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Accompanying document to the

PROPOSAL FOR A REGULATION OF THE EUROPEAN PARLIAMENT AND THE COUNCIL ON THE BANNING OF EXPORTS AND THE SAFE STORAGE OF METALLIC MERCURY

IMPACT ASSESSMENT

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IMPACT ASSESSMENT

This impact assessment has been prepared by the Commission's services. The text has been prepared as a basis for comment and does not preempt the final form of any decision taken by the Commission.

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INTRODUCTION

On 28 January 2005, the Commission adopted the Communication to the Council and the European Parliament on a Community Strategy Concerning Mercury[1]. The Strategy addresses all aspects of the mercury life cycle. The proposal from the Commission was accompanied by an extended impact assessment[2]. The Strategy proposes twenty actions, two of which are implemented by the present proposal.

The Mercury Strategy includes a broad range of actions in all the steps in the mercury cycle. Two key actions in the Mercury Strategy are the banning of mercury exports (action 5) and the safe storage of surplus mercury (action 9). This impact assessment will provide an in-depth evaluation of how best to implement these actions. When assessing these actions on a EU-level, the global perspective and international actions related to supply and trade of mercury need to be discussed in parallel.

1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

The findings of: the extended impact assessment for the Mercury Strategy; a stakeholder meeting to discuss the export ban and storage obligation and the report entitled "Mercury Flows and safe storage of surplus mercury", Concorde East/West Sprl., 2006[3] form the main basis for the impact assessment of the current proposal.

Extensive stakeholder consultation was on-going throughout the preparation of the Mercury Strategy.[4]

Moreover, a further stakeholder meeting took place in Brussels on 8 September 2005. The invitation was sent to a broad selection of interested entities including Member States, industry and environmental and health NGOs. Stakeholder contributions included[5]:

- Information on the legal situation throughout the European Union, on mercury waste streams and on the recycling and recovery of mercury containing products (collected from the Member States). These contributions have provided useful information on the mercury flows and the availability of mercury in the European Union both before and after the proposed export ban.

- At the stakeholder meeting the Commission presented its basic concept for the planned legislative proposal and asked for feedback on the exact scope of the export ban (metallic mercury, compounds) as well as of the storage obligation (metallic mercury from the chlor-alkali industry only or also from other sources), and necessary amendments to the landfill directive and other waste legislation.

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1 COM(2005)20 final

2 SEC(2005)101

3 The report is found at: http://www.ec.europa.eu/environment/chemicals/mercury/pdf/hg_flows_safe_storage.pdf

4 For an overview see section 11, p.61 ff, of the extended impact assessment complementing the Strategy. SEC(2005)101

5 Further information is provided in Annex I. All the consultation responses to be found on http://www.ec.europa.eu/environment/chemicals/mercury/.

The Commission also requested additional information on the recovery/recycling of mercury.

Several meetings have been held separately with Spain, the most concerned Member State, and with Eurochlor to discuss the intended instrument and the voluntary agreement from the chlor-alkali industry.

The report "Mercury Flows and safe storage of surplus mercury" was carried out to obtain updated information from EU-25. An important change since the Mercury Strategy was adopted by the Commission in January 2005 is that the price of mercury, after a long term of stability, became particularly volatile. Three mercury experts (Ms. Petra Hagström from the Swedish Environmental Protection Agency, Mr. Lars Hylander from Uppsala University, and Mr. Jakob Maag from COWI A/S) have reviewed the report.

2. PROBLEM DEFINITION

2.1. What is the mercury problem?

Mercury and its compounds are highly toxic to humans, ecosystems and wildlife. Initially seen as an acute and local problem, mercury pollution is now also understood to be global, diffuse and chronic. High doses can be fatal to humans, but even relatively low doses can have serious adverse neuro-developmental impacts, and have recently been linked with possible harmful effects on the cardiovascular, immune and reproductive systems. Mercury also retards microbiological activity in soil, and is a priority hazardous substance under the Water Framework Directive[6].

Mercury is persistent and can change in the environment into methylmercury, the most toxic form. Methylmercury readily passes both the placental barrier and the blood-brain barrier, inhibiting potential mental development even before birth. Exposure of women of child-bearing age and children is therefore of greatest concern.

From a human health point of view, exposure to methylmercury via diet is the main problem. Methylmercury collects and concentrates especially in the aquatic food chain, making populations with a high intake of fish and seafood particularly vulnerable.

2.2. Why an export ban and a storage/disposal obligation?

The European Union is a main exporter of metallic mercury. After mining in the Spanish Almadén mine stopped in 2003, the biggest European Union supply of mercury now comes from the chlor-alkali industry. The chlor-alkali industry currently sells its surplus mercury when switching to mercury-free technology. The remaining amounts in the cells in the chlor-alkali industry are estimated to total

6 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, OJ L 327, 22.12.2000, as amended by Decision 2001/2455/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy, OJ L 331, 15.12.2001.

around 12000 tonnes. The European Union demand for mercury is low. Most of the surplus mercury is therefore exported. According to international trade statistics, 824 tonnes were exported in 2004.

Mercury is a global problem and international actions are needed to solve the mercury problem. The European Union could not credibly argue for and support active efforts worldwide to reduce mercury supply and demand on the one hand while remaining the main global supplier on the other.

The safe storage or disposal of the surplus mercury when the export ban is introduced will be essential

2.3. Who is affected?

The export ban and the storage obligation are key actions to reach the long-term aim to reduce mercury levels in the environment and human exposure. All individuals will be exposed to mercury to some degree. However, as already noted, some groups are particularly vulnerable. High level fish consumers are more likely to be exposed to higher levels of methylmercury. Women who are pregnant, breastfeeding or thinking of becoming pregnant, as well as children, are most vulnerable to its effects. Indigenous peoples, particularly in the Arctic, may be highly exposed to mercury, due to their consumption of traditional diets in which methylmercury bioaccumulates.

The actions assessed in this impact assessment will directly affect the following groups:

- Small-scale gold miners using mercury are particularly exposed to health risks. While they may profit from using mercury to produce gold or silver, they, their families, their communities and others may be highly exposed to mercury released as a result of this activity.

- With respect to mercury supply, key players include: mercury mines (none active in the European Union, but one trading), the chlor-alkali industry, gas companies, mines extracting other minerals where mercury is a by-product, and recyclers.

- Waste operators will gain business through the storage or disposal obligation for surplus mercury.

2.4. Baseline scenario ("Business as usual")

Currently mercury is traded freely on the world market. The European Union is a main global exporter, historically as a result of the mercury produced in Almadén, and recently because of the resale of surplus mercury from the chlor-alkali industry, coupled with a low internal demand for mercury.

In line with the Mercury Strategy, under the baseline scenario we assume that the European Union will remain a main global mercury exporter until 2011, when the export ban is introduced. Analysis of supply and demand developments in the EU shows that surplus in the European Union will sustain, hence bringing the need for a sustainable solution for mercury storage/ disposal. Detailed assessment of economic, environment and social developments is presented in the *Section 5 'Baseline scenario'*.

2.5. Legal basis

There are two basic elements: an export ban on the one hand, and an obligation to store mercury in a way that is safe for human health and the environment on the other. The export ban element indicates Article 133 ECT as the appropriate legal basis, even if the measure is motivated by the objectives of preserving, protecting and improving the quality of the environment as well as protecting human health, and not by commercial policy considerations. The second element, the storage obligation including the subsequent information and reporting obligations, is clearly motivated by environmental policy considerations as laid down in Article 175 ECT. In accordance with the recent judgments of the ECJ in cases C-94/03 and C-178/03 concerning the approval of the Rotterdam Convention and Regulation (EC) No 304/2003 concerning the export and import of dangerous chemicals, the proposal builds on both Articles 133 and 175 ECT. Both the Rotterdam Convention and Regulation No 304/2003 are characterised by a mix of environmental and trade policy elements very similar to this Proposal.

2.6. Subsidiarity and proportionality

The legislative proposal covers trade as well as internal market aspects. Mercury is a substance subject to the internal market rules and, if considered as waste, it is governed by Community waste legislation. The measures foreseen in this legal instrument must therefore also be taken at Community level and cannot be left to the Member States.

Storage/disposal possibilities may vary from country to country, depending on local environmental circumstances. Therefore, while some general standards should be met, detailed storage or disposal requirements are left to the Member States.

The measures foreseen in this Regulation are also necessary to comply with the objectives of the Waste Strategy. They avoid any form of micro-management that could be considered as problematic in terms of proportionality.

3. OBJECTIVES

3.1. What is the overall policy objective?

The key long term aim of the Mercury Strategy is that levels of mercury in the environment will be reduced so that there is no longer any need for concern over methylmercury in fish. This will probably take decades, since the present levels of mercury in the environment are also representative of past mercury emissions. Even without further emissions, it would take some time for existing levels to fall sufficiently.

To reach this long term aim, goals to globally reduce the supply and demand of mercury are needed.

- *To reduce global supply of mercury.* Since the European Union is a main exporter, an export ban from the EU will significantly reduce the global supply. Together with other measures (see below), this will help to reduce the anthropogenic mercury releases into the environment. Introducing an export ban has been envisaged in the Mercury Strategy and the circumstances that led to such a proposal have not changed. This impact assessment looks in detail at how to design the export ban and what should be the scope for the export ban, e.g. if mercury compounds and products already restricted in the European Union should also be covered.

- *To reduce global demand for mercury.* Mercury is used in many products and applications also where mercury-free alternatives exist. A big supply of mercury from the European Union means there is no incentive to find or use alternatives. In parallel to the actions evaluated in this impact assessment it is important to actively reduce the demand for mercury. Work is on-going in the European Union to further restrict mercury use in products and applications, but these actions are not assessed here.

- *To find a safe and sustainable solution for the surplus mercury.* Given the declining use of mercury and the planned export ban from the Community and the large stocks of mercury in society that will eventually become surplus, the issue of the long term fate of surplus mercury needs to be addressed. A viable solution to this excess mercury must be found so that it does not re-enter the environment. A main concern is the surplus mercury from the chlor-alkali industry.

- *To make progress at a global level.* There is a significant global dimension to the mercury problem. Consequently, the mercury problem cannot be solved by the European Union acting alone. It is important to reduce global mercury use and thereby help in reducing emissions. A main concern is the use of mercury in small-scale gold-mining and other non-desirable uses in developing countries.

3.2. Consistency with objectives of the Strategy for Growth and Jobs (Lisbon Strategy)

In terms of economic growth, overall effects of the export ban and the safe storage or disposal of mercury should be largely neutral, although there may be some negative implications for some businesses. These have been assessed in detail in the following sections of the impact assessment. This being said, the introduction of the mercury export ban and safe storage or disposal of surplus mercury will contribute to promoting more sustainable production patterns – one of the Lisbon agenda actions that have recently been underlined by the European Council[7]. It will also have a positive impact on public health, in particular, for those populations that rely on a fish diet. To a lesser extent it can potentially contribute to preserving biodiversity in the marine environment.

The overall effect on employment should be neutral. Even in those sectors which are likely to face some costs stemming from storage or disposal obligations, these costs

7 See Spring Council conclusions of 24th of March 2006.

should not have significant effects on employment. Some jobs may also be created through storage and disposal activities, but again this effect should be marginal.

Additionally, the export ban will be accompanied by a voluntary agreement by the chlor-alkali industry in the European Union. While ensuring necessary safety and environmental protection, it will allow for optimising the costs for industry and allow necessary flexibility, in line with the better regulation principles

3.3. Sustainable Development Strategy

The mercury strategy, including the export ban and mercury storage, contributes to the objectives contained in the Renewed European Sustainable Development strategy (EU SDS):

- The revised EU SDS strongly emphasizes the need for preventive action to avoid damage to human health or to the environment. Through the export ban and storage/safe deposit of mercury, the strategy will prevent health threats from exposure to mercury. The costs endured in implementing the strategy are in line with the polluter pays principle, also advocated in the EU SDS.

- The mercury strategy also contributes to another objective of the EU SDS, namely to ensure that by 2020 chemicals are produced, handled and used in ways that do not pose significant threats to human health and the environment. And taking a global perspective, it helps to advance implementation of the Strategic Approach to International Chemicals Management (SAICM).

- Another priority for the EU SDS, to which the mercury strategy contributes, is the overall improvement of the environmental performance of products and processes. This is part of a broader aim to promote sustainable production and consumption patterns and to ensure that the EU's internal and external policies are consistent with global sustainable development.

- Introducing a general export ban (though accompanied by a voluntary instrument) by means of a Regulation provides a clear and stable legal framework, allowing – in line with principles of better regulation – for enough time for business and control authorities for preparation before it enters into force. Regulation will be directly applicable in the Member States, thus levelling the playing field for all economic actors. Additional administrative burden both to business and public administration (e.g. customs officers, landfill checks), as estimated under the *Section 6.9 'Administrative costs'*, are expected to be rather negligible. The Regulation is fully in line with the subsidiarity principle.

4. POLICY OPTIONS

4.1. Which policy options have been considered?

The aim is to assess the specific measures to be taken, in order to introduce an effective export ban and to guarantee safe storage/disposal of surplus mercury.

In the Mercury Strategy it was agreed to introduce an export ban from the Community by 2011 (action 5) and to store the surplus mercury from the chlor-alkali industry (action 9). These options were assessed in the extended impact assessment that was presented together with the Strategy. The Table below summarises what was agreed and which issues need to be defined and assessed further.

Issues selected for more detailed assessment

Action agreed	**Issues selected for more detailed assessment**	**Legal instruments**
Banning export of mercury from the Community by 2011.	The scope of the export ban, e.g. if mercury compounds and products already restricted in the EU should be covered. Reporting and information exchange	Changing existing legislation New legislation An export ban is by definition a regulatory measure and cannot be put in place by means of market-based instruments.
Storage/disposal obligation for surplus mercury from the chlor-alkali industry	Scope of the storage obligation Different storage and disposal options will need to be presented and compared. Reporting and information exchange	Changing existing legislation New legislation Market-based options Voluntary agreement
International actions in the Mercury Strategy	International activities need to be discussed in parallel to the actions assessed in this impact assessment	

In the extended impact assessment to the Mercury Strategy an export ban was one of the main recommendations to reduce global mercury pollution. Circumstances that led at that time to making such a recommendation have not changed. The European Union will face significant surpluses in the coming years that, if exported, would contribute to global Hg pollution. At the same time, global demand is expected to decrease as mercury free alternatives increasingly replace mercury products and processes. Nevertheless, this decrease can be accelerated by European Union international actions.

This approach has been clearly supported by the Council and the European Parliament[8]. They have confirmed the need for an export ban and storage obligation and have asked the Commission to come forward with a proposal as soon as possible.

Updated information for EU-25 has been collected for this impact assessment. One change since the Mercury Strategy was adopted in 2005 concerns the price of mercury, which, after a long period of stability, has became particularly volatile. This development was, to some extent, foreseen in the previous impact assessment. The "business as usual" scenario presented below includes a separate section on mercury price behaviour now and as it is expected to evolve in the future.

For the issues selected for more detailed assessment, the corresponding policy options looked at in this impact assessment are as shown below. The following sections of this impact assessment contain an analysis of these options - the assessment focusing on those issues that have not been covered in the extended impact assessment to the Mercury Strategy, or those that have significantly changed since then (e.g. mercury price).

