QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS
QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS
QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS
QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS
QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS

Mercury Stewardship
Mercury Commodity Market Review

October 2003

…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS
QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS
QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS
QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS
QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS
QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS
QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS
QUICKSILVER CAUCUS … QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS**
…QUICKSILVER CAUCUS … **QUICKSILVER CAUCUS** … QUICKSILVER CAUCUS

DISCLAIMER

This document was developed under Cooperative Agreement No. 83035101 awarded by the U.S. Environmental Protection Agency (US EPA). US EPA was involved in the drafting of this document, including making comments and suggestions intended to improve the document's scientific analysis and technical accuracy. While the document was developed through a joint US EPA/State Workgroup process, the document is a State product. The views expressed in this document do not represent an official US EPA position. US EPA has not made final decisions on any of the issues highlighted in this document. US EPA also does not endorse any products or commercial services mentioned in this document.

Mercury Commodity Market Review
Economic Facts & Reasoning about the
Global Mercury Commodity Market, including U.S. contributions

Contexts for this Paper:

- This paper has been developed by the Mercury Market Subgroup of the QSC/EPA Mercury Stewardship Workgroup for the purpose of developing and evaluating the economic and environmental impacts of policy options for management of US and global excess commodity grade mercury. This paper summarizes economic and market information known to the subgroup about the US and global mercury commodity market, while noting information gaps. This paper also identifies and discusses key policy questions that are suggested by this information.
- These policy questions and potential policy directions are identified and discussed in this document as well as the Assessment of Market Policy Options document, the subgroup's primary product. This paper is intended to serve as a data and discussion background paper for the Assessment document, which summarizes policy options identified by the subgroup and communicates the consensus or majority/minority positions of the group on various options that policymakers could pursue.
- The mercury commodity market includes competing brokers making private transactions. There are some use and supply statistics for the U.S., which are voluntarily reported by some parties. There is little mercury use data for the rest of the world, even though there are indications of robust demand for mercury in developing countries. Given this overall context of information asymmetries and private transactions, many numbers cited in this paper should be regarded as estimates, sometimes expressed as ranges, and may reflect significant uncertainties.
- This paper was developed by the Mercury Market Subgroup, composed of members from state and federal government, and nothing in this paper should be construed to represent official federal or state positions unless specifically identified as such.

Summary

This paper assembles economic facts and insights into a picture of the mercury commodity market, and considers economic and environmental impacts of public policies pertaining to it. Due to business confidentiality, the small market, and its widespread reach to the economic fringes of developing countries, this picture is inevitably incomplete.

Demand/Price: During the past three decades, the reported use of mercury in the United States has greatly fallen, by about 95%. Similarly, estimated world use has fallen from 10,000 tons in 1975[1] toward 2,000 t/yr in 2002. Partly as a result, the price of mercury on the global market has fallen 95% in real (inflation-adjusted) terms, causing the closure of many dedicated mercury mines, including all those once operated by private owners and some that were owned by governments.

While global mercury use has declined, there are still various major uses. One major use is in the artisanal mining of gold and silver by millions of artisanal miners across Asia, Africa, and Latin America (defined for purposes of this paper as Mexico, Central America, and South America). The amount of mercury used could be 200 to 3,000 t/yr, potentially a very large quantity. Yet this is very difficult to estimate with any certainty because there are no reliable statistics for this type of economic activity. Similarly, mercury use in developing countries in such applications as fungicides, medicines, cosmetics, weapons, foundries, and religious practices defies estimation. Developing nations also use mercury in similar ways to developed countries, e.g., in lighting and electrical applications, dental fillings, instruments, chlor-alkali production, etc. The global chlor-alkali industry is estimated to account for about 740 t/yr consumption, about 570 t/yr for plants outside of the US and Europe, 30 t/yr in the US, and 140 t/yr in Europe.

Supply of mercury: There are five major sources of supply. First, there are industrial-scale mines that receive public subsidies, located in four countries: Spain, Algeria, Kyrgyzstan, and China. Second, there are anecdotal accounts of artisanal miners of mercury near demand "hotspots", e.g., near artisanal gold/silver mining areas in China, Mexico, Mongolia, Peru, and Russia. Third, an increasing supply (300 t/yr) results from byproduct capture by industrial-scale metal producers (e.g., gold, silver, zinc, copper, lead, aluminum). Fourth, secondary supplies are significant, including hundreds of tons of mercury that become available after closure of a chlor-alkali factory; this may yield 500 to 1,000 tons/yr on a global basis. In the U.S., national, state, and local policies require recovery from mercury-containing devices and other wastes. Fifth, there are large stocks in industry and in strategic reserves. The U.S. Government holds a large stock of mercury (4,900 tons) in relation to domestic demand (200 t/yr); stockpile sales were suspended in 1994 and an environmental impact statement (EIS) is currently underway. Ten remaining U.S. chlor-alkali factories are estimated to hold 3,000 to 4,000 tons that can be sold when factories close. European chlor-alkali factories contain 12,000-15,000 tons of mercury and remaining world plants may contain an additional 15,000 tons. A sixth source of supply is extraction of mercury from natural gas. Algeria, Croatia, and the Netherlands[2], for example, recover mercury from natural gas. Extraction of commodity grade mercury from coal and petroleum could become another source of supply, if it is required by future environmental regulations.

---

[1] *Engineering and Mining Journal*, March 1976

[2] United Nations Environment Programme. Global Mercury Assessment. November 2002. Para. 558.

International Trade Flows: There is more available mercury in the United States than our economy will seemingly be able to use, for decades to come, at present levels of demand. At this time there does not seem to be sufficient data available to determine whether the world economy faces a similar supply surplus. Yet as health and environmental regulations have squeezed demand in developed nations, the excess mercury flows toward developing nations in Africa, Asia, and Latin America, where there are fewer regulations and where demand appears to be robust, but for which there is little data on specific end uses. From 1988 until the U.S. Defense Department suspended its mercury sales during 1994, net U.S. exports of mercury were 2,928 tons, an average of 418 tons per year through these seven years. That annual rate of export is about double the current U.S. demand of 200 tons.

This flow of commodity mercury has mixed environmental effects: it discourages the need for new mining of mercury (particularly from private mercury mines), however the ready supply of mercury depresses its price, thereby inviting higher use on a global basis.

Posing Questions for Environmental Policymakers: The overall economic picture raises the following major policy questions for the United States and the international community:

- How is "oversupply" of mercury defined and recognized?
- Do some U.S. environmental policies promote "oversupply" of the mercury commodity market? If so, which policies, and how could or should they be changed?
- What actions could or should be taken by the United States and others to address oversupply and sources of oversupply?
- What actions could or should be taken by the United States and others to address and discourage foreign government subsidies for primary mercury mines?
- How could or should the United States and others encourage reduced use of mercury in developing countries? What combination of policies and activities will have the greatest effect?
- Are there Environmental Justice, human rights, and self-determination issues associated with the global flow of mercury and/or relationships between developed and developing nations that need to be addressed? If so, what are they, and how might the US and others address them? How can individuals and communities around the world, especially those most likely to be affected by mercury contamination, be protected from mercury pollution and health effects?
- What aspects of the mercury market, e.g., production, trade, use, recycling, and disposal should be subject to reporting and disclosure, both within and among countries?
- Do international trade regulations and agreements hinder efforts to reduce mercury use and release? If so, how can these issues be addressed?
- What steps could or should be taken by the United States and others to encourage environmental and economic stewardship of mercury stocks by nations and/or industries that hold or control these stocks?

Table of Contents

- *Market-makers preserve commodity stocks, rather than retire them*
- *Are exports of mercury unwelcome in environmental terms?*
- *When is recycling of mercury warranted? The mining connection*
- *For-profit Mercury Mines as an Economic Indicator: "Canaries" to Help Guide Mercury Stock Stewardship*
- *What are economic and environmental criteria that could guide the choice between sales and storage*
- *Waste or Commodity? An economic and environmental question*

DRAFT Quicksilver Caucus Recommendations based on the work of the Mercury Market Subgroup

Mercury Price Table and Graph, 1910-2002 (adjusted to 2002 dollars)

Economic Facts & Reasoning about the Global Hg Commodity Market, including U.S. contributions

What is commodity grade mercury?

