble lead. Analytical methods.
- NOM-006-SSA1-1993. Environmental health. Paints and varnishes. Preparation of acid extracts from dry paint layers for determination of soluble lead. Analytical methods.

- NOM-007-SSA1-1993. Environmental health. Safety of toys and school items. Metal bioavailability limits for items coated with paints and dyes. Specifications and analytical methods.
- NOM-008-SSA1-1993. Environmental health. Paints and varnishes. Preparation of acid extracts of liquid or powdered paints for determination of soluble lead and other methods.
- NOM-009-SSA1-1993. Environmental health. Glazed ceramics. Analytical methods for determination of soluble lead and cadmium.
- NOM-010-SSA1-1993. Environmental health. Glazed ceramic items. Soluble lead and cadmium limits.
- NOM-011- SSA1-1993. Environmental health. Soluble lead and cadmium limits in glazed pottery.
- NOM-026-SSA1-1993. Environmental health. Criteria for ambient air quality assessment with respect to lead (Pb). Standard value for lead concentration in ambient air as a public health protection measure.
- NOM-117-SSA1-1995. Goods and services. Analytical method for the determination of cadmium, arsenic, lead, tin, copper, iron, zinc and mercury in food, potable water and purified water by atomic absorption spectrometry.
- NOM-127-SSA1-1994. Environmental health. Water for human use and consumption. Quality limits and treatments required to render water potable.
- NOM-EM-004-SSA1-1999. Environmental health. Criteria for determination of blood lead levels. Actions to protect the health of the non-occupationally exposed population. Analytical methods.

Ministry of Labor and Social Welfare (STPS)

- NOM-010-STPS-1994. Respecting health and safety conditions in workplaces producing, storing or handling chemicals with a potential to cause contamination in the workplace environment.
- NOM-033-STPS-1993. Industrial health and safety. Workplace environment. Determination of lead and inorganic compounds of lead. Atomic absorption methods.

Ministry of Agriculture, Livestock Production and Rural Development (Sagarpa)

- NOM-010-ZOO-1994. Determination of copper, lead and cadmium in liver, muscle and kidney of bovines, equines, porcines, ovines and poultry by atomic absorption spectrometry.

In addition, Mexico’s Ministry of Environment and Natural Resources and the Ministry of Health have issued a joint declaration specific to lead, which includes agreement to eliminate unnecessary exposure to lead.

UNITED STATES

In the mid-1970s, lead was listed as a “criteria air pollutant” and a National Ambient Air Quality Standard was set for lead of 1.5 $\mu g/m^3$ (90-day average) (40 CFR 50.12).

Lead compounds are included in the CAA Title III list of hazardous air pollutants (HAPs). Facilities releasing HAPs will be subject to standards established under Section 112, including maximum achievable control technology standards (MACTs) (40CFR Part 61 and 63).

The Clean Air Act Amendments (CAAA) also contains requirements pertaining to the identification of sources of alkyl-lead. Section 112(c)(6) of CAAA specifically directs EPA to identify the sources of alkyl-lead that account for 90% of the aggregate emissions of alkyl-lead, by 1995, and to promulgate alkyl-lead standards, using MACT standards, by 2000. In response, EPA refined emission inventories of known sources of each pollutant and added two source categories to the previous 1990 inventory, on 3 April 1998: 1) open burning of scrap tires, and 2) gasoline distribution Stage I aviation (including evaporative losses associated with the distribution and storage of aviation gas containing lead).

The Clean Water Act (CWA) prohibits any person from discharging a pollutant from a point source into navigable waters without a National Pollutant Discharge Elimination System (NPDES) permit (33 USC sec. 1342, 40CFR 122). Under the CWA, lead and lead compounds are listed priority pollutants (40CFR 423). As a result, many facilities are subject to lead effluent limits or monitoring requirements under their NPDES permits.

Lead-containing substances are classified as hazardous wastes under the Resource Conservation and Recovery Act (RCRA), Subtitle C (40CFR 261.33). As such, lead-containing wastes are subject to hazardous waste regulations (40CFR 302.4) and groundwater-monitoring requirements (40CFR 264). RCRA also establishes universal treatment standards for lead and lead compound levels in wastes (40CFR 268.48).

Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA) also requires that releases of lead and lead compounds to air, water or land be reported to the Toxic Releases Inventory (TRI) by manufacturing facilities (SIC codes 20–39, plus other specific facilities), that have 10 or more full-time employees, and manufacture/process 25,000 lbs. of a listed chemical, or otherwise use 10,000 pounds of a listed chemical (40CFR 372.65).

Section 103(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that any spills/releases of tetraethyl lead in quantities exceeding 10 lbs. must be reported immediately to the National Response Center (40CFR 302.4).

The 1990 CAAA also contains language specific to emissions of lead compounds resulting from the use of leaded gasoline. In particular, Section 213 of the 1990 CAAA requires US EPA to consider regulating emissions from non-road vehicles (construction equipment, boats, farm equipment, lawn equipment, etc.).

US regulations and programs targeting lead emissions and releases (including alkyl-lead compounds) are summarized in the table below:

Table 1. US regulations and programs targeting lead emissions

	CAA / CAAA	CWA	SDWA	RCRA	SARA / EPCRA*	CERCLA
Current Standards and Regulations	§109: NAAQS is 1.5 µg/m³ (lead) §112(b): Designated a HAP; major source categories identified under §112(c)(6); MACT standards to be promulgated §220: Use of gasoline containing > 0.05 grams of lead per gallon in on-road vehicles prohibited (Leaded gasoline is still permitted in non-road vehicles) §211(g): Prohibits misfueling of vehicles built after 1990 designed for unleaded gasoline	CWA Priority: Lead and lead compounds are listed priority pollutants (40CFR 423); subject to NPDES effluent limitations under §304(b) (40CFR 122) and general pretreatment (40CFR 403)	NPDWR: Action level is 0.15 mg/L lead (treatment technique) MCL goal is zero	Subtitle C: Lead-containing substances are (T) classified hazardous wastes based on toxicity characteristic (40CFR 261.33); subject to hazardous waste regulations (40CFR 302.4) and groundwater monitoring requirements (40CFR 264) Universal treatment standards for lead and lead compound levels in waste (40CFR 268.48)	§313: Releases of lead and lead compounds (by facilities with 10 or more employees and that process 25,000 lbs., or otherwise use 10,000 lbs.) must be reported to TRI (40CFR 372.65)	§103: Spills of tetraethyl lead > 10 lbs. must be reported to the National Response Center

Policy and Programs	- Binational Toxics Strategy Level 1 substance - International Joint Commission (IJC) Critical Pollutant - Tier I chemical under the Canada-Ontario Agreement - Recognized pollutant in Lake Superior Lakewide Management Plan (LaMP) - Targeted chemical in the Great Lakes Regional Air Toxic Emissions Inventory Project - Included in the US EPA Cumulative Exposure Project (lead compounds) - Included in CAA §112(m) program, Atmospheric Deposition to Great Lakes and Coastal Waters - Children's blood lead levels monitored in NHANES

*EPCRA: Emergengy Planning Committee and Right-to-know Act.
Source: US EPA, PBT National Action Plan for Alkyl-lead, June 2002.