Baseline scenario	**Actors involved**
Stopping export of metallic mercury	Chlor-alkali industry Spanish mine MAYASA Recyclers Industry with surplus mercury Traders
Storage/disposal obligation for mercury from chlor-alkali industry	Chlor-alkali industry Spanish company MAYASA Waste operators

Policy options	**Actors involved**
Scope of the export ban	
Also stopping export of products already restricted in the European Union.	Industry producing products containing mercury that are restricted in the European Union

8 Community strategy concerning mercury – Draft Council conclusions (9470/05); European Parliament resolution on the Community strategy concerning mercury (A6-0044/2006)

Also stopping export of mercury compounds.	Spanish mine MAYASA Recyclers Industry with surplus mercury Companies producing mercury compounds. Traders
Scope of the storage/disposal obligation	
Storage/disposal obligation also for mercury as a by-product from production of other metals	Non-ferrous metal refining industry in some EU Member States (e.g. zinc production) Waste operators
Storage/disposal obligation also for mercury as a by-product from gas cleaning	Gas companies in some EU Member States Waste operators

Legal instruments	
Changing existing legislation	Amendment of Regulation No 304/2003 (export ban) Amendment of Directive 1999/31/EC on the landfill of waste (storage obligation)
New legislation	EP and Council Regulation covering export ban alone, or export ban and storage EP and Council Directive for storage
Other instruments	Voluntary agreements

There are only few pieces of existing Community environmental legislation that could be used for implementing an export ban and a storage obligation. Insofar as a new legal instrument is concerned, the choice is between a Regulation (directly applicable in all Member States) and a Directive (subject to transposition). At least for the storage obligation and related details, a voluntary (environmental) agreement could also be considered as an option.

For details and the choice of instruments see *Section 6.10 'Legal issues'*.

The different storage/disposal alternatives are:

- Storage/disposal of metallic mercury in an underground salt mine adapted for waste storage
- Disposal of stabilized mercury[9] in an underground salt mine adapted for waste storage
- Disposal of stabilized mercury in an underground bed-rock repository
- Disposal of stabilized mercury in a landfill for hazardous waste
- Storage of metallic mercury in a facility exclusively dedicated to and equipped for the storage of metallic mercury.

The above technical options have been analysed in this impact assessment in order to give more idea of storage and disposal costs, as well as long term safety. At the same time it should be noted that, to date, there has been relatively little research into the disposal of mercury.

A reporting and information exchange to track imports and exports of mercury and its compounds within the Member States as well as to and from the Community is proposed as a tool to implement the export ban and storage obligation in an effective and secure way.

The creation of a flexible information exchange system between the Commission, Member States and other stakeholders is proposed. It would aim to make the best use of available data, to simplify data flows and to limit administrative burdens to a strict minimum. This should also facilitate quick reactions to changing production and consumption patterns. A rigid system based e.g. on a periodic questionnaire is deliberately avoided.

4.2. The need for international action in parallel to the proposed actions

7 out of 20 actions in the Mercury Strategy concern promoting international action. Measures need to be taken on a global level to phase out the production of new mercury from cinnabar, and to prevent mercury surpluses going back to the market. Co-operation with developing countries is planned and the European Union also supports international initiatives, such as the UNEP Mercury Programme.

The UNEP Mercury programme adopted by a 22nd Governing Council Decision in 2003[10] and further developed by a Decision of the 23rd Governing Council in 2005[11] is of particular interest The latter requests *inter alia*, in point 25, governments and

9 Mercury in a stable form, where it is bound to other elements that prevent it from reacting the same way as in its' pure form. These stable forms are e.g. mercury sulphide (HgS) or mercury selenide (HgSe). See Annex I for further information regarding chemical forms of mercury.

10 UNEP GC Decision 22/4 V

11 UNEP GC Decision 23/9 IV

international organisations "*to take immediate actions to reduce the risks to human health and the environment ... by mercury in products and production processes, such as ... considering curbing primary production and the introduction into commerce of excess mercury supply*."

Mercury is not yet subject to binding restrictions under multi-lateral environmental agreements (MEAs), with the exception of the 1998 Protocol on Heavy Metals to the 1979 UN-ECE Convention on Long-Range Transboundary Air Pollution. The Community is a Party to this Protocol.

Some mercury compounds are subject to the procedures of the 1998 Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (PIC Convention).

According to action 16 of the Mercury Strategy, the Community should promote an initiative to make mercury subject to the PIC procedure. It is worth noting that Sweden has launched such an initiative and that the Commission expressed its support. The procedural requirements, however, prove to be difficult to fulfil, as neither the Community nor a Member State can trigger the mechanisms of the Convention alone. Support is needed from another party from a different region of the world.

The Commission is systematically improving its contacts with non-EU countries that are main producers, users and exporters of mercury and/or are subject to mercury pollution problems. An international mercury conference to be held on 26/27 October 2006 in Brussels with significant non-EU participation will build additional momentum for international negotiations, including trade issues, well before the 24th session of the UNEP Governing Council in 2007. The program includes major players such as Brazil, China, UNEP, UNIDO and the US. This event should allow for identifying possibilities to move forward on a global scale as well as common interests with non-EU countries to be brought into the GC negotiation process. Also, the conference aims at identifying partners for future bilateral co-operation.

Further action will also be developed to tackle the complex issue of mercury use in small scale gold mining, in particular in developing countries.

The EU had already asked for a legally binding instrument on mercury at a global scale on occasion of the 23rd GC meeting in 2005. The point is a key issue on UNEPs agenda and will be re-discussed at the 24th GC meeting in February 2007. The Commission is committed to contribute actively to the elaboration of an agreed Community position.

5. BASELINE SCENARIO ("BUSINESS AS USUAL")

Mercury is traded freely on the world market. The European Union is a main global exporter, historically as a result of the mercury produced in Almadén, and recently because of the resale of surplus mercury from the chlor-alkali industry, coupled with a low internal demand for mercury.

Currently the EU internal supply of mercury exceeds the demand, making the European Union an important exporter to the global market. In theory, if the EU domestic demand was to dramatically increase, there would be no mercury available for export. Therefore, for the sake of clarity, we first analyse internal demand and supply in the European Union and then move to an analysis of changes on the international markets and uses. Most of the data have been updated to 2005 and projections have been made up to 2015.

Under the "business as usual" scenario no constraints are introduced on mercury supply and trade until 2011 when the export ban and storage obligation will be in place. Until then, surplus mercury from the chlor-alkali industry continues to be returned to the market. The supply of chlor-alkali surplus mercury therefore replaces the production of new mercury. Metallic mercury is exported from the European Union without restriction. After 2011 an export ban and storage obligation for chlor-alkali surpluses will be in place. There will be no net demand for mercury from the chlor-alkali industry since they will be using own surpluses.

The following sections present current and expected developments in global and European Union mercury supply and demand, price developments, as well as economic, environmental and social impacts, if no further action than the introduction of the export ban in 2011 for metallic mercury and the storage obligation for the chlor-alkali industry, as foreseen in the Mercury Strategy, is taken.

5.1. Supply in the European Union

The main sources of mercury supply in the EU are: surpluses from the chlor-alkali industry when converting to a mercury-free process or when a plant is closed; by-product mercury from non-ferrous mining and smelting activities (e.g. zinc production); and by-product mercury from natural gas cleaning; recycled mercury (process mercury and mercury from products, e.g. fluorescent lamps, etc.); and mercury inventories accumulated over previous years by brokers and traders such as MAYASA. In 2005 the reported total supply (not including any mercury taken from inventories) from the European Union was 625 tonnes.

The estimated mercury supply during 2005 is presented below. For comparison we have shown also the global mercury supply.

Global and EU-25 mercury supply during 2005

2005	**Global supply (t)**	**EU-25 supply (t)**
Mining & by-product mercury	1996	79*
Mercury from chlor-alkali wastes	84	32
Recycled mercury - other	566	69
Mercury from chlor-alkali cells (decommissioning)	644	444
Stocks	400	0**
Total	**3690**	**625**

Note:
* Only by-product mercury in 2005 in EU-25. There is no mining in the European Union any longer, mining and processing of mercury ore in Almadén ceased in 2001 and 2003 respectively.

** The stocks now held in Almadén, Spain, have been previously reported under other sources. Typically the source would have originally been a mercury mine or by-product, chlor-alkali decommissioning or mercury recovered from waste. Mining and processing of mercury ore in Almadén ceased in 2001 and 2003 respectively. Therefore, even if some mercury from stocks was sold in 2005, this is not considered new "supply" in the same sense as the other sources listed.

Source: Maxson, 2006[12]

The main supplier in the European Union is the chlor-alkali industry – surplus mercury comes from switching to non-mercury technology and from site remediation. The surplus mercury is not, however, traded by the industry. Under an agreement made in 2001, the Spanish company MAYASA (Minas de Almadén y Arrayanes, S.A.) buys (below the market price, 30-50 % of the market price) the European Union chlor-alkali sector's surplus mercury for resale. MAYASA reported to have stopped mining mercury ore in 2001 and ceased the production of mercury (from stockpiled ore) in 2003. Currently, it only trades with stocks and new mercury coming from the chlor-alkali industry. Most of the surplus mercury in the European Union is exported. International trade statistics reported 824 tonnes exported in 2004. Following a commitment from the chlor-alkli industry, the phase-out of mercury cells will be finalised, at latest, by 2020. A fairly straight-line phase out is expected which will yield an average of 667 tonnes per year.

Besides the mercury in electrolytic cells in the chlor-alkali industry, there is a great deal more to be recovered or disposed of during plant de-commissioning and decontamination. The mercury content of contaminated buildings and structures, soils, equipment, etc., may vary from tens of tonnes to hundreds of tonnes for one plant. Two plants in the Czech Republic, for example reportedly hold an estimated 472 tonnes of mercury in contaminated buildings and soils, in addition to the quantities in the cells. In addition to the approximate amount of 1.8 kg of mercury available in the chlor-alkali cells per metric tonne of chlorine capacity[13] at least another 10-15 percent of easily recoverable mercury is available from other parts of the plant. These figures are in accordance with data collected by Maxson 2000[14].

The second largest EU source is mercury as a by-product from production of minerals such as zinc, copper, lead, gold, silver and other ores. The total mercury content in all non-ferrous ores refined in the EU-25 is likely to be in excess of 200 tonnes. Most of that ends up in refining wastes, and in some cases the mercury is separated from those wastes. For many years the largest producer of by-product mercury in the EU-25 has been Finland, where Boliden (formerly Outokumpu Oy) has for many years refined zinc and copper ores, including zinc concentrates imported from Sweden. The amount of mercury recovered in Finland has varied between 20 and 75 tonnes per year. Boliden-Norzinc mercury removal systems have

12 "Mercury Flows and safe storage of surplus mercury", Sprl. Concorde East/West, 2006.

13 Chlor-Alkali BREF, EIPPCB, 2000

14 P. Maxson and F. Verberne, *Mercury concerns in decommissioning chlor-alkali facilities in Western Europe*, ERM and Concorde East/West Sprl for the Netherlands Ministry of Environment VROM, The Hague, September 2000.

been installed on zinc smelters in Belgium, France, the Netherlands, Germany, Italy, and Norway. If not recovered as metallic mercury, the by-product from this process is calomel (mercurous chloride). From mercury exports and informal sources, it appears that mostly the Netherlands and Italy recover metallic mercury from the calomel, whilst Belgium, Germany, France and Norway are more likely to send the calomel for disposal. Maxson (2006) estimates that, in 2005, this source generated about 48 tonnes.

The third source of mercury (also referred to here as a by-product) is from gas cleaning. Whereas minerals such as zinc can, but do not have to be cleaned of mercury, natural gas from some sources (the North Sea, Algeria, Croatia), must be removed as the mercury concentrations are high enough to cause serious equipment problems during processing. Besides the Czech Republic, which recovers only a very small amount of Hg from natural gas, the Netherlands and Croatia are the only two Member States of the EU-25 who have reported the cleaning of mercury from gas supplies. Assuming there are other significant gas cleaning operations in the EU-25 as well, Maxson (2006) estimates that this source generates 26 tonnes per year. The gas is cleaned at the source, therefore gas imported from outside the European Union (e.g. Russia) will not generate any mercury in the European Union.

Major natural gas production in the EU and Norway

PJ = TJ*1000	2002	2003	2004
Netherlands	2525	2430	2856
Italy	555	524	494
Czech Republic	1.8	1.6	3
UK	4031	4029	3758
Norway	2755	3083	3277
Denmark	322	307	356
Germany	740	765	710

Sources:
Eurogas at http://www.eurogas.org/
IAEA statistics at http://www.iea.org/textbase/stats/

Another significant source is recycled mercury from mercury-containing products (batteries, measuring and control equipment, switches, relays, lamps, dental amalgam, etc.), manufacturing wastes from the production of mercury containing products, filters and wastes from incinerators and various industrial processes. The following table provides very rough estimates of the main mercury product waste streams, and the amounts of mercury recycled in the European Union and globally.

As mentioned, besides the recycling of mercury products, additional mercury is recycled from manufacturing and process wastes. Much of the mercury from process wastes has been included above in the discussion of by-product mercury. But there are manufacturing and other wastes sometimes recycled as well, that could further increase the total in the table below.

It is important to note that the mercury available in products and waste is much greater than what is actually recycled. With a large mercury supply from other sources there is no strong incentive to recycle mercury if the waste legislation does not require it.

EU-25 and global mercury recycling – 2005

EU25 and global mercury recycling – 2005	Hg in EU-25 waste stream (t)	EU-25 Hg recycled or recovered (%)	EU-25 Hg recycled or recovered (t)	Hg in global waste stream (t)	Global Hg recycled or recovered (%)	Global Hg recycled or recovered (t)
Small-scale gold mining	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Chlor-alkali	n.a.	n.a.	32	n.a.	n.a.	84
Batteries	40	25%	10	500	15%	75
Dental	72	25%	18	200	15%	30
Measuring & control	42	25%	11	160	15%	24
Lighting	46	25%	11	150	15%	23
Electrical & electronic	42	25%	11	150	15%	23
VCM*	unknown	unknown	unknown	700	43%	301
Other, laboratory, pharmaceutical, etc.	36	25%	9	50	15%	8
Total	278		101	1910		566

Note: If the Chinese industry estimate of VCM mercury catalyst recycling turns out to be optimistic (for example, if it is closer to 100 tonnes than 300 tonnes/yr), that could make a very large difference in the global total for recycled mercury.

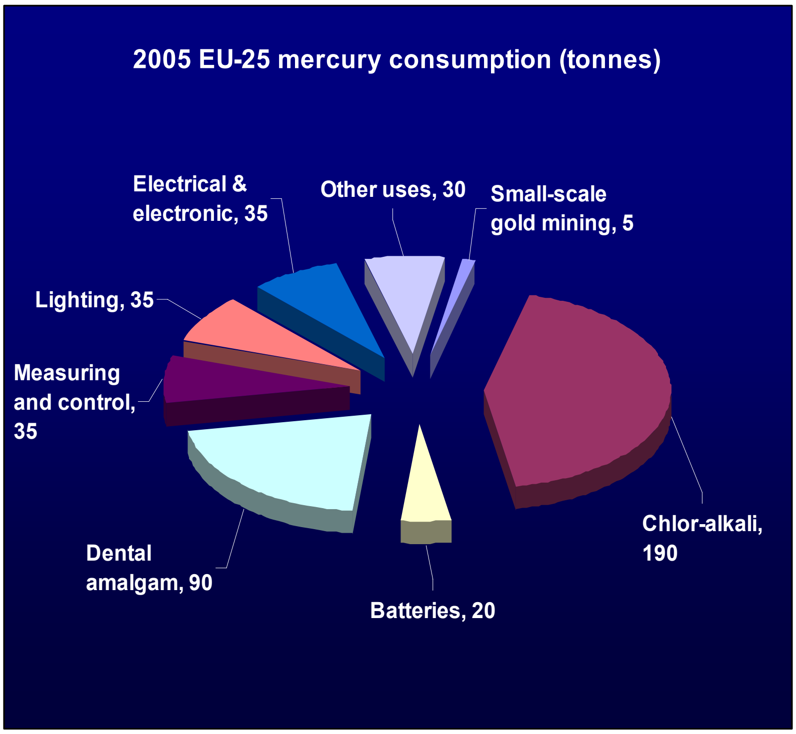
*VCM (vinyl-chloride monomer production with mercuric chloride as a catalyst)

Sources: Maxson (2006) calculations based on responses to the Stakeholder questions posed by DG ENV to the different Member States in September 2005, Brooks (2005), Maxson (2004 and 2005), Euro Chlor reports to OSPAR, and Mukherjee, A.B., Zevenhoven, R., Brodersen, J., Hylander, L. D. & Bhattacharya, P. 2004. Mercury in waste in the European Union: sources, disposal methods and risks. *Resour. Conserv. Recycl. 42*:155-182.