- Commodity mercury is elemental mercury. Elemental mercury is a metal that is natural constituent of the earth's makeup (0.5 parts per million in overall abundance).
- Economists regard commodity-grade mercury as a fungible material (freely interchangeable). One pound of elemental mercury replaces another pound of elemental mercury, either in use or supply.
- Properties of mercury include fluidity at normal temperatures, electrical conductivity, ready amalgamation with many other metals, high surface tension (so it is not sticky), and uniform volume expansion with increasing temperature. Such properties have suited it to use in instruments, chlor-alkali production, lighting, and electrical applications.
- Mercury and its compounds are also widely recognized for their toxicity. They have long been used in medicine, as skin treatments, as disinfectants, as preservatives, and as pesticides. Most of these uses have been discontinued in favor of safer and more effective substances or practices.
- Primary mercury mines extract mercury from cinnabar deposits (HgS). There are estimates that deposits at open and closed industrial-scale mercury mines hold 600,000 tons, principally in Algeria, Italy, Kyrgyzstan, Russia, China, Slovenia, Spain, and Ukraine[3], yet it can also be found in other mercury-bearing ores throughout the world. Mercury produced by mines tends to be marketed as "prime virgin," usually more than 99.99% pure and containing less than one part per million of any base metal[4]. Mercury also associates with other metals, for example, gold, silver, zinc, and copper, and is extracted as a byproduct from such mining operations.
- In general, trade in commodity mercury is not restricted, regulated, or tracked by governments.
- Environmental regulations generally apply to mercury releases (wastes, effluents, air emissions) following use. The Basel Convention, an international agreement addressing international transfer of hazardous and other wastes, aims in part to prevent exports of non-commodity grade (usually low concentration) mercury wastes from developed nations to developing countries (i.e., OECD to non-OECD).

Discussion of Uncertainties

- For the past century, the U.S. Bureau of Mines, recently succeeded by the U.S. Geological Survey, has estimated U.S. mercury use, based on voluntary surveys of known market participants. This has been done by no other nation, to our knowledge[5].

---

[3] Howard B. Masters, Lambert International, in Metals and Minerals Annual Review – 1995, London, *Mining Journal*, page 73-74.

[4] One U.S. distributor sells "ultra refined" mercury marketed as exceeding 99.9999% purity.

[5] The Netherlands government attempted to evaluate mercury use within its economy a few years ago. There have been evaluations of mercury use in Sweden, see: Halldin, A.; Pettersson, O. Turnover of mercury in Sweden. SNV PM 928. Statens naturvårdsverk, Solna, 1978, 120 pp. (In Swedish; English summary.) *and* Hylander, L. D. & Meili, M. 2003. The Rise and Fall of Mercury: Converting a Resource to Refuse After 500 Years of Mining and Pollution. *Submitted ms.* Yet, in general, such analyses have not done by other nations.

USGS reports on mercury were suspended several years ago due to the shrinking market and declining number of survey responses.

- Published estimates of world demand written by some market participants[6] (in essence, primary versus secondary accounts) tend to be derived from reported production by mines, to which are added estimates of secondary supplies. Given the best available estimates of supply, demand is then assumed to be inversely matching, on a world basis. Given that there is little reliable data on mercury demand, this is not an unreasonable way to estimate aggregate demand. Yet information on supply may be incomplete and therefore result in underestimation of use.
- The mercury market, like many others, involves competing brokers making private transactions. Market participants may have business confidentiality concerns.
- Information about this relatively small market is scanty and worsening over time, as mercury use shrinks in developed nations, due to health and environmental concerns. A small and shrinking market reasonably prefers privacy.
- Even less information is available concerning the use of mercury in developing countries, notably in artisanal gold and silver mining by millions of prospectors. This is largely a "shadow" (untaxed and untracked) activity that takes place outside the formal economies and laws of many nations.
- Nevertheless, enough is known about the mercury market in developed countries (through such relatively visible clues as price, U.S. customs data, disclosed output from industrial mines and their corporate governance) and about the economics of how markets function so as to address many potential questions to U.S. and international policy-makers.

Price

- Since peaking during the mid-1960s, the wholesale price of mercury has declined 95 percent. [Expressed in 1995 dollars (to adjust for inflation), the price of a 76-pound flask of mercury was $2,763 in 1965, whereas the same flask cost $152 in 1995.][7]
- This price collapse indicates that there is an over-supply of available commodity-grade mercury in relation to economic demand for it.

Demand

United States Demand

- A major cause of mercury's price decline has been a drastic drop in demand among industrial economies due to health and environmental concerns expressed in laws, regulations, and policies to reduce mercury use and release. Although mercury has been used in more than 3,000 applications[8], non-mercury alternatives have come into use and demand for mercury in the U.S. (and other OECD nations) has vastly declined since the 1960s. Use has fallen in batteries, pharmaceuticals and medical products (e.g.,

---

[6] Annual assessments appeared in the U.S. *Engineering and Mining Journal* until discontinued in 1995. The *Mining Journal* (London) continues to issue annual commodity market reviews.

[7] Dr. E. Swain, Minnesota PCA, inflation-adjusted adjusted price history of Hg during the 20th century, unpublished, 8/30/1996. Provided as attachment.

[8] John Putnam. 1972. "Quicksilver and Slow Death." *National Geographic*, October, pp. 507-527.

mercurochrome), paints, and pesticides, generally owing to environmental and health regulations. Before 1970, several hundred mercury-cell chlor-alkali factories were built worldwide, requiring an initial inventory of about 40,000 tons; after 1970, few such factories have been built. Many existing chlor-alkali plants have converted to non-mercury technologies.

- U.S. demand peaked during the mid-1960s at 2,500 tons/yr[9] and is today 200 t/yr. Year 2000 demand includes thermostats and electrical switches (66 tons); dental fillings (48); electric lights (30); chlor-alkali (30); and instruments (24) (to measure temperature, pressure, or flow, e.g., thermostats, manometers), among principal uses[10]. A 2001 NEMA survey of their member lighting manufacturers indicated that their consumption in 2001 was nine tons[11].
- The U.S. also receives foreign-made products that contain mercury (e.g., thermometers, dental amalgam capsules, and computers).
- Direct use of mercury in the U. S. continues a long-term downward trend. Some firms are researching mercury-free light bulbs.[12] Chlor-alkali factories periodically close. Dentists increasingly offer mercury-free fillings. Mercury-free options may exist for instruments and electrical/electronic equipment; many manufacturers of thermometers, blood pressure cuffs (sphygmomanometers), and thermostats are in the process of phasing out mercury-containing products.

World Demand

- Based on reports of mercury supply, world demand was estimated at 3,753 tons during 1994[13], 2,500 tons during 1996[14], and more recently 2,000 tons[15].
- Is it possible for market observers or participants to have accurate enough information on supply to make reasonably accurate inferred estimates of demand? Because relatively visible industrial scale mercury production is declining, it is presumably ever harder to count sources of supply that will tend to be smaller, intermittent, or more disparate[16].
- The chlor-alkali industry is a major consumer of mercury on a global basis. US and European plants, representing about 60 percent[17] of world mercury cell plant capacity, have made major advances in reducing losses, and therefore reducing demand, over the past ten years. The US industry, for example, has reduced consumption by about 75

---

[9] Jasinski, S. M. 1995. "The materials flow of mercury in the United States." *Resources, Conservation, and Recycling*, 15, 145-179.

[10] Bruce J. Lawrence, *Chemical and Engineering News*, Feb 5, 2001, page 22, plus updated information from the Chlorine Institute.

[11] Personal communication. Peter Bleasby, Osram Sylvania. June 17, 2003.

[12] *MIT Magazine on Technology*, 2002, light-emitting organic diode research.

[13] Howard M. Masters, *Mining Journal*, 1995.

[14] Ed Weiler, USEPA, drawing on USGS and Gobi International reports, which in turn rely on asking market makers.

[15] Bruce J. Lawrence, Boston meeting presentation, May 2002.

[16] Is it possible to improve world demand data? One approach might be to contact the electrical, electronic, and chlor-alkali industries and ask them to estimate demand for mercury for their sectors on a global basis. Since the Spanish Government may be the world's largest distributor of mercury, the U.S. could also ask it to disclose the quantity of its mercury sales and countries to which sold.

[17] United National Environment Program Chemicals. "Global Mercury Assessment." December 2002. Para. 574. Page 131.

percent on a unit capacity basis since 1995 and now consumes about 30 t/yr[18]. If one assumes that the US and EU have 60 percent of the world's production capacity, consume 170 t/yr, and the consumption rate for the rest of the world is five times the US/EU consumption rate, then total world consumption is 740 t/yr, with 570 t/yr consumption for non-US/EU plants. This is a significant portion of total world demand estimated above. Bringing all global chlor-alkali plant mercury consumption rates into line with US/EU plants would reduce global consumption to about 280 t/yr. This represents a very significant decrease in consumption and emissions of about 460 t/yr on a permanent basis.

