



Scientific Facts on Mercury

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Level 2 - Details on Mercury

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This Digest is a faithful summary of the leading scientific consensus report produced in 2002 by the United Nations Environment Programme (UNEP):
"Executive Summary of the Global Mercury Assessment"

The full Digest is available at: <http://www.greenfacts.org/en/mercury/>



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- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific consensus report which is faithfully summarised in Level 2 and further in Level 1.

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1. What is mercury?

1.1 In what forms does mercury exist?

Mercury occurs naturally in the environment. Sometimes known as quicksilver, it is a heavy metal, like lead or cadmium, that exists in different chemical forms:

- Elemental mercury or metallic mercury is the element in its pure, 'un-combined' form. It is a shiny, silver-white metal that is liquid at room temperature, but is rarely found in this form in nature. If not sealed off, mercury slowly evaporates into the air, forming a vapour. The quantity of vapour formed increases as temperatures rise. Elemental mercury is traditionally used in thermometers and some electrical switches.
- Inorganic mercury compounds or mercury salts, more commonly found in nature, include mercuric sulphide (HgS), mercuric oxide (HgO) and mercuric chloride (HgCl₂). Most of these are white powders or crystals, except for mercuric sulphide which is red and turns black after exposure to light. Some mercury salts, such as mercury chloride, also form vapour, but they stay in the air for a shorter time than elemental mercury because they are more soluble in water and more reactive.
- Organic mercury is formed when mercury combines with carbon and other elements. Examples of organic mercury compounds are dimethylmercury, phenylmercuric acetate and methylmercuric chloride. The form most commonly found in the environment is methylmercury.

1.2 How does mercury exist in the environment?

Several forms of mercury exist naturally in the environment, the most common being metallic mercury, mercuric sulphide, mercuric chloride, and methylmercury.

Natural processes can change the mercury from one form to another. For instance, chemical reactions in the atmosphere can transform elemental mercury into inorganic mercury.

Some micro-organisms can produce organic mercury, particularly methylmercury, from other mercury forms. Methylmercury can accumulate in living organisms and reach high levels in fish and marine mammals via a process called biomagnification (i.e. concentrations increase in the food chain).

Because mercury is one of the basic chemical elements, of which all things are made, it cannot be broken down or degraded into something else. Once released into the biosphere through natural events or human activities (see Question 4), mercury readily moves and cycles through the environment. Soil, water bodies and the sediments underneath them are believed to be the places where mercury comes to rest until it is ultimately removed from the biosphere again.

1.3 How can the form of mercury affect living organisms and the environment?

Different forms of mercury (see 1.1) affect living organisms and the environment differently.

For exposed living organisms, the form of mercury affects:

- how available it is to cause effects within the body;

- how it moves around inside the body;
- how toxic it is;
- how it accumulates, is transformed and leaves the body;
- how it biomagnifies (builds up) along the food chain.

For the environment, the form of mercury influences how readily it can move within and between the atmosphere and oceans, and how far it can travel in the air. For instance, elemental mercury vapour can stay in the atmosphere long enough to travel around the world, whereas other forms of mercury may fall back to earth relatively close to their source.

Emissions of some forms of mercury into the air (for example from industry) can be controlled more easily than others. Inorganic mercury can be removed from air emissions reasonably well, while elemental mercury emissions are more difficult to capture and eliminate.

2. What are the impacts of mercury on human health?

2.1 What are the potential health effects of mercury?

The toxicity of mercury depends on the form of mercury to which people are exposed.

Although mercury and its compounds are toxic substances, there is ongoing debate about exactly how toxic they are. Toxic effects, especially in the case of methylmercury, may be taking place at lower concentrations than previously thought, but this is proving difficult to establish because the suspected toxic effects are subtle and their mechanisms complex. Methylmercury is of particular concern because it can accumulate in the food chain to reach high concentrations (biomagnification).

2.1.1 Methylmercury is special among organic mercury compounds because large numbers of people are exposed to it and its toxicity is better understood. Methylmercury in food, such as fish, is a particular health hazard because it is easily taken up into the body through the stomach and intestines.