5.2. European Union demand (consumption) of mercury

Total market consumption (including mercury in products imported to the European Union) is approximately 440 tonnes per year. The graph below shows more detailed overview of the mercury consumption. The demand presented in the graph shows the market demand. Since some mercury products are imported, the EU-25 actual demand will be approximately 20% less than the "market" demand. The market demand has, conservatively, been used for calculations in this impact assessment.

EU-25 mercury consumption



Note: Small-scale gold mining is ongoing in French Guyana.

Sources: Brooks (2005)[15], Maxson (2004[16] and 2005[17]), Euro Chlor reports to OSPAR, and author estimates based on responses to the Stakeholder questions posed by DG Environment to the different Member States in September 2005, etc.

The biggest user (about 50%) of metallic mercury is the chlor-alkali industry. In 2005 the demand from the chlor-alkali industry was on the order of 190 tonnes.

The next most significant use in the European Union is in dental amalgam. Among other major product groups, Community legislation already covers lighting and other electrical equipment. The Commission recently adopted a proposal with restrictions for non-electrical or electronic measuring and control equipment[18].

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15 W Brooks and G Matos, Mercury Recycling in the United States in 2000, U.S. Geological Survey, 2005.

16 Mercury flows in Europe and the world: The impact of decommissioned chlor-alkali plants, report for the European Commission – DG Environment, Brussels, February 2004. Available at http://www.ec.europa.eu/environment/chemicals/mercury/

17 "Global mercury production, use and trade". Chapter in: Dynamics of Mercury Pollution on Regional and Global Scales – Atmospheric Processes and Human Exposures around the World (eds.: Pirrone and Mahaffey), Kluwer Academics Publishers.

18 Proposal amending Council Directive 76/769/EEC relating to restrictions on the marketing of certain measuring devices containing mercury. COM(2006) 69 final

The main factors behind the decrease in the EU-25 during the last 10-20 years are the substantial reduction or substitution of mercury content in regulated products and processes (paint, batteries, pesticides, chlor-alkali, etc.), and a general shift of mercury product manufacturing operations (thermometers, batteries, etc.) from EU-25 countries to third countries.

5.3. Product restriction within the European Union

Regulation 304/2003 implements the Rotterdam Convention concerning the export and import of dangerous chemicals. The Convention provides for an exchange of information between its parties on restrictions on hazardous chemicals and pesticides and their import and export. The Regulation also bans the export of certain chemicals and articles listed in Annex V, cosmetic soaps containing mercury are subject to this ban. The background to the ban is that cosmetic soaps containing mercury (used for skin bleaching) banned in the European Union since 1976, were exported in considerable amounts from the European Union prompting complaints from several developing countries. For example, Ireland imported 17 tonnes of mercury in 1999 for use in soaps[19], which were subsequently exported from the EU before the export ban for this product was in place.

However, there are several products containing mercury whose marketing is restricted in the European Union, although their production is not banned, hence the producers manufacturing these products for external (international) markets are not constrained by these restrictions. The inclusion of these products in the export ban is therefore assessed as an option. A description of existing and planned restrictions is listed below.

- Directive 2002/95/EC on the restrictions of the use of certain hazardous substances in electrical and electronic equipment (ROHS). The Directive 2002/95/EC requires substitution of certain heavy metals and other substances, including mercury, in new electrical and electronic equipment by 1 July 2006.

- Directive 91/157/EEC on batteries and accumulators containing dangerous substances. The aim of the Directive is the collection and safe recovery and disposal of spent batteries and accumulators containing dangerous substances

The adoption of Commission Directive 98/101/EC adapting the above mentioned Directive to technical progress prohibited the marketing of batteries and accumulators containing more than 0,0005% of mercury by weight. Button cells with a mercury content of no more than 2% by weight are exempted.

On 2 May 2006 the Council and the European Parliament reached agreement on a new Directive on batteries and accumulators which will replace Directive 91/157/EEC as amended. This new Directive will apply to all batteries not just the hazardous ones, and it will keep the same quantitative restriction on mercury as in the existing directive.

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19 Irish submission to UNEP, 2001

- Directive 2000/53/EC on end-of-life vehicles. According to Article 4 of this Directive mercury, *inter alia*, is restricted in materials and components of vehicles. Member States must ensure under Article 4(2)(a) that materials and components of vehicles put on the market after 1 July 2003 do not contain mercury other than in lamps and instrument display panels.

- Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations. The Directive creates a framework legislative procedure under which the Community may ban or restrict the use of hazardous chemicals by adding the substances and controls to an annex.

Restrictions on the use of mercury in the following applications were added by Directive 89/677/EEC:

a) To prevent the fouling by micro-organisms, plants or animals of: - the hulls of boats,
- cages, floats, nets and any other application or equipment used for fish or shellfish farming, - any totally or partly submerged appliances or equipment; b) the preservation of wood; c) the impregnation of heavy-duty industrial textiles and yarn intended for manufacture; d) in the treatment of industrial waters, irrespective of their use On 21 February 2006 the Commission adopted a proposal amending Directive 76/769/EEC relating to restrictions on the marketing of certain measuring devices containing mercury. These include fever thermometers containing mercury for all uses and other measuring and control equipment for consumer use.

- Directive 79/117/EEC prohibiting the placing on the market and use of plant protection products containing certain active substances. According to Article 3 of the Directive, plant protection products containing one or more of the following active substances may be neither placed on the market nor used: mercury oxide, mercurous chloride (calomel), other inorganic mercury compounds, alkyl mercury compounds, alkoxyalkyl and aryl mercury compounds. Commission Directive 91/188/EEC deleted some limited exemptions from these restrictions which had previously been allowed.

- Restrictions on Marketing of Biocides, Directive 98/8/EC concerning the placing of biocidal products on the market. Biocidal products cannot be placed on the market and used in the territory of the Member States unless authorised in accordance with Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market. No biocidal products containing mercury have been authorised and accordingly they are banned in the Community.

- Directive 88/378/EEC concerning the safety of toys. The Directive controls the placing of toys on the market in order to protect the health and safety of users and third parties. Annex II sets out essential safety requirements for toys. It provides that bio-availability resulting from the use of toys must not, as an objective, exceed levels specified for a variety of chemicals. The level for mercury is 0.5 µg per day.

- Directive 76/768/EEC relating to cosmetic products. Mercury and its compounds may not be present as ingredients in cosmetics, including soaps, lotions, shampoos, skin bleaching products etc. (except for phenyl mercuric salts as a preservative in eye makeup and products for removal of eye makeup.

To our knowledge, there is no production in the EU of products that are restricted in the EU. For non-electrical and electronic measuring and control equipment, restrictions are proposed, but not yet in place. The proposal recently adopted by the Commission was accompanied by an impact assessment showing that the number of remaining producers in the EU is limited to a small number of small and medium sized enterprises, although determining the precise scale and extent of the mercury business has proved to be difficult.

5.4. Mercury compounds

Most of the above data and trends refer to metallic mercury. However, to have a full picture, we also need to analyse the **mercury compounds**. The compounds that are discussed in this impact assessment are mercury oxide, mercury sulphide (cinnabar) and mercurous chloride (calomel). These are the main compounds used or produced in the European Union.

Mercury oxide is used in e.g. anodes and in batteries. Mercury oxide batteries are not produced in the European Union but some production is still ongoing in e.g. China and also imported to the European Union. In 2004, according to international trade statistics, 521,519 kg (value US$ 999,877) of mercury oxide batteries were exported from China, some of them going to the UK[20]. Alternatives normally used in the European Union are zinc-air batteries, alkaline batteries and silver-oxide batteries.

Mercury sulphide (cinnabar) is the mercury ore. Since mining in the mercury mine in Almadén ceased, there is no longer any supply within the European Union.

Calomel (mercurous chloride) is used e.g. in electrochemistry, pesticides and cosmetics such as soaps and skin lightening creams. The compound is a by-product of production of other non-ferrous metals (e.g. zinc). It is produced in significant quantities as a “waste” from the Boliden-Norzinc process, which is used most commonly to remove mercury from flue gases during zinc, gold, copper, etc., refining.

Currently the main export flow from the European Union consists of metallic mercury. However, a few years ago mercury compounds were exported in bigger amounts (for instance 253 tonnes of mercury in mercury oxide was exported from Almadén in 1997). Also, the cinnabar from Almadén has exceptionally high mercury content. As retrieving metallic mercury from these three compounds is technically easy and not an expensive process, it could be profitable to export cinnabar and/or mercury compounds.

5.5. Outlook 2011/2015 – the European Union internal situation

This section is provided in order see if the current situation of mercury surplus will continue in the future. It will also help to quantify mercury surpluses to appear on the

[20] "NRDC submission to UNEP in response to March 2006 request for information on mercury supply, demand, and trade", National Resources Defence Council, Washington DC, May 2006.

EU market after the introduction of the export ban in 2011. Supply and demand projections for the EU-25 are presented below.

EU-25 mercury demand and supply (tonnes) - "Export ban & storage" scenario

EU-25 mercury demand - "Export ban & storage"											
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Small-scale gold mining	5	2	1	0	0	0	0	0	0	0	0
Chlor-alkali	190	179	168	157	146	135	0	0	0	0	0
Batteries	20	19	18	16	15	14	13	12	10	9	8
Dental	90	89	87	86	85	83	82	81	79	78	77
Measuring & control	35	32	29	26	23	20	19	18	17	16	15
Lighting	35	34	33	32	31	30	29	28	27	26	25
Electrical & electronic	35	28	21	14	7	0	0	0	0	0	0
VCM	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other, laboratory, pharmaceutical, etc.	30	29	29	28	27	27	26	25	25	24	23
Total demand	**440**	**412**	**386**	**359**	**334**	**309**	**169**	**164**	**158**	**153**	**148**
EU-25 mercury supply - "Export ban & storage"											
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Mercury mining	0	0	0	0	0	0	0	0	0	0	0
By-product total includes:	79	80	80	80	81	81	82	82	82	83	83
By-product - zinc	48	49	50	50	51	52	53	54	54	55	56
By-product - other non-	5	6	7	8	9	10	11	12	13	14	15

ferrous											
By-product - natural gas	26	25	23	22	21	19	18	16	15	13	12
Chlor-alkali - Elemental mercury from cells	444	667	667	667	667	667	0	0	0	0	0
Recycled total includes:	101	101	101	102	102	102	82	84	86	88	90
Recycled Hg from chlor-alkali wastes	32	30	28	26	24	22	0	0	0	0	0
Other recycled Hg	69	71	73	76	78	80	82	84	86	88	90
Hg from EU stocks	0	0	0	0	0	0	0	0	0	0	0
Total supply	**625**	**848**	**848**	**849**	**850**	**850**	**163**	**166**	**168**	**170**	**173**
Total supply - demand	185	436	463	490	515	541	-6	2	10	17	25

VCM (vinyl-chloride monomer production with mercuric chloride as a catalyst)

Source: Maxson, 2006, including underlying assumptions.

The above table assumes there will be "zero" mercury coming from the chlor-alkali industry. In reality, there will be continued consumption and supply from this sector – however, we assume that after 2011 it will not take place on the market. A detailed analysis of surplus amounts, i.e. those to be stored is included in *Section 5.10 'Economic developments under the BAU'*.

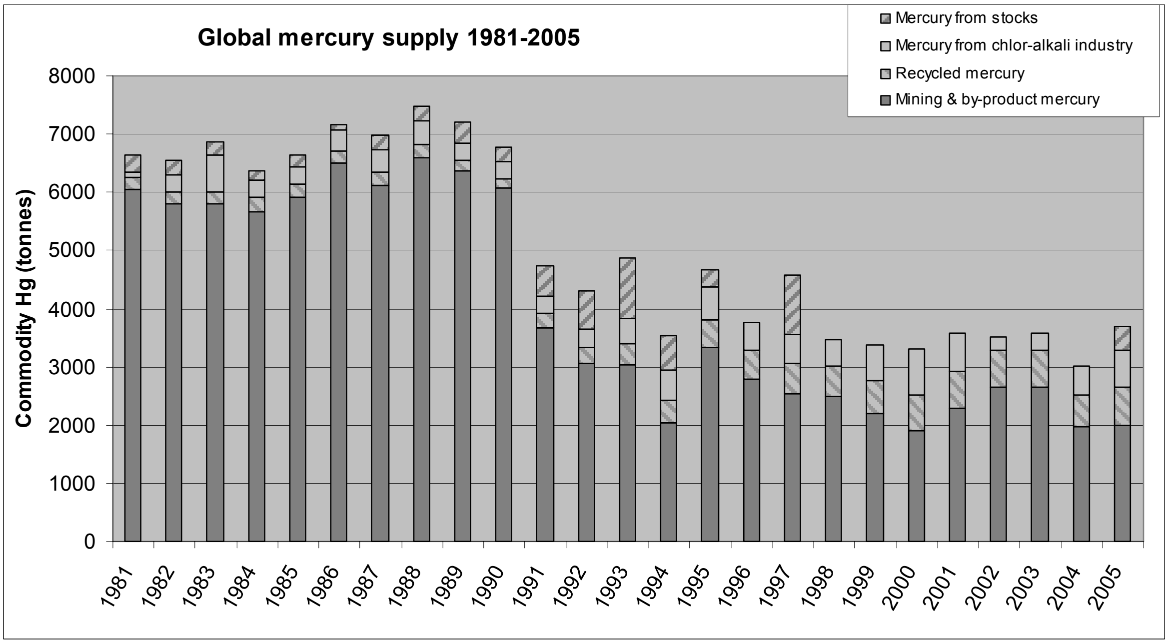
The phase-out of mercury in the chlor-alkali industry is expected to be a fairly straight-line phase-out of remaining mercury cell capacity by 2020. The industry has, through a voluntary agreement, committed to phase out the use of mercury until 2020. The switch to mercury-free technology in the chlor-alkali industry will release around 12000 tonnes of metallic mercury. Yearly supply from the industry is estimated to account for 667 t/year, while consumption is estimated to gradually lower from 190 t/year in 2005 to 80t/y in 2015 – and very low in 2020. This adds up to around 5629 tonnes surplus in 2005-2015, and 2825 tonnes surplus in 2011-2015 alone.

Even in 2020, however, a few mercury cell plants producing speciality chemicals will probably remain open since mercury may be indispensable for that production. This may be a characteristic of plants producing potassium hydroxide, which account for almost 1300 tonnes chlorine capacity. (Maxson, 2006)

5.6. Global supply

Total global supply presently stands at somewhere around 3,400 tonnes of mercury per year, the figure below summaries global mercury supply since 1981. EU-25 supply stands at around 780 tonnes per year. (Maxson, 2006)

Global mercury supply 1981-2005



Source: Maxson, 2006.