- Another major use is artisanal gold and silver mining via mercury. According to published reports, this type of mining is practiced in more than 30 nations across Asia, Africa, and Latin America[19] by several million miners at the economic fringes of their societies; their gold output is poorly known, perhaps 200-600[20] tons per year. The ratio of mercury consumption to unit output of gold varies (and can be ameliorated by better techniques), but may average between 1:1 and 5:1. Accordingly, the use of mercury in artisanal gold/silver mining may range from 200 to 3,000 tons per year. Much of this mercury is lost via heating of mercury/gold amalgam over open fires, to burn off the mercury as vapor. Given long-range transport of mercury vapor via the atmosphere and subsequent deposition to earth, this practice affects water quality in the United States[21]. The extent of artisanal mining and its mercury consumption is dynamic, affected by such ever-changing factors as national and local economies; the price of gold; discovery of ore deposits and their depletion; societal regulation of property rights; and mining techniques.
- One EU study[22] estimates that 25 percent of Almaden's mercury production/sales is used for "illegal gold mining" around the world.
- There are other cottage or artisanal uses of mercury in developing and some developed countries: medicines, fungicides, paints cosmetics, soaps, other metals production, cultural practices, etc.
- Developing countries also use mercury in many of the ways it is or has been used in the U.S. China's production of light bulbs is 800 million per year[23]. Dentists use mercury in fillings the world over. India has more mercury-cell chlor-alkali factories than any other nation (20+) and manufactures thermometers and other devices. Asian nations excel at

---

[18] Chlorine Institute. Fifth Annual Report to the EPA; For the Year 2001. April 2002. Available at: http://www.epa.gov/Region5/air/mercury/reducing.html#chlor-alkali

[19] **Asia**: China, India, Indonesia, Kyrgyzstan, Mongolia, Philippines, Russia. **Africa**: Burkina Faso, Ghana, Mali, Mozambique, S. Africa, Tanzania, Zimbabwe. **Latin America**: Bolivia, Brazil, Chile, Columbia, Ecuador, French Guyana, Mexico, Peru, Suriname, Venezuela.

[20] Estimate derived from Mining, Minerals, and Sustainable Development report and in consultation with Professor M. M. Veiga, Univ. of British Columbia and the UN Industrial Development Organization.

[21] The United National Industrial Development Organization has a $75M program underway to provide technical and further assistance to miners in 6 nations so as to improve the sustainability of their activity. The World Bank also has a program of outreach to artisanal mining communities.

[22] Towards an Integrated EU Policy for HEavy METals (EUPHEMET) . Contract n^0 ENV4-CT97-0614, March 1998 – August 2000. University of Athens (Coordinator), Institute for European Environmental Policy – Brussels – IEEP-B, Imperial College/IC Consultants Ltd (ICON) London. §§ 3.11.3; 8.3.1.

[23] Ed Weiler, USEPA.

manufacturing sophisticated electronics products, including computers, which use mercury in electrical applications.

Value of Use

- The value of world use of mercury was estimated at $75M in 1982, yet by 1992 had fallen by two-thirds to $25M[24]. (This two-thirds decline would be even more severe, if expressed with a real dollar adjustment.)
- The mercury market is small and shrinking. It may be $8M today[25].

Sources of Supply

State-sponsored Primary Production

- In response to mercury's price collapse, most mercury-dedicated, industrial-scale mines have closed. Centuries-old mercury mines closed in Slovenia (mid-1990s) and Italy (mid-1980s). In 1965, the U.S. had 151 mercury mines (only 5 of which produced more than 34 t/yr); the last closed in 1990[26].
- Yet several industrial-scale mercury mines persist and produced 9,532 tons during 1975[27], 8,000 tons during 1987[28], 2,235 during 1994[29], and 1,700 tons during 2000[30] (by another estimate 1,000 tons[31]).
- Given the price collapse, these mines remain open because of financial support from their national governments. One economist has noted: "The decrease in price and the increase in environmentally mandated handling and storage costs will have some fairly predictable effects. Where mercury is a primary product, mines operating for profit must close… The major producers are State-owned and may be operated for social rather than profit objectives."[32]
- The most prolific mercury mine in history is Spain's Almaden, which has produced 300,000 tons since 1499 and remains in operation today. Other mines currently or recently operating include those in China (four in Guizhou Province), Kyrgyzstan (Khaidarken), and Algeria (ENOF).
- Almaden has been owned by the Spanish Government's Department of the Treasury since 1520. During much of its history, it has paid a handsome return. By 1977, however, its losses more than exceeded gross sales, with losses of $6.9M after gross sales of $5.6M[33].
- An economic analysis published during 2001 by the World Bank indicates that Almaden received the equivalent of US$150M from the Spanish government between 1986 and

---

[24] Bruce Lawrence, *Engineering and Mining Journal*, March 1993.
[25] A guesstimate based on 4,000 tons of mercury use at $2 a pound.
[26] Jasinski, op. cit.
[27] A. P. Ryan, Engineering and Mining Journal, March 1976.
[28] Howard M. Masters, *Mining Journal*, 1995.
[29] Masters, op. cit.
[30] *USGS Minerals Yearbook 2000*
[31] Bruce J. Lawrence, May 2002
[32] Rieber, Michael and Harris, DeVerle. 1994. "The impact of U.S. Government Stockpile Releases." In: *Mercury Pollution*, Carl Watras and John Huckabee editors, Lewis Publishers
[33] *Engineering and Mining Journal*, March 1979.

1998. (For perspective, such subsidies are about 8 times the value of mercury sold, though it can also be said that these funds go for other purposes than mercury mining, including worker retraining into alternative occupations.) The authors note:

- "New investments have depended exclusively on public capital, whether from the central Treasury Department or from the regional government...resulting in utilization of the company and its projects as tools for political management, giving priority to political accomplishments over business or economic accomplishments;
- technical decapitalization of the company's upper level management, so that projects were managed by political appointees;
- loss of economic rigor in the business analysis, both in terms of economic feasibility and the design of commercial policies;
- In the case of Almaden, any investments realized have been used to artificially sustain uneconomic activities and subsidize anticipated retirements. The investments have not stimulated private investment that would provide economic alternatives and thus have not created any hope whatsoever of sustainable development.
- The State should abstain from playing the role of entrepreneur…International experiences indicate that the State is not a good mining entrepreneur; moreover, it is incapable of developing profitable and sustainable economic enterprise."[34]

- During 1996, the Spanish Government proposed to privatize (sell its share in) Almaden.
- A study[35] commissioned by the EU estimated that 25 percent of Almaden's production/sales went to "illegal gold mining." In addition, 25 percent of Almaden revenues were derived from the sale of mercuric oxide for batteries banned in the US, the EU, and nearly all OECD countries.
- During 2002, China's national government announced closure of a mine or mines, though such announcements may not always be honored by miners in local practice. The following mines have been or may be in operation: the Danzhai Gold-Mercury Mine, Guizhou Mercury Mine, Wuchuan Mercury Mine, and Tongren Mercury Works, all within the Province of Guizhou. All Guizhou mines were reportedly closed by the Chinese lunar new year in 2002[36], pursuant to the Chinese Government's directive. However it has been reported that operations may be continuing on an informal basis.
- The Khaidarken mine in the Kyrgyz Republic has operated since 1942, and has also produced antimony and fluorite. Due to the collapse of demand from former customers within the Union of Soviet Socialist Republics, Khaidarken suspended operations circa 1994. With funding from the World Bank, its operations resumed in 1995. World Bank funds were generally intended to convert previously state-owned industries to private ownership[37]. By 1997, the workforce was halved to 1,200 to reduce costs[38]. As of 2003,

---

[34] Enrique O. Girones and Carolos D. Viegobueno. 2001. "Spain's Almaden Mine: 2,000 years of Solitude." In: *Large Mines and the Community: Socio-economic and Environmental Effects in Latin America, Canada, and Spain*. International Development Research Center and the World Bank. See: http://www.idrc.ca/books/Focus/949_mining/949/F949c05Spain.html.

[35] Towards an Integrated EU Policy for HEavy METals (EUPHEMET). Op. Cit.

[36] "Mercury Market Alert to Chinese Whispers." Kyne, Phelim. DowJones Newswires. April 9, 2002.

[37] V. Bogdetsky et al. 2001. "Mining Industry and Sustainable Development in Kyrgyzstan." International Institute for Environment and Development, Mining, Minerals, and Sustainable Development, 110. Available at: "http://www.iied.org/mmsd/mmsd_pdfs/110_bogdetsky"

[38] Howard M. Masters, *Mining Journal*, 1997

however, the mine remains State-owned. Mercury concentrations at Khaidarken are quite low (under 1 percent), rendering its economic prospects poor. During 1995, the cost of production at Khaidarken was estimated at $130-$140 per 76-pound flask of mercury. "The plant had difficulties when forced to sell material in the $80-90 range." In China, that same year, cost of production was estimated at $180 per 76-pound flask[39].