US regulations controlling use of lead

In the early 1970s, the US EPA issued two regulations under the statutory authority of the CAA (1970). First, EPA required major gasoline retailers to begin selling one grade of unleaded gasoline by 1 July 1974. This mandate was primarily focused on preventing the deterioration, as a result of leaded gasoline, of emissions control systems (e.g., catalytic converters) in motor vehicles so equipped. In developing these regulations, EPA first established the working definition of "unleaded" gasoline as "gasoline containing not more than 0.05 gram of lead per gallon and not more than 0.005 gram of phosphorus per gallon" (38FR1255, 10 January 1973). Second, EPA issued a regulation calling for the gradual phase-out of leaded gasoline. The schedule for reduction of lead content in automobile gasoline was 1.7 grams per gallon (g/gal) in 1975, to 1.4 g/gal in 1976, 1.0 g/gal in 1977, 0.8 g/gal in 1978, and 0.5 g/gal in 1979 (38FR33741, 6 December 1973). Subsequent regulations reduced the allowable lead content to 0.1 g/gal in 1986 (50FR9397, 7 March 1985), and prohibited leaded gas use after 1995 (61FR3837, 2 February 1996).

Most recently, alkylated lead compounds have been regulated under the 1990 Clean Air Act Amendments (CAAA). Section 220 of the CAAA specifically targets the use of leaded gasoline for on-road vehicles, calling for a complete prohibition on the use of leaded gasoline in on-road vehicles after 31 December 1995. However, as outlined below, the 1990 CAAA specifically exempts fuels for racecars or "competition use vehicles." Also, although Section 213 of the 1990 CAAA requires EPA to consider regulating emissions from non-road vehicles (construction equipment, marine vessels, farm machinery, lawn equipment, recreational vehicles, etc.), these vehicles are currently permitted to use leaded gasoline. The following components of the 1990 CAAA relate to the use of alkyl-lead in gasoline:

<u>Prohibition on the Use of Leaded Gasoline in On-Road Vehicles</u>. Section 211(n) of the 1990 CAAA states: "After December 31, 1995, it shall be unlawful for any person to sell, offer for sale, supply, offer for supply, dispense, transport, or introduce into commerce, for use as fuel in any motor vehicle (as defined in Section 219(2)) any gasoline which contains lead or lead additives." This provision applies only to on-road vehicles. Enacting regulations were promulgated (61FR3837, 2 February 1996).

<u>Misfueling with Leaded Gasoline</u>. Section 211(g) of the 1990 CAAA prohibits misfueling vehicles built after 1990 (or vehicles designated solely for unleaded gasoline) with leaded gasoline.

<u>Prohibition on Production of Engines Requiring Leaded Gasoline</u>. Section 218 of the 1990 CAAA requires US EPA to promulgate rules that prohibit the "manufacture, sale, or introduction into commerce of any engine that requires leaded gasoline." Further, these rules apply to all motor vehicle engines and non-road engines manufactured after the 1992 model year.

Thus, the sale or use of gasoline containing alkyl-lead (greater than 0.05 grams of lead per gallon) is now prohibited in on-road vehicles (40CFR Part 80.22).

US regulations governing emissions, releases and spills

The 1990 CAAA also contains language specific to emissions of lead compounds resulting from the use of leaded gasoline. In particular, Section 213 of the 1990 CAAA requires US EPA to consider regulating emissions from non-road vehicles (construction equipment, boats, farm equipment, lawn equipment, etc.). Currently, these vehicles are permitted to use leaded gasoline, but may be regulated in the future.

US regulations pertaining to drinking water

In 1991, through the National Primary Drinking Water Regulations for Lead and Copper (56 FR 26460), the US EPA set an action level of 15 parts per billion (ppb) for lead content in drinking water and a maximum contaminant level goal of 0 ppb at the tap.

The US has lowered the reporting threshold under the Toxic Substances Release Inventory for the release of lead and lead compounds into the environment through US EPA's issuance of a final TRI lead rule on 17 January 2001. Facilities that manufacture, process, or otherwise use more than the 100 pounds of lead or lead compounds established as the reporting threshold under the rule must submit a TRI form. The rule is expected to significantly expand the information available to the public about lead emissions in their communities. The first report submissions under the new rule for the 2001 reporting year were to be submitted by 1 July 2002.

The US is currently implementing the recommendations of the federal Strategy to Eliminate Childhood Lead Poisoning by 2010, developed under the President's Task Force on Environmental Health Risks and Safety Risks to Children. The recommendations include the following: acting before children are poisoned by preventing residential lead paint hazards; improving early intervention by expanding blood lead screening and follow-up services for at-risk children; conducting research that promotes innovation to drive down lead hazard control costs and quantify ways in which children are exposed to lead to improve prevention strategies; and measuring progress.

The Identification of Dangerous Levels of Lead Rule sets standards for soil and dust that trigger US compliance activity. The program includes compliance assistance, monitoring, and enforcement effort, as well as community outreach and educational materials to inform parents and community centers about the dangers of lead, especially exposure from lead-based paint.

During 2000, US Government agencies issued several proposed and final rules on matters affecting the lead industry. The rules included issuance of new standards for identifying lead in paint, dust and soil, issuance of new motor vehicle standards to address battery safety in electric vehicles (EVs), revision of regulations for hunting and sport fishing in the National Wildlife Refuge System, and approval of new, nontoxic forms of ammunition for hunting water fowl. In addition, the availability of transition assistance was announced, with regard to implementation of the new requirements for notification, evaluation, and reduction of lead-based paint hazards in federally owned residential property and housing receiving federal assistance. A notice of funding availability also was announced in which proposals from Indian Tribes were solicited to conduct blood-lead screening tests on tribal
Children (USGS, 2000).

State legislation

In April 2000, the State of Massachusetts began enforcing a ban on the disposal of cathode ray tubes (CRTs) at landfills, transfer stations, and incinerators. The action was taken by the state's Department of Environmental Protection as a measure to prepare for the projected significant increase in the level of CRT disposals in unwanted older televisions and computer monitors. Lead is used in CRTs to protect consumers from exposure to harmful radiation; it is present in CRTs at a level of about 2kg to 4 kg. Environmental officials in Massachusetts are hopeful that the ban on discarding CRTs will prompt a strong interest in reuse and recycling of CRT components (American Metal Market, 2000b in USGS 2000).

Voluntary US activities and programs

While government regulatory action has contributed significantly toward reducing lead exposures to the US population over the last 20–30 years, voluntary actions taken in the private sector have also contributed to reduced lead exposures. Some actions by the private sector have already been discussed, such as the voluntary decline of lead content in paint that occurred in the 1950s and the manufacture of vehicles that did not require lead additives in gasoline. Voluntary actions also reduced the percentage of food cans containing lead solder, from over 90 percent in 1979 to less than 5 percent in 1990 (Adams 1991), leading to the FDA's 1995 ban on lead solder in food containers. Over the same period, foods imported into the US in lead-soldered containers have also been dramatically reduced. The private sector has also voluntarily ended the practice of using lead solder in copper water pipes in new homes.

The Centers for Disease Control and EPA have worked in partnership with other countries to conduct blood lead level surveys and promote the phase-out of lead from gasoline.

