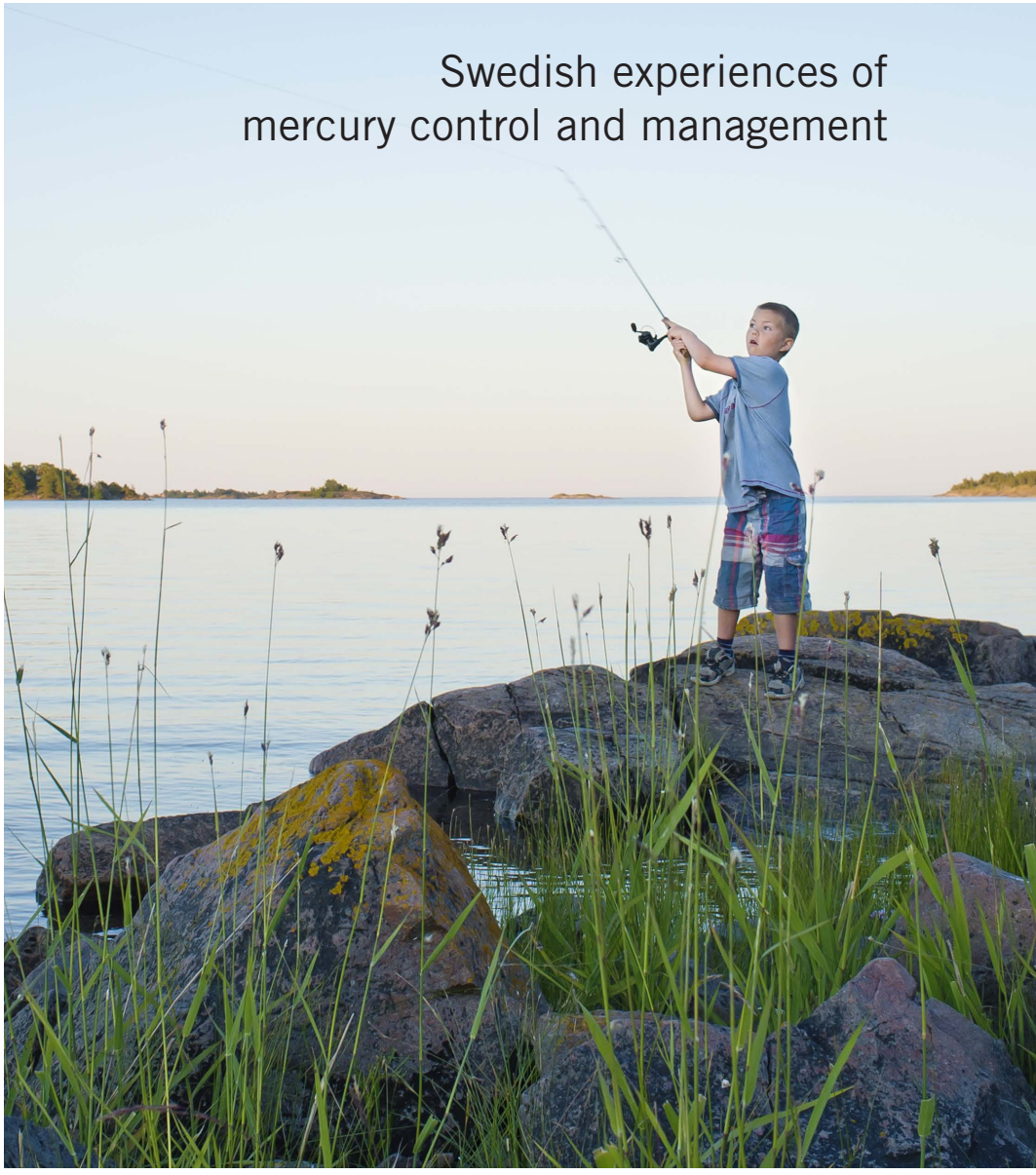
Mercury management in Sweden



Swedish experiences of
mercury control and management

Abbreviations

ASGM	Artisanal and Small-scale Gold Mining
BAT	Best Available Techniques
CLRTAP	Convention on Long-range Transboundary Air Pollution
EMEP	European Monitoring and Evaluation Programme
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
Swedish EPA	Swedish Environmental Protection Agency
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
VCM	Vinyl Chloride Monomer
WHO	World Health Organization

Mercury – a global environmental and health problem

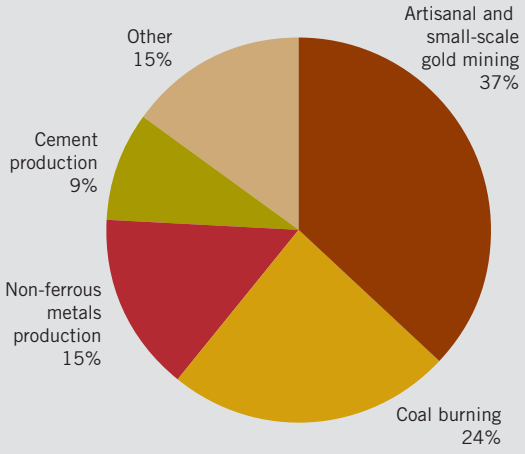
Mercury is recognized as a chemical of global concern due to its long-range transport in the atmosphere, its persistence in the environment, its ability to bioaccumulate in ecosystems and its significant negative effect on human health and the environment. To reduce its environmental and health impacts, there is a need for international understanding and collaboration. The work to reduce mercury pollution cannot be accomplished by individual countries alone.