- During 2000, the World Bank evaluated investment in another mercury mine at Ulug-Too in the Kyrgyz Republic[40], though this project has apparently not been undertaken.
- It has also been reported that there is a mercury-antimony mine in Tajikistan at Jijikrut (Dzhidzhikrut). The operational status of this mine is unknown[41].
- Through its L'Enterprise Nationale des Produits Miniers Non-Ferraux et des Sustances Utiles (ENOF), the government of Algeria pays miners to produce mercury. The government barters this mercury to nations to which it is indebted[42]. Within recent years, Algeria has passed a law to encourage foreign private investment in its hitherto State-monopolized mining sector.[43]
- State support to mercury mines is not a new phenomenon, nor the exclusive preserve of other nations. The United States provided support to the Almaden mine under its post-WWII Marshall Plan and guaranteed a price to U.S. mercury miners during the 1950s[44]. Both of these support programs ended long ago. Yet, State support seems an essential feature of remaining industrial-scale, mercury-dedicated mining. Public subsidies to mercury production are unwelcome in environmental terms, since they generate higher output than the market price of mercury would warrant. Moreover, this mercury is inevitably exported to developing countries at use-inviting prices. Subsidies represent a distortion of the commodity market and fuel an increase in world mercury use.

Artisanal Production

- Small-scale, artisanal miners are reported to be producing mercury near demand hotspots. Such miners are reported in Peru[45], Mexico[46], Mongolia[47], China[48], and Siberia[49], though it would be very difficult to estimate their output.
- Such miners represent an unusual economic phenomenon today, because they are not State supported. Their production costs must be very low to enable them to undercut the transportation and brokerage costs of shipping mercury from countries with large

---

[39] Howard M. Masters, *Mining Journal*, 1995.
[40] Howard M. Masters, *Mining Journal*, 200l.
[41] Personal communication. Lars Hylander. July 25, 2003.
[42] Masters 2001
[43] http://www.universalnews-us.com/algeria/mining.html.
[44] George B. Parker. 1967. "The Long Term Outlook for Mercury." In: *Commodity Year Book 1967*, Commodity Research Bureau, New York.
[45] Prof. M. M. Veiga, Univ. of British Columbia.
[46] Howard M. Masters, *Mining Journal*, 1995: "Production in Mexico is difficult to determine due to being from many small independent mines for consumption in the gold refining industry, which in itself is poorly regulated."
[47] Hylander, L. D. & Meili, M. 2002. 500 years of mercury production: global annual inventory by region until 2000 and associated emissions. *Sci. Total Environ. 304 (1-3)*: 13-27.
[48] Prof. M. M. Veiga, Univ. of British Columbia.
[49] Steve Hoffman, USEPA.

mercury supplies. The miners be paid in cash or gold, valuable income in countries where cash incomes may be very low.

- They illustrate the potential for fresh mining of mercury, when its price (or value) increases on a local scale.

Byproduct Production

- Mercury is produced as a byproduct from industrial-scale mining of other metals (e.g., zinc, gold, silver, copper, lead[50], aluminum), where it is a trace contaminant. Mercury is produced by U.S. gold mines in Nevada, California, and Utah[51], zinc mines in Finland[52], Norway, Italy[53], and Spain, copper mines in Slovakia[54] and Sweden, and mines in Canada. World production is estimated at 300 tons per year[55]. The contribution from the U.S. is estimated at 60-70 tons per year[56]. Byproduct mercury from Norway and Sweden is not being placed on the market at this time[57].
- This production seems likely to grow, as mining firms may be increasingly motivated or required to capture mercury previously emitted to the atmosphere. Byproduct mercury enjoys an intrinsic cost advantage over primary mercury since its recovery is required and its sale at market price is incidental to the primary products (gold, silver, zinc, copper) and profits that sustain these companies.
- Fossil fuel cleaning can extract commodity grade mercury. Algeria, Croatia, and the Netherlands report extraction of mercury from natural gas. Future environmental regulations may result in extraction of commodity grade mercury from petroleum and coal.

Secondary Supply (Chlor-alkali)

- Chlor-alkali factories typically manufacture chlorine and caustic soda and may reach the end of their economic lives when demand for those products change. There were 39 in the United States during the late 1960s; currently 9 are operating with production from another suspended.
- Factories vary in size. On average, U.S. chlor-alkali factories have onsite 300 tons of mercury that is continuously used within the production system. West European factories are on average 10 percent smaller, so they may hold 270 tons of mercury each, whereas factories in developing countries are smaller and may on average hold 100 tons of mercury, or about one third the size and capacity of US plants. The mercury cell process predominates in Western Europe, which has 55 factories. There are about 100 others worldwide.

---

[50] Pacyna et al 2001.
[51] USGS estimates the mercury yield is 20% that of gold. Sznopek, John L. and Thomas Goonan. "The Materials Flow of Mercury in the Economies of the United States and the World." US Geological Survey Circular 1197. Washington DC Dept. of Interior. 2000.
[52] Outokumpu Finnmines produced 104 tons in 1994, *Who Owns Who in Mining 1995*
[53] Howard M. Masters, *Mining Journal,* 1995.
[54] Masters, *Mining Journal,* 1995.
[55] Ed Weiler, May 2002.
[56] J. Gilkeson, Minnesota OEA. Masters (1995) may estimate 300 tons.
[57] Personal communication. Michael Bender, Mercury Policy Project. March 17, 2003.

- Operating U.S. factories hold 3,000-4,000 tons and West European factories 12,000-15,000 tons.
- The worldwide rate of factory closures is uneven from year to year, but likely averages 3 to 5 closures annually. These closures may yield 500 to 1,000 tons per year of commodity mercury.
- The U.S. chlor-alkali industry has indicated a willingness to transfer surplus mercury (estimated at 3,000 to 4,000 tons) to a US government operated permanent storage facility after their factories close[58]. They would forego the modest yield (estimated at $600,000 per factory) from the traditional choice of sale. This offer is contingent on State or Federal agencies accepting title to and assuming future responsibility to manage this mercury, as would be the case for these firms under their alternative recourse of sale[59].

Table 1: Estimated Hg Yield After Closure of U.S. Chlor-alkali Factories

Location	**Hg yield range[60]**
Muscle Shoals, AL	215 - 331 tons
Delaware City, DE	224 - 345
Augusta, GA	183 - 282
St. Gabriel, LA	293 - 452
Lake Charles, LA	396 - 610
Ashtabula, OH	73 - 112
Charleston, TN	404 - 622
Deer Park, TX	149 - 229
Port Edwards, WI	185 (rpt)[61]
New Martinsville, WV	112 - 173
Total	**2,234 – 3,341**

Secondary Supply (Recovery from Mercury Containing Devices by drainage/extraction)

- Federal and state laws, regulations, and programs require industries and encourage or require households to recycle mercury from waste mercury-containing products. Such collection is estimated to yield 40-80 tons per year in the U.S. and an equal amount in Europe[62]. These estimates have a high degree of uncertainty since there is no centralized or consistent tracking or recordkeeping system.

[58] Tom Parrott, Chlorine Institute, May 2002. Art Dungan, Chlorine Institute, June 2003.
[59] It may be asked why companies are proposing to forego selling mercury? Perhaps they consider this offer may earn public support for continuing to operate their factories. Perhaps they are skeptical about the flow of mercury to developing nations.
[60] Estimate by F. Anscombe, USEPA. Range depends on whether factories have raised mercury levels within production equipment to optimize chlorine yield.
[61] 1 ton of mercury yielded 423 tons of chlorine.
[62] E. Weiler, May 2002.

Secondary Stock (Mercury Held by the U.S. Government)

- During the 1950s, the Defense National Stockpile Center was tasked to stock hundreds of commodities to prevent shortages of strategic materials. One of these commodities was mercury. During the 1970s, the U.S. policy changed and the result was a decision to sell these holdings and close storage depots. For perspective, DNSC has raised five billion dollars thus far in liquidating its various commodity holdings and has sold a number of former storage facilities.
- Federal law requires DNSC to sell its commodity positions gradually, so as to minimize disruptive impacts on commodity markets.
- During 1993, DNSC sold 375 tons of mercury. (That same year, net U.S. exports were 349 tons, suggesting that mercury from DNSC sales fueled exports.)[63]
- DNSC suspended sales in 1994, pending an evaluation of the environmental ramifications of sales or alternate management options. DNSC currently holds 4,889 tons of commodity mercury.
- In 1989, a U.S. mercury mine engaged a university economist to analyze the impacts of DNSC mercury sales. This is the only known, published quantitative analysis of this issue in peer-reviewed literature. This study concluded that during the market conditions then present, U.S. mercury sales lowered the market price by $20/flask at 1,500 flasks sold, and by $60/flask at 4,500 flasks sold. This economist observed:
  "It is impossible to require private companies permanently to store and monitor mercury. It would be difficult to ask the US Government to do so. Yet, as disposal sites are foreclosed, as consumer demand is further proscribed, the choice must be storage or export. Prices must fall as the U.S. government reduces its stockpile. Consumers will reap the benefits. They may be the wrong type of consumer."[64]

Secondary Supply Once Held by C.I.S.

