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IMPACT ASSESSMENT

Ratification and Implementation by the EU of the Minamata Convention on Mercury

Accompanying the document

Proposal for a Regulation of the European Parliament and of the Council on mercury, and repealing Regulation (EC) No 1102/2008

{COM(2016) 39 final}
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ACRONYMS AND ABBREVIATIONS

AMAP	Arctic Monitoring and Assessment programme
Art.	Article(s)
ASGM	Artisanal and Small-scale Gold Mining
BAT	Best Available Techniques
BAU	Business as usual
BEP	Best Environmental Practices
BR	Better Regulation
BREF	BAT Reference Document
CED	Council of European Dentists
CONTAM	EFSA Panel on Contaminants in the Food Chain
COP	Conference of the Parties
EEB	European Environmental Bureau
EFSA	European Food Safety Authority
ELV	Emission Limit Values
EPBA	European Portable Battery Association
EU	European Union
FAO	Food Agricultural Organisation
Hg	Mercury
IASG	Impact Assessment Steering Group
IED	Industrial Emissions Directive
INC	Intergovernmental Negotiating Committee
IPPC	Integrated Pollution Prevention and Control
MC	Minamata Convention on Mercury
MCP	Medium Combustion Plants
MS	Member State(s)
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Co-operation and Development
PIC	Prior Informed Consent
PRTR	Pollutant Release and Transfer Register
PUR	Polyurethane
PVC	Polyvinylochloride
R&D	Research and Development
RoHS	Restriction of Hazardous Substances
SCENIHR	Scientific Committee on Emerging and Newly Identified Health Risks
SCHER	Scientific Committee on Health and Environmental Risks
TFEU	Treaty on the Functioning of the European Union

TWI	Tolerable Weekly Intake
UNEP	United Nations Environment Programme
USA	United States of America
USD	United States Dollar
VCM	Vinyl chloride monomer
WEEE	Waste Electrical and Electronic Equipment
WFD	Water Framework Directive
WHO	World Health Organisation
WPIEI	Working Party on International Environmental Issues
WSR	Waste Shipment Regulation
WTO	World Trade Organisation
WWTP	Waste Water Treatment Plant

INTRODUCTION

Mercury is a global pollutant that poses significant threats to human health and the environment. The general population is exposed to mercury mainly through their diet, especially the consumption of fresh water and marine fish and seafood.

The European Union (EU) has a well-developed policy and legislative framework to control the risks posed by mercury. The overall policy framework is the EU Mercury Strategy adopted by the European Commission ("Commission") in 2005, with the objective to reduce mercury levels in the environment and associated human exposure. The 2010 evaluation and review of the EU Mercury Strategy concluded that it had delivered on most of its actions. However, as EU action alone proved not to be sufficient to address the mercury problem, the Commission considered the negotiation of a legally binding instrument on mercury under the auspices of the United Nations Environment Programme (UNEP) as a priority for further work. The European Parliament and the Council have also emphasised the importance of the international dimension of mercury policy.

The EU played an instrumental role in the international negotiations on mercury launched by the Governing Council of UNEP in February 2009 and concluded successfully in January 2013. The Minamata Convention on Mercury[1] (MC) adopted in October 2013 in Japan has been signed by 128 parties (including the EU and 26 MS) and it has already[2] been ratified by 19 countries[3]. As the entry into force of the Convention requires 50 ratifications, an early ratification by the EU and its Member States (MS) could trigger its entry into force and an early implementation, which is an objective supported by all MS.

The MC has been inspired to a great extent by existing EU legislation. As a consequence, the vast majority of its provisions mirror EU law on mercury and thereby contribute to levelling the international playing field regarding mercury use and emission controls.

Yet, the comparative analysis[4] of the Convention text vis-à-vis the EU *acquis* shows that ratification of the MC would necessitate limited adjustments to EU legislation in certain areas, including imports of metallic mercury; exports of mercury-added products[5]; use of mercury in industrial processes; new mercury uses in products and processes; artisanal and small-scale gold mining; and use of dental amalgam.

Hence, this impact assessment focuses on the adaptations of the EU mercury legislation required to comply with the Convention and enable the EU to ratify it, as a means to trigger regulatory action at global level that would significantly complement existing EU action on mercury.

The present report provides an in-depth assessment on how best to address the identified issues.

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1 http://www.mercuryconvention.org/

2 As of 14/12/2015

3 Chad, Djibuti, Gabon, Guinea, Guyana, Jordan, Lesotho, Madagascar, Mauritania, Mexico, Monaco, Mongolia, Nicaragua, Panama, Samoa, Seychelles, United Arab Emirates, United States of America, Uruguay.

4 See *Annex 7*

5 "Mercury-added product" means a product or product component that contains mercury or a mercury compound that was intentionally added.

1. POLICY CONTEXT, PROBLEM DEFINITION AND SUBSIDIARITY

1.1. Policy context

Mercury is recognised as a global threat to human health and the environment and there is broad consensus internationally on the need to phase it out. *Annex 4* provides a general description of the mercury issue and its global dimension.

The EU has made considerable progress in addressing domestically the challenges posed by mercury since it launched the EU Mercury Strategy[6] in 2005, which was supported by an impact assessment[7] addressing the mercury issue and areas for possible action. The Mercury Strategy was welcomed by Council Conclusions on 24 June 2005[8] and a European Parliament Resolution on 14 March 2006[9]. It is a comprehensive plan consisting of 20 measures aiming at reducing mercury emissions, cutting mercury supply and demand and at protecting individuals against exposure, especially to methylmercury found in fish.

The Mercury Strategy recognises the global character of the mercury issue and hence the imperative need for action at global level. Thus, seven of its actions (actions 14 to 20) support and promote international activities.

As described in *Annex 6*, the existing EU *acquis* covers the whole mercury lifecycle (supply, demand, products, trade, emissions, waste, etc.) via a broad range of policy areas (e.g. environment, energy, health and trade). One of the key measures in implementing the EU Mercury Strategy was the adoption of the Mercury Export Ban Regulation[10], which set an export ban on mercury and certain mercury compounds and mixtures that entered into effect on 15 March 2011.

The Commission evaluated the EU Mercury Strategy in 2010[11], examining in particular:

- progress made in implementing the Strategy and each of its 20 actions;
- areas where implementation was lagging behind and the need for complementary measures;
- amendments, as needed, as well as additional actions, taking into account new studies, best practices, and policy initiatives at the EU and international levels.

On the basis of this evaluation, in December 2010, the Commission adopted a Communication on the review of the Community Strategy concerning Mercury[12], which concluded the following:

- While the EU Mercury Strategy has resulted in significant progress in some areas, such as the establishment of a ban on EU exports of mercury from March 2011 and the ban on mercury use in some measuring devices, its implementation, however, has been lagging behind in other areas, e.g. the industrial emissions of mercury, the issue of dental amalgam use and waste management.
- Internal EU legislation alone could not guarantee effective protection of the European citizens and the negotiation of a global legally binding instrument on mercury, under the auspices of UNEP, was therefore identified as priority for further action.

The EU contributed to a great extent to the adoption in 2009 of a UNEP decision on the start of such negotiations. The EU actively participated in and influenced the outcome of these international negotiations. The Minamata Convention on Mercury, adopted in October 2013 in Japan, seeks "to

6 COM(2005)20final, 28.1.2005

7 SEC(2005)101, 28.1.2005

8 Community Strategy Concerning Mercury – Draft Council Conclusions, 9470/05, 16/6/05 and Report on proceedings in the Council's other configurations 11017/05 of 13/7/2005

9 European Parliament resolution on the Community strategy concerning mercury, P6_TA(2006)0078, 14.3.2006

10 Regulation (EC) 1102/2008, OJ L304 of 14/11/08, p.75

11 BioIntelligence Service, Review of the Community Strategy Concerning Mercury- Final Report, 4.10.2010

12 COM/2010/0723 final, 7.12.2010

protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds". This objective is fully in line with the EU Mercury Strategy, as well as with the European Parliament's[13] and the Council's[14] statements on this issue. Some key provisions of the MC are described in *Annex 5*. The EU has an advanced legislative framework regarding mercury and the vast majority of the binding provisions of the MC are already covered by the EU *acquis*, including in particular:

- not allowing primary mining of mercury;
- banning the export of mercury;
- not allowing the marketing and import of the mercury containing products listed in Annex A to the MC;
- not allowing the use of mercury in chlor-alkali plants after 2017;
- establishing inventories of industrial emissions of mercury to air, soil and water from the sectors listed in Annex B to the MC;
- preventing and reducing the industrial emissions of mercury to air, soil and water from the sectors listed in Annex B to the MC by the application of Best Available Techniques (BAT);
- environmentally sound management of mercury waste.

Given the instrumental role played by the EU in concluding the Convention, the important benefits expected at global and EU levels from its implementation, including in terms of levelling the global playing field regarding the use of mercury in products and processes and the controls of mercury emissions to the environment, it is in the interest of the EU to ratify it as soon as possible.

The Convention has been signed by 128 parties[15] and it has been ratified by 19 parties so far[2]. It will enter into force once it is ratified by at least 50 parties.

The EU and 26 of its MS[16] have signed the MC and thereby committed themselves to work towards its ratification and implementation. As the MC's provisions have been inspired to a great extent by EU legislation, full compliance with the Convention requires only few additional measures or amendments.

This impact assessment complements previous work by focusing on the measures needed to ensure that the international action called for by the EU Mercury Strategy materialises. It assesses options for the ratification of the MC and examines how these contribute to the overall objective of reducing exposure to mercury, taking into particular account the global dimension of the issue.

1.2. Problem definition

Exposure to high levels of mercury can cause harm to the brain, lungs, kidneys and immune system of people of all ages. Human exposure through eating of contaminated fish is due to the increased levels of mercury in the environment. The EU has already taken action to tackle the problem by reducing mercury emissions and use domestically. However, the global character of the mercury problem implies that the EU cannot provide sufficient protection to its citizens on its own, as exposure in the EU to mercury is largely due to emissions originating in other parts of the world.

Hence, the EU actively supported the international negotiations for a global treaty on mercury and signed the Minamata Convention on Mercury.

However, as long as the MC is not ratified by at least 50 Parties, it does not enter into force and

[13] European Parliament resolution on the Community strategy concerning mercury, P6_TA(2006)0078, 14.3.2006

[14] 3075 Environment Council meeting, Brussels, 14 March 2011

[15] A list of the signatories and the parties is available at http://www.mercuryconvention.org/Countries

[16] Portugal and Estonia did not sign but fully supported the Minamata process and they intend to ratify.

therefore the above problem is not being tackled at a global scale.

Given the significant extent of the EU mercury *acquis* and as the Convention is to a large extent modelled after the EU *acquis,* ratification would require only a limited number of adjustments to the EU *acquis*. Following a detailed analysis of the Convention text vis-à-vis the EU *acquis* presented in tabular form in *Annex 7*, existing gaps have been identified where EU legislation does not cover the requirements of the MC Convention:

1. imports of metallic mercury: imports into the EU of mercury from countries not party to the Convention are not controlled with a view to ensure that the mercury does not come from certain sources;
2. exports of certain mercury-added products: the export from the EU of a number of mercury containing products listed in the MC is not prohibited under EU law;
3. mercury use in new products and processes: putting on the market of new products or processes using mercury that do not currently exist is not sufficiently discouraged;
4. use of mercury in certain manufacturing processes: two industrial processes using mercury and prohibited under the MC are still allowed in the EU and certain restrictions applicable under the MC to three other processes, e.g. concerning the use of mercury and the reduction of mercury emissions, are not applied within the EU;
5. mercury use in Artisanal and Small-scale Gold Mining (ASGM): no steps are taken in EU law to reduce and were feasible eliminate the use of mercury in ASGM;
6. use of dental amalgam: there are no special measures for the phase down of the use of dental amalgam.

1.3. What are the underlying causes of the problem?

Mercury can enter our environment (and subsequently the food chain) in many different ways. Emissions of mercury can travel through air and water and end up thousands of kilometers away from their source. Unless it is properly disposed of, mercury produced, used or discarded adds up to the global mercury pool, persists in the environment, and is concentrated mainly in predatory fish that may be consumed by humans. Additionally, significant quantities reach the environment as unintentional emissions, e.g. through the burning of fossil fuels and biomass.

Global mercury emissions from human activity have been estimated at 1960t/y. This represents about 30% of annual mercury emissions to air. Another 10% comes from natural sources (e.g. volcanoes), and the remaining 60% is caused by re-emission, which again is largely due to mercury accumulated in the environment due to human activity over several centuries. *Figure 1-a* indicates the origin of these emissions on a global basis. It is clear that EU's contribution is rather limited (4,5%), while almost half of global emissions (931t) originate in Asia.

The origin of atmospheric mercury deposition can differ substantially in different areas in the EU. Emission models predict currently that atmospheric deposition originating in Europe is up to 60% in certain industrialised areas, while in other areas, such as the Mediterranean, European emissions contribute only 20% or less to the total deposition. It is thus obvious, that the transboundary component of mercury pollution is very significant and addressing the problem requires not only local or regional, but global action.

The underlying cause of the problem of the exposure of EU citizens to mercury is therefore significantly linked to the transboundary character of mercury pollution and to the fact that only the EU and a few other countries (e.g. Norway, Switzerland, the USA, Canada and Japan) have implemented advanced policies addressing mercury emissions and use, minimising their contribution to the global mercury pool in the last two decades, while there was an opposite trend with significant increases of mercury emissions (currently contributing almost 50% of the global total) by countries in Asia due to their industrialization.