Photo: Matton Collection

Mercury sources, demand sectors and fate

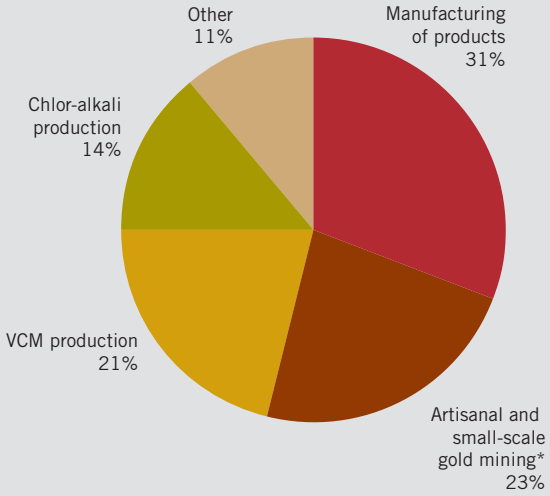
Global mercury emission sources and demand sectors

Biggest sources of air emissions 2010



Source: UNEP, Global Mercury Assessment 2013

Biggest demand sectors 2005



Source: UNEP, Summary of Supply, Trade and Demand information on Mercury 2006

Total global anthropogenic emissions were estimated at 2,000 tonnes in 2010.
Total global demand was estimated at 3,500 tonnes in 2005.

* The 2005 estimate for mercury use in artisanal and small-scale gold mining (ASGM) is approximately 800 tonnes. In the Global Mercury Assessment 2013, estimated use in 2010 amounted to around 1,600 tonnes as a result of better information; hence the use of 800 tonnes in ASGM 2005 is probably an underestimate.

The predominant form of mercury causing concern is methylmercury (MeHg), which is formed through methylation of inorganic mercury by micro-organisms in the environment. MeHg is accumulated in the aquatic food chain and represents a threat to populations reliant on fish, shellfish and marine mammals as their daily nutrient source. The high concentration of MeHg in certain species of fish has led to dietary recommendations in some countries.

Mercury cycles in our environment

Mercury can travel far from its original point of emission. Once released, it persists in the environment, where it circulates between air, water, sediments, soil and living organisms.