- The Commonwealth of Independent States (ex-USSR nations) has also sold mercury from stockpiles. Between 1994 and 2000, the CIS provided about 1,900 tons of mercury to the world market[65].

Secondary Supply (Recovery from Wastes by thermal or chemical processes)

- EPA and State hazardous waste management programs recover mercury from old mining, manufacturing, and chlor-alkali sites, among others. Private recyclers also recover mercury from a variety of wastes and waste mercury-containing -products. In the U.S., the quantity of mercury recovered from wastes may be 60-80 t/yr[66].
- In addition, many U.S. generators of mercury waste legally elect to ship some types of waste to Canada, where they may be landfilled at lower cost.

---

[63] F. R. Anscombe, analysis of sales/exports, unpublished, 1994.
[64] Rieber, Michael and DeVerle Harris. 1994. "Mercury Pollution: The Impact of U.S. Government Stockpile Sales." In *Mercury Pollution: Integration and Synthesis*, edited by Carl Watras and John Huckabee, Lewis Publishers.
[65] Bruce J. Lawrence, personal conversation, July 2002. Many containers appeared old, suggesting an origin from stored stocks rather than new mining.
[66] Linda Barr, EPA OSW.

- The quantity of mercury supply may be a factor in its marketability. Mercury has a very low price, so there needs to be a considerable amount of it to induce a dealer to pay for it. A closing chlor-alkali factory with several hundred tons can find a dealer willing to buy and remove its mercury.
- In contrast, local household waste collections are not market-driven since they receive relatively small amounts of mercury that will entail net cost to transfer to a dealer. Although the costs of collection and shipment to a retorter may be high, the public health benefits outweigh the costs and justify government action.
- Thus there is an economic motive force (i.e., economic incentive) for a large quantity of mercury, whereas those who receive small quantities of mercury will incur net expense to transport mercury to a dealer.

Summary Observation

- The mercury market is unusual among commodity markets because of the extent to which various government policies affect most sources of supply (e.g., all remaining industrial scale mines receive State support, government-released stocks, environmental regulations that encourage capture/recycling and discourage or prohibit landfilling). Many sources of supply are relatively insensitive to the price of commodity mercury. This situation helps justify this holistic analysis by States as to whether public policies potentially contribute to oversupply of mercury.

International Trade Flows

Some comparative data on U.S. mercury flows are shown in the following table.[67]

Table 2. US Mercury demand, net exports, DNSC sales, chlor-alkali industry sales.

Year	U.S. Demand	Net exports (imports)	U.S. chlor-alkali sales[68]	DNSC sales	Net exports (imports) absent DNSC & C/A sales
1980	2,033	N/A	N/A	335	N/A
1988	1,503	391	170	265	(44)
1989	1,212	90	none	349	(259)
1990	720	296	136	167	(7)
1991	554	730	206	336	188
1992	622	885	none	371	514
1993	558	349[69]	none	543	(194)
1994	480	187	160	86	(59)
1995	436	(198)	none	none	(198)
1996	372	(295)	none	none	(295)
1997	346	(30)	none	none	(30)
1998	400	(65)	none	none	(65)
1999	300	119	220	none	(101)
2000	230	75	50 (80 stored)	none	25
2001	200	10	none	none	10
2002	N/A	N/A	188	none	N/A
Total: 1988-2001	**7,933**	**2,534**	**1,210**	**2,117**	**(605)**

Observations concerning these data:

- U.S. mercury use has fallen 90 percent during the past 20 years.
- By the early 1990s, DNSC sales in the 300 tons per year range began to occupy an ever-larger share of national demand. During 1988-89, DNSC sales were 22.6% of national mercury demand, but by 1992-93, grew to 77.5% of national demand.
- Between 1988 and DNSC mercury sales suspension in 1994, net U.S. exports were 2,928 tons, about 418 tons per year during these 7 years.
- Even without 2,117 tons of mercury sales from the DNSC during this 7 year period, the U.S. would have been a net exporter (811 tons or 116 tons per year).

[67] J. Gilkeson, Minnesota OEA, from USBOM demand data, US Customs, and DNSC sales data.

[68] Estimated F. Anscombe, USEPA, based on factory closure dates and rated production capacity. Whereas DNSC sales are exact numbers, sales from factories are estimates.

[69] Note: This figure differs significantly from 848 metric tons net exports for 1993 noted in Exhibit 2-8 of "Mercury: An Assessment of Commodity Markets and Their Implications for Environmental Policy," September 10, 2002 Draft prepared for the U.S. Environmental Protection Agency.

- During the four years following the DNSC sales suspension, the U.S. economy became a net mercury importer (588 tons or 147 tons per year).
- By 1999 and 2000, U.S. mercury demand had fallen sufficiently that the U.S. become a moderate net exporter (194 tons or 97 per year average).
- Between 1988-2001, estimated sales of mercury from closing U.S. chlor-alkali factories were around 1,210 tons.
- Over the years 1988-2001, the U.S. was a net exporter of mercury (2,534 tons). Taken together, sales of mercury after closure of chlor-alkali factories and from DNSC stock liquidation account for this domestic excess. Without these sources of supply, the U.S. would have been a net importer (605 tons) during this period.

Market participants describe international trends in market reviews published in the trade press

- "Mercury use—by both consumers and industry—continued to drop in the United States and Europe in 1993. Mercury consumption in developing countries remained, with year-end signs of increased demand for the metal. … The U.S. and European countries were net exporters, selling excess mercury stocks to emerging economies. Supplies continued to be plentiful, even with a sharp reduction in world production. The west-to-east shift in mercury use showed up in an increased demand from China and India for most of the traditional uses associated with industrial economies. Year-end demand also came from S. America and S. Africa." —Bruce J. Lawrence, *Engineering and Mining Journal*, March 1994[70].
- A similar statement is made by a market participant with global perspectives: "Mercury consumption in developed countries has been falling for many years, with sales being concentrated in the less developed parts of the world…Environmental regulations that began in Japan after the Minamata Bay disaster have affected mercury uses in developed countries and spread into the regulation of the emerging and less developed countries, threatening the metal's future."[71] – Howard M. Masters, *Mining Journal*, 1995.

Europe also has mercury abundance

- West European chlor-alkali factories hold 12,000 tons of mercury that is steadily sold to the commodity market as factories close. Some of this mercury is sold to Almaden and marketed through its global sales outlets, including several in developing countries.
- As mentioned above, Spanish government subsidies to Almaden support more production than world demand and market prices would justify.
- In light of this abundance, a member of the European chlor-alkali industry has written: "A reassessment of the EU mercury policy as a whole, including mercury mining, secure mercury disposal, and appropriate approaches for the chlor-alkali stockpile appears necessary."[72]

---

[70] Bruce J. Lawrence, Engineering and Mining Journal, March 1994.
[71] Howard M. Masters, *Mining Journal*, 1995.
[72] Dr. Andrew Lindley, ICI Chemicals. "An Economic and Environmental Analysis of the Chlor-alkali Production Process." Report for the European Commission DG III, June 1997.

DISCUSSION

How is the condition of oversupply recognized in economic terms?

- The mercury market is characterized by suppliers who are "price-insensitive," i.e., the supplier will continue to offer mercury into the market, regardless of the low price that the supplier obtains from selling mercury. (The term "price-insensitive" is a value-neutral economic characterization.)
- Such supplies include: recovery of mercury due to governmental regulations; foreign government subsidies to mines that produce mercury; and sale of mercury from government stocks or by private holders of surplus mercury, notably chlor-alkali factories when these close and liquidate their assets.
- Economic symptoms consistent with "oversupply" include:
    - most importantly, a low prevailing price of mercury, lower than known present or historic production costs;
    - sources of supply that are apparently curbed little or not at all by the low price of mercury;
    - cost minimizing-avoidance motivations for suppliers, e.g., minimizing storage costs for unsold mercury;
    - closure of privately-owned mercury mines;
    - mercury mines supported by public subsidies;
    - looming abundant stocks freed from their original purposes (e.g., closing chlor-alkali factories; U.S. Federal mercury stock), and;
    - trade flow from relatively wealthy nations, where mercury is unwanted, to less wealthy nations, where mercury is sold below its full historic cost of production.
- Since these indicators are present, we conclude that the United States contributes to an oversupplied mercury market. An oversupply condition is not signified by unsaleable stocks in the hands of private brokers, instead it is signified by sales from price-insensitive supplies at prices well beneath the full historic cost to produce this mercury. Private brokers are adept at liquidating stocks, especially to nations in which use is little constrained by public health and environmental regulations. Furthermore, the cost minimization incentives of suppliers even raises the prospect that in due course it could behoove them to pay brokers to take their mercury and in turn pay ensuing new customers to receive this mercury. Mercury could thus achieve a negative selling price. Indeed, it came close to this in the early 1990s when the US government sold stockpile mercury for 50 cents a pound compared to acquisition costs much higher than this.
- Some potential supplies to the commodity market (e.g., US government stocks and those to be sold by closing chlor-alkali facilities) are very large relative to known measures of demand. Yet these supplies can be 'cleared' by the market, since it has no price floor, prospectively not even zero. Cost-avoiding producers will lower their selling price to whatever level is necessary to clear their inventory. Data in this paper demonstrates that this happens.