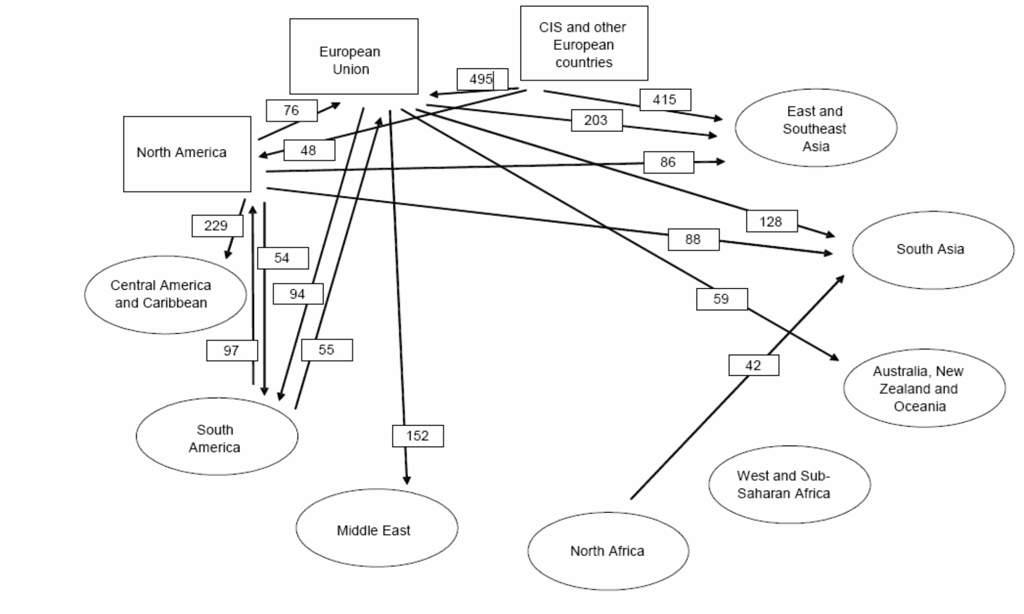
Historically the main global supplier was the Spanish State-owned firm MAYASA (Minas de Almadén y Arrayanes, S.A.). Even after the mining stopped in 2003, the European Union remains a main exporter of metallic mercury. The biggest supply now comes from the chlor-alkali industry.

The main current producers of primary mercury are Kyrgyzstan and China. In China the production of mercury has recently restarted since they have a substantial internal market for the metal. Algeria had an active mine until recently but this was closed at the end of 2004 in the light of continuing technical problems and in spite of increasing mercury market prices. (Maxson, 2006)

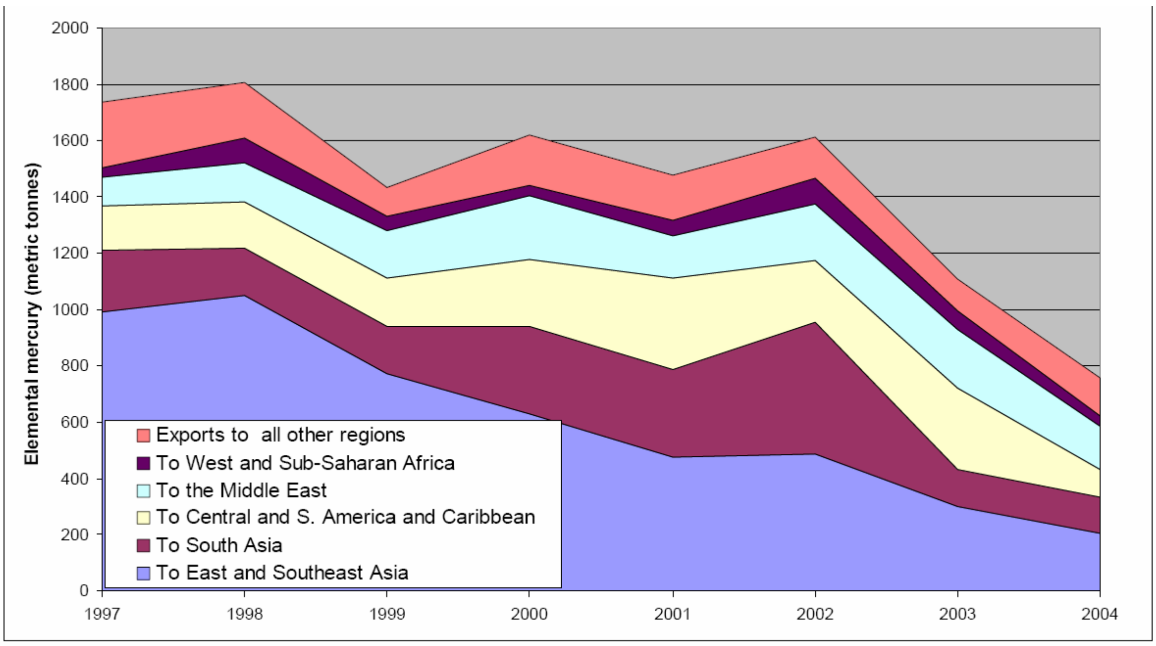
Given recent export figures from Europe[21] (1648 tonnes in 2002, 1110 tonnes in 2003 and 824 tonnes in 2004), it is apparent that the export ban will seriously decrease (at least in the near term) the mercury supply. This would raise the market price, on the one hand discouraging use, but on the other encouraging new production.

Regional trade of elemental mercury, 2004, tonnes

[21] Comtrade data, http://unstats.un.org/unsd/comtrade/



European Union mercury exports



Source: UNSD Comtrade statistics, as of April 2006.

However there are only two countries where new production could be expected, Kyrgyzstan and China. China seems to have no interest in exporting mercury, especially in the light of international scrutiny.[22] The Khaidarkan mining complex in Kyrgyzstan produces mercury using raw material from its own mines and from Russia and Tajikistan. Recent production has reached approximately 600 tonnes per year. Production capacity has been reported at up to 1,000 tonnes per year, which suggests a reasonably significant potential to increase production. However, for a

22 "NRDC submission to UNEP in response to March 2006 request for information on mercury supply, demand, and trade", National Resources Defence Council, Washington DC, May 2006.

variety of reported reasons – including difficulties with flooding and maintenance, complex mining conditions, potential exhaustion of the higher quality ore reserves, and tension over mercury production with neighbouring Uzbekistan – a real increase in production up to this capacity figure seems unlikely. An attempt to privatise the complex in August 2003 failed due to lack of interest from investors.[23]

Based upon many years of operating experiences it is highly unlikely that the Khaidarkan mercury mine could produce more than 600 tonnes per year. Overall, it is very unlikely that production could increase much. Production in Kyrgyzstan could rise in response to a permanent halt in production in Almadén, but probably not very quickly, and also not sufficiently, at least in the short term, to match recent years' production at Almadén. Note also that the mining operation in Kyrgyzstan is government-owned and subsidised, so would not necessarily react in a normal market-based way. The closure of the Algerian mine, despite an increased mercury price, shows that other factors are more important.

Therefore, the export ban and the permanent stop of the production at Almadén would achieve a net cut in global supply, a rise in mercury prices and a fall in the amount of new mercury entering circulation.

5.7. Global demand

Mercury is consumed in a broad range of products and processes around the world. The major categories of mercury demand in OECD countries include:

- Chlor-alkali production
- Dental amalgams
- Fever and other thermometers
- Other measuring and control equipment
- Mercuric oxide and other batteries
- Neon, compact fluorescent, HID and other energy-efficient lamps
- Electrical switches, contacts and relays
- Laboratory and educational uses
- Other industrial processes requiring catalyst, etc.
- Pharmaceutical processes, products and preservatives
- Other product uses, such as cosmetics, fungicides, toys, etc.

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[23] Bogdetsky (2001), Kyrgyzstan Development Gateway (http://eng.gateway.kg/mercury); Kyrgyzstan Daily Digest (http://www.eurasianet.org/resource/kyrgyzstan/hypermail/200203/0039.shtml); and Maxson (2006).

- Additional categories of mercury demand more prevalent in, but not exclusive to, less developed countries include:

- Small-scale gold mining

- Cosmetics

- Cultural uses and traditional medicine

- Paints and pesticides/agricultural chemicals

The main global uses are small-scale gold mining and chlor-alkali and VCM production (vinyl-chloride monomer production with mercuric chloride as a catalyst). Of these, only the chlor-alkali industry remains a significant user in the European Union, and here the mercury cell process is being phased out. The next most significant use in the European Union is in dental amalgam.

EU-25 and global mercury demand by sector (2005)

Mercury demand	**Global demand (t)**	**EU-25 market demand (t)***
Small-scale gold mining	1000	5
Chlor-alkali	619	190
Batteries	400	20
Dental	270	90
Measuring & control	150	35
Lighting	120	35
Electrical & electronic	140	35
VCM*	700	unknown
Other, laboratory, pharmaceutical, etc.	40	30
Total	**3439**	**440**

* "Market demand" represents all mercury consumed in the EU-25, including mercury imported in products, etc. "Direct demand" for elemental mercury that needs to be available to the EU-25 economy as a direct input into products manufactured in the EU ("EU-origin"), or industrial processes that take place within the EU is estimated to be 50-100 tonnes less than "market demand."

*VCM (vinyl-chloride monomer production with mercuric chloride as a catalyst)

Sources: Euro Chlor, Stakeholder Responses to DG Environment (2005), Maxson (2004, 2005), NRDC (2006)

Global mercury demand by region (2005)

Region	Metric tonnes
EU-25	440
North America	230
Other OECD	100
Eastern Europe/CIS	210
Arab States	100
East Asia & Pacific	1550
Latin America & Caribbean	270
South Asia	450
Sub-Saharan Africa	100
TOTAL	3450

Sources: Maxson (2004), NRDC (2006), Comtrade statistics, consultant estimates.

Demand in small-scale gold mining: The price of gold has increased significantly, leading to ever increasing small-scale gold mining. Recent detailed studies of mercury demand around the world for small-scale gold mining give an estimate of approximately 1000 tonnes of mercury per year (Veiga, 2006)[24].

5.8. Outlook 2010-2015 global situation

The following summary table combines the above projections of global mercury supply and demand.

Global mercury demand and supply (tonnes) - "Export ban & storage" scenario

Global mercury demand - "Export ban & storage"											
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Small-scale gold mining	1000	1000	1000	1000	1000	1000	970	940	910	880	850
Chlor-alkali	619	597	576	555	534	512	491	470	449	427	406
Batteries	400	380	360	340	320	300	280	260	240	220	200
Dental	270	270	270	270	270	270	270	270	270	270	270

24 Veiga (2006), P Maxson, L Hylander. "Origin of mercury in artisanal and small-scale gold mining", J. of Cleaner Production, 14: 436-447.

Measuring & control	150	145	140	135	130	125	120	115	110	105	100
Lighting	120	120	120	120	120	120	120	120	120	120	120
Electrical & electronic	140	128	116	104	92	80	77	74	71	68	65
VCM*	700	760	820	880	940	1000	1000	1000	1000	1000	1000
Other, laboratory, pharmaceutical, etc.	40	40	40	40	40	40	40	40	40	40	40
Total	**3439**	**3440**	**3442**	**3444**	**3446**	**3447**	**3368**	**3289**	**3210**	**3130**	**3051**
Global mercury supply - "Export ban & storage"											
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Mercury mining	1465	1450	1200	1200	1100	1000	1300	1300	1200	1100	900
By-product	531	546	560	575	590	604	639	673	708	742	777
Chlor-alkali - Elemental mercury from cells	644	800	800	800	800	800	257	246	235	224	213
Recycled Hg, incl. chlor-alkali wastes	650	720	790	860	930	1000	1019	1061	1103	1145	1187
Hg from stocks	400	100	0	0	0	0	0	0	0	0	0
Total	3690	3616	3350	3435	3420	3404	3215	3280	3246	3211	3077

Supply-demand	252	175	-92	-9	-26	-43	-153	-8	36	81	26
Cumulative	252	427	335	326	300	257	104	96	132	213	239

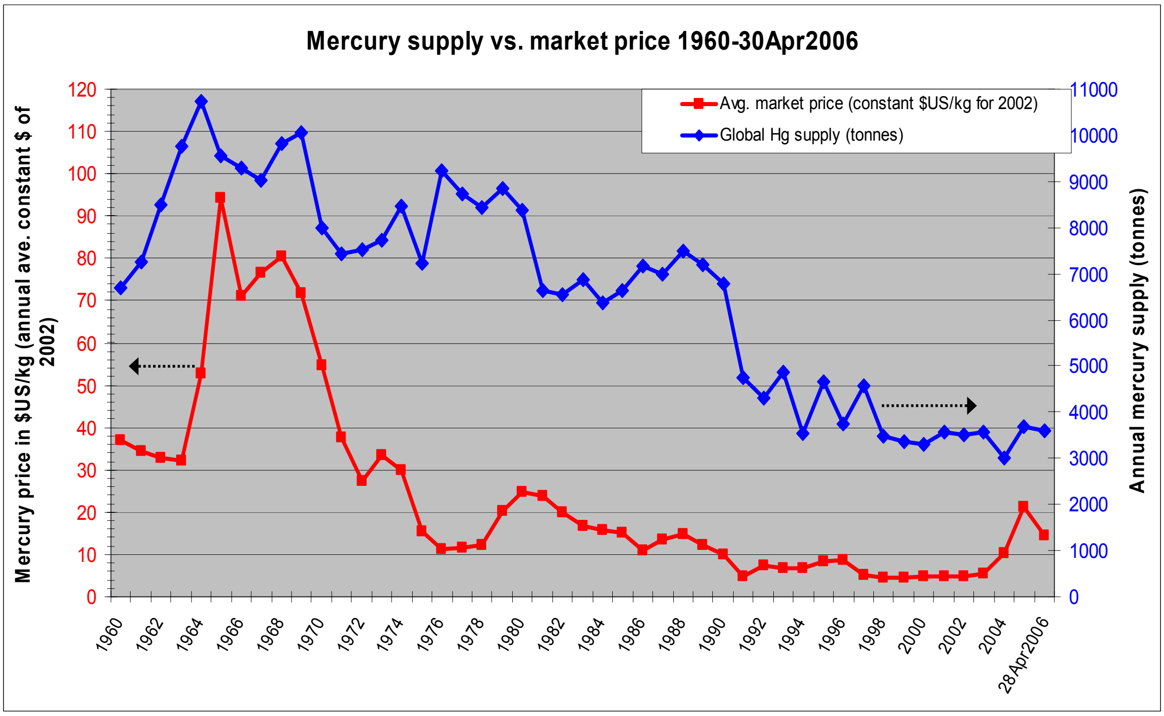
* VCM (vinyl-chloride monomer production with mercuric chloride as a catalyst)

Source: Maxson, 2006, including underlying assumptions.

5.9. Price developments

The mercury market has some special features, making it somehow different to other commodity markets. The main feature is that mercury can be relatively easily stored and kept for traders until they see favourable prices. Mercury supply can also be subject to abrupt changes. Firstly, the conversion of chlor-alkali industries happens at different speeds – and the price of mercury does not seem to be a driver for it. Secondly, non-EU mines seem to be in a poor technical condition – making them vulnerable to production interruptions and unable to respond quickly to larger demand.

As evident in the following figure, mercury prices have been on a downhill slide for most of the past 40 years. During the last 10 years they stabilized at their lowest levels ever – in the range of US$4-5 per kg of mercury – before spiking up considerably from the middle of 2004. Adjusting for inflation, mercury at US$5 per kg was worth less than five percent of its peak price during the 1960s. That price level reflected a chronic oversupply.



It is difficult to see how the mercury price will behave in the medium to long term. Firstly, the elasticity of the demand for mercury with price changes is impossible to calculate due to a lack of sufficiently detailed and precise data. Many mercury uses are relatively immune to variations in the mercury price.

Likewise, there is no reliable information on mercury prices for future transactions being concluded now.

While one should keep in mind that mercury markets are far from predictable, one could expect that, with European Union chlor-alkali mercury flooding onto the market until exports are banned, prices will continue falling to US$10/kg or lower over the next year, and continue to fall to US$5/kg or less if the large amounts of mercury from the chlor-alkali industry are not stored.