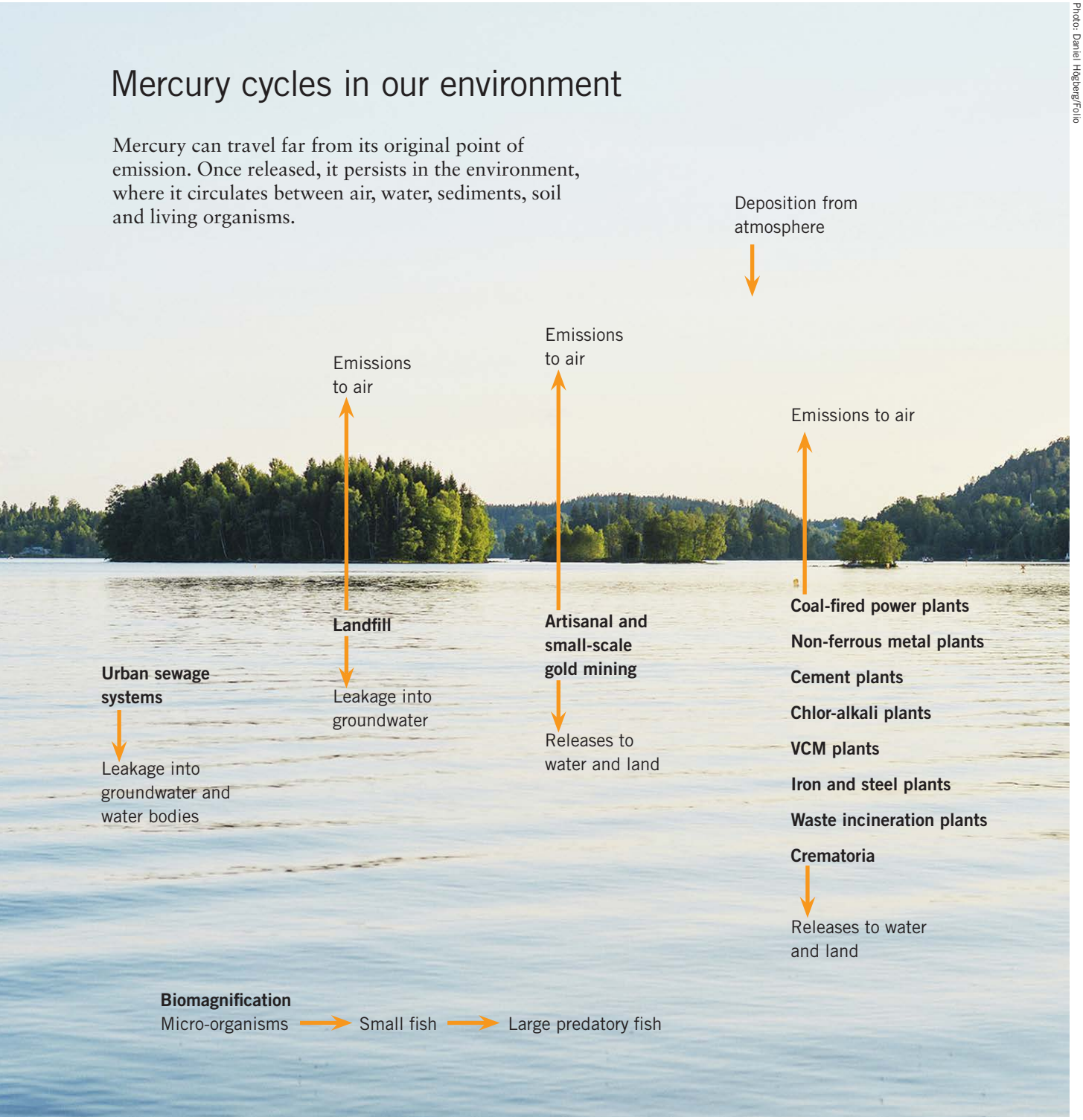


Photo: Daniel Högberg/Folio

Photo: MASKOT

Mercury and human health

Mercury can produce a range of adverse health effects, including permanent damage to the nervous system, kidneys and cardiovascular system. Methylmercury accumulates in food chains and may cause serious health problems, especially in fish-eating populations. Developing organ systems are particularly sensitive and mercury can be transferred from a mother to her unborn child. Infants, children and women of child-bearing age are therefore considered vulnerable populations.

General exposure

Large predatory fish and marine mammals

Vegetables from mercury-contaminated soils

Cosmetics and soaps containing mercury

Waste containing mercury

Occupational exposure

Artisanal and small-scale gold mining

Manufacturing of products containing mercury (e.g. compact fluorescent lamps, batteries, medical devices)

Chlor-alkali industry

Dental use of amalgam

Waste management

Most affected organs

Central nervous system, including the brain, skin, lungs, heart, liver, kidneys, thyroid and immune system

Why mercury is such an important issue for Sweden

Mercury levels in Swedish forests and arable fields are three to five times higher than natural background levels. Fish in thousands of lakes have increased levels of mercury and cannot be eaten without applying stringent dietary recommendations.

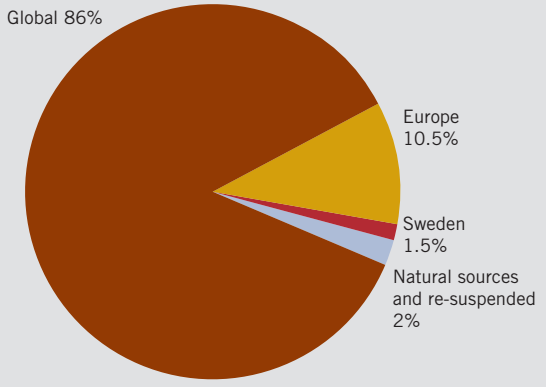
In Sweden, this situation is regarded as one of the most serious effects of transboundary air pollution. It is estimated that mercury deposition to Sweden must be reduced by 80 per cent to achieve tolerable concentrations in the environment.

Mercury deposition to Sweden

The deposition of mercury to Sweden in 1990 was estimated at 5.4 tonnes, of which one third originated from other European countries and nearly two thirds via inter-continental transport from countries outside Europe.

Since then, emissions in Europe have been reduced. Countries in the European Union (EU) have agreed a number of directives that require emission reductions and the use of Best Available Techniques (BAT) at industrial plants. Most important for mercury emissions is the Large Combustion Plants Directive, which was first adopted in 1987 and requires coal-fired power plants to install efficient particulate filters and desulphurisation equipment which have the added benefit of significantly reducing mercury emissions.

However, this has not led to substantial reductions in deposition to Sweden. The reduced emissions in Europe have been offset by increased mercury emissions globally.