Owing to uncertainties about actual mercury use and supply on a global basis, it seems unclear whether the global economy faces a supply surplus if the chlor-alkali industry remains stable in terms of mercury consumption and closure rates.

- Relying on estimates of supply, world demand is inversely estimated at 2,000 to 2,500 tons per year. Sources of supply may be becoming more varied and less visible; therefore actual demand on a global scale may be higher. The quantity of mercury used by developing countries is little known, but demand seems robust, largely owing to artisanal gold mining.
- Primary production of mercury appears to be 1,000 to 2,000 tons per year, whereas secondary supplies of mercury may include 500 to 1,000 tons per year from closure of chlor-alkali factories, 80-160 tons from recycling mercury-containing devices, 300 tons from byproduct mining, and 60-80 tons in the U.S. from waste recovery.
- The global chlor-alkali industry is a significant consumer of mercury, with large potential to reduce demand and releases, as noted below.

But there are indications of an impending global mercury surplus if there is large scale use reduction and/or closure of mercury cell chlor-alkali plants over a relatively short period of time.

- As noted above, global consumption is estimated to be 2,000 t/yr or about 1,800 t/yr excluding the US for year 2002.
- US and EU chloralkali facilities (60 percent of global capacity) account for about 170 t/yr of global mercury consumption.
- Other global chloralkali facilities (40 percent of global capacity) account for about 570 t/yr of global consumption. However, there are significant opportunities to increase efficiency and reduce annual global demand, potentially contributing to oversupply. If these plants consumed mercury at the same rate as US/EU plants, they would consume about 110 t/yr.
- European chloralkali facilities hold 12,000 to 15,000 tons of mercury and many of these plants are slated to close within the next 20 years.
- Based on production capacity, all non-US/EU chlor-alkali facilities may hold 15,000 tons of mercury. The rate of closure or conversion cannot be estimated at this time.
- Together all of these facilities hold perhaps 35,000 tons of mercury relative to annual global demand of 2,000 tons.
- Thus chlor-alkali plant closures increase supplies of mercury to the market while simultaneously reducing market demand.

More clearly, relative to its modest domestic needs, the U.S. has a mercury surplus

- U.S. mercury demand is 200 tons per year. This demand can largely be met by domestic sources of mercury supply (byproduct mining and recovered secondary mercury).
- Yet the USG holds 4, 889 tons of mercury, U.S. chlor-alkali factories may hold 3,000 tons. If made available to the market, this would be enough mercury to meet 40 years of U.S. demand, even without other sources of supply.

- Between 1988 and DNSC mercury sales suspension in 1994, net U.S. exports were 2,928 tons, about 418 tons per year during these seven years. Even without 2,117 tons of sales from the DNSC during this period, the U.S. would have been a net exporter (811 tons or 116 tons per year). During the four years following the DNSC sales suspension, the U.S. economy became a net mercury importer (588 tons or 147 tons per year). Yet by 1999 and 2000, U.S. mercury demand had fallen sufficiently that the U.S. had again become a net exporter (194 tons or 97 per year average).
- There is more mercury in America than our economy will seemingly be able to use, for decades to come, at present consumption rates.

This domestic surplus inevitably impacts price and exports

- If mercury is sold by U.S. chlor-alkali firms, or if sales were to be resumed by the Defense Department, economists would expect, qualitatively, that such increased supply would have a depressive price effect.
- There is very little in the economics literature on this point. There appears to be only one economist who has published in the peer-reviewed literature on the topic of mercury stockpiles and sales, and this writer notes: "The impact of stockpiles on commodity prices has been known since Exodus. Their disposal, or even the threat of their release, is sufficient to quell price increases and enrage producers. Both U.S. Government and private stocks of mercury are very large relative to domestic or even annual world consumption."[73]
- When mercury stocks are released, much of these sales inevitably are exported via intermediaries to countries with more robust demand.

Market-makers preserve (so as to sell) commodity stocks, rather than retire them

- Mercury brokers are not in business to "hold" mercury. Holding mercury does not earn them any income and pay bills. Brokers will seek to avoid storage and other costs.
- Rather market makers are in business to serve customers. They buy mercury from those who have some to sell and then sell it to customers who seek mercury. The latter are mostly in developing countries. Unsurprisingly, Almaden has sales representatives in developing nations.
- The ECOS recommendation to "Retire" surplus commodity mercury from U.S. sources intrinsically requires federal government action. Without government involvement of some kind, retirement will not happen of its own accord.

Are Exports of Surplus Mercury Unwelcome in Environmental Terms?

- Mercury is used in developing nations in many of the same ways as in the U.S., including dental care, instruments, chlor-alkali plants, lighting, and computers. Although many of these uses serve legitimate purposes, non-mercury alternatives are increasingly available in developed countries. Because nations receiving mercury have weaker regulatory controls and less awareness of mercury's toxicity, and emissions have both local and global impacts, many consider such sales to be "toxic trade."

[73] Rieber 1994.

- Some argue that denying mercury from a nation with a surplus to one with a shortage could encourage new or additional mining of mercury. Others maintain that withholding surplus mercury may reduce its use in artisan mining and other sectors, and not affect new mining.
- By withholding mercury, can surplus nations reduce use of mercury in artisanal gold mining? This would probably occur to only a modest extent. The price of gold is vastly higher and the cost of mercury a minor factor.
- A lower mercury price and abundant supply (resulting from surplus nations selling their mercury) can promote more use of mercury in developing countries, and some of the uses are dissipative, such as in pesticides, paints, medicines, soaps, and cosmetics. Such uses may pose direct exposure health risks, produce wastes that are little regulated, and contribute to the atmospheric mercury burden.

When is recycling of mercury warranted? The mining connection

- Some argue that reintroducing mercury stocks into commerce represents a justifiable environmental policy, if it discourages or prevents new production of mercury from privately-owned mines. However, commercial mining for mercury is nonexistent and existing mines are subsidized. There are also other ways to forestall new mining, for example, by encouraging an end to production subsidies, increasing secondary recovery (primarily to prevent release and meet current demand in the short term), and most importantly, promoting global demand reduction efforts that result in permanent rather than temporary demand reduction.

For-profit Mercury Mines as an Economic Indicator: "Canaries" to Help Guide Mercury Stock Stewardship

- It would be welcome if there were accurate and complete information about world mercury use, but this is not the case. Whether use of mercury in developing countries is 45 tons or 4,500 tons is likely not relevant to U.S. decisions about its mercury stocks.
- Recycling mercury as an environmental good is predicated in part on curtailing primary mining from ores and reducing emissions from mining and smelting operations. If there are active, privately-owned mercury mines that supply an international market, then recycling mercury seems justified to curtail those operations.
- This insight should be of use to policy-makers facing uncertainty about what to do with American mercury stocks. It is not critically important to model the global mercury commodity market in order to decide what to do with potentially surplus mercury. This is fortunate, because the mercury market is sufficiently non-public and widely dispersed, and such modeling cannot be done very easily, if at all.
- The status of private mines can be considered as a relatively simple economic indicator in the determination of whether to store or to sell mercury stocks. Since industrial scale mercury mines are hard to hide, their status should be easily verifiable.
- Ironically, this reverses the concept of using a canary in a coal mine to alert miners to dangerous gases. Instead, a private mercury mine becomes a canary. If it exists, then it

is one criterion for releasing government controlled mercury stocks. If private mines do not exist, then stocks should be maintained.

What are economic and environmental criteria that could guide the choice between sales and storage?