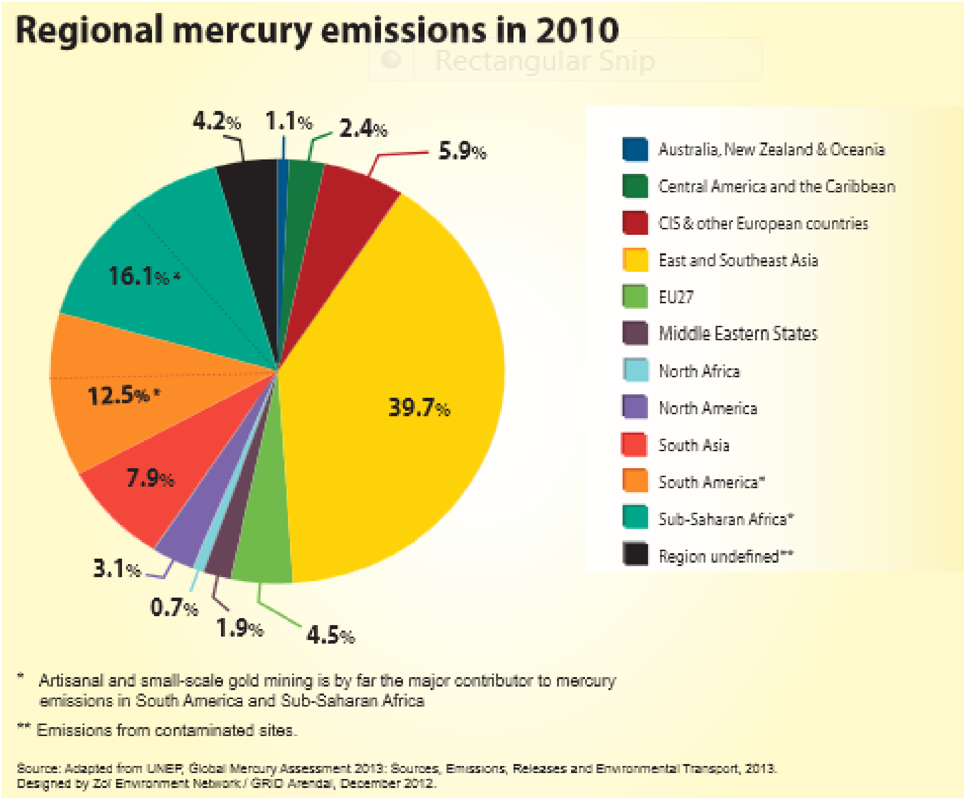

Figure 1-a[17] Anthropogenic mercury emissions in 2010 on a regional basis

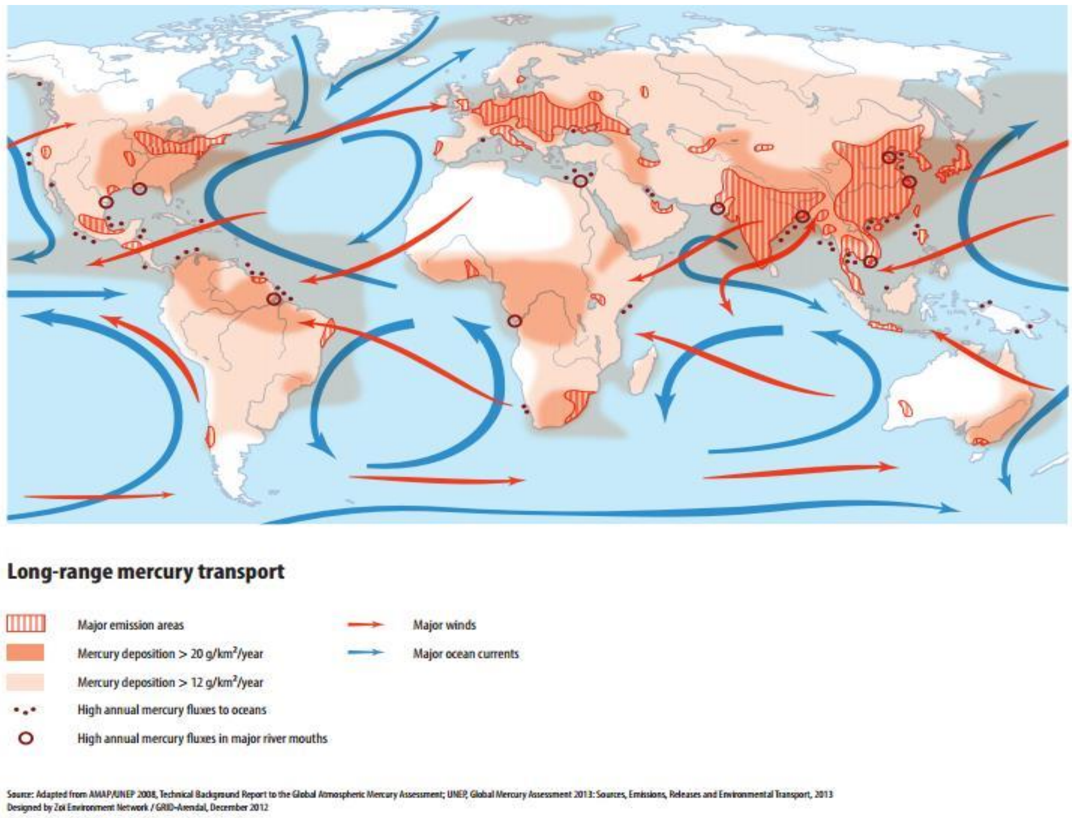

Figure 1-b[17] Long-range mercury transport

17 UNEP (2013), Mercury: Time to Act

1.4. How will the problem evolve?

Figure 1-c shows clearly the increase of mercury deposition since the industrial age. While emissions may have been slightly reduced after reaching a peak during the 1970s mainly due to control measures in Europe and North America, there are nowadays indications that this trend is reversed due to the exponential industrialisation in East and South-East Asia. As a result, concentrations in marine animals have increased substantially (in some areas, e.g. the Arctic, up to 10-12 times) compared to pre-industrial times.

Given the size of the global mercury pool (estimated at 350 000t), it will take decades before reductions in atmospheric emissions can have a visible impact on mercury levels in the environment and fish. Delaying the ratification of the MC would thus have long-term consequences both for Europe and the rest of the world leading to unacceptably high contamination of marine and freshwater foods.

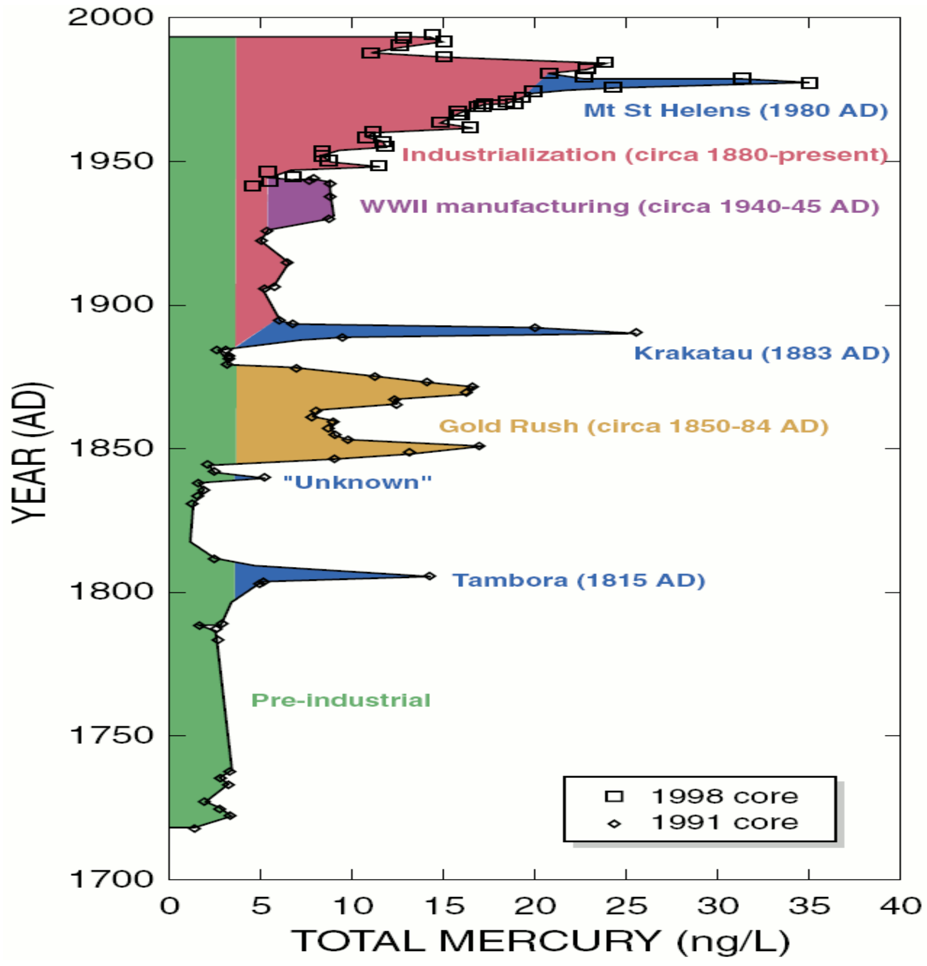

Figure 1-c Atmospheric mercury deposition during the last three centuries (UpperFremont Glacier, Wyoming, USA 1991&1998)

1.5. Who is affected and how?

Citizens:

All individuals will be exposed to mercury through fish consumption to some extent. However, certain groups (toddlers, women in childbearing age and high fish consumers) are particularly vulnerable. The level of exposure can obviously vary greatly depending on dietary habits, contamination levels and the species consumed. Everybody is affected to some extent, but indigenous people in the Arctic and citizens in Southern Europe are at higher disk due to dietary habits and the availability of large fish species from the Mediterranean.

In its scientific opinion on the risk for public health related to the presence of mercury and methylmercury in food[18], the EFSA Panel on contaminants in the food chain (CONTAM) concluded that high fish consumers, which might include pregnant women, may exceed the Tolerable Weekly Intake (TWI) for methylmercury by up to approximately six-fold. While dietary inorganic mercury exposure in Europe does not exceed the TWI[19] in most cases, parallel inhalation exposure of elemental mercury from dental amalgam is likely to increase the internal inorganic mercury exposure; thus the TWI might be exceeded.

Unborn children constitute the most vulnerable group. Due to the critical effect of methylmercury exposure to the brain of the embryo, exposures of pregnant women are of major concern. The DEMOCOPHES project[20] has analysed exposure levels on the basis of mercury concentrations in the hair of women of reproductive age in different countries. It was found that parts of the European population exceed the tolerated level (0,58 µg/g hair). The percentage of the population exceeding this level differs between the 17 participating European countries, with some exhibiting levels higher than 0,58 µg/g hair in over 50% of the population, while in others less than 5% of the population exceeded the tolerated level.

Economic operators:

This includes mainly importers and exporters of mercury and/or mercury containing products, manufacturers of products containing mercury, industries using or emitting mercury, waste handlers and recyclers. Mercury is still used in several sectors, such as the chlor-alkali industry[21], dental amalgam fillings, light sources, batteries, measuring equipment, switches and relays, chemicals, etc. However, since mercury use is heavily regulated within the EU (while this is not the case in most other countries), non-EU companies producing goods containing mercury enjoy a competitive advantage. A study report[22] carried for the Commission in 2008 provides detailed information on all remaining uses of mercury, sectors involved and EU companies concerned.

Member States:

Twenty six MS[16] have signed the MC and they would also need to ratify and implement it. Lack of global action makes it extremely difficult, if not impossible, for MS to guarantee to their citizens the required level of protection from the risks posed by mercury. MS will obviously share the burden of implementation, but will also reap the environmental and health benefits.

Third countries:

Given the lack of strict regulatory control, populations in third countries are at even higher risk of exposure to mercury. ASGM is one of the major sources of anthropogenic emissions of mercury, in more than 70 countries, mainly in Latin America, Africa, and Southeast Asia. Around 10-15 million people are directly involved (among those 4-5 million women and children) and are exposed to dangerous levels of elemental mercury.

[18] EFSA Journal 2012;10(12):2985 [241 pp.]

[19] The TWI (=Tolerable Weekly Intake) is the amount of a substance that can be consumed weekly over an entire lifetime without an appreciable risk to health.

[20] LIFE09ENV/BE/000410

[21] Chlor-alkali refers to the industry that produces chlorine (Cl_2) and alkali, in the form of sodium hydroxide (NaOH) or potassium hydroxide (KOH), by electrolysis of a salt solution.

[22] Options for reducing mercury use in products and applications and the fate of mercury already circulating in society. Study contract carried for the European Commission by COWI A/S and Concorde East West, 2008.

1.6. The EU's right to act and justification

The MC is a multilateral environmental agreement addressing the mercury problem on a global scale. It establishes a legally-binding framework providing for trade-related measures (import and export restrictions on mercury, mercury compounds and mercury-added products) falling under the exclusive competence of the EU in accordance with Art. 3(1)(e) of the Treaty on the Functioning of the European Union ("TFEU") and for environmental protection measures (e.g. reduction of mercury emissions from certain manufacturing processes) regarding which competence is shared between the EU and the MS by virtue of Art. 4(2)(e) TFEU.

Hence, this Convention is a so-called "mixed agreement", as not all the matters covered by it fall exclusively within the competence of the EU or of its MS. As such, the MC is an agreement to which both the EU and the MS are signatories and which can be ratified by the EU and the MS.

The EU's legal right to act regarding the MC is based on the external competences of the EU, as defined in Art. 216 TFEU, on the basis of which the EU may conclude international agreements, where the conclusion of an agreement is necessary to achieve one of the objectives of the EU, including the establishment of a common commercial policy and the protection of the environment.

To control and reduce mercury use and pollution fits clearly with the EU environmental objectives established in Art. 191(1) and (2) TFEU that are concerned with e.g. the preservation, protection and improvement of the quality of the environment, the protection of human health and the promotion of measures at international level to deal with regional or worldwide environmental problems. The transposition into EU law of the trade-related measures provided for in the MC and aiming at restricting imports and/or exports of mercury and mercury-added products fits also with the objectives of the EU common commercial policy. The proposed EU mercury regulation has therefore a twofold legal basis, namely Art. 192 and 207 TFEU that entitle the EU to regulate in the field of the environment and of common commercial policy.

The legal right of the EU to act regarding the MC is also based on the mere fact that EU competence in the fields of mercury trade and environmental protection from mercury is already widely exercised, as demonstrated by the significant EU *acquis* on mercury described in *Annex 6*. In fact, the EU *acquis* covers already most of the issues addressed by the MC, including mercury export restrictions, the placing on the market of mercury-added products, the use of mercury and mercury compounds in industrial processes, the control of mercury emissions from large point sources and the management of mercury waste. It is also worth noting that the negotiating positions, and subsequently the content of the MC, were developed in close cooperation between the Commission and the MS, in accordance with Art. 218(3) and (4) TFEU.

Not only has the EU the right to act vis-à-vis the MC, but EU action is clearly justified given the significant transboundary component of mercury emissions, which therefore requires action at EU level.

EU action is also necessary as MS would not be entitled to ratify the MC in the absence of EU transposing legislation. Indeed, as specified above, since the MC trade-related measures are to be addressed within the context of the establishment of an EU common commercial policy, only the EU is competent to set out trade restrictions on mercury and mercury-added products. Furthermore, the EU *acquis* covers MC provisions relevant for the EU internal market. Hence, the ratification of the MC and its implementation within the EU requires beforehand the enacting of EU transposing legislation.

1.7. Issues identified in the assessment of the Mercury Export Ban Regulation

The Commission contracted COWI A/S in 2014 to carry out an ex-post assessment of the Mercury Export Ban Regulation. Such assessment was limited, given the short time period for implementation of the Export Ban (2011-2015) and concomitantly, the limited evidence base available. Therefore, this assessment was also limited in scope as it covered 3 evaluation criteria: effectiveness, efficiency and coherence. Yet, COWI's study[23], based on stakeholder consultation and available statistical data, provides important information on the performance of the Mercury Export Ban Regulation so far and guidance on potential improvements[24].

Overall, the export ban seems to be effective in reducing the global mercury supply:

- As a result of the export ban, it is estimated that approximately 650t of mercury are prevented annually from reaching the global market, corresponding to approximately 20% of the global mercury supply.
- Available data indicates that the decrease in mercury supply may not have been replaced by increased mine production outside the EU and that the threefold increase in the price of mercury can most probably be attributed to the decreased supply of mercury from the EU and the USA.

However, the effectiveness of the Mercury Export Ban Regulation has not been entirely met regarding the safe storage of mercury as waste.

Whilst Art. 4(3) of that Regulation foresees the adoption of criteria for the admissibility of such waste in landfills, only criteria for the temporary storage, for a period up to 5 years, have so far been enacted by Council Directive 2011/97/EU[25], as there was so far no majority amongst MS enabling the adoption of criteria for permanent storage of metallic mercury which is liquid[26]. The issue of the lack of criteria for the permanent safe storage of mercury as waste has been identified as a concern by stakeholders consulted, since there may be stocks in 2016 of mercury waste that would have been stored for 5 years. However, as other forms of environmentally sound storage exist (i.e. in solidified form), the lack of permanent storage criteria for mercury in liquid form is considered as a minor issue not leading to significant impacts. Therefore, this issue is not pursued further in this Impact Assessment.

As regards the efficiency of the Mercury Export Ban Regulation, it is likely that the health benefits significantly outweigh the costs associated with the export ban. On the one hand the cost to the chlor-alkali industry of storage of surplus mercury is estimated at an average of 0,6-2 million EUR/y, while the lost revenue from sale of mercury is estimated at 3-5 million EUR/y. The most affected industry group is that of recyclers and exporters of mercury. The total lost revenues are estimated at an average of 5-7 million EUR/y i.e. of the same size as the lost revenue to the chlor-alkali sector from sale of mercury to the recyclers and exporters. On the other hand, the total benefits of preventing the 650 t/y in reaching the global mercury market cannot be fully assessed. As an illustrative example: assuming that the reduced export of mercury from the EU would result in a 10% decrease in the expected impacts from lost IQ due to ingestion and inhalation of mercury (one of the environmental and health impacts of mercury), and using available estimates of the costs of mercury impacts, the total benefits can be estimated to be at least 400 million EUR/y at global level and likely significantly higher.