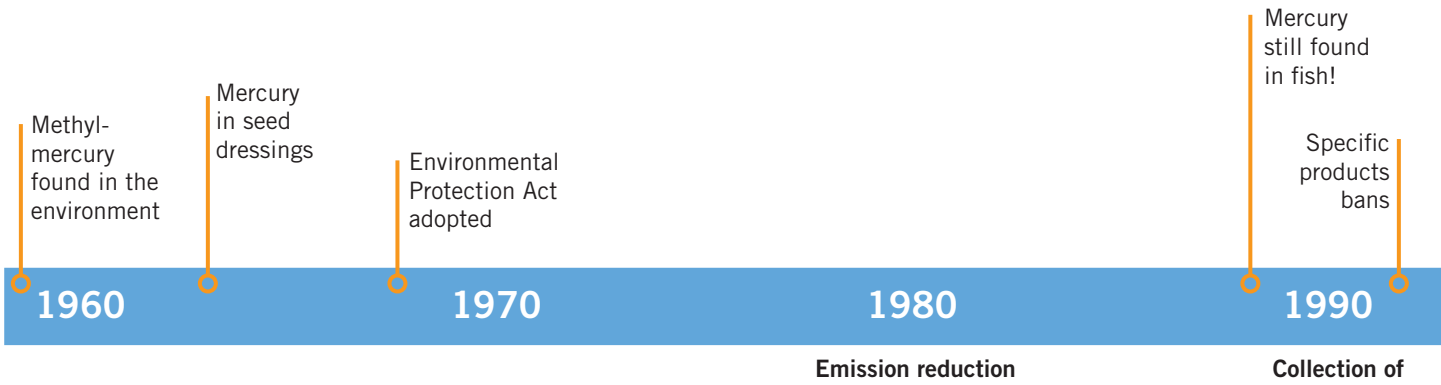


Mercury deposition to Sweden in 2011

In 2011, mercury deposition to Sweden was estimated at 4.0 tonnes. Most of this deposition originates from global sources outside Europe.

Source: EMEP 2013

Mercury policy in Sweden – a historical overview



1960s – THE PROBLEM IS RECOGNISED

During the 1960s, there were a number environmental incidents in Sweden. Dead birds, fish and seals were found and those that were not dead were suffering from hitherto unknown illnesses and reproductive problems.

Some of these problems were caused by seed dressings and pesticides used in agriculture, but high levels of mercury were also found in places not close to a source. Many lakes were black-listed because of high mercury levels and people were recommended not to eat fish from these lakes.

In 1967, the Swedish Environmental Protection Agency (Swedish EPA) was created. One of the new agency's first tasks was to prepare new consolidated legislation to prevent air and water pollution, noise and other types of disturbance.

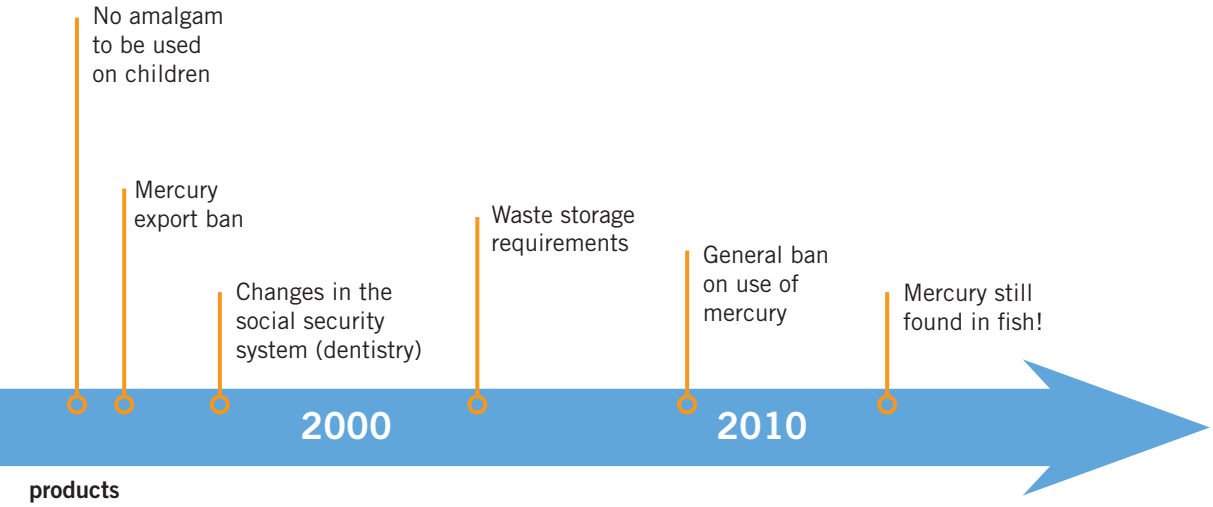
1970s – FOCUS ON REDUCING POLLUTION FROM POINT SOURCES

In 1969, the Environmental Protection Act was adopted. This act dealt with the regulatory framework within which industrial and other stationary plants had to operate, and required environmental impacts to be prevented insofar as was technically feasible, economically reasonable and environmentally justified.

1990s – UPSTREAM MITIGATION

By the early 1990s, mercury emissions from Swedish point sources had been greatly reduced, but it was not enough to improve the environmental situation. It was also found that a high proportion of mercury emissions was caused by the use of mercury in products and processes.

A mercury strategy was formulated to take mercury out of circulation. The basis was a government statement that "the burden caused by mercury on our environment is too high and must be reduced, and every addition should be avoided".



The Swedish mercury strategy

1. Reduce mercury emissions from point sources as far as possible
2. Phase out the use of mercury in products and processes
3. Collect and treat mercury already in use
4. No recycling of mercury
5. Final disposal of mercury waste
6. Export ban on mercury and mercury compounds
7. Enhance international cooperation

Photo: Niclas Albinsson/Folio

The aim of the Swedish Mercury Strategy
is to reduce mercury levels in the environment to natural background levels and to be able to eat fish from Swedish lakes without any concerns about health risks.