- Are there active for-profit mercury-only mines in the United States? Is it not possible to forestall their operation through increased secondary recovery or reduced demand? If these conditions hold, consider selling Federal mercury. [Reportedly there were 150 mercury mines in the U.S. in 1970, now none, the last closing in 1989. Their closure in part is due to Federal sales of mercury by the Defense Department, decreased domestic demand, and the decreased price of mercury.] Government laws, policies, and regulations are continually being strengthened to decrease use and emissions. These efforts also decrease demand and prices.
- Are there active mercury-only mines elsewhere in the world? If so, are these privately-owned or State-owned? If privately owned, do they serve an international customer base or do customers appear local? Are there no other short term secondary supply or demand reduction options available? Based on this determination, if a mercury-dedicated mine is privately-owned and serving an international market, then consider selling U.S. mercury holdings to prevent new resource extraction.
- If instead a mine is State-owned or only serving a local foreign market, then consider continuing to store U.S. mercury holdings, because it is unlikely that U.S. sales would curb production from such sources of supply.
- The criteria above are somewhat simple and do not include all economic and environmental criteria that could be used to make such decisions. In summary, mercury would be sold from stockpiles if there is private mercury mining and no short term potential for increased secondary recovery or reduced demand.
- These criteria set aside byproduct mining, which can serve to meet ongoing world demand at the present time. And it separates sales decisions from attempting to undercut price or production costs of foreign government owned mines. This would likely be a futile race to the bottom.
- Decisions about U.S. government mercury stocks would then be deferred to world demand for mercury. These criteria are in keeping with the principles of RCRA (recycle to prevent new resource extraction). They also respect that mercury demand is poorly known or predictable, with potentially great use in developing countries. There was an operating U.S. mercury mine just 12 years ago. These criteria respect the possibility that a mercury shortage could develop, raising the price of mercury, opening new mines. This argues for containing mercury stocks in marketable, retrievable condition, as insurance against new mercury mines.

Waste versus Commodity? An economic and environmental question

- Some have questioned whether RCRA regulations are well-advised to favor the recycling of elemental mercury, given diminishing need for mercury in the U.S. economy. From the perspective of the commodity market they ask whether it makes sense to recycle something for which there seems little demand? To favor recycling regardless of market conditions presumes indefinite need for mercury, which does not seem to hold in the

U.S. However, there are environmental justifications for recovery to prevent release and the associated health and environmental impacts. Recovered mercury need not be returned to the market, as is currently mandated.

- There are reports that the Swedish government has banned exports of elemental mercury and those members of society who hold commodity grade mercury will be required to transform their mercury to HgS and place it in a deep-rock mine. The Swedish approach thus may define commodity mercury as a waste, preventing its reuse and foreign sale, regardless of circumstances, and seems the opposite of the current RCRA preference for recycling that implies elemental mercury is always a valuable commodity.

Some of the negative economic and policy impacts of the Swedish approach are:

- If a holder of mercury has a large enough quantity that is potentially saleable, then this mercury is "taken" without recompense; and
- The asset of commodity grade mercury must be turned into a waste, regardless of its potential to meet use elsewhere in the world and to discourage new mining.

Some of the positive economic and policy impacts of the Swedish approach are:

- Sweden is acknowledging that mercury currently in Sweden is not and will never be needed elsewhere in the world. There is more than enough in circulation already.
- The Swedish Government has pursued a course of action that does not require recycling of mercury back into commerce.
- Mercury owners are responsible for 'stewardship' in assuming the costs of converting their mercury into a waste. The Swedish Government shares in responsibility by supporting the development and operation of the permanent repository, which individual mercury owners could not accomplish or pay for on their own.

The Quicksilver Caucus has asked: is mercury a waste or a commodity? Economists would tend to answer this question as follows:

- Elemental mercury is always potentially useable.
- Whether U.S. mercury stocks are ever used or not is up to society as a whole over time.
- Economic and technological conditions change through time. Today's surplus could become tomorrow's shortage. Currently, there appear to be few inhibitions on use of mercury in developing nations. However, increasing environmental and health awareness and implementation of policies to encourage use of alternatives could change this. US policy that promotes mercury stewardship and use reduction will send a policy message and potentially an economic message (price increase) to mercury users in developing countries. This combination will likely have a psychological impact that will increase the effectiveness of toxicity and use reduction outreach efforts targeted to artisanal miners and others.
- But could society gradually reduce and virtually eliminate all use of mercury? Given sufficient time, technological changes, and the diffusion of best practices around the globe, it is conceivable that society could gradually reduce and virtually eliminate all mercury use.

- If and when that possibility becomes reality, it would then become clearly reasonable to regard commodity mercury as useless and as a waste.

DRAFT Quicksilver Caucus Recommendations based on the work of the Mercury Market Subgroup:

These Draft Recommendations were developed by the Quicksilver Caucus/state members of this subgroup based on the data presented in this paper and on the discussion in this paper and the Market Subgroup's primary product, the Assessment of Market Policy Options document.

Many of these recommendations are supported by seven active ECOS Resolutions related to mercury. These resolutions are:

96-2 UNITED STATES MERCURY STOCKPILE SALES
01-1 NEED FOR ARTICULATION OF A NATIONAL VISION FOR MERCURY
01-2 ON MULTI-POLLUTANT STRATEGIES FOR THE CONTROL OF AIR POLLUTION
01-3 MERCURY RETIREMENT AND STOCKPILING
01-14 NEED FOR BETTER APPROACH THAN TMDLS FOR ADDRESSING FISH CONSUMPTION ADVISORIES DUE TO ATMOSPHERIC DEPOSITION OF MERCURY
02-7 NEED FOR NATIONAL MERCURY REDUCTION STRATEGY AS AN OPTION FOR ATMOSPHERIC MERCURY TOTAL MAXIMUM DAILY LOADS (TMDLS)
02-8 PRINCIPLES OF PRODUCT STEWARDSHIP

Draft Recommendations:

1. **Discourage Production Subsidies**: The United States should encourage the few foreign governments who provide financial aid to their primary mercury mines to desist from this practice, on environmental grounds. Subsidies to mercury mining increase output beyond the level warranted by demand, and thereby lower the prevailing price of mercury and invite increased use, especially in developing countries.
2. **Encourage International Use Reduction**: The United States should exchange information with other nations, via the UNEP mercury forum and other forums as appropriate, to actively support and encourage reduced use of mercury on an international basis.
3. **Given large stocks plus economic conditions of market oversupply, the U.S. should manage its mercury holdings**: The United States Government should manage its surplus mercury holdings, in a balanced way, factoring market conditions, as they dynamically change. It should resume gradual sale of mercury, if there is sufficient evidence of for-profit mercury mining or based on other relevant market and environmental criteria, so as to dampen demand for new mercury mining. Or if, as now, there does not seem to be for-profit mercury-dedicated mining, then the U.S. should continue to store mercury stocks, to prevent surpluses from being pushed to

developing countries at use-inviting prices. Since there is not presently a way to retire mercury from the commodity market under waste management regulations (i.e., an existing "landban" on conventionally-treated mercury wastes, endorsement of retorting as a treatment, and lack of an explicit federal endorsement of mercury storage), mercury surpluses from developed countries are inevitably pushed toward developing countries by the absence of an alternative to reintroduction of mercury into commerce. Since mercury is currently an internationally traded commodity, the United States Government should ensure that trade agreements and regulations facilitate and do not hinder efforts to require disclosure or reduce mercury production, use, trade, and permanent sequestration.

4. **Private mercury holdings in the U.S. also need to be managed, for the same reasons**: Chlor-alkali industry mercury stocks become available to the market when plants close, and similarly are likely exported to developing countries at low price. The US chlor-alkali industry has indicated a willingness to transfer surplus mercury stocks from closed plants into a federal storage program. The federal government should respond to this offer and begin discussions with the chlor-alkali industry and other stakeholders to make this a reality.
5. **Factor commodity market conditions into waste treatment choices**: USEPA regulations favor recycling mercury into commerce, regardless of market conditions (shrunken demand, low price); USEPA should introduce real-world market conditions into waste management treatment decisions regarding any regulated commodity, including mercury. EPA's present goal of recycling carries with it an attendant responsibility to ensure that mercury is thereafter used responsibly. If the mercury market has abundant supply, then inflexible price-insensitive recycling, by economic logic, fosters overabundance, lowers price, and encourages increased use in developing countries. This present policy posture is tantamount to promoting use of cheap mercury in developing countries. How can this be ameliorated? EPA should establish a mercury storage option as a first step. EPA should continue to work toward developing and implementing a performance-based land sequestration treatment option for long term (>50 years) or permanent storage. Thereafter, waste managers can flexibly chose between recycling, storage, and land sequestration, with their choices shaped by marketplace and environmental conditions through time.
6. **Obtain commodity market information**: The United States Government should require domestic producers of commodity grade mercury, mercury-containing products, and commercial mercury compounds to report production, sales, imports, and exports (quantity, price, destination, anticipated use). The United States should encourage other nations to do so as well via UNEP and other international forums as appropriate.