Appendix B: Inventory Information on Lead

Table 2. Total releases for lead and its compounds, by industry sector, 2000 matched data set

US SIC Code	Industry	Total Releases On- and Off-site		
		North America tonnes	NPRI tonnes	TRI tonnes
12	Coal Mining	162	0	162
22	Textile Mill Products	10	0	10
24	Lumber and Wood Products	2	0	2
25	Furniture and Fixtures	12	0	12
26	Paper Products	55	0	55
27	Printing and Publishing	0	0	0
28	Chemicals	3,887	2,675	1,212
29	Petroleum and Coal Products	22	2	20
30	Rubber and Plastics Products	106	44	62
31	Leather Products	0	0	0
32	Stone/Clay/Glass Products	1,205	3	1,202
33	Primary Metals	18,023	1,839	16,184
34	Fabricated Metals Products	460	3	457
35	Industrial Machinery	17	2	16
36	Electronic/Electrical Equipment	5,317	28	5,290
37	Transportation Equipment	105	5	99
38	Measurement/Photographic Instruments	2	0	2
39	Misc. Manufacturing Industries	38	36	2
491/493	Electric Utilities	3,353	157	3,196
5169	Chemical Wholesalers	0	0	0
495/738	Hazardous Waste Mgt./Solvent Recovery	11,839	374	11,465
--	Multiple codes 20-39*	598	0	598
	Total	45,214	5,168	40,046

Note: Canada and US data only. Mexico data not available for 2000. Data are from industrial/commercial sources meeting the reporting threshold for NPRI and TRI. Data do not reflect all sources and all releases of lead. The data reflect estimates of releases and transfers of chemicals, not exposures of the public to those chemicals. The data, in combination with other information, can be used as a starting point in evaluating exposures that may result from releases and other management activities that involve these chemicals.

* Multiple codes reported only in TRI.

Source: Commission for Environmental Cooperation. *Taking Stock*. 2002.

Table 3. Summary of total releases of lead and its compounds, 1995–2000 matched data set

	North America							
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**Change 1995–2000**	
	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(percent)
*Total On-site Releases**	*9,440*	*9,131*	*10,705*	*10,758*	*11,742*	*10,171*	*731*	*8*
Air	1,384	1,322	1,110	1,039	964	988	-397	-29
Surface Water	48	35	29	36	26	28	-19	-41
Underground Injection	83	303	120	82	83	98	14	17
Land	7,919	7,465	9,441	9,597	10,665	9,054	1,135	14
Off-site Releases (Transfers to Disposal)	*14,034*	*14,468*	*20,932*	*18,825*	*16,318*	*19,722*	*5,688*	*41*
Total Releases On- and Off-site	**23,474**	**23,599**	**31,637**	**29,582**	**28,060**	**29,893**	**6,419**	**27**
	Canadian NPRI							
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**Change 1995–2000**	
	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(percent)
*On-site Releases**	*1,346*	*1,393*	*1,251*	*1,225*	*3,250*	*3,494*	*2,148*	*160*
Air	526	561	547	514	443	467	-58	-11
Surface Water	19	6	5	12	8	5	-13	-72
Underground Injection	0	0	0	0	0	0	0	-93
Land	796	821	694	694	2,795	3,018	2,222	279
Off-site Releases (Transfers to Disposal)	*2,019*	*2,265*	*2,917*	*2,136*	*1,371*	*1,177*	*-842*	*-42*
Total Releases On- and Off-site	**3,364**	**3,658**	**4,168**	**3,362**	**4,620**	**4,670**	**1,306**	**39**
	United States TRI							
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**Change 1995–2000**	
	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(percent)
*On-site Releases**	*8,094*	*7,738*	*9,454*	*9,532*	*8,492*	*6,677*	*-1,417*	*-18*
Air	859	761	563	525	522	520	-338	-39
Surface Water	29	29	23	23	18	23	-6	-21
Underground Injection	83	303	120	82	83	98	14	17
Land	7,123	6,645	8,747	8,903	7,870	6,036	-1,087	-15
Off-site Releases (Transfers to Disposal)	*12,015*	*12,202*	*18,014*	*16,688*	*14,947*	*18,546*	*6,530*	*54*
Total Releases On- and Off-site	**20,110**	**19,940**	**27,468**	**26,221**	**23,439**	**25,223**	**5,113**	**25**

Note: Canada and US data only. Mexico data not available for 1995–2000. Data include chemicals common to both NPRI and TRI lists from selected industrial and other sources. The data reflect estimates of releases and transfers of chemicals, not exposures of the public to those chemicals. The data, in combination with other information, can be used as a starting point in evaluating exposures that may result from releases and other management activities which involve these chemicals.

* The sum of air, surface water, underground injection and land releases in NPRI does not equal the total on-site releases because in NPRI on-site releases of less than 1 tonne may be reported as an aggregate amount.

Source: Commission for Environmental Cooperation. *Taking Stock*. 2002.

CANADA

Canada is a major world producer and supplier of lead, ranking fifth in mine production after Australia, China, the United States and Peru (Chevalier 2001).

Lead in Canada is produced primarily as a co-product of zinc and silver. About 70 percent of the lead produced from Canadian mines is exported to other countries in concentrated or refined form. Nearly 90 percent of Canadian exports of refined lead go to the United States.

Atmospheric lead emission estimates in Canada for 1990 and reported in the *State of Canada's Environment* of 1996 were dominated by the primary base metal industry, at 920 tonnes. This sector in 1990 was followed by the secondary iron and steel industry, the secondary nonferrous lead sector, incineration, the chemical sector, the cement industry, the glass industry, coal-fired power plants, the transportation sector, fossil fuel combustion and secondary nonferrous zinc and ferrous foundries. Emissions in tonnes for these sectors are summarized in the table below.

Table 4. Atmospheric lead emissions in Canada, 1990

Source	Lead emissions (tonnes)
Primary base metal industry	920
Secondary iron and steel	56.19
Secondary nonferrous lead	15
Incineration	12.22
Chemical industry	8.6
Cement industry	8.51
Glass industry	7.77
Coal-fired power plants	3.92
Transportation	3.7
Fossil fuel combustion	3.07
Secondary nonferrous zinc	3.00
Ferrous foundries	2.65
Primary iron and steel	1.75
Ferrous alloys	.69
Base metal mining, milling, concentration and drying	.52

Source: Environment Canada. 1996.

MEXICO

In Mexico, the world's sixth leading producer of lead in 1998**,** the most lead-intensive activities, hence those with the greatest polluting potential, are metallurgy and chemical manufacturing (Semarnat-INE 2001).

Significant sources of air emissions include primary and secondary smelters. There are an estimated 480 such smelters, of which eight are lead smelters. Smelting of ore and slag also contribute to lead emissions (Semarnat-INE 2001).

Industrial uses include many metalwork processes in the electronics and computer hardware industry, while, as noted below, lead acid batteries account for the largest input of lead.

Both occupational exposure and exposure of the neighboring populations are a concern as regards smelters and industrial sources.

UNITED STATES

In the United States, as of 1997, principal emissions of lead were the following:

- metals processing, 52%;
- waste disposal and recycling, 17%;
- non-road engines and vehicles, 13%;
- fuel combustion (other), 11%;
- chemical and allied product manufacturing, 4%; and
- all other, 3%.

This corresponds to a total of 3,915 short tons of lead released from all sources, compared to 7,053 short tons in 1988, and 220,869 short tons in 1970. These values are based partly upon emission factor calculations (US EPA 1996, 1997),

Lead concentrations in 1998 were highest in the vicinity of stationary sources such as ferrous and nonferrous smelters and battery manufacturing plants. Such concentrations can result in considerable exposures to humans residing close enough to them (Nomination dossier 1998). Approximately 230,000 children have been estimated to reside near enough to a smelter to result in significant lead exposure (ATSDR 1988).

As of 1999, major sources of airborne lead emissions of alkyl lead in the United States included bulk production plants for aviation gasoline, non-road vehicles, waste incinerators, metal processing facilities, and other fuel combustion facilities (e.g., electrical utility, industrial) (US EPA 1999).