Concerning the coherence of the Mercury Export Ban Regulation, the assessment carried out by COWI and the analysis undertaken by DG ENV services, have identified the following two opportunities for simplification[24]:

- Art. 3 of the Mercury Export Ban Regulation foresees the application of the Seveso Directive[27]

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[23] COWI, BiPRO (2015). Ratification of the Minamata Convention by the EU - Complementary Assessment of the Mercury Export Ban (June 2015).

[24] See *Annex 8* for an overview of the key findings.

[25] Council Directive 2011/97/EU, OJ L328, 10.12.2011, p.49

[26] Metallic mercury is liquid. Mercury can be stored also in solidified form. *Annex 8* explains the possibility to use solidification technologies for the disposal of metallic mercury.

[27] Directive 2012/18/EU, OJ L 197, 24.7.2012, p. 1

for all mercury waste above-ground temporary storage facilities. However, following the adoption of Council Decision 2011/97/EU, this obligation could now be considered as disproportionate in view of the limited added-value of the application of the Seveso Directive to facilities that are regulated by the Landfill Directive[28].

- Certain reporting obligations established under Art. 5 and 6 of the Mercury Export Ban Regulation are now outdated as they refer for instance to information that had to be communicated to the Commission and to the competent authorities of the MS by 1st July 2012.

Considering that those two issues are very minor and will not significantly affect existing EU legislation, they are not pursued any further in this impact assessment.

[28] Directive 1999/31/EC, OJ L182, 16.7.1999, p.1

2. OBJECTIVES

The **general objective** of this initiative is to enable a significant reduction of global mercury pollution by international action complementing EU efforts. This objective has been identified as a priority following the 2010 review of the EU Strategy concerning mercury.

Given the current international developments and the global context, the general objective can best be achieved by narrowing it down to the following specific objective.

The **specific objective** is an early ratification of the MC by the EU and its MS, its early entry into force and implementation on the global scale.

The **operational objectives** are to adapt the EU *acquis* to the points required by the MC and not yet reflected in the EU *acquis*, by addressing the legislative gaps in the areas listed below in an effective and efficient manner:

- import of metallic mercury;
- export of certain mercury-added products;
- mercury use in new products and processes;
- use of mercury in certain manufacturing processes;
- mercury use in Artisanal and Small-scale Gold Mining (ASGM);
- use of dental amalgam.

3. POLICY OPTIONS

It should be noted that other approaches were initially considered despite calls from the EU and other countries for a legally binding instrument on mercury. In 2005, UNEP Governing Council decision 23/9 launched global mercury partnerships between governments and other stakeholders. Such partnerships still exist today and cover a number of areas (coal combustion, cement production, chlor-alkali, mercury in products, supply and storage, mercury waste, ASGM and air transport). However, they were not successful in addressing the global mercury problem as only few (less than 30) governments were involved, not including major polluters such as Asian countries contributing nearly 50% of the global mercury anthropogenic emissions. Partnership projects could be continued on a voluntary basis or be encompassed by the MC framework, however, there is no obligation even for participating countries to implement or even take into account the outcome of the process. The limited success of voluntary approaches (e.g. partnerships) so far, confirms the necessity of a legally-binding instrument to address the mercury problem on a global scale, which was already called for in the EU Mercury Strategy.

Different policy options for the ratification of the MC have been examined and are presented below. As the majority of the provisions in the Minamata Convention are binding, for those provisions only legally binding policy options would serve the objective of future ratification of the Convention. The options considered hereunder are based on:

1. the minimum actions required to fulfil the obligations set-out in the MC;
2. more stringent measures in the cases where they have been suggested by stakeholders and which would allow to further tackle the mercury problem. These options go beyond what is strictly required by the MC, and represent another way to address the operational objectives.

It should be noted that the MC allows the Parties to take additional domestic measures that are consistent with its provisions (as indicated in the preamble).

The measures foreseen under the different policy options would address the existing gaps in the EU legislation and would allow the ratification of the MC, which in turn foresees the appropriate measures to tackle the mercury issue on a global scale.

3.0 Baseline - "No EU Action"

Under the baseline, the EU would not take any additional measures. This would correspond to an option **O0** for each of the various provisions described below.

Under the baseline, the MS would not be able to ratify the MC, as certain provisions in the MC (e.g. trade or internal market related) are exclusive EU competence or would have an impact on the EU *acquis*.

3.1 Import of mercury (P1)

The export of metallic mercury and certain mercury compounds is already banned under existing EU legislation. The export ban is intended to reduce the global mercury supply and prevents the EU's mercury surplus from entering the global market and (particularly) being diverted to polluting activities, such as ASGM.

No import restrictions for metallic mercury currently exist under EU law. The MC establishes a Prior Informed Consent (PIC) procedure for imports from non-Parties. In particular, Art. 3(8) of the Convention restricts imports of metallic mercury and certain mercury compounds and mixtures from non-Parties, when such mercury is derived from sources not allowed under the Convention (e.g. primary mining or excess mercury from the decommissioning of chlor-alkali facilities).

When considering implementation of Art. 3(8) of the Convention, the EU has the option of restricting imports only from non-Parties, as foreseen by the Convention (**P1O1**), or adopting a stricter approach (**P1O2**) by legislating a prohibition on imports from all non-EU countries.

3.2 Export of certain mercury-added products (P2)

In many parts of the world, mercury is still used in products quite extensively. Art. 4(1) of the MC foresees a prohibition on the manufacture, import and export of nine major mercury-containing product categories: batteries, switches and relays, compact fluorescent lamps, linear fluorescent lamps, high pressure mercury vapour lamps, electronic displays, cosmetics, pesticides/biocides/topical antiseptics and non-electronic measuring devices such as barometers, hygrometers, manometers, thermometers, sphygmomanometers, after the phase-out date of 2020, as specified in Annex A, Part I of the Convention.

Under EU law, products in the above categories containing mercury are already regulated under various regimes (e.g. RoHS Directive[29], Batteries Directive[30], REACH Regulation[31]), making it illegal to place them on the EU market (or indeed to import them). However, no export restrictions currently exist.

The internal market restrictions under EU law are in some cases stricter than those under the MC[32]. An EU export prohibition could thus apply either to all products already prohibited on the internal EU market (**P2O2**) or only to those prohibited for export under the Convention (**P2O1**).

3.3 Mercury use in new products/processes (P3)

The MC obliges Parties to take measures discouraging mercury use in new (i.e. not yet placed on the market at global level) products and processes, unless an assessment of the risks and benefits demonstrates environmental or human health benefits (Art. 4(6) and 5(7) of the Convention). There is currently no provision in EU law that would reflect this obligation.

One option to implement this would be to establish an obligation for operators and MS to notify the use of mercury in new products and processes. This would enable an assessment to be made by the Commission in consultation with MS experts of potential risks and benefits (**P3O1**) and could lead to a notification to the MC Secretariat for inclusion in the list of products or processes prohibited by the Convention. An alternative approach would be to enact an *a priori* prohibition of mercury use in new products and processes (**P3O2**), while it would remain possible to grant future derogations in case an assessment of the risks and benefits demonstrates environmental or human health benefits.

3.4 Use of mercury in certain manufacturing processes (P4)

The MC covers five manufacturing processes in which mercury or mercury compounds are used, namely the production of:

- chlor-alkali;
- acetaldehyde;
- vinyl chloride;
- sodium (or potassium) methylate (or ethylate);
- polyurethane.

Phase-out dates are foreseen in the Convention for mercury use in chlor-alkali production and acetaldehyde production (2025 and 2018, respectively), while a number of measures to be taken by the Parties are specified for each of the other processes.

[29] Directive 2011/65/EU, OJ L174, 1.7.2011, p.88

[30] Directive 2006/66/EC, OJ L266, 26.9.2006, p.1

[31] Regulation (EC) No 1907/2006, OJ L396, 30.12.2006, p.1

[32] For example for some lamps the amount of mercury allowed in each lamp is lower under EU rules than under the MC.

Processes subject to a phase out date

Emissions from industrial installations are currently regulated under EU law by the Industrial Emissions Directive 2010/75/EU (IED). The IED imposes the use of Best Available Techniques (BAT) aiming at reducing the environmental impact of industrial activities, and covers to a great extent the requirements concerning the manufacturing processes undertaken by the EU in view of ratifying the Convention. As an example, Commission Implementing Decision 2013/732/EU, concerning the chlor-alkali industry, concludes that the mercury cell technique cannot be considered BAT under any circumstances and hence, this process will have to be phased out in the EU by end 2017, much earlier than the 2025 deadline specified in the Convention.

There is no acetaldehyde production using mercury catalysts in the EU.

Processes for which the Convention foresees certain restrictions

The manufacturing, placing on the market or use of five phenylmercury compounds, known to be used especially as catalysts in polyurethane systems, as well as the placing on the market of articles containing these substances above a certain concentration limit is restricted by EU law under REACH as from 10 October 2017.

There is only one plant in the EU that is using catalysts containing mercury in the production of vinyl chloride as an ancillary activity. Ongoing work on the review of the reference document on best available techniques on large volume organic chemicals includes conclusion that use of such mercury-based catalysts would not qualify as BAT, which means that such use should not be allowed under the Industrial Emissions Directive.

There are two plants in the EU that use a mercury process for the production of sodium or potassium methylate or ethylate.

The measures listed in the Convention differ depending on the process and fall in the following categories:

- prohibiting the use of mercury from primary mining and reducing the use of mercury from other sources;
- reducing emissions and releases of mercury;
- supporting research and development in respect of mercury-free processes.

In practice, given the measures already taken by the EU and the activities that take place within the EU, as described above, and as EU policy on research allows for supporting research in these fields, the mandatory measures to be taken are:

- for the three processes concerned, the duty not to use mercury from primary mining;
- for the production of sodium or potassium methylate or ethylate, the obligation to reduce mercury emissions and releases to air and water by 50% by 2020 compared to 2010.

In transposing and implementing this Article, the EU could opt for the following option which restricts such processes (**P4O1**):

- prohibit by 2018 the use of mercury in the production of acetaldehyde and vinyl chloride;
- impose the measures listed above to other processes;
- encourage through dialogue Germany and the concerned companies to find solution for conversion of the two installations producing alcoholates into non-mercury technologies.

The other option would consist in establishing a stricter approach by simply prohibiting mercury use in these processes (**P4O2)**.

3.5 Mercury use in Artisanal and Small-scale Gold Mining (ASGM) (P5)

ASGM is an important source of mercury emissions on a global scale with an estimated 37% contribution to the global anthropogenic mercury emissions in 2010[17]. However, the only part of the EU concerned is the overseas department of French Guiana.

Art. 7 of the Convention (in conjunction with Annex C) foresees measures to reduce (and where feasible, eliminate) both the use and the emissions of mercury from ASGM and requires a national action plan from the Parties in case such activity on their territories is “more than insignificant”.

Given the limited scope of this activity in the EU and the existence of relevant legislation at Member State level (France), transposition of this provision into EU law would have limited consequences from the practical point of view.

However, there are again two options: transpose all requirements as they are set out in Art. 7 (and Annex C) of the Convention (**P5O1**) or adopt a stricter approach by prohibiting mercury use in ASGM altogether (**P5O2**).

3.6 Use of dental amalgam (P6)

Dental amalgam has been used for over 150 years in the treatment of dental cavities and is still used, in particular in large cavities due to its excellent mechanical properties and durability. Dental amalgam is a combination of alloy particles and mercury that contains about 50% of mercury in the elemental form. Overall, the use of alternatives is increasing either due to their aesthetic properties or alleged health concerns related to the use of dental amalgam.

Mercury vapour is released from dental amalgam and absorbed in a variety of tissues; however the clinical significance of mercury toxicity and its potential health impacts have remained a matter of debate for more than a century. Improperly managed dental amalgam waste can pose a risk for the environment. If it ends up in a landfill, mercury may be released into the groundwater or air; if it is incinerated, mercury may be released to the atmosphere; even mercury in fillings may eventually end up in the environment as a consequence of cremation or burial.

Dental amalgam and its substitutes are regulated under the Medical Devices Directive[33], according to which they must comply with the essential requirements laid out in the Directive, in particular in relation to the health and safety of the patients.

In 2008, the Commission consulted two independent scientific committees, the Scientific Committee for Health and Environmental Risks (SCHER) and the Scientific Committee for Emerging and Newly Identified Health Risks (SCENIHR), on the health and environmental risks posed by mercury in dental amalgam. Whilst SCENIHR concluded that dental amalgam was safe to use and that there was no evidence of systemic disease caused by its use, SCHER concluded that on the basis of the information available, it was not possible to "comprehensively assess the environmental risks and indirect health effects from use of dental amalgam", and identified a number of gaps that would have to be addressed.

In reviewing the Community Strategy Concerning Mercury in 2010, the Commission identified dental amalgam as one the biggest remaining use of mercury in the EU and undertook a comprehensive study. The study focuses mainly on the environmental impacts of dental amalgam use and seeks also to address, to the extent possible, the gaps identified in the SCHER 2008 opinion. It concluded that a prohibition on the use of mercury in dentistry in combination with better enforcement of EU waste legislation would reduce the environmental impact of dental amalgam use. The main conclusions of the study are summarised below, while a detailed summary of the study report is provided in *Annex 10A*:

[33] Council Directive 93/42/EEC, OJ L 169, 12.7.1993, p. 1

- Mercury demand for dentistry in the EU was estimated at around 75 t/y representing 24% of total mercury use (ca. 320 t/y). Despite its decline in the last few years, dental use of mercury remains a significant contributor to overall mercury releases to water in the EU.
- In some MS (e.g. SE, DK, IT, EE) the use of dental amalgam is very limited due to policy measures in place, while in others (e.g. FR, PL) it is still rather widespread.
- Around 46 t/y of mercury from EU dental practices end up in chair side effluents, with only part of it being captured and treated as hazardous waste.
- Only 14 MS adopted national legislation obliging dental practices to use separators (to capture mercury in the waste stream), while around 25% of EU dental facilities were still not equipped with separators.
- The total stock of mercury in European citizens' mouths has been estimated at 1000 t. Given the longevity of amalgam fillings (10-15 years), this means that the environmental problem cannot be addressed only by measures restricting future use of mercury in fillings.
- Alternative mercury-free filling materials are available and gain momentum (mainly on aesthetic grounds); they comprise ca. 66% of tooth restorations in the EU.
- There are significant differences among MS regarding the cost of dental amalgam restorations born by the patients, mainly due to differences in labour costs and insurance reimbursement schemes. A major component of the cost is the time required for the placement of the filling, which is linked to some extent with the training of the dentists. The WHO has pointed out that staff training is a major component for success in using mercury-free alternatives.

In Annex A, Part II, the MC requires Parties to take at least two out of a list of measures covering the following areas:

- national health care policies and systems;
- education and research;
- best environmental practices;
- restrictions on the form of dental amalgam used by dentists.

Most of these measures would be best addressed by MS.

As promotion of research at EU level is covered by EU research programme *Horizon2020*, it is considered that the EU is already taking one of the measures listed in the Minamata Convention. Hence, at the minimum the EU would have to take at least one more measure out of the following measures listed in the Convention:

- restrict the use of dental amalgam to its encapsulated form;
- promote best environmental practices at dental clinics by imposing the use of separators in dental practices.

In implementing this article, the EU could seek to meet the minimum requirement of the Convention by taking only one additional measure. This could be either restricting the use of dental amalgam to its encapsulated form (**P6O1a)** or imposing the use of separators in dental practices **(P601b**). As the Minamata Convention encourages Parties to take more than two measures, the EU could also opt for taking both **P601a** and **P601b,** which are independent from each other.

Alternatively, the EU could legislate with the aim of prohibiting the use of dental amalgam (**P6O2**).

3.7 Summary

The information above is presented in a summary form in the following tables. *Table 3-a* lists the MC provisions not covered by EU law that would have to be transposed before ratification.