Reduce mercury emissions from point sources as far as possible

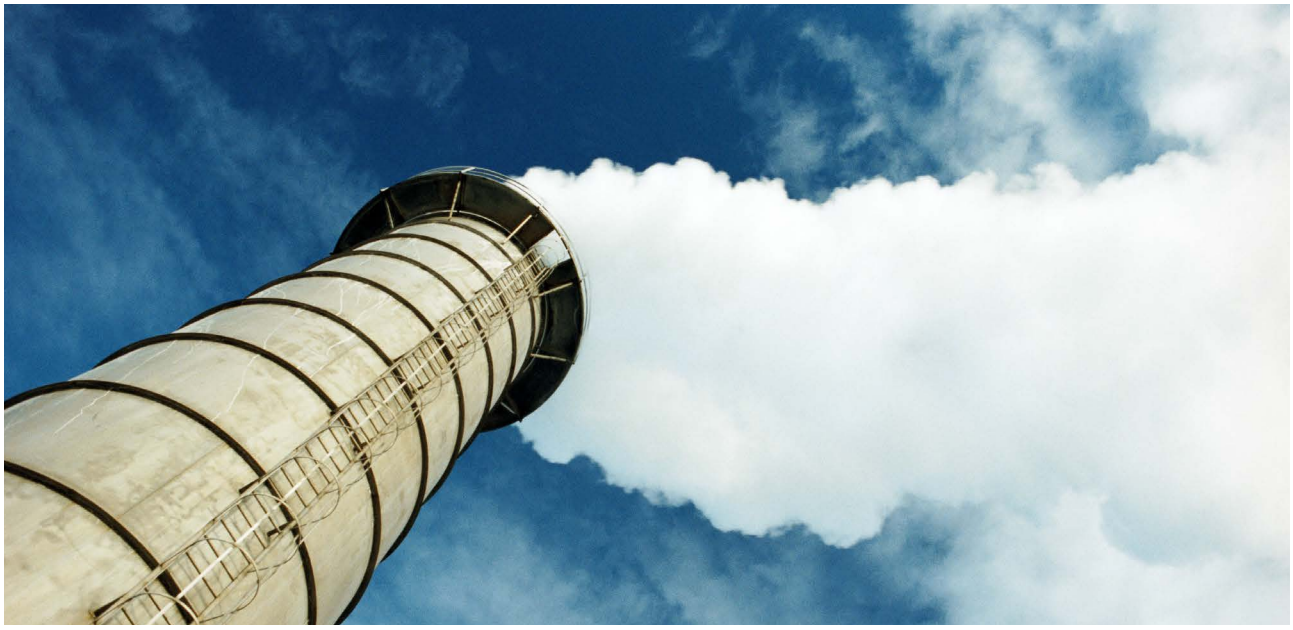


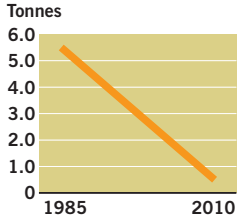
Photo: Malcolm Hanes/Johner

Since the Environmental Protection Act was adopted in 1969, mercury emissions from industrial plants have been greatly reduced.

Requirements were initially primarily aimed at reducing sulphur dioxide, nitrogen oxides and particulate matter, but an additional benefit of implementing these measures was reduced emissions of other pollutants, such as mercury, lead, cadmium and dioxins. In many cases, energy and raw material consumption was also reduced as a result of emission reduction measures as recirculation of materials and general improvements in controls of the processes.

We do not have any comparable figures dating from before 1985, but emissions were much higher during the 1960s and -70s.

Mercury emissions from Swedish point sources decreased from about 5.5 tonnes in 1985 to 0.5 tonnes in 2012.



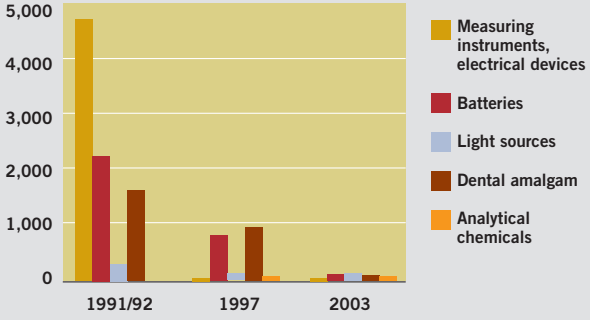
Source: Swedish EPA

Phase-out the use of mercury in products and processes

A number of good alternatives to using mercury in products are available, and since 2009 Sweden has had a general ban on mercury in place. The work to phase out the use of mercury in products also plays an important role in reducing total emissions of mercury to air. Mercury in products can be emitted to air during production, use or disposal via either incineration or landfill.

During the early 1990s, product-specific bans were introduced in Sweden. In 1992, a Regulation was introduced which banned certain goods containing mercury from being manufactured or sold. These goods included measuring instruments and electrical components such as switches, thermostats, relays and circuit breakers.

The measures resulted in substantial reductions in the amount of mercury being used in products. Between 1992 and 2003, around 95 per cent of sold amounts of mercury was phased out. However, areas of use remained – and new ones could arise – which were not covered by the legislation.



Annual supply of mercury in products in Sweden (kg)

The measures implemented have resulted in substantial reductions in the amount of mercury being used in products. Between 1992 and 2003, about 95 per cent of sold amounts of mercury was phased out.