Table 5. Emission sources of alkyl lead by source category for 1995 and 1996 in the United States

US 1995 and 1996 National Alkyl Lead Emissions by Source Category:	Emissions (short tons)	
	1995	1996
Metals	**2,067**	**2,000**
• Primary lead production	674	636
• Secondary lead production	432	400
• Gray iron production	366	339
• All other	595	625
Fuel combustion other	**414**	**414**
Chemical and allied products (lead oxide and pigments)	**144**	**117**
On-road	**19**	**19**
Non-road	**545**	**545**
• Non-road gasoline	0	0
• Aircraft	545	545
All other	**754**	**774**
Total	**3,943**	**3,869**

Source: US EPA Binational Toxics Strategy *Draft Report on Alkyl-Lead: Sources, Regulations and Options*, as reproduced there from Table 2-1 in the *National Air Pollutant Emission Trends Report, 1900–1996*, EPA 1997.

The US EPA notes that Section 112 (c)(6) of the CAA requires emissions inventories from oil refineries, but gross estimates used did not provide a clear picture of the production and release quantities.

Appendix C: Trade Information on Lead

Of the 42 countries in which lead was mined in 2000, the top five accounted for 70% of the world's total production of 3.1 Mt. Australia was the largest producer, with 23% of the world total, followed by China, 18%; the United States, 15%; Peru, 9%; and Mexico, 5% (USGS 2000).

Worldwide reserves of lead contained in demonstrated resources from producing and non-producing deposits at year-end were estimated by the US Geological Survey (USGS) to be 64 Mt. Reserves for the three largest producers in the world, Australia, the United States and China, were about 15 Mt, 6.5 Mt, and 9 Mt, respectively. The reserve bases (reserves plus measured and indicated resources that are marginally economic and some of those that are currently sub-economic) for Australia and China were 28 Mt and 30 Mt, respectively. The reserve base for the United States was 20 Mt. The total world reserve base at the end of 1999 was estimated to be 130 Mt. The USGS estimates of the amount of lead in undiscovered mineral deposits in 2000 ranged from greater than 47 Mt (90% probability) to greater than 130 Mt (10% probability). The mean estimate of lead in undiscovered deposits was 85 Mt, with nearly one-half thought to be contained in undiscovered sedimentary exhalative deposits. Other major lead deposit types considered in the report were Mississippi Valley and polymetallic replacement deposits. Identified US lead resources were estimated to be 51 Mt. Coupled with an estimated past lead production of 41 Mt, the total discovered lead resource in the United States was estimated to be 92 Mt. (USGS 2000).

Table 6. Lead: World mine production of lead in concentrates, by country (metric tons)

Country	**1996**	**1997**	**1998**	**1999**	**2000 e/**
Algeria	1,016	845 r/	3,467 r/	5,801 r/	6,215 3/
Argentina	11,272	13,760	15,004	14,256 r/	15,000
Australia	522,000	531,000	618,000	681,000	699,000
Bolivia	16,538	18,608	13,848	10,153 r/	10,100
Bosnia and Herzegovina e/	200	200	200	200	200
Brazil	13,157	14,258	12,394 r/	16,319 r/	16,400
Bulgaria	28,000	32,000	25,000	18,000	15,000
Burma e/	2,200	1,900	2,200	2,000	2,000
Canada	**257,253**	**186,234**	**189,752**	**155,369 r/**	**143,049 p/ 3/**
Chile	1,374	1,264	337	170	180
China e/	643,000	712,000	580,000	549,000 r/	570,000
Colombia e/	300	300	300	300	300
Ecuador e/	200	200	200	200	200
Georgia e/	200	200	200	200	200
Greece	8,400	19,300	18,000 e/	16,000 e/	14,000
Honduras	4,700	5,900	4,329	5,226	5,100 p/
India	35,000	32,000	39,300	32,100 r/	28,900
Iran e/ 4/	15,700	18,200 3/	11,000 r/	11,000 r/	15,000
Ireland	45,344	45,149	46,000 e/	45,000 e/	58,600
Italy	11,100	11,792	6,800 e/	6,000 e/	2,000
Japan	7,753	5,227	6,198	6,074	8,835 3/
Kazakhstan e/	35,000	31,000	30,000 3/	34,100	40,000
Kenya e/	5	5	--	--	--
Korea, North e/	80,000	75,000	70,000	70,000	70,000
Korea, Republic of	5,131	3,632	3,558 r/	1,822 r/	1,500
Macedonia	27,000	28,000	26,000	26,000 e/	25,000
Mexico	**173,831**	**174,661**	**166,060**	**125,656 r/**	**156,000**
Morocco	71,667	77,056	79,300 r/	79,798 r/	79,800
Namibia	15,349	13,577	13,568 r/	9,361 r/	12,900
Norway e/	2,083 3/	2,000	-- r/	--	--
Peru	248,787	258,188	259,710	271,782 r/	270,576 p/ 3/
Poland	58,700	55,000	60,000	61,000	60,000
Romania	18,712	17,000	15,000	20,484	20,000
Russia	23,000	16,000	13,000	13,000	13,300
Serbia and Montenegro	10,000	11,000	12,000 e/	3,200 r/ e/	9,000
South Africa	88,613	83,114	84,128	80,191	75,262 3/
Spain	23,826	23,900	18,800	15,000 r/ e/	51,000
Sweden	98,800	108,600	114,430	116,300 r/	108,000 3/
Tajikistan e/	800	800	800	800	800
Thailand	21,000	5,400 r/	6,700 r/	11,900 r/	12,000 3/
Tunisia	4,764	1,424	4,274	6,599 r/	6,602 3/
Turkey	10,971	13,113	13,500 e/	12,000 e/	12,000
United Kingdom e/	1,800	1,800	1,600	1,000	1,000
United States	**436,000**	**459,000**	**493,000**	**520,000**	**468,000 3/**
Uzbekistan e/	10,000	-- 5/	-- 5/	-- 5/	-- 5/
Total	3,090,000	3,110,000	3,080,000	3,050,000 r/	3,100,000

e/ Estimated. r/ Revised.
p/ Preliminary. -- Zero.
1/ World totals, US data, and estimated data are rounded to no more than three significant digits; may not add to totals shown
2/ In addition to the countries listed, lead is also produced in Nigeria, but information is inadequate to estimate output. Table includes data available through 29 June 2001.
3/ Reported figure.
4/ Year beginning 21 March of that stated.
5/ Mining operations appear to have been sharply curtailed or to have ceased.

Source: USGS 2000

Table 7. Western world recovery of recycled [1] lead, 1997–2001

	1997	1998	1999	2000	2001 (p)
			(000 t)		
EUROPE					
Austria	22	23	24	23	22
Belgium	27	33	77	107	100
France	159	158	150	137	132
Germany	198	192	192	216	218
Ireland	12	13	11	9	10
Italy	146	142	148	163	164
Netherlands	19	17	18	21	20
Spain	90	94	98	120	122
Sweden	43	48	44	47	44
United Kingdom	189	184	183	182	183
Other Europe	42	39	40	36	34
Total Europe	947	943	985	1 061	1 049
AFRICA					
Algeria	7	6	6	6	6
Morocco	4	4	4	2	2
South Africa	43	50	52	46	49
Other Africa	9	9	7	6	5
Total Africa	63	69	69	60	62
AMERICAS					
Brazil	53	48	52	50	47
Canada	132	136	118	125	104
Mexico	80	87	91	79	80
United States	1 089	1 099	1 097	1 130	1 098
Other Americas	65	68	60	59	54
Total Americas	1 419	1 438	1 418	1 443	1 383
ASIA					
India	17	17	19	25	19
Indonesia	30	22	18	18	18
Iran	28	26	28	28	28
Japan	154	158	168	182	175
Malaysia	36	29	33	32	38
South Korea	61	47	50	50	50
Taiwan	36	39	45	42	40
Thailand	15	19	23	24	28
Other Asia	70	69	69	70	76
Total Asia	447	426	453	471	472
OCEANIA					
Australia	25	28	32	34	34
New Zealand	6	6	6	5	5
Total Oceania	31	34	37	38	39
Total Western World	2 907	2 910	2 963	3 073	3 005

Sources: Natural Resources Canada; International Lead and Zinc Study Group.
(p) Preliminary.
(1) Refined lead and lead alloys (lead content) produced from scraps, wastes and residues.