Table 3-a Summary of Minamata Convention provisions to be transposed in EU law

Provision	MC Article	Description
P1	3(8)	Restrict the import of metallic mercury from non-Parties
P2	4(1)	Prohibit the export of certain mercury-added products (Annex A)
P3	4(6) & 5(7)	Discourage mercury use in new products and processes
P4	5(2)	Restrict mercury use in manufacturing processes (MC Annex B)
P5	7	Restrict mercury use in ASGM
P6	4(3)	Restrict the use of dental amalgam

In identifying options for each of the provisions listed in *Table 3-b*, **O1** corresponds to the requirements of the MC, while **O2** goes beyond that:

Table 3-b Summary of options

Provision	Option	Description
P1	**P1O1**	Import restrictions at EU level for metallic mercury from non-Parties
	P1O2	General EU import prohibition of metallic mercury
P2	**P2O1**	Export prohibition of the mercury-added products listed in MC Annex A
	P2O2	Export prohibition of all mercury-added products currently not allowed in the EU market
P3	**P3O1**	Notification of mercury use in new products and processes
	P3O2	Prohibition of mercury use in new products and processes
P4	**P4O1**	Restriction of mercury use in certain processes listed in MC Annex B
	P4O2	Prohibition of mercury use in the processes listed in MC Annex B
P5	**P5O1**	Controls on mercury use in ASGM
	P5O2	Prohibition of mercury use in ASGM
P6	**P6O1a**	Restrict the use of dental amalgam to its encapsulated form
	P6O1b	Impose the use of separators in dental practices
	P6O2	Phase out of dental amalgam use

Various combinations of these options are obviously possible, such combinations (consisting of 6 options each) are defined and examined as scenarios in *Section 6*.

3.8 Legal instrument

As mentioned earlier, certain provisions of the MC are not covered by the existing EU *acquis* and they would need to be introduced into EU legislation before the ratification of the Convention by the EU and by the MS. Such provisions concern different areas including trade, products, chemicals, environment, etc. A number of legislative options were examined for each provision (whatever the level of its ambition), including amending already existing EU legislation specific to the area under consideration.

In line with the principles of better law making, an approach with a single legislative proposal addressing all necessary provisions appears to be more appropriate, in terms of both legal clarity and workload/time needed in the inter-institutional process, than proceeding with amendments of various regulations and directives. This single legislative proposal could complement the internal market ban by an international trade ban of mercury-added products which are so far regulated, in terms of restricting their placing on the market, under several pieces of waste legislation (WEEE/RoHS, Batteries, End-of-Life Vehicles) as well as under REACH, and cosmetics legislation.

Regulation (EC) No 1102/2008 on the banning of exports of metallic mercury forms a good basis for adding provisions needed to ensure compliance with the MC. It already contains trade measures and provisions for the storage of waste mercury and it has a double legal base (environment and trade).

However, given that:

- the amendments (additions) to be made are numerous and outweigh the existing text,
- the scope of the instrument will be extended, which should also be reflected in its title,

in the interest of legal clarity and readability, a proposal for a new Regulation, integrating the new elements and the existing provisions of Regulation (EC) No 1102/2008, as well as repealing the latter, would appear as the most straightforward way.

4. ANALYSIS OF IMPACTS[34]

4.0 Baseline - "No EU Action"

At the time of drafting this report, the entry into force of the Convention requires 31 additional ratifications (19 parties have ratified so far). On the basis of available information, a few other countries (e.g. Japan, Switzerland, Peru, Bolivia, Brazil) intend to ratify very soon and the number of ratifications is expected to reach 25 early in 2016. Therefore, ratification of the Convention by the EU and its MS (planned for 2016) would most likely trigger its entry into force in 2016.

In view of the leading role the EU played in the negotiations and the expressed political will, both at the EU and MS level, to address the mercury problem globally, the international community is aware of EU's strong commitment to ratify the Convention. Most important countries in terms of mercury pollution[35] have signed the Convention and there are reasonable expectations they will also ratify it[36].

Non-ratification by the EU would not only have a negative impact on EU's reputation and credibility on the international scene but would additionally send a strong negative signal that would discourage ratification by other countries. In particular, it could be expected that several key developing countries would probably not ratify unless a critical mass of developed countries (such as the EU, Japan and USA) have ratified first. Ratification by many developing countries could also be delayed or even deterred by an EU decision not to ratify, as many of them look forward to the EU in particular for capacity-building, technical assistance and technology transfer (Article 14 of the MC) for implementing the Convention.

Based on these considerations, with a strong commitment by the EU, entry into force of the Convention would likely take place in 2016, otherwise entry into force will probably be delayed substantially, most likely to a date not earlier than 2020. In such a case, the Convention would also be significantly weakened as its Parties would be limited in terms of number (ca. 50-60) and impact (e.g. due to non-participation of major polluters). As explained earlier, given the long-range transboundary character of the mercury pollution, in such a case, the environmental and health impacts would be experienced both on the global scale and within the EU and the overall objective would not be met. Models conclude that without measures to control mercury pollution on the global scale, mercury emissions are likely to be substantially higher in 2050 than they are today.

Furthermore, early ratification of the MC by the EU and its MS is essential as only then can they participate as a Party in the first meetings of the COP that will elaborate (among others) the rules of procedure of the Implementation and Compliance Committee and adopt guidance on best available techniques used to reduce and/or prevent emissions of mercury from industrial activities. It is very difficult to quantify either the cost of inaction or expected benefits of a ratification by the EU, as these depend on actions undertaken by the rest of the world to reduce emissions. *Bellanger et al*[37] estimated the annual benefits of removing mercury exposure to be approximately €9 billion in

[34] The information and analysis used in this section are based on the ICF, COWI, BiPRO, Garrrigues (2015). Study on EU Implementation of the Minamata Convention on Mercury (March 2015). The reader is referred to this study for a more detailed explanation.

[35] The main polluting activities on a global scale are linked to power generation, in particular through coal burning in China and India, and ASGM in developing countries (many of them in Latin America). As such activities depend heavily on locally available resources (e.g. coal and gold), the participation of those countries in the Convention is essential for its effectiveness.

[36] Kyrgyzstan has active primary mercury mining but did not sign the MC, although it actively participated in the negotiations. Given the restrictions the Convention imposes on mercury use from non-Parties, it is expected that Kyrgyzstan will be inclined to accede, also taking into account the funding possibilities available to support implementation of the Convention by developing countries.

[37] Bellanger et al (2013). *Economic benefits of methylmercury exposure control in Europe: Monetary value of neurotoxicity prevention*. Environ. Health, **12**:3

Europe. A comprehensive study on the socio-economic costs of continuing the status-quo of mercury pollution[38] undertaken by the Nordic Council estimated at 2 439 tonnes the global emissions of mercury to the atmosphere in 2020 for a Status Quo scenario (no further actions to control mercury) and the corresponding annual damage costs due to loss of IQ at 8 billion USD, acknowledging that the total cost to society of mercury pollution would be considerably higher in view of the additional costs not taken into account in the analysis.

While one can safely conclude that the cost of inaction would be very high, such costs can neither be estimated accurately nor easily monetised and the authors themselves acknowledge that such estimates are highly influenced by uncertainties. Most studies so far analysed neurotoxic impacts, but they have not taken into account a significant body of evidence on potential elevated risk for cardiovascular diseases, especially myocardial infarction. A thorough analysis of societal costs and benefits would require the consideration of certain other aspects, e.g. co-benefits. Moreover, regional aspects may be quite important, therefore extrapolation to a global scale is very difficult.

In order to demonstrate the impact of a ratification/non-ratification of the MC to the competitiveness of the European businesses, a few illustrative examples are presented below:

- Most of the mercury-added products listed in Annex A of the MC have already been phased out within the EU. By way of example, mercury thermometers and sphygmomanometers are illegal to place on the EU market since 10 April 2014[39], thus the European businesses concerned have already undergone the transition to alternative, mercury-free products (i.e. electronic thermometers and electronic or anaerobic sphygmomanometers). Provided the MC enters into force, a phase out obligation would be imposed to all Parties by 2020. China, one of the main players in this business sector, has a production capacity of 183 million mercury thermometers and 4,18 million mercury sphygmomanometers and an employment of 5 500[40]. Production capacity for both products has been increasing in recent years and this trend will certainly continue in the coming years due to rapid economic growth unless these products are regulated. Provided China becomes Party to the MC, this whole business sector would face the need of a transition that would entail significant costs (e.g. due to technology introduction, investment in alternative equipment). It should be mentioned that there is no available mature technology for the production of electronic thermometers and sphygmomanometers in China and thus basic electronic components would have to be imported from other countries (e.g. Germany) creating potential business opportunities for European companies in this field. As an additional example, battery producers within the EU are already subject to a prohibition on placing on the EU market of batteries containing mercury[41], a restriction that MC would impose on Parties by 2020. In fact, all mercury-added products listed in Annex A of the MC are already restricted within the EU, thus the Convention would establish a level playing field in these sectors.
- Certain provisions of the MC on processes using mercury (*Article 6* in conjunction with Annex B) would have minimal impact on European industry, as such processes are either practically non-existent in Europe (e.g. acetaldehyde production, vinyl-cloride monomer production) or are already regulated beyond the requirements of the Convention (e.g. chlor-alkali production, where mercury technology will be phased-out by 2017 within the EU, while the phase-out date foreseen by the Convention is 2025). For example, while PVC in Europe is produced almost exclusively from oil or natural gas, China, one of the major producers of PVC globally, uses an alternative process with coal as a raw material, utilising a mercury-containing catalyst. In fact, PVC

38 Pacyna, J., Sundseth, K., Pacyna, E., Munthe, J. *The socio-economic costs of continuing the status-quo of mercury pollution*, Nordic Council, 2008

39 Regulation (EC) No 1907/2006, OJ L396, 30.12.2006, p.1

40 *Socio-economic Analysis on Mercury Thermometer and Sphygmomanometer Transition towards Mercury Free Products in China*. UNEP/CRC-MEP(2012)

41 Directive 2006/66/EC, OJ L266, 26.9.2006, p.1

production is the largest intentional use of mercury in China with an annual consumption of ca. 1000 t of mercury in recent years and with a forecast of significant growth in the future. As a Party to the Convention, China would have to reduce the use of mercury in this sector by 50% by the year 2020 or even eliminate such use once alternative mercury-free catalysts become technically and economically viable. Such a transition would entail costs for Chinese PVC producers, while there is no economic impact on the European industry. In fact, there are business opportunities, as a European company (Johnson Matthey) reported promising results from a pilot-scale test of a mercury-free catalyst carried out in China.[42]

- Industrial emissions of mercury have been regulated within the EU since long. The Industrial Emissions Directive (IED) currently into force requires the application of Best Available Techniques (BAT) and Best Environmental Practices (BEP) that cover all major industrial sectors[43]. The MC will impose similar obligations to Parties with regard to the industrial sectors listed in Annex D (Coal-fired power plants; coal-fired industrial boilers; smelting and roasting processes used in the production of non-ferrous metals; waste incineration facilities; and cement clinker production facilities). Guidance will be adopted at the first meeting of the Conference of the Parties on the basis of documents currently developed by an expert group on emissions, where the Commission is actively participating. Adoption of stricter emission standards by industry in other countries will entail for them a compliance cost, the EU industry is already facing. It would thus establish a level playing field and have a positive impact on the competitiveness of the sectors concerned.

It should be noted, that given the high number of signatory countries (128) and the restrictions imposed by the Convention to non-Parties, the risk of potential competition by non-acceding countries is minimal.

4.1 Import of mercury (P1)

Mercury supply in the EU is currently estimated at around 200 t/y, of which 100 t/y represents imports, while another 100 t/y is mercury originating from recycling activities within the EU. Mercury demand at the moment is estimated at 260-400 t/y, but projected consumption in 2025-2030 is estimated at 40-220 t/y (see *Table 4-e* for details). The expected decline is justified mainly by the phase-out of the use of mercury in the chlor-alkali industry by 2017, which accounts for ca. 40% of current mercury consumption within the EU.

Table 4-a Current and projected mercury (Hg) EU consumption (t/y)

	Low	**High**
Current Hg consumption	260	400
Projected Hg consumption in 2025-2030	40	220

On the basis of historical data, mercury prices could be expected to fluctuate significantly based on the relative decrease of supply and demand in 2025-2030, when the MC would have been implemented. It would be reasonable to assume that such fluctuation would range from -50% to +100% of current mercury prices, hence (after rounding) between 19 000 €/t and 78 000 €/t.

[42] http://www.matthey.com/innovation/innovation_in_action/vcm-catalyst
http://www.matthey.com/innovation/innovation_in_action/making-pvc-production-more-sustainable

[43] http://eippcb.jrc.ec.europa.eu/reference/

Table 4-b Current and projected mercury (Hg) market prices (€/t)

	Low	High
Current Hg price	38 900	38 900
Projected Hg price in 2025-2030	19 000	78 000

Given the high number of signatories (128) of the MC and the fact that most of the major EU trading partners are currently working on its ratification, it is reasonable to assume that about 90% of mercury imports to the EU would originate from future Parties, while only 10% (hence about 10 t/y) may originate from countries that will not become Parties to the Convention.

Option **P1O1** (import restrictions at EU level for metallic mercury from non-Parties) would result in annual import loss = 10t/y, of a total value of 10t/y*€38 900/t[44]= €389 000/y.

Option **P1O2** (general import prohibition of metallic mercury) would result in annual import loss = 100 t/y, of a total value of 100 t/y*€38 900/t= €3 890 000/y.

Depending on mercury demand, imports from allowed sources and for allowed uses may increase and outweigh or even overcompensate the possible losses of revenue under option **P1O1**. Option **P1O1** is not expected to impose additional costs on industry, while option **P1O2** may do so, but much depends on how the demand for mercury will change in the years ahead.

Both options will potentially lead to a lower supply of mercury. Option **P1O1** could lead to a small decrease in mercury supply (under an assumption that import restrictions from non-Parties will reduce supply imports from 100 to 90 t/y; and the remaining supply will be about 190 t/y). Option **P1O2** could lead to a significant decrease in mercury supply; the remaining supply would be about 100 t/y. Yet demand is also expected to drop as a consequence of the MC (to 40-220 t/y). Decreasing supply and decreasing demand have inverse effects on mercury prices.

No mercury shortage is expected under the option **P1O1**, while some shortage may occur under option **P1O2,** if demand for mercury remains high (see *Table 4-c* below).

Table 4-c Expected supply, demand and balance of supply and demand

	BAU (no import restrictions)	Option P1O1	Option P1O2
Supply (t/y)	~200	~190	~100
Demand (t/y)	40 to 220	40 to 220	40 to 220
Balance (t/y)	+160 to -20	+150 to -30	+60 to –120

If EU demand for mercury remains high (up to 220 t/y) it may lead to higher prices and additional costs to industry. If demand falls to the lower range of the estimate (down to 40 t/y) then prices may fall, with commensurate cost savings to industry.

If prices increase, substitution is expected first to occur in those areas where it is most economically feasible and costs of mercury-free alternatives are not significantly higher than those of the mercury use. Substitution costs cannot however be estimated at this stage. If prices fall, additional costs of substitution would not become relevant (at least not due to increased mercury prices). Based on these considerations, any actual costs of substitution will be similar to the costs of the corresponding mercury use, unless the alternatives provide added functional benefits (which represent an added value).

[44] Average mercury price in the period 2011-2014

In a foreseeable future (2025-2030), industry would need, as per projections of demand above, to purchase between 40 and 220 t /y of mercury at an average price of €38 900/t[45], equalling a value of €1,6 to €8,6 million/y (average €5,1 million/y). In case of an average demand of 130 t/y, the incremental costs of option **P1O2** would thus correspond to 0 – 5,1 million EUR/y. If demand would be in the lower end of the projected interval, cost savings for industry could be possible. If demand would be at the top of the interval, estimated cost increases (compared to business as usual) would be between 9-16 million EUR/y[46]. Therefore, across the whole range of possible developments, the incremental costs interval would be 0-16 million EUR/y.

Under both options, extra administrative costs for importers and competent authorities would arise, however they are expected to be low. As the option **P1O1** requires a procedure for checking imports from non-Parties to the MC, its administrative burden (for industry and authorities) would be expected to be higher than that of option **P1O2**, where only regular import (border) control is required.