Source: Swedish Chemicals Agency, Report No. 4/04

GENERAL BAN IN 2009

It was recognised that a general ban would better correspond with the Swedish environmental quality objective for "a non-toxic environment". On 1 June 2009, a general ban on mercury came into force. This general ban states that:

- Mercury, or mercury compounds or preparations, must not be placed on the Swedish market; nor is it permitted to use mercury in Sweden or to commercially export mercury from Sweden.
- Mercury-containing goods must not be placed on the Swedish market or commercially exported from Sweden.
- Mercury-containing goods already in use prior to the ban may still be used but must not be placed on the market or exported. It is not permitted to refill these products with new mercury.

A number of time-limited exemptions have been granted by the Swedish Chemicals Agency. Applications where harmonised European Union legislation applies, such as electrical and electronic equipment and batteries, are also exempt from the Swedish ban.

THERMOMETERS AND BLOOD PRESSURE MEASURING DEVICES

Thermometers containing mercury were prohibited back in 1991. Virtually all types of thermometer had to be phased out from the market. Today, all thermometers for general purpose use are mercury-free and modern digital devices are widely used.

Swedish hospitals are essentially free from products that contain mercury. One example of many is blood pressure measuring devices, where mercury has been completely phased out since the early 2000s without any adverse medical or practical consequences.

Photo: Pixtal/TT Bild

DENTAL AMALGAM

Dental amalgam has been replaced by mercury-free alternatives. Today, the most common filling materials used in Sweden are composites. Other materials used are ceramics, glass ionomer cement and cast metal (mainly cobalt-chromium alloys, titanium and gold alloys).

The reasons behind this success are access to, and demand for, mercury-free alternatives, and a high level of awareness of the risks to the environment and health among both patients and dentists.

In 1995, the state and county councils signed an agreement to phase out the use of dental amalgam from children's dentistry, and since 1999 there has been no financial support for amalgam fillings from the Swedish dental insurance.

Even if no new dental amalgam is used, existing amalgam fillings will remain a source of mercury release for decades. An estimated 75 per cent of the adult Swedish population has amalgam fillings, and it is estimated that the teeth of the Swedish population contain about 40 tonnes of mercury in total.

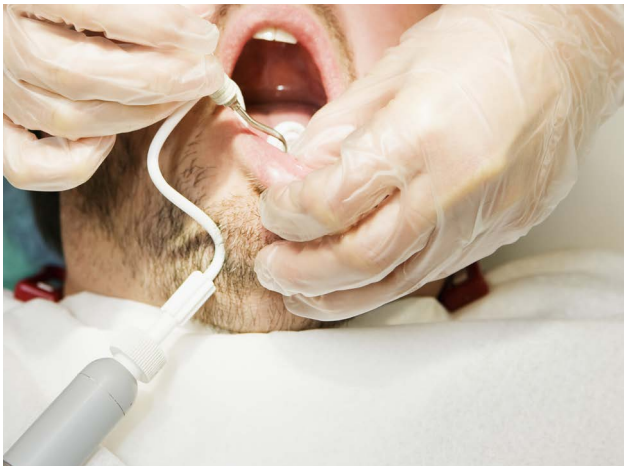
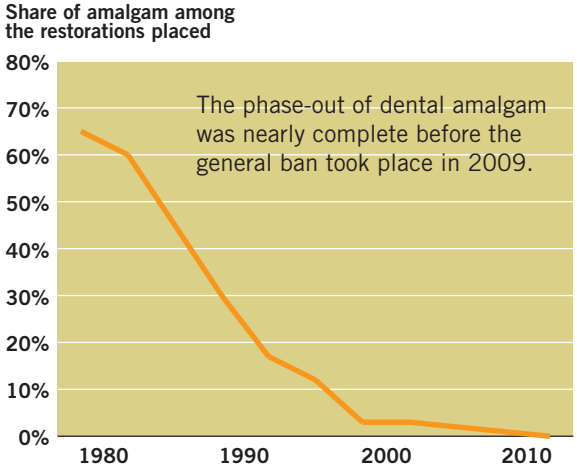


Photo: Carina Gran/Folio

Amalgam is the single largest source of mercury contamination of sludge in waste-water treatment-plants in Sweden.



Source: The National Board of Health and Welfare

Collect and treat mercury already in use

COLLECTION CAMPAIGNS

Between 1995 and 1999, the Swedish government carried out an action programme to collect mercury from schools, hospitals, laboratories, factories etc. This programme was implemented by the Swedish EPA in co-operation with the Swedish County Administrative Boards and the municipalities.

Participation was voluntary, but take-up within society was high and nearly all municipalities and schools, many universities, property owners and industries took part, contributing to knowledge generation, greater awareness and information dissemination.

The world's first mercury-tracker dogs were used in the projects. Electricians were also hired as 'mercury hunters' to help identify mercury used in instruments, electronic devices and other products. The project included many awareness-raising activities, which were considered essential to the success of the project.

COLLECTION OF MERCURY CONTAINING WASTE PRODUCTS

In Sweden, the municipalities are responsible for collecting hazardous waste from households. As regards electrical and electronic waste, batteries and scrap cars, producers are responsible for such collection and treatment. Many products containing mercury belong to these categories.

For many years, the municipalities have had infrastructure in place for the collection of various waste fractions from households. Instead of setting up a system of their own, producers of electrical and electronic equipment and batteries cooperate with the municipalities to collect these waste fractions.