Source: Canadian Minerals Yearbook. 2001. Chevalier, P. "Lead," pp 29.1–29.17.

CANADA

Canada ranked fifth in the world in mine production of lead in 2001. Significant events in Canada in 2001 included the closure of the Sullivan mine in December and the announcements of closures in 2002 of the Nanisivik and Polaris mines in Nunavut. Together the closure of these three mines will leave the Brunswick mine in New Brunswick as the sole major producer of lead concentrates in Canada.

As of 1999, Canada's base metals smelting industry consisted of 15 plants, of which two are secondary lead smelters. Five smelters are located in each of Ontario and Quebec. Two facilities are located in Manitoba. British Columbia, Alberta, and New Brunswick each have one facility. In 1995, these 15 smelters produced approximately 1.69 million tons of copper, lead, nickel and zinc, and contributed approximately $2 billion in sales to the Canadian economy.

Table 8. Canada, lead production and trade, 2000 and 2001, and use, 1999 and 2000

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS (1)					
	New Brunswick	64 490	43 466	79 998	57 999
	British Columbia	46 930	31 631	36 688	26 599
	Nunavut	31 883	21 489	32 743	23 738
	Total	143 303	96 586	149 429	108 336
	Mine output (2)	148 769	. .	157 127	. .
	Refined production				
	Primary	159 192	. .	125 185	. .
	Recycled	125 141	. .	101 637	. .
	Total	284 333	. .	226 822	. .
EXPORTS					
2603.00.20	Lead content of copper ores and concentrates	1 000	269	–	–
2607.00	Lead ores and concentrates				
	Sweden	23 786	17 224	23 384	16 597
	Germany	10 196	7 480	10 600	7 860
	China	3 691	1 141	15 049	7 575
	Belgium	–	–	4 792	2 454
	Italy	–	–	4 368	2 320
	Total	37 673	25 845	58 193	36 806
2607.00.20	Lead content of lead ores and concentrates	37 673	25 845	58 163	32 809
2608.00.20	Lead content of zinc ores and concentrates	12 227	3 761	10 929	3 458
2616.10.20	Lead content of silver ores and concentrates	–	–	–	–
7801.10	Unwrought lead				
	Refined lead				
	United States	146 223	122 216	123 586	104 485
	Italy	–	–	1 604	1 120
	Japan	199	266	116	166
	Malaysia	–	–	71	61
	Other countries	722	503	–	–
	Total	147 144	122 985	125 377	105 832
7801.91	Lead, unwrought, containing by weight antimony as the principal other element	19 717	18 901	18 225	18 234
7801.99	Lead, unwrought, n.e.s.	59 371	50 999	28 775	26 603
7802.00	Lead waste and scrap				
	United States	4 016	1 320	1 632	729
	Other countries	31	39	–	–
	Total	4 047	1 359	1 632	729
7803.00	Lead bars, rods, profiles and wire				
	United States	485	1 398	308	490
	Other countries	1	1	–	–
	Total	486	1 399	308	490
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	47	117	–	–

Table 8. Continued

Item No.		2000	2001 (p)

		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7804.19	Lead plates, sheet, strip and foil, n.e.s.	745	1 156	877	1 199
7804.20	Lead powders and flakes	6	61	89	113
7805.00	Lead tubes, pipes, and tube or pipe fittings (i.e., couplings, elbows, sleeves)	18	152	8	28
7806.00	Other articles of lead				
	United States	. .	4 752	. .	5 876
	Other countries	. .	21	. .	48
	Total	. .	4 773	. .	5 924
	Total exports	. .	257 622	. .	232 225
IMPORTS (3)					
2603.00.00.20	Lead content of copper ores and concentrates	. . .	. . .	–	–
2607.00	Lead ores and concentrates				
	United States	14 318	21 457	23 477	58 579
	Peru	26 786	43 103	28 374	39 120
	Chile	10	3 131	3 079	3 859
	Honduras	3 269	3 923	16	2 793
	Morocco	9	2 712	1 579	2 273
	Brazil	5	771	13	1 776
	Other countries	6 181	7 825	1 286	2 449
	Total	50 578	82 922	57 824	110 849
2607.00.00.20	Lead content of lead ores and concentrates	47 300	56 373	52 652	63 520
2608.00.00.20	Lead content of zinc ores and concentrates	380	529	2 376	2 153
2616.10.00.20	Lead content of silver ores and concentrates	4 359	2 113	3 186	1 767
7801.10.10	Unwrought lead Refined lead, pig and block	4 747	4 370	975	834
7801.10.90	Refined lead, other	179	206	2 349	6 762
7801.91	Lead, unwrought, containing by weight antimony as the principal other element	4 177	4 241	205	236
7801.99	Lead, unwrought, other	8 431	38 157	495	1 770
7802.00	Lead waste and scrap				
	United States	65 354	14 241	54 956	11 882
	Other countries	54	40	221	102
	Total	65 408	14 281	55 177	11 984
7803.00	Lead bars, rods, profiles and wire				
	United States	1 535	2 104	842	1 354
	Other countries	11	20	275	498
	Total	1 546	2 124	1 117	1 852
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	311	387	396	429
7804.19	Lead plates, sheet, strip and foil, n.e.s.	152	230	201	294
7804.20	Lead powders and flakes	93	169	71	136

DRAFT

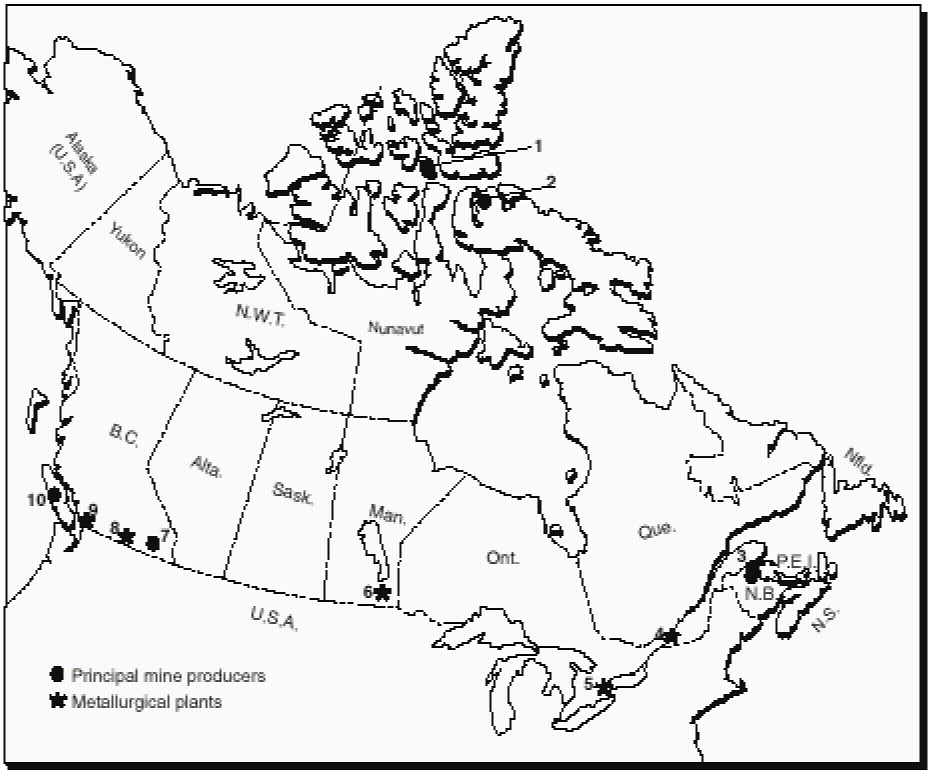
Table 8. Continued

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (3) (cont'd)					
7805.00	Lead tubes, pipes, and tube or pipe fittings (i.e., couplings, elbows, sleeves)	25	39	18	30
7806.00	Other articles of lead				
	United States	3 913	4 554	4 049	5 416
	Japan	512	660	371	467
	Netherlands	4	4	234	327467
	France	56	32	166	173
	Germany	98	91	130	122
	Other countries	94	122	161	190
	Total	4 677	5 463	5 111	6 695
	Total imports	192 363	211 604	182 153	209 311