It is a poison for the nervous system. Exposure during pregnancy is of most concern, because it may harm the development of the unborn baby's brain. Some studies suggest that small increases in exposure may affect the heart and circulatory system.

Moreover, there is some evidence at present that methylmercury can cause cancer in humans, but it is far from conclusive: the International Agency for Research on Cancer (**IARC**) has classified methylmercury as "possibly carcinogenic to humans" (Group 2B).

Methylmercury's poisonous potential was highlighted by an incident in Minamata (Japan), in the 1950s, where wastes from a chemical factory using mercury were discharged into the local bay.

2.1.2 Elemental mercury is also poisonous to the nervous system. Humans are mainly exposed by inhaling vapours. These are absorbed into the body via the lungs and move easily from the bloodstream into the brain. However, when elemental mercury is ingested, little is absorbed into the body.

The inhalation of elemental mercury vapours can cause neurological and behavioural disorders, such as tremors, emotional instability, insomnia, memory loss, neuromuscular changes and headaches. They can also harm the kidneys and thyroid. High exposures have also led to deaths. However, there is no evidence at present that elemental mercury causes

cancer in humans and it has been classified by **IARC** into Group 3 "unclassifiable as to carcinogenicity in humans"

2.2 How are we exposed to mercury?

The main source of elemental mercury vapour is dental amalgam (a tooth filling).

Diet, particularly fish, is generally the main source of both inorganic and organic mercury. Methylmercury is by far the most common organic form, and is especially found in fish and other seafood.

For some people, the workplace may also be an important source of exposure. Examples include chlor-alkali plants, mercury mines, thermometer factories, refineries and dental clinics, as well as the mining and manufacturing of gold extracted with mercury.

People can also receive extra doses in specific situations, such as when mercury compounds are used in skin-lightening creams, soaps and traditional medicine. Exposure may also arise from localised pollution through air and water, and from mercury spills at home or work (e.g. from certain old gas meters containing mercury).

2.3 What levels of mercury might cause harm?

For methylmercury, the US Environmental Protection Agency (**US EPA**) has estimated a safe daily intake level of 0.1 µg/kg body weight per day. This was based on a study in the Faroe Islands, where fish containing significant levels of mercury form a large part of the diet. The study compared development test scores for children whose mothers had been exposed during pregnancy¹ [see Annex 1, p. 15]. A European Union scientific review, in 2001, has supported this safe daily intake level.

For elemental mercury vapour, several studies show that long-term workplace exposures – at around 20 µg/m³ of air or higher – have subtle toxic effects on the central nervous system.

Other adverse effects of various forms of mercury have been seen in humans, but either the findings are less consistent or the doses involved are much higher.

The Working Group that prepared this assessment, in line with its mandate, did not assess the potential effects of exposures to elemental mercury vapour from dental amalgams or reach any conclusions about whether or not dental amalgams cause adverse effects. This remains a matter of scientific debate² [see Annex 1, p. 15].

2.4 How great are the risks from mercury today?

2.4.1 Whilst the diet and amalgam fillings in teeth are respectively the main sources of methylmercury and mercury vapour exposure for most people, sources such as local pollution, exposure at work, cultural practices and traditional medicines are important in some regions (see 2.2).

Assessments of mercury exposure have been made in various parts of the world. For example, a recent study of 1700 women in the USA found that about 8% of them had

mercury concentrations in their blood and hair exceeding the levels that correspond to the **US EPA's** estimated safe dose.

Data indicate that exposures in Greenland, Japan and some other areas are generally higher than in the USA. On the other hand, measures have been taken in recent decades to reduce emissions of mercury in various countries (see 6.3).

2.4.2 Fish is the main food source in many parts of the world and provides nutrients that are not easily replaced. Mercury contamination adds health risks to this important food supply.

Many countries, international organizations and scientific investigations have reported mercury concentrations in fish between about 0.05 and 1.4 mg/kg of fish tissue, depending on the water and the fish.