Batteries are a good example of products with high collection rates. To simplify the collection process, all batteries are collected, not just those containing mercury. There have been many information campaigns over the years, many aimed at children.

Collection systems for batteries have been in place since the mid 1970s and for electronic waste since 2001.

Photo: Rebecka Andersson/Batteriinsamlingen

This is a clever strategy, as children are very good at educating their parents, and enables the whole family to be reached.

Surveys show that nearly 70 per cent of the Swedish population are aware that batteries should be collected separately and not thrown in the household waste bin.

TREATMENT OF WASTE CONTAINING MERCURY

When waste containing mercury has been collected, it must be treated. Low level contaminated waste is heated in a furnace with efficient flue gas cleaning equipment to collect mercury vapour.

After treatment, waste which contains mercury is placed in underground final disposal. If the waste is in stable form it can be disposed of directly; otherwise it must be stabilised before disposal. The most commonly used commercial technique is to convert the mercury into mercury sulphide prior to disposal.

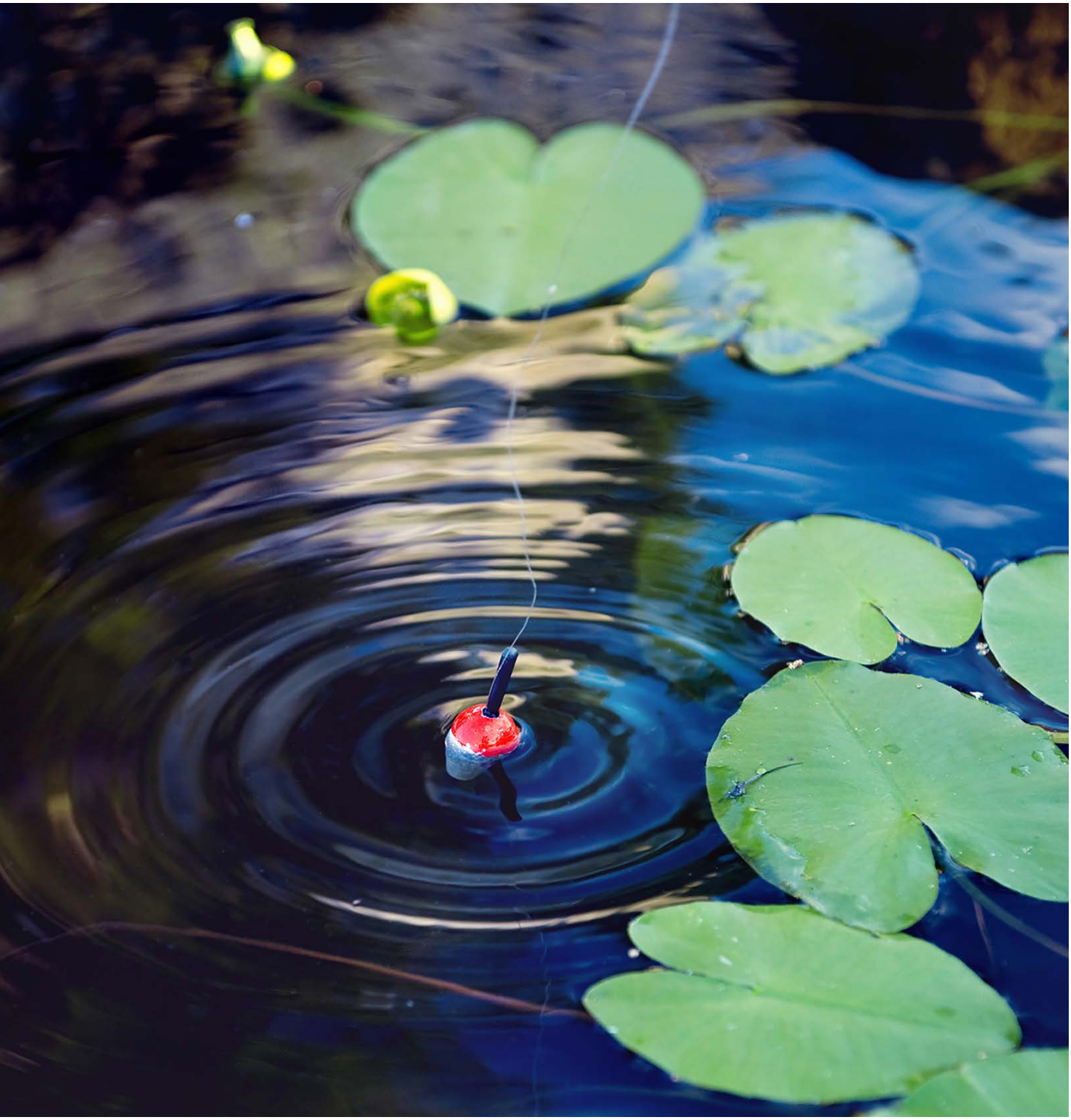


Photo: Anna Larsson/Folio

No recycling of mercury

Mercury is an element and cannot be destroyed. Once released, mercury will circulate in our environment. The only way to reduce the burden on the environment is to take mercury out of circulation and immobilise it. Over time, this will reduce the negative impact that mercury has on the environment and human health.