	1999			2000 (p)		
	Primary	**Recycled** (5)	**Total**	**Primary**	**Recycled** (5)	**Total**
QUANTITY USED (4)						
Lead used for or in the production of:						
Antimonial lead	x	x	x	x	x	x
Batteries and battery oxides	16 741	20 024	36 765	13 286	12 915	26 201
Chemical uses: white lead, red lead, litharge, tetraethyl lead, etc.	x	x	x	x	x	x
Copper alloys: brass, bronze, etc.	14	11	25	14	13	27
Lead alloys:						
Solders	462	910	1 373	273	1 184	1 457
Others (including babbitt, type metals, etc.)	x	x	x	x	x	x
Semi-finished products:						
Pipe, sheet, traps, bends, blocks for caulking, ammunition, etc.	2 914	241	3 155	2 428	195	2 624
Other lead products	2 375	844	3 219	2 014	1 809	3 823
Total, all categories	34 108	58 449	92 557	30 146	51 219	81 365

Sources: Natural Resources Canada; Statistics Canada.
– Nil; **. .** Not available; **. . .** Amount too small to be expressed; n.e.s. Not elsewhere specified; (p) Preliminary; x Confidential.
(1) Production includes recoverable lead in ores and concentrates shipped valued at the Montréal Exchange average price for the year.
(2) Lead content of domestic ores and concentrates exported.
(3) Imports from "other countries" may include re-imports from Canada.
(4) Available data, as reported by users.
(5) Includes all remelt scrap lead used to make antimonial lead.
Note: Numbers may not add to totals due to rounding.

Figure 1. Lead producers in Canada, 2001



Numbers refer to locations on map above.

LEAD-PRODUCING MINES	WEB SITE
1. Polaris, Teck Cominco Limited	www.teckcominco.com
2. Nanisivik, Breakwater Resources Ltd.	www.breakwater.ca
3. Brunswick, Noranda Inc.	www.noranda.com
7. Sullivan, Teck Cominco Limited (closed Dec. 2001)	www.teckcominco.com
10. Myra Falls, Boliden Limited	www.boliden.ca

LEAD METALLURGICAL PLANTS	
3. Belledune, Noranda Inc.	www.noranda.com
4. Nova Pb Inc.	www.novapb.com
General Smelting Company of Canada	
American Iron and Metal Co. (1999) Inc.	www.americanironandmetal.com
5. Tonolli, Tonolli Canada Ltd. and Canada Metal Company	
6. The Canada Metal (Western) Ltd.	
8. Trail, Teck Cominco Limited	www.teckcominco.com
9. Metalex Products Ltd.	

Figure 2. Canadian mine production of lead, 1996–2001

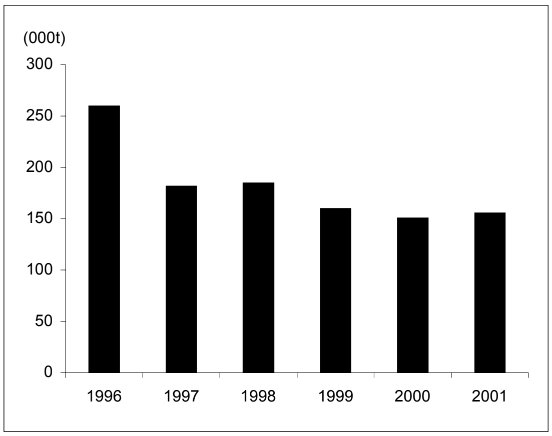
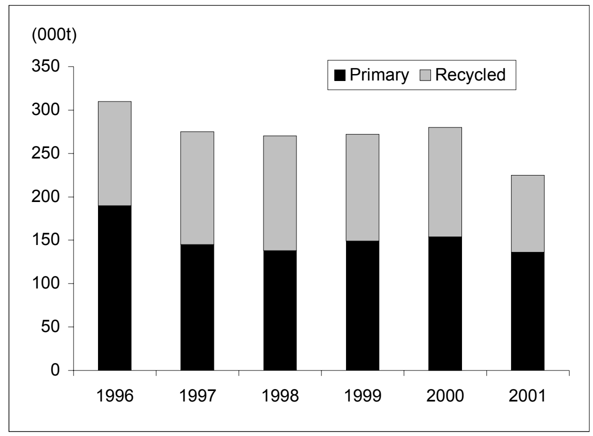


Figure 3. Canadian refined lead metal production, 1996–2001



Source: NRCan

Table 9. Canada, lead production, trade and use, 1975, 1980 and 1985–2001

	Production				Exports (1)				
		Refined			In Ores and			Imports	Quantity
	All Forms (2)	Primary	Recycled	Total	Concentrates	Refined	Total	Refined	Used (3)
					(tonnes)				
1975	349 133	171 516	. .	171 516	211 909	110 882	322 791	(a) 1 962	89 192
1980	251 627	162 463	72 117	234 580	147 008	126 539	273 547	(a) 2 602	106 836
1985	268 291	173 220	66 791	240 011	93 657	113 993	207 650	(a) 5 675	104 447
1986	334 342	169 934	87 746	257 680	118 373	111 831	230 204	(a) 4 247	94 680
1987	373 215	139 475	91 186	230 661	207 936	100 204	308 140	(a) 12 558	97 281
1988	351 148	179 461	88 615	268 076	200 822	179 946	380 768	15 132	88 728
1989	268 887	157 330	85 515	242 845	170 582	121 444	292 026	11 734	88 408
1990	233 372	87 180	96 465	183 645	221 566	84 007	305 573	11 781	72 203
1991	248 102	106 420	105 946	212 366	175 150	86 631	261 781	7 553	80 253
1992	339 626	151 252	101 633	252 885	190 822	131 546	322 368	8 289	92 420
1993	183 105	147 907	69 107	217 014	96 428	124 610	221 038	11 612	91 915
1994	167 584	153 035	98 605	251 640	55 923	133 203	189 126	5 119	95 764
1995	204 227	178 019	103 372	281 391	90 254	140 478	230 732	3 967	91 171
1996	241 751	192 877	117 914	310 791	154 697	159 860	314 557	4 179	93 373
1997	170 847	139 736	131 659	271 395	112 694	155 639	268 333	5 843	92 997
1998	150 019	129 750	135 737	265 487	52 250	145 358	197 608	6 458	87 466
1999	155 369	148 526	117 889	266 415	58 831	139 622	198 453	7 663	92 557
2000	143 303	159 192	125 141	284 833	50 900	148 428	199 328	7 028	81 365
2001(p)	149 429	125 185	101 637	226 822	69 092	126 652	195 744	5 109	. .