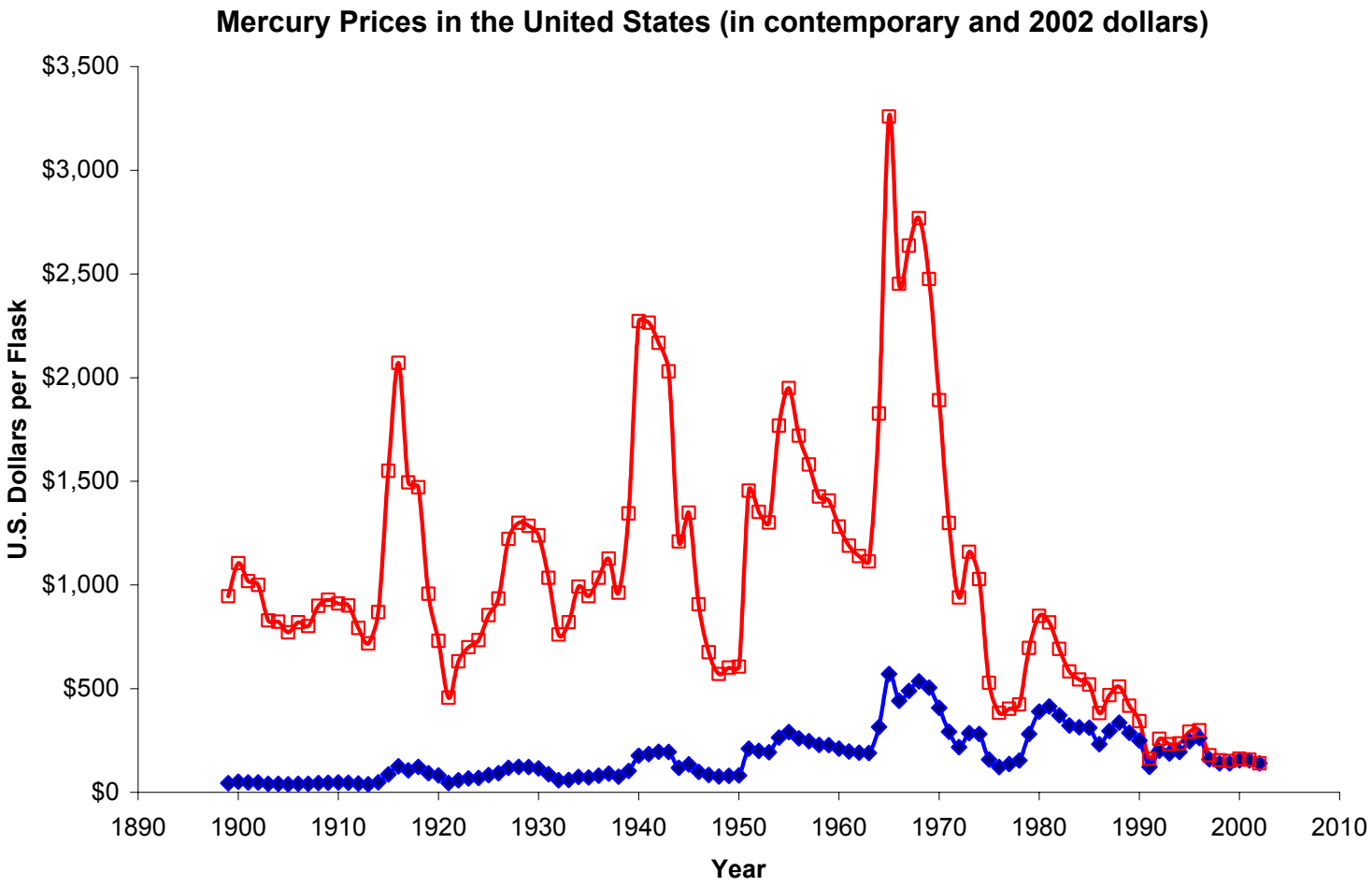
Mercury Price data from 1899-2002

1899- 1995 Mercury Prices from Robert G. Reese (1998) "Metal Prices in the United States through 1998"
http://minerals.er.usgs.gov/minerals/pubs/commodity/mercury/430798.pdf

1996-2002 prices from "2003 Minerals Commodity Summary: Mercury"; http://minerals.er.usgs.gov/minerals/pubs/commodity/mercury/430303.pdf

CPI from Federal Reserve Bank of Minneapolis 7/23/2003; http://minneapolisfed.org/research/data/us/calc/hist1800.cfm

YEAR	$/Flask	2002 $/Flask	CPI
1899	$43.63	$945.02	8.3
1900	$51.00	$1,104.66	8.3
1901	$47.00	$1,018.02	8.3
1902	$48.03	$1,000.32	8.6
1903	$41.32	$828.69	9.0
1904	$41.00	$822.28	9.0
1905	$38.50	$772.14	9.0
1906	$40.90	$820.27	9.0
1907	$41.50	$802.58	9.3
1908	$44.84	$899.29	9.0
1909	$46.30	$928.57	9.0
1910	$47.06	$910.11	9.3
1911	$46.54	$900.05	9.3
1912	$42.46	$792.83	9.6
1913	$39.54	$718.51	9.9
1914	$48.31	$869.10	10.0
1915	$87.01	$1,549.81	10.1
1916	$125.49	$2,071.16	10.9
1917	$106.30	$1,494.01	12.8
1918	$123.47	$1,471.01	15.1
1919	$92.15	$958.25	17.3
1920	$81.12	$729.67	20.0
1921	$45.46	$456.89	17.9
1922	$58.95	$631.26	16.8
1923	$66.50	$699.61	17.1
1924	$69.76	$733.91	17.1
1925	$83.13	$854.58	17.5
1926	$91.90	$934.06	17.7
1927	$118.16	$1,221.67	17.4
1928	$123.51	$1,299.38	17.1
1929	$122.15	$1,285.08	17.1
1930	$115.01	$1,238.94	16.7
1931	$87.35	$1,033.83	15.2
1932	$57.93	$760.70	13.7
1933	$59.23	$819.65	13.0
1934	$73.87	$991.73	13.4
1935	$71.99	$945.33	13.7
1936	$79.92	$1,034.36	13.9
1937	$90.18	$1,126.62	14.4
1938	$75.47	$962.91	14.1
1939	$103.94	$1,345.24	13.9
1940	$176.86	$2,272.65	14.0
1941	$185.02	$2,264.29	14.7
1942	$196.35	$2,167.08	16.3
1943	$195.21	$2,029.96	17.3
1944	$118.36	$1,209.83	17.6
1945	$134.89	$1,348.15	18.0
1946	$98.24	$906.33	19.5
1947	$83.74	$675.55	22.3
1948	$76.49	$570.98	24.1
1949	$79.46	$600.62	23.8
1950	$81.26	$606.58	24.1
1951	$210.13	$1,453.94	26.0
1952	$199.10	$1,351.63	26.5
1953	$193.03	$1,300.60	26.7
1954	$264.39	$1,768.17	26.9
1955	$290.35	$1,949.03	26.8
1956	$259.92	$1,719.10	27.2
1957	$246.98	$1,581.20	28.1
1958	$229.06	$1,425.88	28.9
1959	$227.48	$1,406.31	29.1
1960	$210.76	$1,280.94	29.6
1961	$197.61	$1,188.96	29.9
1962	$191.21	$1,139.03	30.2
1963	$189.45	$1,113.79	30.6
1964	$314.79	$1,826.80	31.0
1965	$570.75	$3,259.62	31.5
1966	$441.72	$2,452.64	32.4
1967	$489.36	$2,635.80	33.4
1968	$535.56	$2,768.60	34.8
1969	$505.04	$2,475.66	36.7
1970	$407.77	$1,890.67	38.8
1971	$292.41	$1,298.88	40.5
1972	$218.28	$939.44	41.8
1973	$286.23	$1,159.75	44.4
1974	$281.69	$1,027.91	49.3
1975	$158.12	$528.73	53.8
1976	$121.30	$383.51	56.9
1977	$135.71	$402.88	60.6
1978	$153.32	$423.04	65.2
1979	$281.10	$696.55	72.6
1980	$389.45	$850.27	82.4
1981	$413.86	$819.07	90.9
1982	$370.93	$691.51	96.5
1983	$322.44	$582.40	99.6
1984	$314.38	$544.34	103.9
1985	$310.96	$519.90	107.6
1986	$232.79	$382.11	109.6
1987	$295.50	$467.96	113.6
1988	$335.52	$510.23	118.3
1989	$287.72	$417.43	124.0
1990	$249.22	$343.04	130.7
1991	$122.42	$161.70	136.2
1992	$201.39	$258.23	140.3
1993	$187.00	$232.81	144.5
1994	$194.45	$236.04	148.2
1995	$247.39	$292.03	152.4
1996	$261.61	$299.96	156.9
1997	$159.52	$178.80	160.5
1998	$139.84	$154.34	163.0
1999	$140.00	$151.18	166.6
2000	$155.00	$161.93	172.2
2001	$155.00	$157.45	177.1
2002	$140.00	$140.00	179.9


Mercury Prices in the United States (in contemporary and 2002 dollars)
U.S. Dollars per Flask
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Year