Predator fish and marine mammals that eat other fish tend to have higher levels of mercury because mercury bioaccumulates in fish and is biomagnified up the food chain (see 3.1). Mercury levels are thus higher in such fish as king mackerel, pike, shark, swordfish, walleye, barracuda, large tuna (as opposed to the small tuna usually used for canned tuna), scabbard and marlin, as well as in seals and toothed whales.

Moderate consumption of fish with low mercury levels is not likely to result in worrying levels of exposure for humans. However, people who consume higher amounts of contaminated fish or marine mammals may be highly exposed to mercury and are, therefore, at risk. Indeed, high concentrations of mercury in fish have led governments in a number of countries to give warnings to consumers. These advise people, especially sensitive groups (such as pregnant women and young children), to limit or avoid consumption of certain types of fish from specific areas.

3. What are the impacts of mercury on the environment?

3.1 How does mercury accumulate in organisms?

The harmful effects that different forms of mercury can have on living things are greatly influenced by bioaccumulation (build up inside an organism) and biomagnification (build up along the food chain).

All forms of mercury can accumulate in organisms. However, methylmercury is taken up at a faster rate than other forms and bioaccumulates to a greater extent.



Methylmercury can accumulate along the food chain © Aurileide Alves

In fish, methylmercury becomes so tightly bound in the tissues that, if exposure ceases, it takes a very long time for it to be removed.

This tighter binding leads methylmercury to build up (biomagnify) much more than other forms of mercury along the food chain, e.g. from smaller fish to larger predatory fish. As a result, nearly 100% of the mercury that accumulates in predator fish is methylmercury. Another consequence is that older fish typically have higher mercury concentrations in their tissue than younger fish of the same species, partly because older fish eat more fish and larger fish as they age.

The extent to which mercury will bioaccumulate in any given situation depends on several factors. One important factor is how much mercury is converted to methylmercury, and vice-versa, particularly by some bacteria in the aquatic environment. Consequently, the extent of bioaccumulation and biomagnification of mercury in fish remain difficult to predict in specific situations.

The mercury in fish is passed on to the predators at the top of the food chain (e.g. humans, seabirds, seals, otters, eagles and ospreys) and how much they accumulate depends on the type and size of fish they eat.

3.2 How is wildlife affected?

Methylmercury is a poison for the central nervous system. During the Minamata poisoning incident in Japan (see 2.1.1), birds had trouble flying and behaved abnormally in other ways.

Mercury can also affect reproduction. Methylmercury poses a particular risk to the developing foetus because it readily moves into the placenta and can damage the developing nervous system. Mercury may be present in eggs and harm bird reproduction even when concentrations in eggs are low.

The kidneys are the organs most vulnerable to damage from inorganic mercury.

Rising levels of mercury are a concern for some seals and whales in the Arctic and for predatory marine mammals in warmer waters.

3.3 How may certain ecosystems be affected?

Recent evidence suggests that mercury is reducing microbiological activity, vital to the terrestrial food chain. This may already be affecting forest³ [see Annex 1, p. 15] soils over large parts of Europe and potentially in many other places in the world with similar soil characteristics.

Impacts from long-range transport of mercury in the Arctic region have been the focus of recent discussion, but the effects are by no means restricted to this region of the world. The same food web characteristics are found in specific ecosystems and human communities in many countries, particularly in places where a fish diet is predominant.

There are indications that climate change might also increase the levels of methylmercury in water in some areas, and its accumulation in fish.

4. Where is mercury found?

4.1 How does mercury cycle through the biosphere?

Mercury moves from the Earth's crust into the biosphere as a result of both natural processes and human activities.

Examples of **natural processes** include the weathering of rocks and volcanic activity.

Human activity can release mercury

- when it is intentionally mined, processed or used in products;
- unintentionally, from processes where mercury is an unwanted impurity in raw materials, minerals and fossil fuels, particularly coal; and
- from soils, sediments, water bodies, landfills and waste or tailings piles, contaminated previously by human activities.

Once released, mercury enters the air, water and soil and can continue to move between them over long periods of time, depending on its chemical form (see section 1.3).