As indicated above, option **P1O1** will practically not reduce mercury imports in the EU, while they would fall from current levels of 100 t/y to 0 t/y under option **P2O2.** A reduction in mercury supply within the EU under a general import prohibition would have a positive environmental impact at local level. However, in the global context, this would probably be more than counterbalanced by the negative impact expected due to increased supply in the rest of the world (following reduced use in the EU) and particularly in the areas and activities (such as ASGM), where environmental management is markedly worse than in the EU. It should be noted that while mercury use has significantly decreased in the OECD countries in the last 20-30 years, mercury consumption increased in many developing countries, particularly in South East Asia and Central and South America. The main reasons are a general shift of mercury product manufacturing operations from OECD to developing countries, as well as ASGM activities. Global mercury flows have been extensively analysed in a dedicated study[47] contracted by the Commission in preparation of the Mercury Export ban legislation.

Social impacts (e.g. job losses) are difficult to assess in detail, but are deemed to be minimal, based on the relatively low cost.

The table below compares the impacts of options **P1O1** and **P1O2**.

Table 4-d Overview of impacts of option P1O1 vs. option P1O2

Provision	Option P1O1	Option P1O2
P1 – import restrictions	No significant cost impacts (0-0,4 million EUR foregone imports but may be outweighed or even overcompensated by imports from allowed sources and for allowed uses). Larger administrative burden than **P1O2**. Reduced releases from primary Hg mining globally.	Possible cost for Hg importers: 0-4 million EUR/y. Potential cost range for industry due to raised Hg prices: 0-16 million EUR/y. Low administrative burden. Environmental benefits: uncertain and potentially negative.

45 The average price of mercury in 2011-1014 is taken as a basis for the calculations for comparison purposes

46 €9 million = 220t * €78 000/t –220t*€38 900/t

€16 million = 220t * €78 000/t – 40t*€38 900/t

47 Concorde Sprl, Mercury flows in Europe and the World: the Impact of Decommissioned Chlor-Alkali Plants, study prepared for DG ENV, 2004.

Stakeholder consultation

The vast majority of stakeholders responding to the relevant question in the public consultation favoured option **P1O2** (43%), with only 7% preferring option **P1O1**. Another 50% of the participants did not submit a response. Individual respondents are in favour of a strict approach concerning import restrictions. When it comes to organisations, NGOs are clearly in favour of a strict approach, while private sector and other organisations have a split view concerning this issue. However, among the participants in the public consultation, even organisations that opted for option **P1O1** would mostly not reject a stricter approach, provided their worries concerning the effects of **P1O2** on the global mercury market were addressed. A strict approach (preference for option **P1O2**) was favoured by Dragon Recycling Solutions Ltd, a private company in the UK, who argued that mercury supply within Europe would be more than sufficient to cover potential demand.

Conclusions

The expected **economic impacts** under option **P1O2** are 0-20 million EUR, significantly higher than those of option **P1O1**.

Concerning **environmental impacts**, the general objective of the MC to reduce mercury supply and use would be better achieved within the EU by implementing Option **P1O2**, i.e. prohibiting the import from all countries. However, on a global scale, this option may have negative environmental impacts as the reduction of mercury demand in the EU may well result in an increased availability of mercury on the worldwide market and potentially increased mercury consumption elsewhere, in particular in areas and activities, such as ASGM, where supply restrictions are most needed. Option **P1O2** would probably be less effective than **P1O1** and it goes further than necessary, it could thus be considered disproportionate.

Social impacts (e.g. job losses) are difficult to assess in detail but are expected to be minimal based on the relatively low cost.

Keeping in mind the general objective of achieving a reduction of mercury pollution on the global level, **P1O1** would score higher than **P1O2** in terms of effectiveness, efficiency and coherence. As an additional consideration, given that there are no clear environmental advantages of option **P1O2** in relation to option **P1O1**, import restrictions going beyond the MC would be difficult to defend in view of relevant WTO provisions.

Therefore, **P1O2** is not retained and **P1O1** is the preferred option.

4.2 Export of certain mercury-added products (P2)

A comprehensive study on the use of mercury in products and applications within the EU had been carried out by DG ENV in 2008[48]. The consumption of mercury (and its distribution across different uses) back in 2007, along with an update for 2014-2015 and a projection for 2025-2030 are shown in *Table 4-e*[49]. As the information in the table is based on the MC and EU legislation requirements, as well as background knowledge of trends and technical considerations, ranges have been used in certain cases, where the lower and upper end limits represent correspondingly the best and the worst case scenario.

For the majority of mercury-added products controlled under the MC export prohibition (e.g. batteries, switches and relays, cosmetics, pesticides, non-electronic measuring devices, etc.) mercury use is minimal due to already existing EU restrictions; lamps is the only product category within the

[48] COWI, Concorde East/West (2008). Options for reducing mercury use in products and applications and the fate of mercury already circulating in society (Dec 2008)

[49] ICF, COWI, BiPRO, Garrrigues (2015). Study on EU Implementation of the Minamata Convention on Mercury (March 2015)

EU, where substantial amounts of mercury are still used. The analysis of options will thus focus on this, however, all other products categories are discussed in *Annex 9A*.

Table 4-e Mercury consumption within the EU

Intentional mercury use	**2007 (EU25) (t/y)**	**2014-2015 (EU28) (t/y)**	**2025-2030 (EU28) (t/y)**
Batteries	7-25	0	0
Switches and relays	0,3-0,8	0,3-0,8	0,3-0,8
Lamps	11-15	11-15	11-15
Barometers, hygrometers, manometers, thermometers, sphygmomanometers	7-17	<3	0
Preservatives in vaccines and cosmetics + disinfectants (including cosmetics, pesticides, biocides, topical antiseptics)	1,1-2,5	1,1-2,5	1,1-2,5
Dental amalgam	90-110	55-95	10-95
Chlor-alkali production with Hg cells (CAK-Hg)	160-190	160-190	0
Acetaldehyde production with mercury catalysts	Unknown	0	0
"Chemical intermediates and catalysts except PUR" (may include VCM production with mercury catalysts)	10-20	10-20	0-10
Alcoholates (sodium or potassium methylate or ethylate)	(perhaps part of CAK-Hg above)	0,3-1	0,3-1
Polyurethane production using mercury catalysts	20-35	Likely below 20-35	0-10
ASGM (illegal)	3-6	3-6	3-6
Hg compounds in laboratories and pharmaceutical industry	3-10	3-10	3-10
Preservatives in paints	4-10	0	0
Porosimetry, pycnometry and hanging drop electrodes	10-100	12-58	10-50
Other miscellaneous uses	1-14	1-14	1-14
Total[50]	**320-530**	**~260-400**	**~40-220**

Under the baseline scenario (i.e. EU does not ratify the Minamata Convention), EU exports might be negatively affected by import restrictions imposed by the Parties to the Convention.

Under option **P2O1**, the export of mercury-added products that do meet the MC specifications would not be affected and manufacturing and export could continue. On the other hand, the

[50] Rounded and adjusted to avoid double counting of intermediates, e.g. the mercury used as "chemical intermediates and catalysts except PUR" is not included when calculating the total.

manufacturing and export of mercury-added products that do not meet the MC specifications would have to cease; which may lead to a loss of associated production jobs. This impact is considered insignificant as industry reported that there are no such exports.

Under option **P2O2**, the EU exports would be regulated by stricter standards than those applicable to similar production outside the EU (where the MC standards would likely dominate). Therefore, any such production currently existing inside the EU and intended for export may simply be relocated outside the EU, with consequent losses of EU revenues and jobs.

When examining the environmental impact, under option **P2O1**, mercury input and emissions/releases will remain unchanged. Under option **P2O2**, mercury use and releases inside the EU will be reduced, but if production of the targeted products is relocated out of the EU to the countries with lower environment and health standards than in the EU, the global negative impact of mercury emissions/releases on the environment and health may increase.

Lamps

Mercury-containing non-electronic measuring devices are regulated within the EU by the RoHS Directive[51] that has prohibited the placing on the EU market of electrical and electronic equipment containing mercury, with certain exemptions.

LightingEurope (2014) has advised that, of the lamps concerned by the MC, only fluorescent lamps of the halophosphate type would be affected under option **P2O2,** but not under option **P2O1**. LightingEurope estimates that around 143 million pieces of halophosphate lamps per year are manufactured in the EU for export, which comply with the standard set by the MC (maximum 10 mg mercury per lamp) but do not comply with the standard applicable for marketing within the EU (0,1% of mercury by weight, which is in practice lower than 10 mg mercury per lamp). Assuming an average consumer price of 5 EUR/piece (within a range of between 2 and 8 EUR) the consumer market value of these lamps is estimated at 715 million EUR/y.

The actual export revenue from this production was not reported, but would probably not exceed one third to half of this amount, or approximately 240–360 million EUR/y. As these lamps are reported to have mercury content below 10 mg/piece, their export would not be affected under option **P2O1**, but could be eliminated under the option **P2O2**, meaning loss of export revenues of maximum 240–360 million EUR/y. The number of jobs at risk was not reported.

No specific quantitative information on mercury emissions and releases from production of lamps for export was provided, but these are assumed to be minimal in EU production. Conservatively assuming that the lamps exported contain an average of 10 mg of mercury per lamp, the total mercury in these lamps would be 1,4 t/y. This defines the maximum potential mercury emissions/releases in the life cycle of the lamps under option **P2O2**. While some lamps may be recycled and mercury therein reused or deposited as waste, most of this mercury is expected to end up in the environment. Under option **P2O1**, no environmental impacts are expected.

Table 4-f Overview of impacts of option P2O1 vs option P2O2

Provision	Option P2O1	Option P2O2
P2 - export prohibition of the mercury-added products listed in MC Annex A	Very minor impacts are expected, as targeted products are already restricted for placing on the market within the EU and for several products the existing export is in conformity with MC requirements as reported by EU industry.	Lost export revenues from the lamps industry is estimated at 240-360 million EUR/y with possible associated job losses. Potential reductions in mercury input to society (0-5 t/y). However, negative global environmental impacts are expected, in case production is moved outside the EU.

[51] Directive 2011/65/EU, OJ L174, 1.7.2011, p.88

Table 4-f above presents the impacts generated by the two options. The types of impacts are the same for both options, but the scale of impact will be higher under option **P2O2** for the stakeholders involved in production and export of products which are targeted by EU marketing restrictions but not by MC marketing restrictions. *Table 4-g* below provides an overview of the stakeholders affected and the impacts expected.

Table 4-g Stakeholders affected by options in question and impacts in summary.

Options assessed	Stakeholders affected	Impacts
P2O1: Export prohibition of the mercury-added products listed in MC Annex A and **P2O2:** Export prohibition of all mercury-added products currently not allowed in the EU market	Industry and exporters	*Costs:* Loss of revenues from exports of targeted products manufactured in the EU. *Social:* Loss of jobs with cessation or reduction of production and export of targeted products manufactured in the EU. Impacts could be qualified as insignificant for option **P2O1** and as limited for option **P2O2**.
	Competent authorities	*Administrative burden of enforcement:* as control programmes are already conducted for diverse restrictions of marketing of mercury containing products, incremental efforts are deemed minimal.
	Environment and consumers globally	*Environmental:* Reduction of releases of mercury from the life cycle of the targeted products (from manufacture in EU; from use and disposal outside the EU). No impact under option **P2O1**, potentially negative impact under option **P2O2,** in case production is moved outside the EU.

Stakeholder consultation

The majority of respondents (39%) in the public consultation favoured option **P2O2**, while 10% expressed a preference for option **P2O1**. The rest of the participants (51%) did not respond to the relevant question in the public consultation. The percentage of supporters of a strict approach (option **P2O2)** is higher (51%) among participating organisations than among individual participants (39%). Certain business sectors (e.g. button cell batteries) expressed clear support for the option going beyond the requirements of the MC (EPBA position paper of 14/8/2015), while others such as LightingEurope (the industry association representing the European Lighting manufacturers preferred the simple transposition option as certain types of lamps for which EU law sets stricter standards than those established in the MC could still be exported after the entry into force of the Convention. All stakeholders' views, included the ones referred to earlier have been published and are available on our mercury webpage[52].

Conclusions

The main economic impact is expected from the potential loss of exports of 143 million pieces of halophosphate lamps per year, corresponding to an estimated loss of revenues of about 240-360 million EUR/y under option **P2O2**. The number of jobs at risk is not known. No specific quantitative information for the mercury emissions and releases from production of lamps for export was received but these are assumed to be minimal. While this option could have a positive environmental impact due to the elimination of up to 1,4 t of mercury input to society, this would probably not materialise if production is moved outside the EU. Even worse, increases of emissions/releases from manufacturing and waste disposal may occur, thus leading to a negative environmental impact,

[52] http://ec.europa.eu/environment/chemicals/mercury/ratification_en.htm

which would be contradictory to the general objective. **P2O2** is thus less effective than **P2O1** and it goes further than necessary, it could thus be considered disproportionate. **P2O1** is therefore preferable to **P2O2** in terms of effectiveness, efficiency and coherence. For this reason **P2O2** is not retained.

Under option **P2O1**, no environmental impacts are expected and therefore **P2O1** is the preferred option. While preference to **P2O1** means that the standards foreseen in Annex A of the MC will be applied, care will be taken to maintain stricter provisions where relevant (e.g. those foreseen by the batteries directive, given especially the support expressed by EPBA, main representative of the business sector concerned).

4.3 Use of mercury in new products/processes (P3)

These provisions of the MC relate to future products and processes which are unknown today, so a specific impact assessment is not possible. It is only possible to outline the type of impacts that may occur.

Impacts of the two considered options on stakeholders are summarised in *Table 4-h* below:

Table 4-h Stakeholders affected by options in question and impacts in summary

Options assessed	Stakeholders affected	Impacts
P3O1: notification of mercury use in new products and processes	Researchers and developers of new products and processes	Possible stimulation to develop mercury-free alternatives. Possible jobs and profits related to inventions for mercury-free alternatives.
	Industry	Possible loss of jobs and profit in industry related to products which will not be placed on the market and manufacturing processes which will not be used. Possible creation of jobs and profit related to mercury-free products and processes which will be placed on the market or used instead of products and processes using mercury.
	Competent authorities	Possible costs at competent authorities in order to manage increased administrative burdens. Administration efforts for implementation may vary quite heavily depending on the implementation mode. However, they are expected to be very limited given the low likelihood of new products or processes.
	Consumers	Possible cost impacts (positive or negative) due to changes in manufacturing costs. Reduced risk of exposure due to avoidance of new mercury uses.
	Workers	Reduced risk of exposure due to avoidance of new mercury uses.
	Environment	Reduced risk of exposure due to avoidance of new mercury uses.

P3O2: Prohibition of mercury use in new products and processes	Researchers and Developers of new products and processes	Generally the same as above for option **P3O1** - potentially more effective and with higher signal value.
	Industry	Generally the same as above for option **P3O1**. Moreover, possible additional (authorisation) costs for (i) the assessment of the risks and benefits of mercury related products to demonstrate (or not) environmental or human health benefits and/or (ii) for the assessment whether a manufacturing process provides significant environmental and health benefits and that there are no technically and economically feasible mercury-free alternatives available providing such benefits.
	Competent authorities	Possible costs for market surveillance. However, this is expected to be very limited given that (1) any such activity would be combined with the current market surveillance related to the vast mercury *acquis*, where the illegal import of existing product is the main issue, and (2) the low likelihood of new products or processes.
	Consumers	Generally the same as above for option **P3O1**.
	Workers	Generally the same as above for option **P3O1**.
	Environment	Generally the same as above for option **P3O1**.

Mercury is being phased out in most of its former uses in commercial products and manufacturing processes. The probability that new mercury related commercial products and manufacturing processes will achieve significant market scale is considered as very low, but the possibility cannot be entirely excluded. A conditional restriction would be an effective means of discouraging such applications. However, R&D activities are exempted from the MC and would thus still be possible.