After the export ban, with great confidence in suppliers' ability to plan ahead, one could assume there will be quite adequate mercury stocks set aside to accommodate mercury demand during the 2-3 years just following the mercury export ban. If so, prices will change little, at least through 2015, probably maintaining a level of close to $10/kg in constant dollars.

In this impact assessment we assume that the European Union domestic market price will equal the global price, as imports to the European Union will be allowed after 2011. A price of **USD10/kg** (€7.85/kg or €7851.76 per tonne) is used for further calculations.

5.10. Economic developments under the BAU

Whereas overall economic impacts should be neutral, there will clearly be some industries which might be negatively (to a varied extent) affected by the introduction of the export ban in 2011 and the inability to sell excess mercury abroad. These would be all major European Union suppliers and, to a lesser extent, mercury traders.

In order to monetise the impact we need to apply the mercury price taken over the last few months in a period of high fluctuations. Therefore, we give a high and low-end estimate – the low-end being more realistic due to the reasons explained above in the section on price developments.

It should also be noted that price increase will have a rather neutral effect as long as it happens before 2011. The higher price of mercury means higher profits now and greater (hypothetical) loss afterwards, so the question is rather on when any big change in price would happen.

Another issue **is the storage and disposal costs**. Estimates vary greatly depending on technical standards of storage or whether disposal is chosen. Available data suggests that the costs of disposal would pay off in 20-50 years time, as compared to storage. Since very few businesses apply such a long time horizon in their decisions, the lowest yearly costs of storage, currently estimated at approximately €200 per year per tonne have been taken for the baseline scenario.

The chlor-alkali industry is expected to sell its surplus mercury to MAYASA up until 2011 at volume of around 670 tonnes per year. It's own consumption would reach approximately 100 tonnes per year, however, this figure is expected to decrease. On average the sector will be able to sell around 470 tonnes per year.

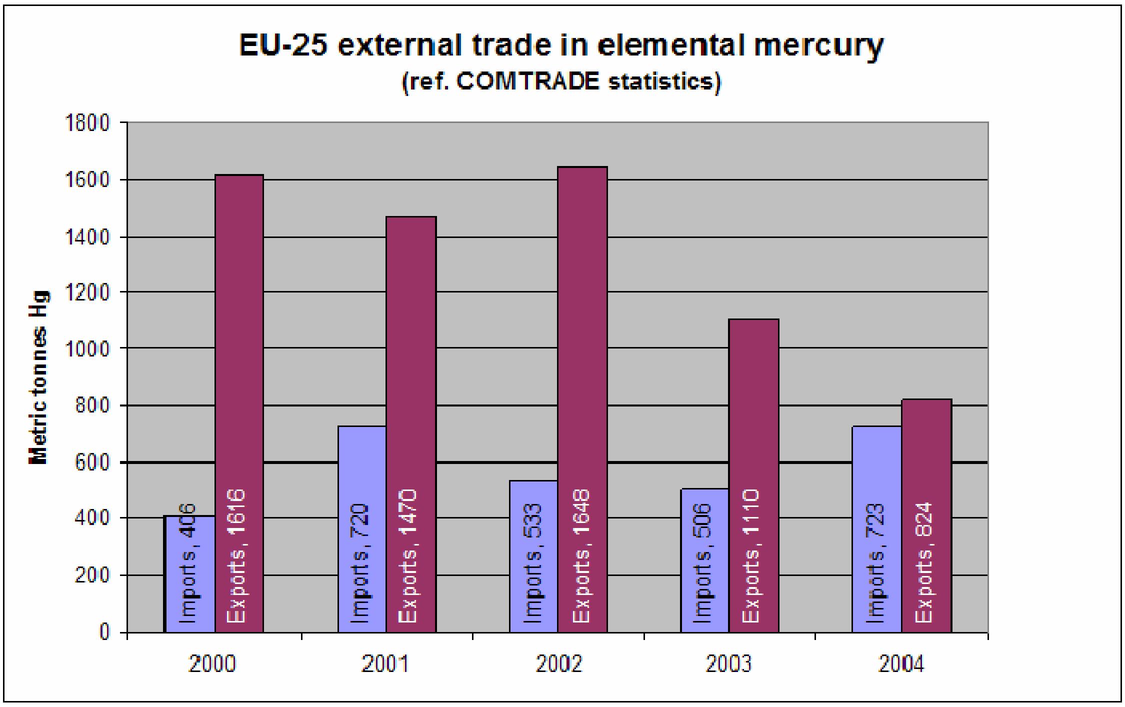
The situation will change as of 2011. The sector will have around 560 tonnes of yearly surplus which will no longer be exportable. As agreed in the Mercury Strategy we assume that this surplus mercury will have to be stored one way or another. The table below gives a summary of financial implications for the chlor-alkali plants.

EU chlor-alkali industry		
Years	2005-2010	2011-2015
Amount of Hg available	494 t/y to be sold	582 t/y to be stored
Income/ costs of storage per tonne	10 USD/ kg (€7.85/kg)	€196.3/tonne/year
Total yearly income /cost	4.9 m USD*/year (€3.87 m)	- €114,243/year

* This is a high-end estimate. Currently this income is lower, as industry sells to Mayasa below market price (30-50% of the market price), additionally estimates take Hg recovered from installations

as a pollutant (from site and buildings) into account, but do not consider the costs of removing mercury from membrane cells and of site decontamination

EU traders. Currently the major trader is MAYASA. There are also other traders (e.g. Lambert Metals), however, most mercury traders also deal in some other non-ferrous metals and frequently in other commodities. The mercury business has never been reliable or profitable enough for a company to depend on it for its livelihood. No data is available to estimate profit margin to mercury traders from selling one tonne of mercury, but since 2000 mercury trade is decreasing. Economic impact should be largely neutral as the 2011 export ban will not prevent these companies from trading on global markets.



The situation of industries that produce mercury as a **by-product** of their principal activities until 2011 will be similar to that of the chlor-alkali industry.

Remaining suppliers (other than chlor-alkali producers)		
Years	2005-2010	2011-2015
Amount of Hg available	24 t/year to be sold	42 t/year to be stored
Income/ costs of storage per tonne	10 USD/ kg (€7.85/kg)	€196.3/tonne/year
Total yearly income /cost	0.24 m USD* (€0.19m)	- €8,244/year

*this figure should be corrected downwards by the cost of producing mercury as a by-product (cleaning gas, extracting it from zinc ores, etc.)

Economic developments in the **recycling sector** will depend on how internal demand and supply develops, the scope of the storage/disposal obligation and the mercury price. The impact is likely to be neutral to positive. The sector has high remaining capacities and, if needed, can deliver more mercury for the remaining uses.

Waste operators should be the economic sector clearly gaining from increased storage/disposal. Their income can be estimated to be at least equal to the lowest storage costs for surplus mercury, which would total approximately €122,491 (624 tonnes per year at €196.3).

The situation in **sectors using mercury as an input** will depend on the mercury price. In case of (unlikely) shortages of mercury delivered by the European Union suppliers, these sectors will be able to import mercury from abroad. Also, a decrease in the overall demand from these sectors is expected.

5.11. Environment impacts of the BAU

5.11.1. Export ban

The export ban of metallic mercury will give rise to several advantages from an environmental point of view. The current situation, where the European Union is the main global exporter stimulating demand, will stop. The big supply of mercury is likely to result in increased consumption and emissions, including uses that are particularly harmful to the environment. Some of the mercury finds its way to illegal and poorly controlled applications with high level of emissions. The export ban of mercury from the European Union will contribute to the reduction of global mercury supply and thereby reduce the risk of exposure to mercury for humans and the environment, including reducing the use in small-scale gold mining. Currently, mercury exported from the European Union is mainly used in small-scale gold mining, causing negative effects on the global environment and to humans.

The ban will also give an important political message that the Community is concerned and takes a level of responsibility for global mercury emissions. The export ban will be a visible commitment and it will give a signal to the world that the European Union takes mercury seriously.

In the impact assessment to the Mercury Strategy, we stated that quantifying the benefits is difficult and often impossible. Since the science on the subject has not changed since then, in this impact assessment we limit ourselves to describing qualitative processes, rather than attempting to give quantified data.

One example is the gold mining sector. The mercury used in small-scale gold mining (~1000 tonnes/year) pollutes thousands of sites, and contributes more than 10% of the anthropogenic loading of mercury to the atmosphere.[25] The export ban will is likely to contribute considerably to a reduction in use and emissions. However, it is difficult to quantify how big the reduction will be since it depends on factors such as supply available from other sources, the gold price, and the efforts in other countries to reduce the mercury problem.

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[25] Declaration of the International conference on mercury – Mercury as a global pollutant, Madison, 2006http://www.mercury2006.org/portals/31/press/pressconference/mercury2006nr081106.pdf

The dimension of the mercury problem with its environmental and health impacts are comprehensively described in other recent documents, such as: the UNEP Global Mercury Assessment (UNEP Chemicals)[26]; State of the world 2006 (the Worldwatch Institute)[27]; Dynamics of Mercury Pollution on Regional and Global Scales (Pirrone and Mahaffey, 2005)[28]; and reports from the World Health Organization (WHO)[29].

5.11.2. Storage/disposal obligation

A storage/disposal obligation for the surplus mercury from the chlor-alkali industry will be in place from 2011. Compulsory storage for surplus mercury from the chlor-alkali industry will mean that it cannot be traded internally in the European Union. Since it is the biggest source of supply, we can assume that allowing circulation would bring internal EU prices down, and thus would not encourage the further limitation of use in the European Union. The overall environmental effect would be negative.

The environmental impact of storage of mercury could be expected to be negligible. Storage alternatives exist, for example there are experiences from the USA currently storing 4,436 tonnes of metallic mercury[30]. The US Defense Logistic Agency (DLA) has carried out an Environmental Impact Statement in 2004[31]. The storage alternatives were assessed as having negligible human health and ecological risks.

The environmental impact of a disposal option would depend on the nature and location of the operation and how the mercury will be disposed. The different options still need to be assessed, especially concerning the long-term effects.

Transport of mercury due to the storage/disposal obligation will decrease or be similar as today. Currently the surplus mercury from the chlor-alkali industry is transported to MAYASA in Spain for resale.

5.12. Social impacts of the BAU

As presented above, the overall economic impact for the economy will be largely neutral, the costs of storage (unless the most expensive disposal options are chosen) are not likely to be significant enough to create any marked economic losses or gains in any of the sectors, hence any shift in employment will be modest.

As far as trading companies are concerned, the biggest social impact is expected in Almadén, in the Spanish Region Castilla-la-Mancha. MAYASA employed 148 people in 2003.[32] Some of these positions will relate to areas other than the mercury business (e.g. agriculture, geological services) into which MAYASA has diversified

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26 http://www.chem.unep.ch/mercury/Report/Final%20Assessment%20report.htm
27 State of the world 2006, Chapter 6: Curtailing Mercury's Global Reach, the Worldwatch Institute
28 'Dynamics of Mercury Pollution on Regional and Global Scales – Atmospheric Processes and Human Exposure around the World', Edited by Nicola Pirrone and Kathryn R. Mahaffey, 2005
29 http://www.who.int/en/
30 Article in New Haven, State of Connecticut, posted 3 February 2006, by Amy Soper (asoper@news-senitel.com).
31 Final Mercury Management Environmental Impact Statement, The US Defense Logistic Agency (DLA), 2004.
32 Data from www.sepi.es. SEPI is the Spanish state-owned holding company which owns MAYASA.

in recent years. As extraction and production of mercury have both stopped in Almadén (since June 2001 and July 2003 respectively), there is no current operational employment associated with these activities. Presumably, therefore, such limited employment as continues to be connected with the mercury business in Almadén will relate to management of the stockpiles of ore and mercury, handling of surplus mercury from the chlor-alkali industry and handling of mercury trades. It should also be noted, that MAYASA (but not necessarily its mercury part) reported losses in 2000-2002 of about €30m[33].

Castilla-la Mancha is defined as an "Objective 1" region under the European Union development policy and the region already receives Structural Fund assistance for 2000-2006 amounting to €2.1 billion. Castilla-la Mancha will continue to be an Objective 1 region in the next funding period 2007-2013, and will be entitled to receive EU Structural Funds. The Funds that are applicable to the Almadén area are the ERDF Fund and the ESF Fund.

A Spanish project managed by MAYASA on safe disposal of surplus mercury will also be co-financed by the European Commission under the LIFE Preparatory Actions Program. The total project budget is €4,310.175.

Employment implications from converting to new technology in the chlor-alkali industry might be negative, if the new technologies are less labour intensive, but this would then be a natural process of modernisation and the 2011 export ban is unlikely to have any impact on it.

5.13. External impacts of the BAU

The European Union will remain the dominant global supplier until 2011. A significant amount of the negative effects associated with global mercury use will be attributable to EU-sourced mercury until the export ban comes into force.

Major EU-25 exporters (tonnes elemental Hg)					
	2000	**2001**	**2002**	**2003**	**2004**
Germany	128	162	125	93	69
Netherlands	272	312	292	145	228
Spain	850	648	730	678	444
United Kingdom	255	259	47	70	24
Others	111	89	455	123	59
Total	1616	1470	1648	1110	824

Introducing the export ban in 2011 and reducing supply to international markets, is expected to make it more difficult to use mercury in poorly controlled situations. At the same time some external producers using mercury might lose input for their production processes, although at the same time any external producers

[33] Profit/Loss before tax. Source: http://www.bvdep.com/AMADEUS.html

manufacturing mercury-free substitutes would find themselves in a better competitive position.

5.14. Tracking/enforcement system

Introducing the export ban in 2011 will also require an efficient monitoring system to ensure that the mercury is not illegally shipped to the global markets. Such a system will entail some administrative costs. These have been assessed in *Section 6.9 'Administrative costs'*.

6. ANALYSIS OF IMPACTS

6.1. What kind of benefits can be expected?

The key, long term benefit of reducing mercury emissions will be decreased levels of mercury in the environment. This, in turn, will lead to lower levels of human exposure to mercury, including methylmercury in fish, with resultant health benefits. It will also reduce the impacts of mercury on soils and biodiversity, in particular in the marine environment.

Specific benefits, to be achieved from the proposed measures are:

- Reduced poorly controlled use and emissions.
- Progress at a global level.
- A safe and sustainable storage/disposal solution for the surplus mercury, which will avoid causing severe damage to the environment.

6.2. Who is affected?

In the European Union:

- All individuals exposed to mercury
- Mercury mining industry
- Chlor-alkali industry
- Mining and smelting companies with mercury as a by-product
- Gas companies with mercury as a by-product
- Recycling industry
- Waste operators
- Mercury traders
- Industry producing mercury-containing products

- Industry producing mercury-free products
- Consumers
- Fishing industry

Outside the European Union:

- All individuals exposed to mercury
- Industry using mercury, e.g. chlor-alkali industry and industry producing mercury-containing products
- Mercury mining industry
- Small-scale gold miners
- Mercury traders
- Industry producing mercury-free products
- Consumers
- Fishing industry

6.3. Description of the options

Policy options	**Actors involved**
Scope of the export ban	
Also stopping export of products already restricted in the European Union.	Industry producing products containing mercury that are restricted in the European Union
Also stopping export of mercury compounds.	Spanish mine MAYASA Recyclers Industry with surplus mercury Companies producing mercury compounds. Traders

Scope of the storage/disposal obligation	
Storage/disposal obligation also for mercury as a by-product from production of other metals	Non-ferrous metal refining industry in some EU Member States (e.g. zinc production) Waste operators
Storage/disposal obligation also for mercury as a by-product from gas cleaning	Gas companies in some EU Member States Waste operators

6.3.1. Scope of the export ban

The Mercury Strategy foresees the introduction of an export ban on mercury. The scope of the export ban needs to be decided. The baseline scenario includes an export ban for metallic mercury. The options could also include mercury compounds and products containing mercury that are already restricted in the European Union. The mercury compounds assessed are mercurous chloride (calomel), mercuric oxide and mercury sulphide (cinnabar).