Mercury is only removed from the biosphere when it reaches sediments deep under the oceans or when it is immobilised in controlled landfills. This implies that, even as we gradually eliminate mercury releases from human activity, levels in the environment will take several decades or longer to go back down. However, improvements may be quicker in places where local or regional contamination is a major source.

4.2 Do local releases cause global effects?

Airborne mercury may deposit into water or onto soil close to its source of emission, or even on the other side of the world, depending on its chemical form. Several studies have concluded that the amount of mercury deposited at any particular place can come from both local and global sources. Virtually any local source contributes to the global mercury pool in the biosphere.

Most of the mercury emitted to the air through human activity is elemental mercury vapour, which can stay airborne long enough to cross continents. Other forms of mercury, such as inorganic mercury, fall to earth within roughly 100 to 1 000 km. However, how far the mercury travels also depends on whether mercury converts from one form to another in the air.

Computer modelling has estimated that 50% of the mercury, released by human activity and deposited in North America, comes from elsewhere. This figure is 20% for Europe and 15% for Asia.

Mercury can also be re-released from water and soil, prolonging the time it stays in the biosphere. One study suggests that around 20% of the amount deposited can be re-released over a two-year period.

4.3 How much mercury do we release into the environment?

4.3.1 Human activity (see 5.1) is now the main source of mercury to the atmosphere, water and soil. A recent study has suggested that the amount of mercury in the atmosphere has tripled because of this.

On average around the globe, there are indications that human activity has raised the rate of mercury deposition by 1.5 to 3 times since pre-industrial times. In and around industrial areas, the deposition rates have increased by 2 to 10 times during the past 200 years.

4.3.2 Much data exists about how much mercury some countries and industries release into the environment, but the global picture is incomplete.

Fossil fuel power plants and waste incinerators emit about 70% of the mercury released into the atmosphere by human activity, for which there is data.

These releases are expected to increase unless alternative energy sources or technologies to control emissions are further developed and widely used.

Mercury production from mines has been decreasing from about 6 000 to about 2 000 tonnes per year during the 1980s and 90s. Thus, releases from mining and mercury use may also be in decline. Small-scale gold and silver mining can be an important source in some countries⁴ [see Annex 1, p. 15] .

Emissions from a number of major sources have decreased in North America and Europe. In Canada, for example, emissions into the air were reduced from about 33 to 6 tonnes between 1990 and 2000.

4.3.3 Emissions from human activities come both from the intentional use of mercury, and the unintentional releases of mercury impurities. The share of emissions into the air emanating from intentional uses ranges between 10% and 80% for different countries.

The relative importance of the two types of source in a country or region depends upon:

- progress made in substituting mercury use in products and processes;
- reliance on fossil fuels for energy production, particularly coal;
- the size of the mining and mineral extraction industry;
- waste disposal methods (incineration or landfill); and
- the use of technologies to remove mercury from emissions.

4.4 How is mercury released naturally?

Mercury occurs naturally in forms that are volatile, so mercury continuously evaporates into the atmosphere, from both soils and water. Mercury-rich rocks and soils can lead to elevated mercury levels across wide areas. The weathering of rocks, volcanic activity and forest fires all contribute to the natural emission of mercury into the air.

Actual natural mercury emissions are very difficult to determine, because total emissions of mercury from soil and water surfaces come from both natural sources and from re-emission of previously deposited mercury. This, in turn, will have come from both natural sources and human activity.

Natural mercury emissions are beyond our control, and it is currently estimated that less than 50% of total mercury releases are from natural sources. However, it is important to keep them in mind as significant sources of mercury in the environment.

5. Where do the world's supplies of mercury come from?

5.1 How does mercury reach the world market?

The natural levels of mercury in the Earth's crust vary from place to place, but average about 50 mg per tonne of rock. Mercury is mined when present in cinnabar ores, which generally contain about 10 kg per tonne of rock.

Mercury is also present at very low levels throughout the biosphere. Thus, mercury absorbed by ancient plants may account for its presence in fossil fuels like coal, oil and gas.