The Swedish mercury strategy is that mercury should not be recycled, but be permanently disposed in a safe and environmentally sound way.

Final disposal of mercury waste

In 2003, the Swedish Parliament decided that waste containing mercury was to be permanently stored deep underground. This decision was taken after many years of studies and research, which concluded that deep underground storage is the best solution to protect the environment in the long term, i.e. through the next ice age or for at least ten thousand years.

Photo: Pixtal/TT Bild

REASONS FOR CHOOSING DEEP UNDERGROUND STORAGE

Deep underground storage was chosen because it can provide long-term protection against physical and chemical changes and reduce the risk of unintentional disturbance and, once sealed up, does not require monitoring or maintenance, and thus will not be a burden to future generations. A model of a final storage was presented:

- A stable physical and chemical environment and low groundwater flows.
- Long transport paths and high capacity for sorption, matrix diffusion and dilution
- No supervision or maintenance required

STORAGE OBLIGATION WITHIN THE EU

It was initially intended that a Swedish final disposal facility would be constructed deep underground in bedrock. However, it has now been concluded that salt mines in Germany could provide the same level of protection at lower cost.

Since March 2011, there has also been an export ban and storage obligation in force within the EU.

Photo: Mark Ralston/AFP Photo

Workers at a new mercury-free processing facility in Mandal district, northern Mongolia. Members of the United Nations Environment Programme (UNEP) have been helping small-scale gold miners to move away from their reliance on mercury processing methods.

Export ban on mercury and mercury compounds

The Swedish view is that mercury is too hazardous to be used and should not be sold to other countries. The Swedish government therefore decided to ban exports of mercury and compounds containing mercury. This export ban took effect in 1997.

GOLD MINING CONTAMINATES THE ENVIRONMENT AND PEOPLE

Artisanal and small-scale gold mining (ASGM) is the largest sector of demand for mercury, using it to separate the metal from the ore. Mercury amalgamation is currently the most commonly used method to extract gold in ASGM due to its ease of use, low cost and abundant availability. The practice is informal and in some countries illegal.

Virtually all mercury that is used is released into the environment. At least 10–15 million miners are involved worldwide, mainly in Africa, Asia and South America. An estimated three million of these are women and children. The practice threatens the health of the workers and their families, as well as that of people living downstream who eat mercury-contaminated fish or drink the water.

Enhance international cooperation on mercury

Mercury pollution is recognised as a global problem of high concern. Some international agreements to address mercury pollution are briefly described below.

MINAMATA CONVENTION ON MERCURY UNDER THE UNEP

The Minamata Convention on Mercury was agreed in January 2013 and opened for signature in October of the same year. The convention will enter into force once it has been ratified by 50 countries. The Minamata Convention on Mercury covers all aspects of the mercury life-cycle, from primary mining to waste disposal, including trading provisions, rules for artisanal and small-scale gold mining, products containing mercury, industrial processes using mercury and mercury emissions to air.

www.mercuryconvention.org

EU MERCURY STRATEGY

In recent decades, a number of steps have been taken at EU level to reduce emissions, use and exposure of mercury. The European Commission launched the EU Mercury Strategy in 2005, addressing mercury pollution both in the EU and globally. The Strategy contains 20 measures to reduce mercury emissions, cut supply and demand and protect against exposure, especially to methylmercury in fish. The EU also played an active role in the negotiations of the Minamata Convention on Mercury.

www.ec.europa.eu/environment/chemicals/mercury

HEAVY METALS PROTOCOL UNDER THE UNECE CLRTAP CONVENTION

The Convention on Long-range Transboundary Air Pollution (CLRTAP) was signed in 1979. The Protocol on Heavy Metals (HM Protocol) was adopted in 1998 and entered into force in 2003. The HM Protocol has 33 Parties so far and is aimed at mercury, cadmium and lead. Parties to the protocol agree to reduce their total annual emissions of these three metals into the atmosphere below their base year levels. The protocol provides guidance on Best Available Techniques for industrial sectors, sets specific emission limit values and introduces product control and management measures.

www.unece.org/env/lrtap

EMEP – European Monitoring and Evaluation Programme

EMEP is a scientific, policy-driven programme under the LRTAP Convention. The main objective is to regularly provide governments and subsidiary bodies under the LRTAP Convention with reliable scientific information, in order to support the development and further evaluation of the international protocols on emission reductions negotiated within the Convention. The EMEP Programme relies on three main elements: (1) collection of emission data, (2) measurements of air and precipitation quality and (3) modelling of atmospheric transport and deposition of air pollutions.

www.emep.int

Some success factors behind the achievements of the Swedish mercury strategy

- Strong political will and leadership.
- Long-term, targeted information campaigns to create awareness and acceptance of measures.
- General ban with time-limited exemptions. Clear messages that allow time for adjustment if necessary.
- Financial incentives. No subsidies when using dental amalgam.

Photo: Magnus Rietz/Folio

GRAPHIC DESIGN: BNG COMMUNICATION COVER PHOTOS: LASSE EKLÖF, JONAS TULLDAHL AND LOVE LANNÉR/FOLIO ISBN 978-91-620-8691-6

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