6.3.2. Storage obligation

A storage obligation for the surplus mercury from the chlor-alkali industry is foreseen in the Mercury Strategy and included in the baseline. The introduction of a storage obligation for mercury and its compounds from production of other metals and mercury from gas cleaning is assessed.

Additionally, we investigate the technicalities of storing or disposing of the mercury and whether the method should be set at the European Union level and who should bear the costs.

6.3.3. Reporting and information exchange

Reporting and information exchange of mercury and its compounds will be necessary to ensure the export ban is an effective instrument and the best way to introduce it is therefore assessed.

6.4. Environmental impacts

6.4.1. Scope of the export ban

Banning export of mercury compounds

The environmental impacts of the export ban of metallic mercury have been described in the baseline. The Commission services also had a look at compounds and products. Extending the export ban on mercury compounds is likely to increase environmental benefits outside the European Union. If the export ban is not expanded to mercury compounds, they can be exported from the European Union.

A compound of some concern is calomel (mercurous chloride), since it is already produced in significant quantities as a "waste" from the Boliden-Norzinc process, which is most commonly used to remove mercury from flue gases during zinc, gold, copper, etc. refining.

The concern is that when calomel waste is generated within the European Union, it could be exported as a compound. A third-country processor could then possibly recover the mercury at little cost (probably less than $100/flask[34]).

Banning exports of products containing mercury

Several restrictions for products containing mercury have been introduced at Community level, e.g. mercury use in electrical and electronic equipment, batteries, pesticides and cosmetics. Recently further restrictions were proposed by the Commission for non-electrical and electronic measuring and control equipment. Even with restrictions in place in the European Union it is still possible for these products to be produced within the Community and then exported to other countries. Once exported, the mercury contained in these products could end up in waste streams and finally in the environment.

6.4.2. Scope of the storage/disposal obligation

Introducing compulsory storage or disposal must be seen in the context of the overall supply and demand developments. If European Union supply remains higher than demand, it may lead to a situation where mercury is sold on the market to a very low price to avoid the costs for the handling of waste and the incitement for using alternatives to mercury will be lower. There is also a risk that desirable collections from the waste streams will stop since there will be no market for the recycled mercury. Limiting surpluses on the European Union internal market is likely to increase mercury recycling, which should have a positive environmental impact. If the mercury is not recycled, two negative consequences may occur. Firstly, the amount of mercury going to final waste disposal, via landfill or incineration, will increase. Secondly, the presence of mercury in the waste may also inhibit the recycling of other materials.

From an environmental point of view the ideal situation would be a storage obligation for all surplus mercury not needed in the European Union in parallel with measures to guarantee that collections of mercury from waste streams and the production process take place.

6.4.3. Storage/disposal solution

When it comes to choosing the storage/disposal design it is clear that storage/disposal is feasible and that safe alternatives will be available. From an environmental point of view disposal is the preferred option. However, secure storage might be needed for economic and technical reasons for a limited period in order to find a good long-term solution. It is important to assess the environmental effects of the disposal site, also regarding the long-term effects, before deciding on

[34] one flask contains 34.5 kg mercury

the exact design for the long-term solution. It is also important to consider advantages and disadvantages for different kinds of storage/disposal. Storage/disposal of metallic mercury has the advantage that a conversion process is not needed. Conversion to a stabilized form is likely to be more secure in the long-term but, at the same time, it might cause emissions during processing.

A storage/disposal obligation for the surplus mercury from the chlor-alkali industry is foreseen in the Mercury Strategy and is described in the baseline. The sections below analyse in more detail the storage/disposal solutions for the other sectors.

Mercury and its compounds from production of other metals

Environmental effects will be similar to those of introducing a storage or disposal obligation on surplus mercury from the chlor-alkali industry, but proportionally lower, as the quantities involved are also lower.

An alternative to storing or disposing of metallic mercury or calomel would be to leave mercury in the tailings, from where at a least part of it would escape into the environment.

If a storage obligation for mercury compounds is introduced they could be stored/disposed of in the future mercury storage/disposal site or in a normal landfill for hazardous waste if the criteria are met. Storage/disposal techniques for mercury compounds already exist.

Mercury from gas cleaning

Currently, mercury from gas cleaning is not stored. Environmental impacts of introducing such an obligation would be similar to those of introducing compulsory storage for surplus mercury from the chlor-alkali industry, but proportionally lower, as the quantities involved are also lower.

Mercury and its ore from mercury mines

Mining of mercury ore stopped in Almadén in 2001, and mercury extraction from the ore also ceased in 2003. It is difficult to estimate the amount of remaining mercury ore. However, we can assume that, by 2011, there should not by any left.

Mercury from recycling

Environmental effects of compulsory storage or disposal of mercury retrieved from recycling are likely to be negative. On the positive side, it would cut another source of supply, thus contributing to a quicker phase-out of remaining uses. On the other hand, it would discourage recycling so that products and materials containing mercury would need to be landfilled.

6.4.4. *Reporting and information exchange*

The establishment of an informal information exchange procedure is proposed. This should allow a follow-up of developments in the mercury supply and demand chain and to identify needs for further action. The information exchange mechanism should be flexible and require only a limited resource input. For this reason no formal committee procedure is proposed.

Under a complementary voluntary commitment from the chlor-alkali industry, this key stakeholder would transmit annual data on mercury flows within the industry and from the business to storage and disposal operators.

Taken together, these measures should ensure that their effect and impact on the environment is monitored.

6.5. Economic impacts

6.5.1. Scope of the export ban

Banning export of mercury compounds

At current mercury prices the export of cinnabar and/or mercury compounds would still be profitable after the introduction of the 2011 export ban. The current market price for mercury is approximately 600 US$/flask[35]. Since Hg mining and refining costs are low, at between 90-180 US$/flask at Almadén (Maxson, 2004[36] and Maxson, 2005[37]), even with an additional cost for exporting cinnabar ore, a significant profit margin would remain. Conversion of metallic mercury into a mercury compound, and then its conversion back to metallic mercury would cost approximately 200 US$/flask. The current market price is approximately 600 US$ so this would be profitable for a mercury trader (during the first quarter of 2004 the price of mercury was only 200 US$ per flask (Maxson, 2005).

Banning the export of mercury compounds would deprive trading companies (or producers of mercury compounds) of such a hypothetical profit. However, this negative economic effect on some producers and some traders has been largely taken into account in the baseline scenario, where we assumed no export of metallic mercury. Therefore, the overall economic impact is not likely to differ from the baseline scenario.

Banning export of products containing mercury

The economic impact of banning the export of mercury-containing products already restricted in the European Union is likely to be small. As described in the baseline there seem to be no production in the EU of products that are restricted in the EU. According to the information in the impact assessment for marketing restrictions for measuring and control equipment[38], the number of remaining producers in the European Union is limited to a small number of small and medium sized enterprises. This is also illustrated by the fact that no sectoral organisation exists on a European or Member State level. Determining the precise scale and extent of the mercury

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35 One flask contains 34.5 kg mercury

36 'Mercury flows in Europe and the world: The impact of decommissioned chlor-alkali plants', Peter Maxson for the European Commission, 2004.

37 'A brief assessment of mercury supply and demand in the EU25+2 during the transition through the mercury export ban – 2007-2020, Peter Maxson, 2005)

38 COM(2006) 69 final

business has, however, proved difficult. There are some information gaps, for example concerning the possible export of mercury-containing components for the automobile industry that do not comply with EU rules in terms of mercury content.

6.5.2. Storage/disposal obligation

The economic impact of the storage obligation will depend on its scope (i.e. which sources are covered and the quantities involved) and which standard is adopted for storage or disposal. As concluded in the above section, imposing a storage or disposal obligation on mercury from recycling would be counterproductive from an environmental point of view. Therefore the assessment below concentrates on the remaining sources (the surplus mercury from the chlor-alkali industry, mercury and its compounds from production of other metals and mercury from the cleaning of natural gas).

In the baseline scenario we assumed the lowest yearly costs for storage of metallic mercury, that is €196.3 /tonne/year. Options for storage already exist today. However, disposal alternatives are in the planning and development stage. The table below summarises the different options and their expected costs and environmental aspects.

Overview of the storage cost estimates	Costs per tonne per year		Costs adjusted to EUR		Environmental aspects
Type of storage	low end	high end	low end	high end	
Consolidated surface storage [39]	USD 250	USD 250	196	196	Environmental/health risks are "negligible" to "low". Safe long-term management. Need of surveillance also in the long-term
Landfill for hazardous waste in Sweden[40]	SEK 1 300	SEK 1 3000	140	1403	
Hazardous waste (salt mine) [41]	EUR 260	EUR 260	260	260	
Metallic mercury in salt mine[42]	EUR 260	EUR 1 000	260	1000	
Deep bedrock repository (permanent disposal in a stabilised form)[43]	SEK 250 000	SEK 650 000	26972	70127	Considered to be the safest solution for Swedish conditions. Long-term safety expected. No surveillance needed in the long-term. Final design still to be developed.
Surface disposal facility (permanent disposal in a stabilised form)[32]	SEK 16 667	SEK 43 333	1798	4675	Less safe than bedrock in the long-term and not considered as an acceptable solution in Sweden.
Disposal in monofill (including macro-encapsulation)[44]	USD 6 000	USD 16 000	4711	12563	Considered to be environmentally safe
Storage of metallic mercury Sweden	SEK 300 000	SEK 350 000	32 366	37 761	

39 "Draft mercury management environmental impact statement", Defense National Stockpile Center, Defense Logistics Agency (DLA), see also Appendix D – Cost Analysis, Washington DC, 2003.

40 "A safe mercury repository – a translation of the official report SOU 2001:58", Swedish Environment Protection Agency, 2003

41 K+S Entsorgung GmbH, price could decrease if bigger quantities

42 Informal communication with salt mine operators. The price will depend on the requirements from the authorities. A more secure area than for normal hazardous waste will be needed.

43 "A safe mercury repository – a translation of the official report SOU 2001:58", Swedish Environment Protection Agency, 2003

44 "Economic and environmental analysis of technologies to treat mercury and dispose in a waste containment facility", prepared for the Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio, prepared by Science Application International Corporation, Germantown, Maryland, April 2005.

The above cost estimates (apart from consolidated surface storage), do not take transportation costs into account.

The costs for storage and disposal vary greatly. Data sources reveal that there is relatively little research on mercury disposal options, and these costs can be expected to be brought down if more research is invested in that area.

The costs for disposal could seem very high, but it is important to consider that this is a one-time cost compared to storage that is presented as a cost/year. However, for comparison reasons we have calculated the cost per year, seen over a 40-year period for the disposal options.

It is important to note that the costs cited have relatively little connection with the volume of mercury to be stored or disposed of. Most of the costs are related to the development of the site and the facility, unless there are pre-disposal mercury treatment costs, which are directly related to the volume of waste treated, and may be quite significant.

6.5.3. Reporting and information exchange

As mentioned in chapter 1.8.4, reporting and information requirements should be designed so that they can be handled flexibly, avoiding unnecessary administrative burdens on both Member States and industry. This should also allow for easy adaptation to new and emerging issues related to mercury. This high degree of flexibility, however, implies that it is not possible to make any reliable estimate on the costs of the proposed information exchange.

6.6. Social impacts

Apart from health improvements stemming from better control over mercury use and emissions (difficult to quantify), the social impact will be mainly visible in additional employment in the waste management sector. The waste management sector is one of the most labour-intensive sectors, (as compared to e.g. air protection) however, any positive employment impacts would be rather short term. After preparation of a site and after mercury packing and cleaning, one would not expect to see any significant level of job creation. If mercury were to be stored on existing landfills, job creation would be limited even further.

A more positive and long lasting effect should be visible in the recycling sector. However, the scale of this effect would depend on the demand for recycled mercury.

Negative employment impacts are not very likely to appear. Selling of mercury is not a core activity either for gas companies or for producers of zinc.

Overall employment impacts are likely to be marginally positive in the short term and neutral in the long term.

6.7. External impacts (i.e. outside the EU)

Extending the export ban to mercury compounds and products containing mercury would have positive, albeit limited – as compared to the current situation – external environmental impacts. Current production levels in the EU are rather low Available data do not allow for a more detailed assessment of the potential impacts of an export ban extended to compounds and products. As shown in the baseline, economic international implications may include an increase in the global mercury price. Extending the export ban to products containing mercury and to compounds might contribute to that increase, although its impact would be rather low, as compared to banning the export of mercury surplus from the chlor-alkali industry.

6.8. How benefits are assessed

A cut in global supply and a rise in the price of mercury are both seen as desirable to create incentives to use less mercury and to handle it more carefully. The potential effect of a measure on supply can be quantified by mass, while the potential effect on price is harder to predict and can only realistically be estimated in broad, qualitative terms.

If there is not a safe and sustainable storage/disposal solution this could cause severe damage to the environment and health. Remediation costs could be huge afterwards if not well handled.

It is well known that mercury has severe effects on humans and the environment. One example is the catastrophe in the 1950's in Minamata, a fishing village in Japan. Several thousands of people suffered from illness, and many died, after they had eaten fish contaminated by the industrial discharge of mercury. Additionally, many children were born with brain damage.

Some previous attempts have been made at valuing in monetary terms the benefits of preventing mercury emissions and pollution. These are summarised in the Extended Impact Assessment for the Mercury Strategy, Annex 5.

New research[45] confirms significant health-related benefits that can accrue if mercury emissions are controlled. The lower range of benefits related to persistent IQ deficits from fetal exposures and to cardiovascular effects is estimated at €3,160 000-3,230 000 per t/y. Comparing it with the upper range of costs of disposal (deep bedrock) €37-70,000 t/y (for 40 y time period) and income loss (€10,000/t) –clearly shows that benefits significantly outweigh the costs.

6.9. Administrative costs

The export ban and compulsory storage (or disposal) is likely to entail limited additional administrative costs. The Member States and business will have to keep track of mercury movements and report to the Commission. Waste operators will have to report on mercury accepted for storage, and bear the costs of permits should they develop new storage/disposal sites.

Most of these will be one-off costs: chlor-alkali plants will bear most of the administrative costs upon converting to new (mercury-free) technology. Similarly, costs of permitting for waste operators will occur only once.

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[45] See Annex III for details

Recurrent costs will include:

- Reporting from the concerned companies to responsible authorities in the Member States for the following: import of mercury (metallic mercury and mercury compounds), export of mercury compounds, and cross-boundary movements within the EU.

- Registration import of mercury (metallic mercury and mercury compounds), export of mercury compounds, and cross-boundary movements within the EU.

It should be noted, that the administrative costs are difficult to estimate and the numbers below give rather an order of magnitude, than precise figures. Administrative costs calculated in the standard model give a range of about €100,000/year – hence, for 10 year period between entry into force of the export ban (2011) and phasing out of the mercury from the chlorine industry, would amount to about €1m. Estimates from the chlor-alkali industry give about 10% of the storage costs. The Swedish estimate which also accounts for expensive permitting for permanent disposal arrives at a higher figure (€0.5-3.2m), that is about 3-12% of storage costs.