Today, the world market is supplied by mercury that is:

- newly extracted from mines;
- recovered as a by-product of the mining or refining of other metals, minerals, natural gas and old mining waste;
- recycled from spent products and waste from industrial processes;
- held in government reserve stocks; and
- held in private stocks, such as in chlor-alkali and other industries.

By the year 2000, the production of mined mercury had fallen to a third of its level in the early 1980s. Despite low demand, low prices and the alternative sources available, mercury is still mined in a number of countries such as Spain, China, Kyrgyzstan and Algeria. Moreover, unrecorded small-scale mercury mines have been reported in Asia and Latin America.

5.2 How important is mercury recycling?

Since the 1990s, about 700 to 900 tonnes of recycled mercury have been put on the world market every year. Most of this has come from recently closed mercury-based chlor-alkali factories. Their equipment employs a lot of mercury, though it is not consumed in the chemical process.

Over the next decade and beyond, up to 13 000 tonnes of mercury will become available from the European Union alone. Similarly, large stocks of mercury held by various governments have become surplus and could be put on the market. For instance, the US government has a large mercury stock of 4 435 tonnes and has suspended sales since 1994 pending an evaluation of the potential environmental and market impacts.

The reuse and recycling of mercury replaces the mining processes, and prevents new mercury entering the market and the environment. However, giving preference to recycled mercury creates complications, because an excess supply may drive the market price down. This would encourage increased use, and thus disposal of mercury. For this reason, certain steps are being taken to manage supply, for example in Europe.

5.3 What is mercury used for?

Mercury is a versatile material known for thousands of years. It is the only metal that is liquid at room temperature. It is a good electrical conductor, has a very high density and high surface tension, expands and contracts uniformly when pressure and temperature change, and it can kill micro-organisms, including pathogenic organisms and other pests.

Elemental mercury has been used:

- to extract gold and silver from ore (for centuries);
- to assist the manufacture of chlor-alkali chemicals;
- in manometers, which measure and control pressure;
- in thermometers;
- in electrical and electronic switches;
- in fluorescent lamps; and
- in dental amalgam fillings

Mercury compounds have been used:

- in batteries;



See also our summary on Dental amalgam [see <http://copublications.greenfacts.org/en/dental-amalgam/index.htm>]

- as biocides, to control or destroy micro-organisms, e.g. in the paper industry, in paints and on seed grain;
- as antiseptics in pharmaceuticals;
- for chemical analysis;
- as catalysts, to make the manufacture of other chemicals more efficient; and
- in pigments and dyes, detergents, and explosives (mainly in the past).

In industrialised countries, awareness of the potential adverse impacts of mercury on health and the environment has led to a reduction of both the volume and the range of uses of mercury and its compounds, particularly during the 1980s and 1990s. Nonetheless, mercury is still used in many ways in some other parts of the world.

6. What can be done to reduce mercury releases?

6.1 What are the possible ways of controlling mercury releases?

Mercury releases from natural processes, and from human activity in the past, are largely beyond human control. Mercury releases from current human activity may be limited by either preventive measures or control measures.

6.1.1 Reducing the use of mercury-containing products and raw materials containing unwanted mercury impurities are examples of **preventive measures**.

- improving efficiency;
- using low-mercury fuels and alternatives, such as natural gas instead of coal; and
- using fuels with a composition that makes mercury easier to control.

Such measures are generally cost-effective, though sometimes there could be negative effects. For instance, greater demand for low-mercury fuel will lower the market price of high-mercury fuel and – if not regulated – may encourage its use.

6.1.2 Replacing products and processes that contain or use mercury with ones that do not is one of the most powerful **preventive measures**.

This may substantially reduce mercury in households, in the waste stream and in the environment.

Such steps tend to be cost-effective, especially as demand grows, but there are exceptions and possible trade-offs. Today, for example, low-energy fluorescent lamps that contain mercury may have a lower overall environmental impact than ordinary bulbs, because less mercury containing fuel may be burnt to generate the required electricity.