Sources: Natural Resources Canada; Statistics Canada.
. . Not available; (p) Preliminary.
(a) Lead in pigs, blocks and shot.
(1) Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Ores and concentrates include HS classes 2603.00.20, 2607.00.20, 2608.00.20 and 2616.10.20. Refined exports include HS classes 7801.10, 7803.00, 7804.11, 7804.19 and 7804.20. Refined imports include HS classes 7801.10.10, 7801.10.90, 7803.00, 7804.11, 7804.19 and 7804.20.
(2) Recoverable lead in ores and concentrates shipped.
(3) Primary and recycled in origin, as measured by a survey of users.

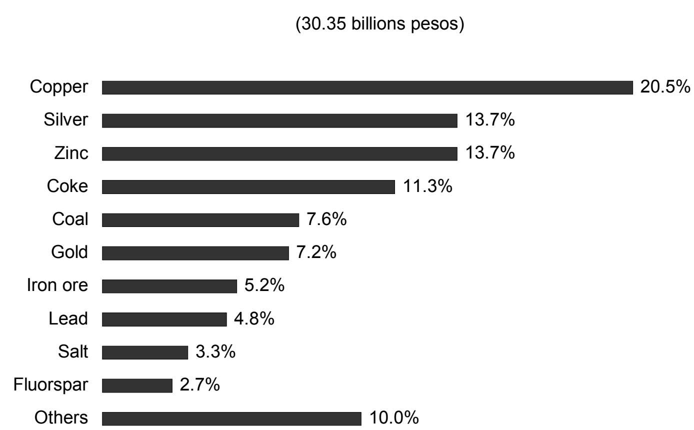
MEXICO

Mining activity in Mexico is located mainly in the central-northern region. Chihuahua state is a leader in the production of lead and zinc. Zacatecas State ranked second in lead mine production in Mexico. Durango ranks fourth in lead production.

Lead production increased by 22 percent, with 160,607 tons, in 2000. The Rey de Plata new mine operations and the expansion at the Sabinas facility, both Peñoles properties, contributed to these figures, which helped compensate for a drastic fall in the volumes at Frisco's San Francisco and Minera Tayahua mines (*Secretaría de Economía* 2000).

One of the most outstanding achievements was the annulment of the penalties enforced by Semarnat on Met-Mex Peñoles. Because of environmental issues, the lead foundry operated at 75 percent capacity from the last few months of 1999 until February 2000; however, the plant was operating at full capacity by March 2000.

Figure 4. Value share in domestic production 2000, by mineral



Source: Mining Division. Ministry of Economy.

Table 10. Summary of mining production in Mexico, by state, of principal metals during January–December 2001 (projected)

STATES (*)	GOLD (KGS)	SILVER (KGS)	LEAD (TONS)	COPPER (TONS)	ZINC (TON)	IRON (TONS.)
Total	23,277.9	2,628,449.0	133,465.0	367,379.0	413,518.0	5,539,944.0
Aguascalientes	0.0	0.0	0.0	0.0	0.0	0.0
Baja California	1,303.3	15,673.0	1.0	0.0	0.0	0.0
Chihuahua	324.9	343,293.0	66,886.0	13,046.0	129,677.0	0.0
Coahuila	0.0	50,530.0	208.0	0.0	0.0	2,147,370.0
Colima	0.0	0.0	0.0	0.0	0.0	2,060,417.0
Durango	6,306.7	360,338.0	9,507.0	2,925.0	12,330.0	0.0
Guanajuato	3,067.9	165,198.0	70.0	80.0	56.0	0.0
Guerrero	776.7	105,087.0	9,926.0	740.0	37,258.0	0.0
Hidalgo	187.6	81,048.0	7,589.0	559.0	22,509.0	0.0
Jalisco	139.7	71,782.0	67.0	10.0	8.0	0.0
México	983.1	152,007.0	8,214.0	1,959.0	30,493.0	0.0
Michoacán	0.2	6.0	0.0	2,087.0	0.0	1,299,856.0
Morelos	0.0	78.0	2.0	0.0	0.0	0.0
Nayarit	13.7	1,076.0	2.0	7.0	3.0	0.0
Nuevo León	0.0	0.0	0.0	0.0	0.0	0.0
Oaxaca	77.9	4,174.0	17.0	0.0	0.0	0.0
Querétaro	995.3	12,101.0	145.0	41.0	468.0	0.0
San Luis Potosí	1,178.8	101,928.0	4,900.0	16,042.0	63,898.0	1,165.0
Sinaloa	690.7	54,525.0	39.0	444.0	140.0	0.0
Sonora	6,300.2	96,574.0	0.0	304,675.0	0.0	0.0
Tamaulipas	0.0	0.0	0.0	0.0	0.0	0.0
Zacatecas	931.2	1,013,031.0	25,892.0	24,764.0	116,678.0	31,136.0

Source: INEGI

Note: The data are rounded and may not add up to totals shown.

(*)= Includes extraction and refining.

P/ = Preliminary numbers as of December 2001.

UNITED STATES

Lead import sources for 1997–2000 were as follows: Lead in concentrates: Peru, 25%; Mexico, 16%; Australia, 10%; Canada, 8%; and other, 41%. Metal, wrought and unwrought: Canada, 64%; Mexico, 15%; Australia, 5%; Peru, 2%; and other, 14%. Total lead content: Canada, 61%; Mexico, 15%; Australia, 5%; Peru, 4%; and other, 15% (USGS 2000).

Domestic lead mine production decreased by about 9%, compared with that of 1999. Alaska and Missouri were the dominant producing states, with a 91% share. Other appreciable lead mine production was in Idaho and Montana. Lead was produced at 19 mines, employing about 1,100 people. The value of domestic mine production was about $440 million. The lead concentrates produced from the mined ore were processed into primary metal at two smelter-refineries in Missouri and a smelter in Montana.

The USGS notes that the value of recoverable mined lead in 2001 for domestic production and use, based on the average US producer price, was $404 million. Seven lead mines in Missouri plus lead-producing mines in Alaska, Idaho, and Montana yielded most of the total. Primary lead was processed at two smelter-refineries in Missouri and at a smelter in Montana. Of the 26 plants that produced secondary lead, 15 had annual capacities of 15,000 tons or more and accounted for more than 98% of secondary production. (Data is provided in thousand metric tons of lead content, unless otherwise noted.)

Secondary lead, derived principally from scrapped lead-acid batteries, accounted for 77% of refined lead production in the United States. About 1.1 million tons of secondary lead was produced in 2000, an amount equivalent to 67% of domestic lead consumption. Nearly all the secondary lead was produced by seven companies operating 15 smelters. The basic operations performed at these facilities include battery breaking, smelting, refining and alloying. Some smelters also burn cathode ray tubes. In 1995, there were 23 secondary lead smelters in the United States.

Lead was consumed at about 140 manufacturing plants. The transportation industries were the principal users of lead, consuming 76% of it for batteries, fuel tanks, solder, seals, bearings, and wheel weights. Electrical, electronic, communications uses (including batteries), ammunition, television glass, construction (including radiation shielding), and protective coatings accounted for approximately 22% of consumption. The balance was used in ballast and counterweights, ceramics and crystal glass, tubes and containers, type metal, foil, wire, and specialized chemicals (USGS 2000).

The following tables are excerpted from the US Geological Survey *Minerals Yearbook* 2000. Domestic survey data and tables were prepared by Richelle J. Ellis, statistical assistant, and the world production tables were prepared by Glenn J. Wallace, international data coordinator.