Costs of labour have been taken from ESTAT[46]. We apply following rates:

NACE	Hourly earnings (EU-25 average)
(c_to_f) Industry	12.2
(c) Mining and quarrying	10.78
(g_to_k) Services (excluding public administration)	12.85
(l)Public administration and defence; compulsory social security	14.14

[46] http://epp.eurostat.ec.europa.eu/extraction/retrieve/en/theme3/earn/earn_ses_agt12?OutputDir=EJOutputDir_676&user=unknown&clientsessionid=2F1EA9200CA45BB111AF7D475CA65D3D.extraction-worker-2&OutputFile=earn_ses_agt12.htm&OutputMode=U&NumberOfCells=12&Language=en&OutputMime=text%2Fhtml&

Regulation on the banning of mercury exports and the safe storage of mercury						Tariff (€ per hour)		TIme (hour)		Price (per action or equip)	Freq (per year)	Nbr of entities	Total nbr of actions	Total cost	Regulatory origin (%)			
No.	Ass. Art.	Orig. Art.	Type of obligation	Description of required action(s)	Target group	i	e	i	e						Int	EU	Nat	Reg
1										0,0			0	0				
2			Notification of (specific) activities	Retrieving relevant information from existing data	Member States	14		24,00		339,4	0,2	25	5	1.697	0%	100%	0%	0%
3				Adjusting existing data	Member States	14		24,00		339,4	0,2	25	5	1.697	0%	100%	0%	0%
4				Submitting the information (sending it to the designated recipient)	Member States	14		24,00		339,4	0,2	25	5	1.697	0%	100%	0%	0%
6			Submission of (recurring) reports	Retrieving relevant information from existing data	Mercury suppliers and waste operators	12		24,00		292,8	1,0	100	100	29.280	0%	50%	50%	0%
7				Adjusting existing data	Mercury suppliers and waste operators	12		24,00		292,8	1,0	100	100	29.280	0%	50%	50%	0%
8				Filing forms and tables	Mercury suppliers and waste operators	12		24,00		292,8	1,0	100	100	29.280	0%	50%	50%	0%
9										0,0			0	0				
10			Inspection	Inspecting and checking (including assistance to inspection by public authorities)	Member States	14		16,00		226,2	1,0	10	10	2.262			100%	

6.10. Legal issues

So far there is no Community legislation addressing the export of mercury from the Community, nor any legislation on its storage. Regulation No. 304/2003 concerning the export and import of dangerous chemicals lists cosmetic soaps containing mercury in its Annex V listing chemicals and articles subject to an export ban.

A pre-condition for listing in the Annex V is that the use of the chemical or article in question is prohibited in the Community for the protection of human health or the environment (Article 14 (2)). The use of mercury in the Community is severely *restricted*, but not *prohibited*, and some residual uses will remain in the future. An opening of Article 14(2) to chemicals and articles that are severely restricted only is not appropriate as it would allow an export ban on an unlimited number of substances. For this reason Regulation No. 304/2003 is not the appropriate legal basis for a mercury export ban and a new piece of legislation is needed.

As an export ban is a straightforward measure not implying any transposition measure, a Directive is not the appropriate legal instrument. A Regulation appears to be the only appropriate instrument.

The situation is different for the storage obligation as this could allow for some flexibility at Member State level. A Directive could be seen as the appropriate instrument. The splitting into two legal acts – a Regulation for the export ban and a Directive for the storage obligation is, however, unnecessarily complicated and not in line with the principles of better legislation. A single Regulation appears as the preferable option.

The legal obligations relating to storage are limited to what is strictly necessary as a minimum requirement. To the extent that mercury is considered as waste, the relevant Community legislation applies when it comes to its storage. Only minor adjustments are necessary to reflect the specificities of the substance and to ensure a correct interface between old and new legislation.

The Regulation is designed to be a stand-alone instrument not requiring additional measures for its proper implementation and application. Voluntary agreements from stakeholders can, however, play a complementary role, offering more details on how the storage obligation is actually fulfilled.

A specific storage/disposal solution for the surplus mercury is not proposed. In line with the principles of Better Regulation, the legal act is limited to the identification of those types of storage/disposal facilities that provide sufficient guarantees for the safe handling of metallic mercury, given the specificities of the substance. To guarantee the long term safety a site-specific risk assessment for mercury is proposed. The decision on the individual storage/disposal alternative is to be taken by the industry and Member States concerned.

Therefore the Regulation will be accompanied by a voluntary agreement from the chlor-alkali industry which is most concerned in terms of mercury quantities. The agreement will cover three main issues: a commitment from industry to take utmost care in selecting an appropriate storage/disposal facility that meets highest standards, an engagement to ensure appropriate containment and transport conditions and the provision of data on mercury flows within the industry and from industry to storage/disposal facilities. These data will facilitate the monitoring of the agreement.

Other industry associations concerned by the proposed measures are free to propose similar agreements. It is worth noting, however, that the storage/disposal of mercury compounds considered as waste falls within the scope of Community legislation on waste.

6.11. WTO compatibility

Specific attention must be given to compatibility of the proposed export ban with WTO rules. Article XI of the General Agreement on Tariffs and Trade (GATT) of 1994 prohibits quantitative restrictions on exports and imports. Article XX GATT provides for exceptions from the general rules of the Agreement, and it is meant to ensure that trade obligations are not an obstacle for WTO Members to pursue a number of legitimate policy objectives.

Since the proposed export ban would be in breach of Article XI of GATT 1994, it is necessary to analyse whether such a ban is justifiable under the provisions of Article XX GATT. According to this Article, "*nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures ... (b) necessary to protect human, animal or plant life or health (...); (g) relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption ...*", provided that "*such measures are not applied in a manner which would constitute a means or arbitrary or unjustifiable discrimination ... or a disguised restriction on international trade*" (chapeau text).

Article XX of GATT 1994 must be interpreted in the light of relevant WTO reports in dispute settlement cases, in particular the Appellate Body (AB) Decisions in the cases *Gasoline, Shrimps, Asbestos* and *Korea-Beef*.

According to the findings of the AB in *Gasoline*, an Article XX analysis must proceed in two steps: first, characterisation of the measure as falling within one (or more) of the specific exceptions in paragraphs XX(a)-(j); second, further appraisal of the same measure under the criteria of the *chapeau* text.

The overall objective of the measure is the protection of *human life and health*, given that mercury is globally recognised as highly toxic to humans. This is no longer a matter of scientific debate. Therefore, the measure can be examined under paragraph (b) of Article XX of GATT 1994.

In addition, the measure is *necessary* to reach its objective. According to the findings of the AB in *Korea-Beef*, the meaning of "necessary" cannot be reduced to "indispensable" alone, which would mean the absence of any other possible alternative. Rather, the term "necessary" refers to a range of degrees of necessity. The AB has considered that a "necessary" measure is, in a continuum, located significantly closer to the pole of "indispensable" than to the opposite pole of simply "making a contribution to".

The immediate objective of the legal proposal is to *prevent* mercury that is no longer used in processes or products from *re-entering the market*, thereby adding to the total global amount of mercury circulating in society and necessarily increasing mercury exposure. The export ban, even if not recognised as "indispensable", is in any case a straightforward, efficient and targeted tool to reach this objective, if coupled with appropriate rules on disposal of excess mercury.

In *Asbestos* the AB also stressed that the more vital or important the common interests or values pursued, the easier it would be to accept as "necessary" measures designed to achieve those ends, and recognised that the preservation of human life and health, which is the objective pursued by the proposed measures, is "*both vital and important in the highest degree*".

Finally, according to the AB, a WTO Member cannot justify a measure inconsistent with another GATT provision as "necessary" in terms of Article XX if an alternative measure, which it could reasonably be expected to employ and which is not inconsistent with other GATT provisions or less inconsistent, is available to it. Alternative measures with less impact on trade, for example authorised exports for controlled uses and/or guarantees for safe storage or disposal options in the importing country, are unlikely to meet the intended objective. There is a global trend towards reduced mercury use, affecting in particular the few large-scale users: the chlor-alkali industry is progressively converting to mercury-free technology in all parts of the world and no new plant is built anymore using mercury technology. Only diffuse and smaller-scale uses – in the case of artisanal gold mining they are partly illegal and completely uncontrolled – are likely to absorb mercury streams over a couple of years, pending enhanced international efforts as outlined in the Community Mercury Strategy. Against this background, any system of controlled exports appears to be highly volatile, difficult to monitor and most likely unable to achieve the intended purpose, e.g. to prevent the increased exposure to mercury.

In conclusion, the proposed measure can be considered as "necessary" and the conditions of paragraph XX(b) GATT as fulfilled.

Clean water and *clean* air are exhaustible natural resources that must be conserved and protected against increased mercury pollution, justifying the measure under paragraph XX(g) of GATT 1994. Clean air has already been recognised in the AB case law as falling within the notion of exhaustible natural resources (*Gasoline* dispute). The AB in Gasoline held that there is "a requirement of *even-handedness* in the imposition of restrictions, in the name of conservation, upon the production or consumption of exhaustible natural resources". In line with these findings, the proposed export ban is complemented by a storage obligation on metallic mercury covering all relevant EU sources. In addition, the numerous restrictions already in place within the EU (see chapter 5.3) underline the importance given to the protection of air and water against mercury pollution. The proposed measure can therefore be considered as even-handed.

The *chapeau* text of Article XX GATT must be interpreted as being aimed at the prevention of protectionist "abuse" of the exceptions listed in paragraphs XX(a)-(j) (see AB findings in *Gasoline*).

The AB developed in its reports in *Shrimp* criteria for checking the application of measures in the way of an "arbitrary or unjustifiable discrimination". The relevant criterion in this case is whether there is international consensus on the measure or a serious effort to negotiate has been made by the WTO Member adopting the measure.

The actions already taken by the Community and its Member States at the international level, especially in UNEP, to bring about a sharp reduction of production and worldwide consumption of mercury have been very considerable. As a result, the UNEP "Programme for international action on mercury" adopted in 2003 (UNEP GC Decision 22/4) recognized that there was clear evidence of significant global adverse impacts from mercury and its compounds to warrant national and international action. There is no scientific uncertainty, contrary to substances still subject to scientific debate, of the impacts of mercury in terms of major environmental and health problems.

The UNEP GC Decision 23/9, adopted in February 2005, reinforced the Programme and went more into detail concerning actions to reduce exposure to mercury. It reiterated that *"national, regional and global actions, both immediate and long-term, should be initiated as soon as possible"*. It also asks governments, the private sector and international organisations to take "*immediate actions*" in the fields of emission reductions from point sources, exposure reduction related to mercury in products (including the possible introduction of bans or restrictions on uses) and curbing primary production and the introduction into commerce of excess mercury supply. The present proposal should therefore be seen as the EU's direct contribution to the implementation of UNEP's February 2005 Governing Council Decision.

Insofar as the third element of "disguised restriction on international trade" in the *chapeau* is concerned, mercury will remain available from non-EU sources to cover remaining needs in non-EU countries. Under the given conditions (a globally declining trend in mercury use, limited mining capacities) it is expected that demand will largely be covered by available re-used and recycled mercury and not by additional quantities of fresh mercury. Moreover, the possibility to export mercury compounds for further recycling operations is not affected by the proposed measure (subject to the rules of already existing waste legislation).

In conclusion, it appears that the proposed measures are justifiable under Article XX GATT, taking into account the globally recognised priority objective of protecting human health, the design of the measure and existing case law.

7. COMPARING THE OPTIONS

7.1. Scope of the export ban

An export ban for metallic mercury only is proposed. Currently, the main mercury export flow from the European Union consists of metallic mercury (824 tonnes in 2004).

However, there is a risk that, after the introduction of the export ban on metallic mercury in 2011, mercury compounds could be exported causing similar negative effects as the current export of metallic mercury. The proposal therefore builds on commitments from Spain and from the chlor-alkali industry to ensure that no mining and production of mercury compounds for export will restart and that no conversion of metallic mercury to mercury compounds will take place merely to avoid the storage obligation. Another concern is calomel (mercurous chloride) that is produced in significant quantities as a waste from the production of non ferrous metals. Large amounts are available in the European Union and export followed by conversion to metallic mercury could be profitable. It is important to monitor whether the export of mercury compounds increases as a result of the export ban for metallic mercury.

Mercury markets are presently volatile, but the global demand for mercury is unlikely to increase. On the contrary, global initiatives are all working in the opposite direction. Once the European Union strategy and intentions are clear, the markets will stabilise, prices will stabilise and mercury supplies will be more than adequate. It seems unlikely that mining will increase in other countries outside the European Union.

7.2. Scope of the storage/disposal obligation

A storage obligation is proposed for metallic mercury no longer used in the chlor-alkali industry, by-product mercury from production of non-ferrous metals, and by-product mercury from cleaning of natural gas.

From the information received, it would appear that there will be enough mercury for the internal European Union market without using the surplus mercury from these sources. The mercury demand in the European Union is steadily decreasing and after entry into force of the export ban and storage obligation the demand will be less than the supply from recycled mercury and remaining stocks in the European Union.

The storage obligation deliberately does not cover recycled mercury from mercury-containing products. This source is the preferred source from an environmental point of view. Desirable mercury collection is likely to stop if a storage obligation is also introduced for recycled mercury. Without collection, much of this mercury could be released into the environment.

Recycled mercury and existing stocks will be sufficient to ensure supply for the remaining EU-market. Mercury demand seen over the period 2005-2015 for uses other than the chlor-alkali industry[47] runs at about 190 tons/year. Meanwhile, the estimated supply in the EU (not including after 2011 mercury from the chlor-alkali industry and by-product mercury from production of non-ferrous metals and cleaning of natural gas) will be about 481 tons/year.

If all surplus mercury is exported until 2011 there might be a temporary shortage of mercury in the European Union when the export ban and storage obligation enter into force and imports will be needed. This could appear if the expansion of recycling of mercury-containing products does not follow the market demand. However, this is most unlikely since an expansion of recycling of mercury-containing products is

[47] The chlor-alkali industry will re-use its own surplus mercury, and this demand is therefore not included in the above.

clearly possible and also required to ensure sound waste handling. In the long term the demand for mercury will decrease.

7.3. Storage/disposal solution

A specific storage/disposal solution for the surplus mercury is not proposed. It is clear that safe storage/disposal of mercury is feasible but the decision of a storage/disposal alternative is left to the industry concerned and the competent authorities in the Member States where the storage/disposal will take place. To guarantee the long term safety a site-specific risk assessment for mercury is proposed in addition to already existing waste legislation.

7.4. Reporting and information exchange

After a certain period of implementation, the effectiveness of the proposed legal measures will need to be assessed. With a view to establishing an overview report, the Commission would propose a one-time reporting requirement where Member States would submit a set of relevant information. The Commission has deliberately avoided any periodic and questionnaire-based reporting requirement so as to keep the administrative burden as low as possible.

7.5. Supply, demand and trade of mercury: a concise overview

This section tries to resume the information on supply, demand and trade issue in a concise way. More detailed explanation concerning the figures and underlying assumptions can be found in the preceding sections.

Total global supply presently stands at somewhere around 3,400 tonnes of mercury per year, the figure below summaries global mercury supply since 1981. EU-25 supply stands at around 780 tonnes per year. (Maxson, 2006)

The main sources of mercury supply are: mining, surpluses from the chlor-alkali industry when converting to a mercury-free process or when a plant is closed; by-product mercury from non-ferrous mining and smelting activities (e.g. zinc production); and by-product mercury from natural gas cleaning; recycled mercury (process mercury and mercury from products, e.g. fluorescent lamps, etc.); and mercury inventories accumulated over previous years by brokers and traders.

The main global uses are small-scale gold mining and chlor-alkali and VCM production (vinyl-chloride monomer production with mercuric chloride as a catalyst). Of these, only the chlor-alkali industry remains a significant user in the European Union, and here the mercury cell process is being phased out. The next most significant use in the European Union is in dental amalgam.

Global mercury demand and supply (tonnes, estimated)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Global total demand	3439	3440	3442	3444	3446	3447	3368	3289	3210	3130	3051
Global total supply	3690	3616	3350	3435	3420	3404	3215	3280	3246	3211	3077

Source: Maxson, 2006

These global figures show a declining trend over the years of both demand and supply. They also show that the supply figures continue to match by and large the demand figures, shifting from a slight oversupply to a more or less balanced situation. This indicates that the mercury taken out of the trade flow by the export ban does not impact on worldwide supply in a really disruptive way, most of the mercury concerned by the ban really being *surplus* mercury.