6.1.3 End-of-pipe techniques, such as filtering exhaust gases, are **control methods** at the point of emission. These techniques are useful when raw materials contain tiny amounts of mercury, that is in fossil-fueled power plants, cement production and metal mining and processing.

Control measures for other pollutants from coal-fired boilers and incinerators can also reduce mercury emissions, although their effectiveness depends very much on the type of coal, the design of the boiler and the equipment used. Technology aimed specifically at controlling mercury is being developed.

However, end-of-pipe techniques produce contaminated waste that could release mercury in the future unless properly managed or re-used.

6.1.4 Effective **waste management** is another **control method** which can reduce releases, for instance from spills or gradual leakage (e.g. from broken thermometers or auto switches and dental amalgams).

Wastes containing low concentrations of mercury are generally permitted in normal landfills. In some cases, the mercury content of the waste may first be rendered inert in order to minimise release in the future. Sweden requires waste with higher mercury concentrations to be deposited in specially equipped landfills to limit leaching and evaporation, or in 'final storage' deep underground.

In some countries, the cost of waste management is high enough to prompt producers to take preventive action and find alternatives that do not produce mercury-containing waste.

6.2 What is the best overall approach to reduce emissions?

A combination of both control and preventive measures is required for optimum reduction of mercury releases.

Useful approaches for some of the main sources are:

- municipal and medical **waste incinerators** may remove mercury-containing waste before burning. Waste separation in households and hospitals can be effective but costly. Substitution with non-mercury products avoids this problem. In the medium term, some mercury may also be removed from chimney exhaust;
- **power-plant boilers**, especially those burning coal, may use less fuel or change to better alternatives. Cleaning up the fuel before burning, or the chimney gases after burning, can also help but the mercury removed becomes a waste which needs to be managed;
- cement, mining and metal industries using raw materials containing trace contamination may use a better quality **raw material** or implement end-of-pipe controls;
- **The scrap steel industry** may separate out mercury containing components, such as lights and switches, beforehand;
- **small-scale gold miners** may receive training in safer methods using less or no mercury. Central refining facilities could be provided for the miners. It is difficult to enforce a ban;
- **chlor-alkali producers** may apply strict mercury accounting procedures, leak detection, exhaust air filtration and proper waste management;
- **mercury containing products** may be substituted with non-mercury products;
- **dentists** may prepare mercury amalgam fillings more efficiently, use other materials instead or install amalgam traps in the wastewater system;
- dental amalgams may be removed before **cremation** or chimney gases may be filtered. This may be avoided by switching to non-mercury tooth fillings; and
- **uncontrolled disposal of mercury-containing products or wastes** may be reduced by introducing and enforcing regulation and improving access to suitable waste facilities. Substitution with non-mercury products and processes may also help.

6.3 What further research and information is needed?

6.3.1 Many industrialised countries have addressed potential problems caused by the use and release of mercury, with some success.

Some of the more common national initiatives include:

- **environmental quality standards** that set maximum acceptable mercury concentrations for different media, such as drinking water, surface waters, air and soil, and for foodstuffs like fish (in some countries);
- **limits** on the amount of mercury that industrial, mineral and power generation operations can release into the air and water, sometimes requiring the use of 'best available technology' (in many countries); and
- **restriction of mercury use** in specific products (in some countries).

Other actions have been taken, such as regulations on workplace exposures, recording and reporting mercury use and release by industry, consumer safety measures, and advice on fish consumption.

Legal restrictions are complemented by the promotion of safe mercury management. This includes developing and introducing safer alternatives and cleaner technology, the use of subsidies to promote substitutes and voluntary agreements with industry or mercury users.

6.3.2 Because mercury crosses national borders, some regional and international agreements have been reached to coordinate the reduction of mercury releases.

For example, substantial reductions have been achieved by **legally binding agreements** covering releases across central and eastern Europe, Canada and the USA, and by protecting the marine environment off the north-east Atlantic and the Baltic Sea.

Various **non-binding initiatives** also cover North America, the Arctic and Nordic regions, and the North Sea, agreeing common goals, strategies and programmes.