Introduction of authorisation requirements would impose new cost barriers to bringing new products and processes to market and provide additional protection against the health and environmental impacts of mercury use in circumstances where there are no significant social benefits. Such requirements would discourage new uses of mercury and impose no significant direct costs on business if no new products are developed (i.e. there is no need for requests for authorisation).

If a "soft" discouragement, as in option **P3O1** is chosen, it could be considered to establish a reporting obligation (e.g. to the Commission through MS authorities) on new types of mercury products and processes, in order to monitor development and demonstrate conformity. Given the limited number of potential new developments, the associated administrative cost would be negligible.

An explicit prohibition (option **P3O2**) will have a stronger signal value both internally in the EU and towards other Parties of the MC, thereby reducing the likelihood that economic operators would engage in potentially very costly development of products or processes that would not meet the environmental and health benefits condition and thus reduce any related wastage of human and financial resources.

On the basis of experience with similar procedures under REACH, industry could face additional costs in the 100-450 kEUR[53] range for authorisation costs and fees.

[53] 1kEUR = 1 000 EUR

Table 4-i below compares the impacts of option **P3O1** vs option **P3O2.**

Table 4-i Overview of impacts of option P3O1 vs option P3O2

Provision	Option P3O1	Option P3O2
P3 - restrictions on mercury use in new products and processes	Limited impacts, both cost-wise and environmentally.	Limited economic impact. More effective and with higher signal value than **P3O1**, reducing the risk that economic operators would engage in costly developments and marketing of new products or processes that would be subsequently prohibited.

<u>Stakeholder consultation</u>

The majority of respondents in the public consultation (47%) favoured option **P3O2**, while only 6% expressed a preference for option **P3O1**. Again, 47% of the participants did not respond to the relevant question. Among individual participants, only 5% are in favour of **P3O1**, 47% were in favour of **P3O2**, while 48% did not respond to the relevant question. Among participating organisations, the corresponding figures are 21% for **P3O1**, 54% for **P3O2** and 25% not responding.

<u>Conclusions</u>

Economic and social impacts: The discouragement of mercury uses in new products or processes can eliminate potential risks. The mercury applications used today are based on technology invented 50 or more years ago (though some variants are more recent). There are currently no indications of new products or processes involving mercury being brought to the market at any significant scale. The probability that such products and processes will be developed is considered low, but it cannot be ruled out completely. However, R&D activities are exempted from the scope of the MC, as well as under existing EU law relevant to mercury, therefore, the development of new products and processes would still be possible.

The main impact of the considered options is their signal value. The stronger the signal, the more unlikely it would be that operators would waste substantial resources in developing new uses of mercury that do not have significant environmental and health benefits.

Under option **P3O2,** determination of whether the MC conditions for significant environmental or human health benefits are fulfilled would be necessary before a product was placed on the market or a process deployed. This has a significantly stronger signal value than monitoring of the market and possible prohibition of a new use after an assessment process under option **P301**.

Environmental impacts: The choice of option could result in anything between "no effect" (but conformity with the MC) and virtually full elimination of mercury input to society via novel mercury uses.

P3O2 would better achieve the objectives set and at a lower cost**,** it could thus be considered both more effective and efficient than **P3O1,** while both options seem to score equally well in terms of coherence. **P3O2** is therefore the preferred option.

4.4 Mercury use in the manufacturing processes listed in MC Annex B (P4)

Prohibition of the use of mercury from primary mining

Currently, the main industrial activities using mercury in their processes are plants producing chlor-alkali or alcoholates. Any mercury replenishment need for these plants comes from stocks of mercury the operators already have. Therefore, a prohibition of the use of mercury from primary mining would not induce any additional costs.

Reduction of emissions to air

The cost of 50% reduction of emissions of mercury to air per unit production by 2020 compared to 2010, from production of alcoholates, is estimated at 0,6-1 million EUR/y.

Prohibition of using the mercury process

The acetylene mercury catalyst-based process for production of **vinyl chloride monomer (VCM)** is only used in the EU by Fortischem in the Slovak Republic, in parallel to the mercury-free ethylene process. It is used for approximately 25% of the total VCM production. The main reason of still using this process is reportedly the availability of certain quantities of low quality (off-specifications) calcium carbide, which is easily converted to acetylene and subsequently used for VCM/PVC production. Approximately 20t of catalyst containing 10% by weight of mercury chloride (2t) is consumed annually. Used catalyst at the end of its life span is sent for recovery. While there is no information on the intentions of the company regarding phase out of the acetylene process, the dependence on this process is limited, as the company uses in parallel the mercury-free ethylene process. The concerned company has not expressed any objections to the prohibition of the use of mercury catalysts. To comply with the prohibition the company would either have to use mercury-free catalysts that are available on the market at a higher cost or discontinue this ancillary activity.

Existing alternative catalysts (based on palladium/platinum) that could be used as a replacement for mercuric chloride are relatively more expensive. However, two European companies (Johnson Matthew catalysts in the UK and Aker Solutions from NO) have developed a catalyst for the acetylene process that would easily (with no need for changes to process) substitute mercuric chloride. This would have an even higher yield compared to the mercury catalyst and would have a low impact on the process cost. Higher catalyst costs (5-15EUR per ton of PVC) would be compensated to a great extent by achieving a higher yield. Given the minimal production cost increase expected in relation to the PVC production cost (400EUR/t) and market price (900EUR/t), the new catalyst could provide a sustainable solution from an environmental and economic point of view. The additional cost of using the mercury-free catalyst was estimated at less than 1% of the total PVC production cost.

Four **alcoholates** - substances used as catalysts in biodiesel production and in several other syntheses of organic chemicals – are produced in the EU in two plants using a mercury process. The main chemical concerned, by far the economically most important, is sodium methylate. However, the companies concerned consider the production of the four alcoholates as economically mutually dependent and therefore state that they may have to terminate the production of all four substances, should the use of the mercury-based process be prohibited in the EU.

Two German companies (Evonic and BASF) are the world leaders in production of these substances. While they use the mercury-based process in their EU production, they make use of a non-mercury alternative process in their facilities located in North and South America for sodium methylate. All other global production is based on non-mercury technology. In the EU, the non-mercury production method is used by a French company, EnviroCat, which accounts for 10% of the total EU-based production of sodium methylate.

Non-mercury technologies are also commercially available for the production of sodium ethylate and potassium methylate, although they seem not to allow the production of potassium methylate in the quantities and quality required by the market.

The production of potassium ethylate with non-mercury technology appears to be possible at laboratory scale, but the EU producers using mercury do not consider it technically and economically feasible on an industrial scale. The substance is currently not registered under REACH, meaning that (if used) EU consumption is less than 100 t/y. The substance is reported by a stakeholder to be produced without mercury in India, but this has not been confirmed by other sources. The producers argued that cessation of production of potassium ethylate would make downstream users suffer from scarcity of the substance. This argument could not be verified based on available information.

The total costs for the industry of substitution for all four alcoholates is estimated at between 60 and 76 million EUR/y[54], of which about half are investments annualised over a 10 year period and the other half are operational costs. Research costs cannot be quantified precisely, but it is expected that a reasonable research activity would generate costs of 2 million EUR/y. Therefore, the substitution costs could range between 2 and 76 million EUR/y.

Summary of impacts of the options

The costs of reducing emissions under option **P4O1** are estimated at 0,6-1 million EUR/y. As these measures would be taken in a context of discouragement of the use of this process, depending on the measures taken by Germany or voluntarily by industry, costs of research and/or substitution may be also incurred bringing the potential costs range to 3-77 million EUR/y.

For option **P4O2**, the costs of prohibition of the mercury process for alcoholates production the costs could range from 61 to 77 million EUR/y.

Social impacts of option P4O2: While the numbers available are considered uncertain and not necessarily consistent with the lower production costs of the mercury-based process, they could indicate that the mercury-based production technology is more labour-intensive, and the loss of 80-200 jobs cannot be ruled out. Under option **P4O1**, such impacts may be also observed depending on the measures taken by Germany or voluntarily by industry, the transition will come more slowly, or not at all (in case adequate alternatives are not developed for all four alcoholates), and consequently potential job losses would range between 0 and 200.

Environmental benefits under **both options** are moderate in the EU context. For option **P4O2**, the reduction in air emissions is estimated at about 190 kg/y and reductions of the mercury input at about 0,3-1,0 t/y. The reductions potentially achieved under option **P4O1** can also not be quantified more precisely than up to 0,3-1,0 t/y, while in the short term emission reductions should drop by 95kg/y.

[54] A detailed analysis is presented in *Annex 9B*.

Table 4-j Overview of impacts of option P4O1 vs option P4O2

Provision	Option P4O1	Option P4O2
P4 – restrictions on the use of mercury in the manufacturing processes listed in MC Annex B	Moderate to substantial impacts (costs 3-77 million EUR/y), depending on whether an alternative process for the last of the four alcoholates considered technically and economically feasible is identified and implemented following measures taken by Germany or voluntarily by industry. Reductions of mercury air emissions by at least 95kg/y and mercury use by 0,3-1t/y.	Significant economic impacts: Annual estimated costs of 61-77 million EUR/y. Reductions of mercury air emissions by 190kg/y and mercury use by 0,3-1t/y

Stakeholder consultation

The majority of respondents in the public consultation (45%) favoured option **P4O2**, while 7% expressed a preference for option **P4O1**, with 48% of the respondents not responding to the relevant question. Among individuals, 45% favoured option **P4O2**, against 7% favouring option **P4O1** and 48% not responding. Among organisations, the corresponding figures are 54% for **P4O2**, 27% for **P4O1** and 19% for no response. However, while the overwhelming majority of NGOs are in favour of **P4O2**, most private sector organisations (9 out of 14) favour **P4O1**, i.e. an implementation as foreseen in the MC. The business sector concerned is divided, as mentioned above, as the companies using the mercury technology clearly favour **P4O1**, while their competitors support an outright ban (option **P4O2**).

Conclusions

Phase-out of the use of mercury in VCM production does not have significant impacts, as the company concerned could easily switch to the ethylene process or alternatively use a mercury-free catalyst that would have a minimal impact on the process cost.

Whilst there is a clear non-mercury alternative for the production of sodium methylate, the companies using the mercury-based production process state that they would have to terminate the production of all four substances if the use of the mercury-based process is prohibited for sodium methylate as the activity would not be economically viable anymore. There remains uncertainty on the potential negative impacts that such cessation would imply for downstream users of two of the four chemicals.

P4O2 is associated with an economic impact of 61-77 million EUR/y corresponding to a reduction of mercury emissions of about 190 kg/y and potential losses of 80-200 jobs. On the other hand, **P4O1** could achieve similar environmental benefits over time with potentially much lower cost, as the economic impact was estimated between 3-77 million EUR/y depending on the measures taken by Germany or voluntarily by industry. While **P4O2** is more effective than **P4O1**, the latter would probably be slightly more efficient. **P4O2** would score better in terms of coherence as the mercury process used will be phased out in the chlor-alkali industry within the EU by 2017.

P4O1 is thus the preferred option.

4.5 Mercury use in Artisanal and Small-scale Gold Mining (ASGM) (P5)

Artisanal and small-scale gold mining (ASGM) activity is defined by Art. 2(1) MC as "*mining and processing in which mercury amalgamation is used to extract gold from ore*."

Art. 7(2) of the MC requires the Parties for which such activity is relevant to take steps "*to reduce, and where feasible eliminate, the use of mercury and mercury compounds in, and the releases to the environment of mercury from, such mining and processing*."

ASGM is not prohibited under the MC, but where a Party determines that ASGM and processing in its territory is "*more than insignificant*", it is required to develop a National Action Plan (Art. 7(3) MC), in line with the requirements of Annex C to the MC. Such plans have to be submitted to the Secretariat of the Convention within three years after its entry into force with a review every three years.

ASGM activities are very widespread in developing countries, particularly in South America, Africa and South-East Asia. Within the EU, the only Member State concerned is France (as ASGM takes place in the overseas department of French Guiana), resulting in mercury pollution despite the prohibition under French law to use mercury for such an activity.

The incremental impact of the transposition into EU law of a general obligation to restrict the use of mercury for ASGM would therefore be minimal since France has already taken measures and, as a Party to the Convention, would have to provide a National Action Plan, which would also serve as the EU's contribution to this issue.

Given that ASGM activity is informal and often takes place illegally, there would practically be little difference between options P5O1 and P5O2 in terms of effectiveness and efficiency, while both would score equally well in terms of coherence. However, as France has already prohibited ASGM, there is no need for legislation beyond the requirements of the Convention at EU level and therefore option **P5O2** is discarded.

Option **P5O1** is thus the preferred option for transposing this provision of the Convention.

4.6 Use of dental amalgam (P6)

<u>Contextual information</u>

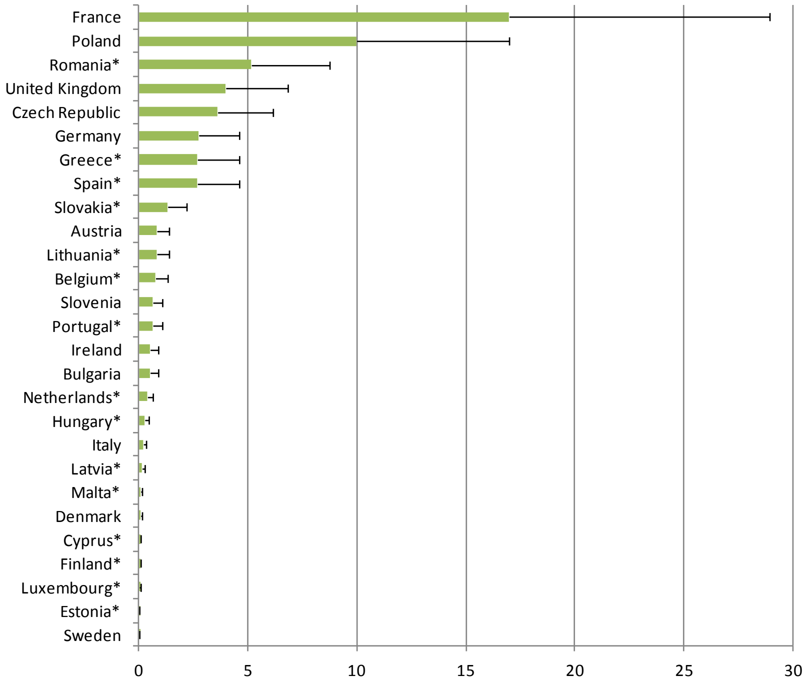
The following analysis of options **P6O1a** and **P601b** is based on data collected in the Bio Intelligence Service (2012) study. *Annexes 10B*, *10C* and *10D* reproduce information on the environmental impact due to mercury emissions from dental amalgam, the use of separators in MS, and the environmental cost of dental amalgam use respectively.

As can be seen from *Figure 4-a*, dental amalgam use varies greatly among MS. The solid line indicates the estimated demand, while the light line indicates the uncertainty of the estimate. Mercury consumption for this use has been estimated at 55 to 95 t/y in 2010, with an average value of 75 t/y. This corresponds to approximately 125 million restorations, while another 245 million are carried out by using mercury-free materials (ca. 66% of the total number of 370 million restorations). There has been a downward trend in the use of dental amalgam over the last years, the greatest decreases being observed in the countries that have imposed restrictions on its use.

In future, the use of dental amalgam may continue to decline in the EU, mainly as a result of growing aesthetic concerns. The Bio Intelligence (2012) study provides an estimate of a potential drop in demand for dental amalgam if no further EU action is undertaken by classifying MS in three groups as depicted in *Table 4-k*.

On the basis of the information presented above, at least a 5% reduction of dental amalgam use is expected annually, leading to a projected overall use in 2025 ca.50% lower than in 2010.

Figure 4-a Demand for dental mercury in EU Member States (t Hg/year)



Source: Data provided by national dental associations and/or health authorities via the study questionnaire, taken from previous studies or estimated by BIO using available data.