Historically the main global supplier was the Spanish State-owned firm MAYASA (Minas de Almadén y Arrayanes, S.A.). Even after the mining stopped in 2003, the European Union remained a main exporter of metallic mercury. The biggest supply now comes from the chlor-alkali industry – surplus mercury comes from switching to non-mercury technology and from site remediation.

Most of the surplus mercury in the European Union is exported. International trade statistics reported 824 tonnes exported in 2004 (2002: 1648 tonnes, 2003:1110 tonnes)[48]. The total value of the mercury exported from the EU is about € 6,3 million per year (US$ 8 million per year, given a market price for mercury of US$ 10 per kg).

The main current producers of primary mercury are Kyrgyzstan and China. Algeria had an active mine until recently but this was closed at the end of 2004 in the light of continuing technical problems and in spite of increasing mercury market prices. In China the production of mercury has recently restarted since they have a substantial internal market for the metal. However, China seems to have no interest in exporting mercury, especially in the light of international scrutiny.[49] Based upon many years of operating experiences it is highly unlikely that the Khaidarkan mercury mine could produce more than 600 tonnes per year. Note also that the mining operation in Kyrgyzstan is government-owned and subsidised, so would not necessarily react in a normal market-based way. The closure of the Algerian mine, despite an increased mercury price, shows that other factors are more important. (Maxson, 2006)

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48 Comtrade data, http://unstats.un.org/unsd/comtrade/

49 "NRDC submission to UNEP in response to March 2006 request for information on mercury supply, demand, and trade", National Resources Defence Council, Washington DC, May 2006.

Mercury mine production (metric tons)	2000	2001	2002	2003	2004	2005
China	203	193	495	612	700	>700
Kyrgyz Republic	590.0	574.4	541.7	396.8	500.0	600.0

Sources: Maxson (2006)

There are no hard data on mercury contained in products and exported from the EU. Taking the limit values set in EU legislation as benchmark (for example, maximum mercury content in batteries or accumulators of 0,0005 % per weight), it can be assumed that the total volume of mercury exported by this way is negligible.

7.6. Summary table

Policy option /impacts	Environmental	Economic	Social
Export ban on compounds	++	?	+
Export ban on products	++	?	?
Storage obligation for by-product mercury from production of non-ferrous metals	++	-	?
Storage obligation for by-product mercury from cleaning of natural gas	++	-	?
Storage obligation for recycled mercury	-	+/-	?
Storage obligation for mercury compounds	++	-	?

8. MONITORING AND EVALUATION

It is worth recalling the basic aim of the proposed measures: reducing mercury exposure by effectively preventing large quantities of mercury getting back onto the market and ending up in the environment. In this perspective, quantitative data on mercury flows must be considered as key indicators for monitoring the success (or failure) of the intended measures: production and recovery data, data on trans-boundary shipments and in particular, data on mercury that goes to storage or disposal.

The proposed measures include a three-track monitoring and information system:

- a reporting obligation on Member States concerning the application and market effects;

- an informal information exchange that can be adapted to emerging needs;

- an annual mercury flow reporting from the chlor-alkali industry under the voluntary agreement.

These three data streams should provide the Commission with sufficient information to assess the effectiveness of the intended measures against the initial objectives.

It can be assumed that, in addition, global data will be available from other sources (UNEP, globally acting NGOs) enabling an assessment of the situation beyond European Union borders.

Annex I – Consultation responses after adoption of the mercury strategy

Consultation with Eurochlor

Several meetings have been held with Eurochlor throughout the process to discuss the intended instrument and the voluntary agreement from the chlor-alkali industry. Eurochlor has proposed a draft voluntary agreement attached for information with the proposal from the Commission.

Consultation with Spain

Spain is the most concerned Member States with a long tradition in mercury mining and they are currently the main exporter from the European Union. High level meetings have therefore been held with Spain. Spain has continuously expressed their support to the Mercury Strategy and is working actively with the mercury problem. A project on safe disposal of surplus mercury, co-financed by the European Commission, is under preparation.

Stakeholder meeting 8 September 2005

Questions were sent together with the invitation to the stakeholder meeting asking for information on mercury flows. The contributions from stakeholders give useful information of the mercury flows and availability of mercury in the EU before and after the proposed export ban. 16 replies were received. This information has been used in the report "Mercury Flows and safe storage of surplus mercury", Concorde East/West Sprl., 2006[50], Annex 2 of this report gives a summary of the information collected.

At the stakeholder meeting the Commission presented its basic concept for the planned legislative proposal: no amendment of existing legislation, but a new Regulation covering both an export ban and a storage obligation, complemented by a voluntary commitment from industry. Article 5(3) of the Landfill Directive as well as section 2.4 of the annex to Council Decision 2003/33 should not apply to mercury. The following questions were raised by the Commission:

- Is there a need also to ban exports of mercury compounds?
- What changes are needed in community waste legislation beyond exempting mercury from Article 5.3 (a) (that prohibits landfilling of liquid waste) and the criteria in Section 2.4., Council decision 2003/33/EC (limit values for landfilling hazardous waste)?
- Is there a need to store mercury from other sources than the chlor-alkali industry?
- Is recovery of mercury from waste containing mercury (e.g. thermometers, batteries) needed/desirable for a good waste handling?
- If so, how to make sure recovery of mercury continue also when there is no market for recycled mercury?

50 The report is found at: http://www.ec.europa.eu/environment/chemicals/mercury/pdf/hg_flows_safe_storage.pdf

Only 8 replies were received for the second round of questions. The views differ among the stakeholders:

Scope of the export ban: four Member States and the environmental and health NGOs are in favour of also covering mercury compounds, two Member States are against and two Member States did not express their views regarding this issue.

Scope of the storage obligation: Four Member States are in favour of including also other surplus mercury than the surplus mercury from the chlor-alkali industry. The other Member States and the environmental health NGOs consider the chlor-alkali surplus mercury as the main issue of concern; a storage obligation for other surplus mercury could be considered later.

Recovery of mercury: all Member States that replied and the environmental and health NGOs consider that recovery of mercury is needed for a good waste handling.

The table below summaries the responses:

	Question 1 (Mercury compounds)	Question 2 (Further changes to current waste legislation)	Question 3 (Scope of storage obligation)	Question 4 (Recovery needed?)	Question 5 (How to continue recovery?)
Austria	No	No views expressed	Yes, also from other sources than chlor-alkali	Yes	Waste legislation
Belgium, Flemish region	Yes	No. If underground storage not needed to change Council decision.	Yes, also from other sources than chlor-alkali	Yes	Waste legislation
Czech Republic	No	No views expressed	Not necessarily	Yes	
Environmental and health NGOs	Yes	No views expressed	Priority list, order of least to most environ-mentally problematic: 1) Byproduct mercury, 2) Mercury recovered/ recycled, 3) Mercury from de-commissioned chlor-alkali plants, 4) Primary virgin mined mercury	Yes	Waste legislation
Germany	Yes	Have to be checked.	Mercury from chlor-alkali largest source. Other mercury to be used for internal market. First step for other mercury is to identify substitutes for all legal uses of mercury and than ban the uses.	Yes	Treatment of waste already required. This needs to be done in a good way.

NL	No views expressed	Limit values can't be applied for storage of liquid mercury. Extra protection measures needed.	If needed. Compare data demand and supply of mercury.	Yes	Waste legislation
Norway	Yes	No	Yes, also from other sources than chlor-alkali	Yes	Waste legislation
Sweden	Yes	Changes will be needed, different requirements depending on type of storage.	Yes, also from other sources than chlor-alkali	Yes	Waste legislation
UK	No views expressed	Need to consider the interface with the waste shipment regulations		Yes	No views expressed

Annex II – information on units used and chemical forms of mercury and their effects

This annex includes explanations on units and currencies employed and brief information on mercury and the chemical forms of mercury that occur in this Impact assessment.

Units

1 flask of mercury = 34.5 kg of liquid mercury

Exchange rates:

EUR/SEK= 0.107888

EUR/USD = 0.785176

Source:
http://fxtop.com/en/historates.php3?C1=EUR&C2=USD&YYYY1=2005&MM1=06&DD1=02&YYYY2=2006&MM2=06&DD2=02

Mercury world prices are quoted in US dollars. For the sake of clarity, for the assessment of future developments we assume a price of US$10/kg, translated into € 7.85 using the current exchange rate. Obviously, any future price in Euro will depend on the US$/EUR exchange rates. However, we have applied constant exchange rates.

Similarly, any future changes in SEK/EUR exchange rates – that may have an impact on future storage cost estimates – have not been factored in.

Chemical forms of mercury

Mercury, also called quicksilver, chemical symbol Hg, is a natural occurring metal which has several forms.

- **Metallic mercury:** Also called elemental mercury or mercury metal. A shiny, silver-coloured, odorless liquid metal. If heated it is a colourless odorless gas.

Mercury combines with other elements, such as chloride, sulphur, or oxygen, to form inorganic mercury compounds or "salts", which are usually white powders or crystals. Mercury also combines with carbon to make organic mercury compound.

- **Methyl mercury:** The most common organic mercury compound. It is mainly produced by microscopic organisms in the water and soil. Its chemical formula is CH_3Hg^+ (sometimes written as $MeHg^+$).

- **Mercuric chloride:** Mercury(II) chloride, chemical formula $HgCl_2$

- **Mercurous chloride:** Also called **calomel** or Mercury(I) chloride, chemical formula Hg_2Cl_2

- **Mercuric (mercury) oxide:** Mercury(II) oxide. Chemical form HgO

- **Mercuric (mercury) sulphide:** Also called **cinnabar** or Mercury(II) sulphide, Chemical formula HgS

- **Stabilized mercury:** Mercury in a stable form, where it is bound to other elements that prevent it from reacting the same way as in its' pure form. These stable forms are e.g. mercury sulphide (HgS) or mercury selenide (HgSe).

The mercury impact on health and the environment

Mercury and its compounds are highly toxic to humans, ecosystems and wildlife. Initially seen as an acute and local problem, mercury pollution is now also understood to be global, diffuse and chronic. High doses can be fatal to humans, but even relatively low doses can have serious adverse neuro-developmental impacts, and have recently been linked with possible harmful effects on the cardiovascular, immune and reproductive systems. Mercury also retards microbiological activity in soil, and is a priority hazardous substance under the Water Framework Directive[51].

Mercury is persistent and can change in the environment into methylmercury, the most toxic form. Methylmercury readily passes both the placental barrier and the blood-brain barrier, inhibiting potential mental development even before birth. Exposure of women of child-bearing age and children is therefore of greatest concern.

From a human health point of view, exposure to methylmercury via diet is the main problem. Methylmercury collects and concentrates especially in the aquatic food chain, making populations with a high intake of fish and seafood particularly vulnerable.

The mercury problem has been described more in detail in other recent documents, such as: the UNEP Global Mercury Assessment (UNEP Chemicals)[52]; State of the world 2006 (the Worldwatch Institute)[53]; Dynamics of Mercury Pollution on Regional and Global Scales (Pirrone and Mahaffey, 2005)[54], reports from the World Health Organization (WHO)[55].

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51 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, OJ L 327, 22.12.2000, as amended by Decision 2001/2455/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy, OJ L 331, 15.12.2001.

52 http://www.chem.unep.ch/mercury/Report/Final%20Assessment%20report.htm

53 State of the world 2006, Chapter 6: Curtailing Mercury's Global Reach, the Worldwatch Institute

54 'Dynamics of Mercury Pollution on Regional and Global Scales – Atmospheric Processes and Human Exposure around the World', Edited by Nicola Pirrone and Kathryn R. Mahaffey, 2005

55 http://www.who.int/en/

Annex III – Human health benefits from controlling mercury emissions

Banning mercury export and introducing compulsory storage for some of the mercury compounds is expected to reduce emissions, although the scale of those emissions is difficult to quantify. Assessing human benefits would require construction of a model linking releases to environment, forming of methylmercury in fish and identifying uptake by vulnerable populations.

The table below gives overview of such modelling for US done by Nescaum[56], using two scenarios with varied policy stringency and – as a result – expected emission reductions. There are two major negative health impacts: persistent IQ deficits from fetal exposures and cardiovascular effects and premature mortality (estimated separately for the male population in the US example).

Health benefits from avoided mercury emissions to air for the US population (per year)

		m EUR 2000 prices, yearly [57]			
		Certain…… …. ------- > … ……….less certain			
	emission reductions per year (t)	persistent IQ deficits - fetal exposure - lower bound	persistent IQ deficits - fetal exposure - upper bound	cardiovascular effects (only limited male population)	cardiovascular effects and premature mortality in all fish consumers
scenario 1	23	69.27	179.18	44.33	3047.88
scenario 2	34	109.91	265.99	79.43	4525.64

Table below shows benefits per tonne – and it demonstrates that benefits per one tonne of emissions avoided increase in the second scenario, which assumes greater emission reductions, but with declining marginal benefits per tonne avoided. Comparing scenario 1 and 2 reveals that doubling the decrease in emissions would bring about a 15% increase in benefits.

56 Economic valuation of human health benefits of controlling mercury emissions from U.S. coal-fired power plants, www.nescaum.org, Feb 2005

57 Average exchange rate for year 2000 applied: EUR/USD=0.9236, source: ESTAT

Health benefits from avoided mercury emissions to air for the US population (per tonne)

		Benefits from avoided mercury emissions to air (m EUR 2000 per tonne)			
		Certain…… …. ------- > … ……….less certain			
	emission reductions per year	persistent IQ deficits - fetal exposure - lower bound	persistent IQ deficits - fetal exposure - upper bound	cardiovascular effects (only limited male population)	cardiovascular effects and premature mortality in all fish consumers
scenario 1	23	3.01	7.79	1.93	132.52
scenario 2	34	3.23	7.82	2.34	133.11

Another US study[58] gives similar range of health related costs stemming from mercury emissions. The costs increase in line with emissions, similarly as to above case.

Health costs associated to mercury emissions to air for the US population

emissions from anthropogenic US sources	(t/year)	costs – low (m EUR 2000)	costs – high (m EUR 2000)	per tonne low (m EUR 2000)	per tonne – high (m EUR 2000)
power plants	49	92.36	6003.40	1.88	122.52
all anthropogenic	117	369.44	14592.88	3.16	124.73

Monetising emissions avoided due to the introduction of an export ban from the EU and the introduction of compulsory storage on the basis of the above costs/benefits figures would be extremely difficult as:

- It is difficult to provide a definitive figure on what part of the mercury exported will be released to the environment, in what form and at what speed. In a longer term or in a worst case scenario one can assume that all surplus mercury (and some of its compounds) would be released to the environment in one form or another.

- The quantities of mercury involved in EU trading are much higher than in the US studies: 1600 tonnes in 2002 and 800 tonnes in 2004. The size of the emissions has an impact on marginal benefits.

- The above costs (or benefits of avoided costs) have been calculated using cost-of-illness and willingness-to-pay data for US. In many regions of the world these figures would be much lower.

[58] Public health and economic consequences of methyl mercury toxicity to the developing brain, Environmental Health Perspectives 113, May 2005

- On the other hand the above costs are estimated on the basis of fish consumption, and fish are traded globally.

- The above estimates are only for negative health impacts. Environmental impacts are not taken into account. One could assume environmental benefits would be at least equal to health benefits.

Bearing this in mind, if we compare the lower range of benefits €3,160 000-3,230 000 per t/y with the upper range of costs of disposal (deep bedrock) €37-70,000 t/y (for 40 y time period) and income loss (€10,000/t) – it is quite clear that benefits significantly outweigh the costs.