In addition, several **voluntary private-sector initiatives** supplement national regulatory measures and help information exchange, awareness raising and goal setting.

International trade in mercury chemicals and wastes is restricted by two general multilateral environmental agreements.

7. What further research and information is needed?

7.1 What are the needs of individual countries?

There seems to be a general need for further information relevant to environmental management strategies for mercury. Some countries lack full information on uses and emissions of mercury, sources of releases, levels and pathways in the environment, impacts on humans and ecosystems, as well as on prevention and control measures. Other countries that are further advanced in managing mercury want more knowledge in order to improve risk assessment exercises and to ensure effective risk management.

Some of these data gaps are specific to a country and must be addressed at the national level. Certain data is universal and might be exchanged nationally, regionally or internationally, even though it may need to be adapted to the cultural and economic framework of an individual country.

7.2 What are the global data gaps?

Mercury is among the best-studied environmental toxicants. There has been about half a century's extensive research on mercury's impacts and its pathways. However, there are gaps in the basic understanding of a number of general, global issues relevant to mercury. Further research is needed to provide the data demanded by environmental modelling and decision-making tools.

Gaps include:

- the pathways of mercury in the environment, and from the environment to humans;
- the pathways of mercury from humans to the environment; and
- the possible effects on humans, wildlife and ecosystems, the numbers affected, and the magnitude and severity of the effects.

Despite these gaps in information, current understanding of mercury is sufficient that international action to address the global adverse impacts of mercury should not be delayed.

8. Conclusions

There is sufficient evidence of significant adverse impacts of mercury and its compounds on a global scale. There should be international action to reduce the risks to human health and the environment arising from mercury releases.

It is important to have better understanding of the issues, but it is not necessary to have full consensus or complete evidence in order to take action. These adverse effects need to be addressed at the global, regional, national and local levels.

Options include:

- reducing or eliminating the production, consumption and releases of mercury;
- substituting products and processes;
- extending legal and voluntary agreements; and
- strengthening cooperation amongst governments for information-sharing, risk assessment and risk communication.

Areas for immediate action have been proposed, which include:

- increasing protection of sensitive populations, such as pregnant women;
- providing technical and financial support to developing countries and to countries with economies in transition; and
- supporting increased research, monitoring and data-collection on the health and environmental aspects of mercury, and on environmentally friendly alternatives.

Annex

Annex 1: Footnotes

1. The US EPA has estimated a safe daily intake for methylmercury of 0.1 µg/kg body weight per day. This was derived by applying a safety factor of 10 to allow for certain uncertainties to a "benchmark dose" of 1 µg/kg body weight per day derived from a number of studies as detailed in the full UNEP report. One important study was conducted in the Faroe Islands where fish containing significant levels of mercury form a large part of the diet. The benchmark dose in this case was the dose at which there was less than a 5% chance that double the normal number of children would achieve scores in tests that would indicate delays in development of attention, verbal memory and language.

See: Chapter 4 of the full UNEP Report, Section 4.2.1 [see <http://www.chem.unep.ch/mercury/Report/Chapter4.htm#4.2>], paragraphs 265 to 269.

2. The Working Group that prepared this assessment, in line with its mandate, did not assess the potential effects of exposures to elemental mercury vapour from dental amalgams or reach any conclusions about whether or not dental amalgams cause adverse effects. This remains a matter of scientific debate.

See: Chapter 4 of the full UNEP Report, Section 4.3 [see <http://www.chem.unep.ch/mercury/Report/Chapter4.htm#4.3>], paragraph 284.

3. The main text of the full UNEP report relating to this point specifically refers to forest soils.

See: Chapter 5 of the full UNEP Report, Section 5.3.1 [see <http://www.chem.unep.ch/mercury/Report/Chapter5.htm#5.3>], paragraph 391

4. Based on:

Chapter 6 of the full UNEP Report, Section 1.3.4 [see <http://www.chem.unep.ch/mercury/Report/Chapter6.htm#6.3>], paragraph 270.