*Estimated by BIO

Table 4-k Projected demand for mercury in dental amalgam

Group	Share of dental amalgam in 2010 (in % restorations)	Expected share of dental amalgam in 2025 (in % restorations)	Dental Hg use in 2010 (t)	Projected dental Hg use in 2025 (t)	Comments
Group 1 **DK, EE, SE, IT, FI**	0-5%	0%	0.3-0.4	0	This group includes countries where amalgam use is very limited and is expected to cease in the mid-term due to policy measures in place (e.g. SE) or other factors.
Group 2 **BG, BE, CY, DE, HU, IE, LU, NL, PT, ES, LV**	6-35%	5 to 15%	9 – 12	3– 8	In these countries, demand for dental amalgam is expected to continue to decrease until it reaches a relatively low share of restorations.
Group 3 **AT, CZ, FR, GR, LT, MT, PL, RO, SK, SI, UK**	>35%	20-30%	46 - 78	23-35	This group includes countries where dental amalgam is still widely used, as well as less wealthy countries where the extra cost may be an important factor in view of citizen's income. In addition, due to the currently high use of dental amalgam in these countries, there would also be a high proportion of dentists unwilling to change their current practices.
		EU	55 - 95	27-43	

Option P6O1a – restrict the use of dental amalgam to its encapsulated form

There are two main ways to prepare dental amalgam: by using pre-dosed capsules containing the substances to be mixed in an apparatus (amalgamator) or by mixing dental alloy and mercury, purchased as separate products.

The use of pre-dosed capsules (instead of bulk mercury) contributes to reducing emissions occurring during amalgam storage and preparation, and the exposure of dental personnel to these mercury vapours. There is thus a clear positive impact to the occupational health and safety of dental workers, including dental assistants, dental nurses, and hygienists, in particular when they are women of childbearing age, which makes them particularly susceptible to the occupational hazards caused by mercury vapours. Additionally, there is a risk of mercury overdose in amalgams made from metal alloys and mercury in bulk form, a risk practically eliminated when using pre-dosed capsules.

Out of 62 companies producing dental filling materials in the EU, 38 produce exclusively mercury-free materials and would not be affected at all by any measure restricting the use of dental amalgam to its encapsulated form. There are 20 companies producing both dental amalgam and mercury-free fillings, half of them located in Germany. Only 3 companies had been identified as producing solely mercury for dental restoration applications, two of them[55] trading solely mercury for dental amalgam in bulk form either directly to dental practices or to the manufacturers of dental amalgam capsules. One company produces solely dental amalgam alloys (silver/copper/tin) and precious metals alloys for crown and bridge work[56]. While enforcing a restriction on the use of dental amalgam to its encapsulated form would have a negative economic impact for these companies, it would probably be compensated by increased supply of mercury to manufacturers of capsules, rather than directly to dental practices.

Pre-dosed capsules use in dentistry was estimated by COWI and Concorde East/West (2008) at approximately 70%, the rest being prepared by using bulk mercury. A recent survey by CED carried in 26 European countries suggests that in 12 countries the use of dental amalgam in encapsulated form is required by law, in another two it is highly recommended, in two countries dental amalgam use is prohibited, while in 9 countries it is not regulated. In terms of use, seventeen European countries reported 100% use of pre-dosed capsules, another four reported very high percentages (65-95%), while another four provided no estimates.

For dental amalgam, whether in bulk or in encapsulated form, the average cost[57] of the filling material is very low (1 EUR) in comparison to the total cost of dental restoration (36 EUR on average for an amalgam restoration)[58]. Given that mercury-free dental filling materials are used more often than dental amalgam (66% of restorations in 2012), and the fact that pre-dosed capsules are used in 70% of dental amalgam restorations, the use of bulk mercury concerns a very small percentage (ca. 10%) of the total number of fillings. The number of dentists concerned would probably be much less than 10% of the total number of dentists[59] i.e. less than 31 050 dentists.

Implementing this option would also imply that all dental practices using dental amalgam would need to get equipped with amalgamators, if this this not currently the case. Amalgamators are relatively cheap equipment, available on the market at a cost as low as 100 EUR.

Hence, implementation of this restriction would impact only a small percentage of dentists (less than

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55 The Czech company Bome S.R.O and the Dutch company M&R Claushuis B.V.

56 The Cookson Precious Metals Ltd company (UK) manufactures dental amalgam alloys (silver/copper/tin) as well as gold fillings and inlays. Amalgam alloy is sold to wholesale companies as well as to producers of dental amalgam capsules.

57 Covers the use of both pre-dosed capsules and mercury in bulk form.

58 Corresponding values for a composite or glass ionomer dental filling would be 5 EUR and 49 EUR respectively.

59 Estimated at 310 500 on the basis of Eurostat data in 2009

10%) using exclusively dental amalgam in non-encapsulated form and not currently owning an amalgamator, and they would face only very low costs.

Option P6O1b –impose the use of separators in dental practices

There are three main pathways for the release of mercury from dental amalgam to the environment:

- discharges from dental clinics to wastewater systems;
- as solid waste;
- through cremation or burial of bodies containing dental amalgam fillings.

Most dental practices are equipped with filters (called amalgam separators) aiming to minimise the quantity of mercury escaping to the sewage system. Amalgam separators are designed with an efficiency of 95% (percentage of mercury captured in dental effluents) however, this presupposes appropriate regular maintenance. On the basis of responses received from 23 MS, at least 14 MS have a legal requirement for the installation of amalgam separators. *Annex 10C* presents detailed information from which it can be seen that the share of dental practices equipped with amalgam separators vary widely across MS.

An estimate of the share of dental facilities equipped with amalgam separators is available for 16 MS (*see Annex 10C* and *Table 4-l* below).

Table 4-l: Share of dental facilities equipped with dental amalgam separators

Share of dental facilities equipped with amalgam separators	Member States
~100%	10 MS: AT, CZ, DK, FI, DE, LV, MT, PT, SE, UK
90-100%	5 MS: BE, CY, FR, IT, NL, SI
Unknown	11 MS: BG, EE, ES, GR, HU, IE, LT, LU, PL, RO, SK

On the assumption that in the MS where no concrete information is available only 20% of dental facilities are equipped with separators, the average EU-wide figure[60] for dental practices equipped with amalgam separators is around 75%.

Bio Intelligence Service (2012) estimated that the actual average efficiency was around 70%, as a number of the existing separators were not adequately maintained. On the basis of the analysis presented in *Annex 10B*, the installation of properly functioning (95% efficiency) amalgam separators in all dental facilities would result in approximately 7 t/y of avoided mercury releases to urban Waste Water Treatment Plants (WWTP).

The impact of imposing the use of separators in dental practices would be more significant in those MS where only a small proportion of dental facilities are already equipped with separators.

A co-benefit of this option would be to increase the capture of other metals present in amalgam and released from dental chairs (e.g. Ag, Sn, Cu, and Zn).

It would also increase the quantity of mercury-containing waste sent to hazardous waste treatment facilities (assuming 100% of the mercury waste generated will follow this route) and will avoid the presence of mercury in the municipal and biomedical waste streams. With all mercury-containing waste treated as hazardous waste, emissions of mercury to air and water resulting from inadequate waste handling and treatment will be avoided, which corresponds to approximately 7 t/y of avoided Hg emissions to air, 2 t/y of avoided mercury emissions to water and 11 t/y of avoided Hg emissions

[60] weighted by the number of dentists per MS (assumed to be proportional to the number of dental practices)

to soil and groundwater (based on the environmental assessment presented in *Annex 10B*). All mercury from dental waste will be either recycled or sequestered for long-term, essentially removing it from the global mercury pool where it could potentially become bioavailable and accumulate in the food chain.

In case this option is implemented, the number of additional dental clinics that would have to install a separator had been estimated at 34 200. The cost of an amalgam separator had been estimated by COWI/Concorde (2007) to be in the range of 400-500 EUR/y including installation, servicing, in-situ evaluation of filter efficiency and accreditation, while Bio Intelligence (2008) considered a wider range of 150 to 750 EUR/y as more appropriate, given the small size of European dental clinics (2,1 practising dentists per dental clinic). The installation of amalgam separators in 34 200 dental clinics would therefore represent a total cost of 5 to 26 million EUR/y (including amalgam sludge treatment). An additional cost of 5 to 32 million EUR/y had been estimated by Bio Intelligence Service (2008) with regard to the improved maintenance and waste management of clinics already equipped with a separator but not yet reaching the expected 95% efficiency target.

The cost of this sub-option for dentists would be counter-balanced by additional revenues for waste management companies involved in the maintenance of amalgam separators and/or in the collection and treatment of dental amalgam waste.

The implementation of sub-option **P6O1b** would result in a lower mercury content of dental effluents entering WWTPs. This may reduce the need for municipalities to invest in expensive mercury abatement devices in sewage sludge incineration plants. In certain cases, it may also increase the possibilities of using sewage sludge for agricultural purposes, a cheaper management option for sewage sludge. Overall, this will have a positive economic impact on municipalities, and consequently on local taxpayers, as it will reduce the environmental costs associated with the management of mercury pollution from dental amalgam.

Finally, the administrative costs of **P6O1b** for public authorities mainly correspond to increased awareness raising activities towards dental clinics and/or a higher frequency of inspections of dental clinics in order to ensure compliance. It is difficult to quantify these costs in the absence of adequate data. Assuming that each inspection (including a visit and follow-up reporting) would take approximately 4 hours and that 10% of EU dental clinics would be inspected each year, this would result in approximately 35 000 h annually, corresponding to a labour cost of approximately 1 million EUR/y for public authorities[61]. However, the actual administrative burden across the EU would probably be lower since effective inspection schemes are reportedly already in place in some MS (e.g. Germany, Sweden) and the above calculation represents a rather conservative upper limit estimate. If MS impose financial penalties as a tool to enforce compliance, some revenues might also be generated through the collection of fines, which may partly offset the labour costs dedicated to inspection.

The impact of option **P6O1b** is expected to be positive with regard to employment. Job creation is to be expected in companies involved in the manufacturing, installation and maintenance of amalgam separators and in companies specialising in the collection and treatment of mercury-containing waste. Properly functioning dental effluents’ treatment devices (chairside traps and amalgam separators) will reduce exposure of dental personnel to mercury vapours and would hence have a positive impact to the health and safety of dental workers.

61 at an hourly wage of 31 EUR

Option **P6O1b** would contribute significantly to the reduction of releases to urban WWTPs and corresponding releases to environmental media, particularly sewage sludge. A positive impact to public health and safety can thus be expected by the implementation of option **P6O1b.**

Option P602 – prohibition of the use of dental amalgam

The economic impacts of a ban on dental amalgam had been examined by the Bio Intelligence Service study[62] in 2012. When replacing 762 million dental amalgam restorations with mercury-free restorations in a fifteen year reference period (2010-2025), the additional costs to be borne by patients had been estimated at 3,9 to 27 billion EUR (or 8-54EUR per capita) calculated on the assumption that the average cost difference between mercury-free restorations and dental amalgam would remain stable over the reference period. On the assumption that the average cost difference between mercury-free restorations and dental amalgam would decrease by 3% annually the corresponding figures would be 2,9 to 20 billion EUR (or 6-40 EUR per capita).

Detailed estimates for the countries where additional costs are expected are shown in the table below copied from the above-mentioned study:

Table 4-m Additional costs borne by patients in case of a ban on the use of dental amalgam for the period 2010-2025

MS with cost differences	Total number of dental amalgam restorations substituted with Hg-free materials in 2010-2025 (‘000)	Additional costs borne by EU patients in 2010-2025 if no change in price difference (million EUR)	Additional costs borne by EU patients in 2010-2025 if 3% annual decrease in price difference (million EUR)
Austria	13,954 - 23,722	837 - 2,420	622 - 1,797
Czech Republic	62,794 - 106,749	1,005 - 1,708	746 - 1,269
Germany	47,270 - 80,359	0 - 2,411	0 - 1,791
Greece*	47,080 - 80,037	518 - 2,129	385 - 1,581
Netherlands*	6,399 - 10,878	70 - 2,89	52 - 215
Poland	174,427 - 296,526	0 - 10,971	0 - 8,149
Luxembourg*	512 - 871	1 - 8	1 - 6
Portugal*	10,853 - 18,451	26 - 165	19 - 123
Romania*	89,380 - 151,945	983 - 4,042	730 - 3,002
Slovakia	22,592 - 38,407	0 - 307	0 - 228
Spain*	46,922 - 79,767	113 - 715	84 - 531
Latvia	2,778 - 4,722	0 - 38	0 - 28

[62] Bio Intelligence Service S.A. (2012). Study on the potential for reducing mercury pollution from dental amalgam and batteries. Final report prepared for the European Commission.

MS with cost differences	Total number of dental amalgam restorations substituted with Hg-free materials in 2010-2025 (‘000)	Additional costs borne by EU patients in 2010-2025 if no change in price difference (million EUR)	Additional costs borne by EU patients in 2010-2025 if 3% annual decrease in price difference (million EUR)
Lithuania*	13,864 - 23,569	153 - 627	113 - 466
Ireland	8,966 - 15,241	90 - 457	67 - 340
Malta	1,726 - 2,934	0 - 17	13 - 0
Slovenia*	10,989 - 18,681	121 - 497	90 - 369
EU27	560,505 - 952,858	3,934 - 26,784	2,922 - 19,893

* Estimated values. For these MS the average cost difference is assumed to be equal to the average value for the group of MS they belong to.

NB: The average restoration costs take into account possible amounts reimbursed by national health insurance schemes, where they exist.

Given the clear disagreement between stakeholders on the nature of potential environmental and health impacts of the use of dental amalgam, the Commission requested SCHER and SCENIHR to update their 2008 opinions on the basis of the latest scientific information. SCHER published an updated opinion in 2014, while SCENIHR’s opinion was published in May 2015.

SCHER concluded[63] that the information available is not sufficient for a comprehensive risk assessment for the environment, in particular for soil and air. For the aquatic environment, mercury from dental amalgam does not represent a risk for European surface waters in general. However, a risk for the aquatic ecosystem cannot be completely excluded, as under exceptional local conditions, the amount of mercury released could be exceed the relevant environmental quality standards.

The SCENIHR opinion[64] issued in April 2015:

- concluded that current evidence does not preclude the use of either amalgam or alternative materials in dental restorative treatment. However, the choice of material should be based on patient characteristics such as primary or permanent teeth, pregnancy, the presence of allergies to mercury or other components of restorative materials, and the presence of impaired renal clearance;
- recognised a need for further research, particularly relating to (i) evaluation of the potential neurotoxicity of mercury from dental amalgam and the effect of genetic polymorphisms on mercury toxicity and (ii) to expand knowledge of the toxicity profile of alternative dental restorative materials; and
- recommended that for primary teeth, and for pregnant patients, alternative materials to amalgam should be the first choice.

The opinions of the scientific committees thus clearly indicate that significant negative impacts of dental amalgam on health are not proven, but there may be situations where the release of dental amalgam to water induces increased pollution endangering the quality of water. Furthermore, there is a clear declining trend of the use of dental amalgam mainly for aesthetic reasons.

[63] Environmental risks and indirect health effects of mercury from dental amalgam, **SCHER, 2014**

[64] The safety of dental amalgam and alternative dental restoration materials for patients and users, SCENIHR, 2015

Therefore, **P6O2** would not be a proportionate measure and it is not retained for further assessment. **P6O1a** and **P6O1b** would score equally well in terms of coherence. While **P6O1b** would score higher in terms of effectiveness, both **P6O1a** and **P6O1b** are considered equally efficient.

Therefore, option **P6O2** would not be a proportionate measure and it is not retained for further assessment.