Table 11. Leading lead-producing mines in the United States in 2000, in order of output

Rank	Mine	County and State	Operator	Source of lead
1	Red Dog	Northwest Arctic, AK	Cominco Alaska Inc.	Lead-zinc ore.
2	Fletcher	Reynolds, MO	Doe Run Resources Corp.	Lead ore.
3	Brushy Creek	do.	do.	Do.
4	Buick	Iron, MO	do.	Do.
5	Sweetwater	Reynolds, MO	do.	Do.
6	Lucky Friday	Shoshone, ID	Hecla Mining Co.	Silver ore.
7	Viburnum #28	Iron, MO	Doe Run Resources Corp.	Lead ore.
8	Greens Creek 1/	Admiralty Island, AK	Kennecott Greens Creek Mining Co.	Zinc ore.
9	West Fork	Reynolds, MO	Doe Run Resources Corp.	Lead ore.
10	Viburnum #29	Washington, MO	do	Do.
11	Casteel	Iron, MO	do.	Do.
12	Montana Tunnels	Jefferson, MT	Apollo Gold Co.	Zinc ore.
13	Sunshine	Shoshone, ID	Sunshine Mining Co.	Silver ore.
14	Gordonsville	Smith, TN	Pasminco Ltd.	Zinc ore.
15	McCoy/Cove	Lander, NV	Echo Bay Minerals Co.	Gold ore.
16	Galena	Shoshone, ID	Silver Valley Resources Corp.	Silver ore.
17	Balmat	St. Lawrence, NY	Zinc Corp. of America	Zinc ore.
18	Pierrepont	do.	do.	Do.
19	Young	Jefferson, TN	ASARCO Inc.	Do.

1/ Updated to reflect locality name change.

Source: US Geological Survey. *Minerals Yearbook.* 2000.

Table 12. Refined lead produced at primary refineries in the United States, by source material

Source material		Year 1999	2000
		(Metric tons, unless otherwise specified) 1/	
Refined lead:			
Domestic ores and base bullion		350,000	341,000
Foreign ores and base bullion		W	W
Total		350,000	341,000
Calculated value of primary refined lead 2/	thousand	$337,000	$328,000

W Withheld to avoid disclosing company proprietary data; included with "Domestic ores and base bullion."
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Value based on average quoted price.

Source: US Geological Survey. *Minerals Yearbook*. 2000.

Table 13. Lead recovered from scrap processed in the United States, by kind of scrap and form of recovery

		Year 1999	2000
		(Metric tons, unless otherwise specified)	
Kind of Scrap			
New scrap:			
Lead-base		42,700	35,500
Copper-base		10,100	11,400
Total		52,800	46,900
Old scrap:			
Battery-lead		1,020,000	1,020,000
All other lead-base		37,100	59,300
Copper-base		7,210	4,730
Total		1,060,000	1,080,000
Grand total		1,110,000	1,130,000
Form of Recovery:			
As soft lead		635,000	651,000
In antimonial lead		444,000	428,000
In other lead alloys		18,100	36,800
In copper-base alloys		17,300	16,100
Total		1,110,000	1,130,000
Value 2/	thousands	$1,070,000	$1,090,000

1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Value based on average quoted price of common lead.

Source: US Geological Survey. *Minerals Yearbook.* 2000.

Table 14. US imports for consumption of lead pigments and compounds, by kind

Kind	Quantity (metric tons)	Value (thousands)
1999:		
White lead carbonate	1	$11
Red and orange lead	86	664
Chrome yellow, molybdenum orange pigments, lead-zinc chromates	8,470	25,900
Litharge	15,700	9,580
Glass frits (undifferentiated)	13,400	20,000
Total	37,700	56,100
2000:		
White lead carbonate	--	--
Red and orange lead	104	594
Chrome yellow, molybdenum orange pigments, lead-zinc chromates	8,900	26,400
Litharge	18,000	10,600
Glass frits (undifferentiated)	13,300	20,100
Total	40,300	57,600

-- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

Table 15. US exports of lead, by country (lead content, unless otherwise specified)

Country	1999 Quantity (metric tons)	1999 Value (thousands)	2000 Quantity (metric tons)	2000 Value (thousands)
Ore and concentrates:				
Belgium	31,800	$7,430	49,300	$12,000
Canada	12,600	10,000	11,100	9,190
China	--	--	--	--
Japan	39,400	9,240	32,200	7,530
Korea, Republic of	1,840	905	5,380	3,400
Mexico	7,600	5,670	17,500	9,230
Netherlands	63	41	--	--
United Kingdom	2	5	629	409
Other	165 r/	57 r/	425	885
Total	93,500	33,400	117,000	42,600
Ash and residues:				
Belgium	280	68	536	116
Canada	709	1,640	695	1,890
Japan	--	--	9,820	16,200
United Arab Emirates	321	232	206	122
Other	122	62	64	75
Total	1,430	2,000	11,300	18,400

Footnotes:
r/ Revised
-- Zero

Table 16. US consumption of lead, by product (metric tonnes)

SIC code	Product	1999	2000
	Metal products:		
3482	Ammunition, shot and bullets	58,300	63,500
	Bearing metals:		
35	Machinery except electrical	W	W
36	Electrical and electronic equipment	W	W
371	Motor vehicles and equipment 2/	1,120	1,090
37	Other transportation equipment	W	W
	Total	1,570	1,480
3351	Brass and bronze, billets and ingots	3,940	3,670
36	Cable covering, power and communication	2,410	W
15	Calking lead, building construction	971	1,140
	Casting metals:		
36	Electrical machinery and equipment	W	W
371	Motor vehicles and equipment	27,600	28,400
37	Other transportation equipment	W	W
3443	Nuclear radiation shielding	1,770	1,270
	Total	34,300	35,100
	Pipes, traps, other extruded products:		
15	Building construction	2,020	2,010
3443	Storage tanks, process vessels, etc.	(3/)	(3/)
	Total	2,020	2,010
	Sheet lead:		
15	Building construction	11,600	17,600
3443	Storage tanks, process vessels, etc.	(3/)	(3/)
3693	Medical radiation shielding	3,890	6,190
	Total	15,400	23,800
	Solder:		
15	Building construction	2,450	1,440
	Metal cans and shipping containers	W	W
367	Electronic components,accessories and other electrical equipment	6,140 r/	5,430
371	Motor vehicles and equipment	W	W
	Total	13,100	11,500
	Storage batteries:		
3691	Storage battery grids, post, etc.	765,000 r/	796,000
3691	Storage battery oxides	707,000 r/	690,000
	Total storage batteries	1,470,000	1,490,000
371	Terne metal, motor vehicles and equipment	(4/)	(4/)
27	Type metal, printing and allied industries	(5/)	(5/)
34	Other metal products 6/	7,130	21,700
	Total	1,610,000	1,650,000
	Other oxides:		
285	Paint	W	W
32	Glass and ceramics products	W	W
28	Other pigments and chemicals	W	W
	Total	58,200	52,400
	Miscellaneous uses	15,100	14,000
	Grand total	1,680,000	1,720,000

r/ Revised. W Withheld to avoid disclosing company proprietary data; included in appropriate totals.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Includes "Terne metal, motor vehicles and equipment."
3/ Included with "Building construction" to avoid disclosing company proprietary data.
4/ Included with "Bearing metals, motor vehicles and equipment."
5/ Included with "Other metal products" to avoid disclosing company proprietary data.
6/ Includes lead consumed in foil, collapsible tubes, annealing, galvanizing, plating, electrowinning, and fishing weights.

Source: US Geological Survey. *Minerals Yearbook.* 2000