Stakeholder consultation

The majority of respondents in the public consultaion (85%) favoured option **P6O2**, while only 12% expressed a preference for option **P6O1**. Only 3% of the participants did not respond to this question, indicating the strong interest this issue raised among participants. Among individuals, 86% favoured option **P6O2**, against 11% favouring option **P6O1** and 3% not responding. Among organisations, the corresponding figures are 61% for **P6O2**, 23% for **P6O1** and 16% for no response. Concerning sub-options **P6O1a,b**, 47% of the respondents gave the highest ranking (5) to option **P6O1a**, while acceptance was even higher (69% gave the highest ranking) for option **P6O1b**. It should be noted that the issue of dental amalgam is the most controversial as certain dentists are very much in favour of an immediate prohibition (option **P6O2**), while the Council of European Dentists (CED) rather support softer measures aiming at the gradual phase down of this use (option **P6O1**).

Conclusion

In the light of scientific advice, a measure prohibiting the use of dental amalgam would not be proportionate. Therefore option **P602** is not assessed any further.

Options **P601a** and **P601b** would accelerate current trends to improved practices, i.e. the use of dental amalgam capsules rather than free mercury and the use of amalgam separators and sound management of the dental amalgam waste. To comply with the Convention, the EU would have to implement at least one of those options. The EU could also choose to take both measures as they are independent and both reinforce current trends that are favourable to protection of human health and the environment.

Therefore, taking both options **P601a** and **P601b** is preferred**.** It should be noted that the Council of European Dentists (CED), the main European professional association of dentists, has endorsed both the exclusive use of encapsulated amalgam and the use of amalgam separators in its resolution on responsible care[65] already since November 2011.

It should be noted, that although the majority of the businesses concerned would qualify as microenterprises, they would not be disproportionally affected by the proposed measures as:

1. given the type of activity they would not suffer from competition with larger undertakings,
2. the implementation cost of the measure is limited and would require only low investment, and
3. no jobs loss is expected in the dentistry sector.

However, as such undertakings would need time to adapt to the obligations set out in this Regulation, a transitional period could be granted before entry into force of the obligation. Finally, the requirement to use amalgam in an encapsulated form would not cause any additional burden to dentists who have opted out from using dental amalgam.

[65] CED resolution on responsible practice (2011)

5. Comparing the Options

5.1 Definition of scenarios

For the purpose of comparing the impacts of options, it is helpful to define packages of options covering all of the legislative gaps that have to be filled in order to ratify the MC. Three policy scenarios have been defined as follows:

Scenario 1 is defined as the implementation of the measures identified in *Section 4*, which correspond to the strict minimum the EU would have to do in order to comply with the MC. For dental amalgam it includes option **P6O1a** which has a lower economic cost than option **P6O1b**.

Scenario 2 is the combination of the preferred options indicated in *Section 4*.

Scenario 3 corresponds to a more stringent implementation approach, going beyond the provisions foreseen in the MC and composed of the stringent options that have a clear environmental and health benefit at EU and global levels.

Scenario 1

Scenario 1 follows a "simple transposition" approach, meaning that EU law is amended only as necessary to comply with the provisions of the MC, without going beyond the minimum requirements.

This scenario would be a combination of all **O1** options assessed in *Sections 4.1* to *4.6*. This is indicated in the following table:

Option	Description
P1O1	import restrictions at EU level for metallic mercury from non-Parties
P2O1	export prohibition of certain mercury-added products listed in MC Annex A
P3O1	notification of mercury use in new products and processes
P4O1	restriction of mercury use in certain processes listed in MC Annex B
P5O1	controls on mercury use in ASGM
P6O1a	restrict the use of dental amalgam to its encapsulated form

Scenario 2

Scenario 2 combines all preferred options.

Option	Description
P1O1	import restrictions at EU level for metallic mercury from non-Parties
P2O1	export prohibition of certain mercury-added products listed in MC Annex A
P3O2	prohibition of mercury use in new products and processes
P4O1	restriction of mercury use in certain processes listed in MC Annex B
P5O1	controls on mercury use in ASGM
P6O1a	restrict the use of dental amalgam to its encapsulated form
P6O1b	impose the use of separators in dental practices

Scenario 3

Scenario 3 corresponds to a stringent implementation approach going beyond the provisions foreseen in the MC that would consist of the options retained after the analysis in Section 5 as they have a clear environmental and health benefit at EU and global levels. Options **P1O2, P2O2** and **P6O2** that have not been retained are not included in this scenario, which is thus a combination of options **P3O2**, **P4O2** with options **P1O1**, **P2O1** and **P6O1**.

Option	Description
P1O1	import restrictions at EU level for metallic mercury from non-Parties
P2O1	export prohibition of certain mercury-added products listed in MC Annex A
P3O2	prohibition of mercury use in new products and processes
P4O2	prohibition of mercury use in certain processes
P5O1	controls on mercury use in ASGM
P6O1a	restrict the use of dental amalgam to its encapsulated form
P601b	impose the use of separators in dental practices

5.2 Comparison of scenarios against the baseline

The combination of options in the defined scenarios is not expected to create synergies or interactions between the options and therefore it is considered that costs and benefits of the separate options add up within the scenarios.

The impacts of the ratification of the MC by the EU can be analysed from two perspectives: the direct impacts caused by measures taken within the EU and the indirect impacts resulting from ratification by third countries.

5.2.1 Indirect impacts

Once implemented, important provisions of the Convention, such as phase out of existing primary mining, prohibition of new primary mining, ASGM restrictions, or limitations of emissions from industrial activities, are expected to have a huge positive indirect environmental impact both globally and for the EU, while the additional cost for the EU is marginal, as such activities practically do not exist on the EU territory or are already regulated.

As it is expected that all major EU trading partners would adhere to the Convention, the indirect positive impacts on competitiveness resulting from ratification by third countries is likely to be significant:

- The Convention foresees a number of measures that mirror existing EU legislation on products (restrictions on mercury use imposed by the batteries directive, RoHS, REACH etc). European companies have already developed products (e.g. low mercury content batteries, fluorescent lamps) needed to comply with existing legislation, their production therefore would practically need no adaptation due to the ratification of the MC. On the contrary, many non-EU countries would need to adapt considerably after the phase-out date foreseen by the Convention in order to reach the standards prescribed in *Annex A* of the MC.
- As third countries implement the Convention, they will apply similar standards as those currently in force within the EU to many industrial activities. This will help address potential competitive advantages currently enjoyed by companies in third countries due to more relaxed (or even non-existing) environmental standards and possibly open new markets for EU companies specialising in environmental technology. For example, the Convention provisions on mercury emissions from certain industrial activities (in particular the production of cement, non-ferrous metals, iron and steel sectors as well as energy production using coal) will practically expand the use of Best Available Techniques and Best Environmental Practices (already applied by the EU industry) to

numerous industrial facilities emitting mercury on the global scale. Thus, the entry into force of the Convention will improve the competitive position of EU companies in these sectors.

- Following the entry into force of the MC, EU companies may also capitalise on their existing patent portfolios and know-how relating to non-mercury technologies by technology transfer and joint ventures with companies situated in third countries.

5.2.2 Direct impacts

Table 5-a below lists the identified impacts of the three scenarios against the baseline.

Table 5-a Comparison against the baseline

Alternatives	**Impacts**		
	Economic	**Environmental**	**Social**
Scenario 1	3-77 million EUR/y	++	0
Scenario 2	13-135 million EUR/y	+++	+
Scenario 3	71-135 million EUR/y	+++	-

Direct Economic Impacts

In all cases, the measures taken by the EU to comply with the Convention have limited direct economic impacts. As these impacts do not concern exporting sectors, but mainly other sectors (e.g. dentists), any negative impact on EU competitiveness is likely to be negligible, in contrast with the positive indirect impacts of entry into force of the Minamata Convention on competiveness.

The most significant economic impacts are expected in the chemicals production sector, where a mercury process is currently applied in two German plants for the production of alcoholates used for various catalytic processes.

Total cost of *Scenario 1* is estimated at 3-77 million EUR/y mainly due to the provision on phase-out of mercury use in certain processes. The cost range is large as it uncertain whether two industrial plants will be converted to mercury-free processes. Some limited additional costs are expected that could not be quantified. This includes mainly the costs of equipping dental practices with the appropriate amalgamator to enable the use of pre-dosed capsules, which is expected to be low as recent information suggests that most dentists are already equipped with such devices.

Scenario 2 (preferred scenario) entails an additional cost of 10-58 million EUR/y in relation to *Scenario 1* due to the extra cost of installing and maintaining amalgam separators. However, this Scenario would also result in avoided health damage costs in the range of 35-140 million EUR/y[66], and an increased annual turnover for the EU waste management and recycling sector, linked also to a positive impact on EU employment, reflected in an improved environmental and social impact in relation to *Scenarios 1a and 1b*.

The lower end of the cost range for *Scenario 3* is significantly higher than for the two other scenarios as it implies the conversion of two industrial plants to mercury-free processes.

[66] Bio Intelligence Service S.A. (2012). Study on the potential for reducing mercury pollution from dental amalgam and batteries. Final report prepared for the European Commission.

Direct Environmental Impacts

Whilst, the measures taken within the EU to ratify the MC would deliver additional direct environmental benefits in terms of reduced use and emissions of mercury, this would be more modest that the indirect environmental benefits.

All three scenarios generate environmental benefits by reducing the trade of mercury and its use in products and processes, hence reducing the emissions of mercury to the environment within the EU and globally. These environmental benefits are however much less significant than the indirect environmental benefits that will be obtained from the entry into force of the Convention and its application by third countries, which will help solving the main remaining mercury problem, i.e. the transboundary transport of mercury pollution from third countries.

Scenarios 2 and *3* have more significant environmental benefits as they include a measure that will end the major release of mercury to water within the EU, i.e. installation of dental amalgam separators at dental clinics.

As the positive environmental impact of solving the mercury releases to water from dental clinics is significantly greater than the positive environmental impact of the options defined for the other areas addressed in this impact assessment, the difference in environmental benefits generated by *scenarios 2* and *3* are very small.

Direct Social Impacts

Scenario 1 entails the loss of jobs due mainly to the restrictions imposed on products and processes and hence a negative social impact. However, reduced occupational health and safety risks for dental workers thanks to option **P6O1a** generate positive impacts.

Given the additional positive contribution of **P6O1b** compared to *Scenario 1, Scenario 2* would be expected to have a positive social impact with some job creation in the sector involved in manufacturing of amalgam separators and the waste sector as well as improved safety for dental workers. Some job losses might occur due to restricting the use of mercury in products and processes, however there are less likely than under *Scenario 3*.

On top of the measures included in *Scenario 2, Scenario 3* entails prohibitions of mercury use in certain processes generating limited job losses.

5.2.3 Effectiveness, efficiency and coherence

As the indirect impacts are the same for all three scenarios and are significantly bigger than the direct impacts, there is only a small difference in effectiveness, efficiency and coherence between these scenarios.

Scenario 2 gathers the individual options that come out most favourably in the analysis of effectiveness, efficiency and coherence presented in section 4 for the sub-options:

- **Effectiveness:** *Scenario 2* compares favourably to *Scenario 1* as it enables the EU to drastically reduce the emissions of mercury to water that mainly originate from dental clinics not equipped with amalgam separators. *Scenario 3* is slightly more effective than S*cenario 2* as it reduces more the mercury emissions to air from two plants;
- **Efficiency:** *Scenario 2* has the highest efficiency as it includes measures with high emission reductions but excludes measures with high costs for very limited emissions;
- **Coherence:** *Scenarios 1 and 2* show good coherence; there is uncertainty on the coherence of *Scenario 3* as it might affect the good functioning of certain downstream economic activities.

5.2.4 Preferred Scenario

As a result of the above analysis, the preferred scenario is *Scenario 2*.

6. MONITORING AND EVALUATION

One of the main objectives of this action is early entry into force of the MC and its broad implementation globally. A key progress indicator is the number of ratifications of the MC. As the Convention will enter into force after 50 Parties have ratified, the EU (along with its MS) could actually trigger the entry into force once 22 ratifications have been reached.

Art. 19 of the MC includes provisions on monitoring, while Art. 21 of the MC summarises reporting obligations for all Parties, concerning trade, processes, ASGM, emissions and releases. The format of reporting will be decided by the Conference of the Parties at its first meeting (possibly in 2017).

Environmental performance of the measures on the European and global scale can be judged thanks to existing monitoring mechanisms.

Environmental impacts of mercury pollution have been monitored within certain projects funded by the Commission as early as 1998, e.g.:

- MAMCS Mediterranean Atmospheric Mercury Cycle System
- MOE Mercury Over Europe
- MERCYMS An Integrated Approach to Assess the Mercury Cycling in the Mediterranean Basin

More recently (2010-2015), the Commission contributed 6,8 million EUR to a 9 million EUR project involving more than 20 partners and aiming to establish a worldwide observation system for the measurement of atmospheric mercury.

- GMOS Global Mercury Observation System.

GMOS supported various international programmes (such as the UNEP mercury programme and the Arctic Monitoring and Assessment Programme - AMAP) that helped build the case for global action and reach agreement on the MC in 2013.

Detailed information is available on the project website (www.gmos.eu), the project will be completed by the end of 2015, but the consortium envisages its extension to the developing countries, provided further financial support is available.

As the main source of human exposure is methylmercury in fish and seafood, achievement of the objectives would ultimately be judged by reductions in the concentration of methylmercury in fish and seafood products intended for human consumption.

The first Conference of the Parties will establish a monitoring system that will provide the information needed for the evaluation of the Convention's performance. The Commission will coordinate implementation at EU level. Concerning dental amalgam, the main issue to monitor is the reduced impact of mercury releases on water quality and operation of urban waste water plants, which will be based on information gathered under existing EU water legislation.

Concerning products, imports surveillance would be based on existing systems operated by MS customs, while market surveillance would be based on existing national systems, whereby operators who wish to place a new product on the market must inform the competent national authorities.

Art. 22 of the MC foresees an effectiveness evaluation no later than six years after the entry into force of the Convention. As the global dimension would be a major aspect of any evaluation of EU mercury policy, the EU will undertake a full-fledged review and evaluation of its mercury policy in parallel to the Convention's effectiveness evaluation.

On the assumption that the Convention will enter into force in 2017, an effectiveness evaluation will take place by 2023 at Convention level. It is at this stage that the EU would undertake a full evaluation of mercury policy and legislation.

7. ANNEXES

ANNEX 1 – PROCEDURAL INFORMATION

Lead DG: **DG ENV**	Agenda planning/WP reference: **2014/ENV/014**

Organisation and timing

Work on this impact assessment started in September 2013, when DG ENV signed a contract with an external contractor to assess the impacts of potential measures envisaged in view of the ratification by the EU of the Minamata Convention on Mercury.

An Impact Assessment Steering Group (IASG) led by DG ENV was set up in December 2013 and met 4 times since then, between January 2014 and September 2015. Whilst the Directorates-General (DGs) of the Commission SG, SJ, ECFIN, GROW, EMPL, ENER, CLIMA, TAXUD, SANTE, TRADE and DEVCO were invited to participate in the work of this group, EMPL and CLIMA declined whereas ECFIN and ENER did not nominate any representative. GROW, TRADE and SG were the DGs that contributed the most actively to the work of the IASG. All nominated members of the group were regularly consulted and informed on progress.

Consultation of the Regulatory Scrutiny Board

The Regulatory Scrutiny Board issued a positive overall opinion with three main recommendations on potential further improvements.

1. *To include information on the likelihood that the most important mercury emitters amond third countries would ratify the Convention and how the Convention would be enforced.*

This was addressed by inserting a new subsection in Section 4, where the important role of certain third countries in terms of mercury pollution is highlighted and the role of an EU ratification in their decision to ratify is explained. The importance of an early ratification by the EU in influencing the compliance mechanism and consequently enforcement of the Convention is also made clear.

2. *To assess the impact of the Convention on the competitive position of EU companies vis-à-vis companies of third countries.*

The impact of the MC ratification on the competitiveness of EU companies was better explained, by providing specific examples (e.g. in relation to mercury-added products, *Section 1.5*), by better defining the baseline (*Section 4*) and by inserting additional explanation in *Section 5.2* which compares impacts against the baseline.

3. *To better explain the reasons for discarding a ban on dental amalgam.*

Additional information on the economic impacts of option **P6O2** was included in *Section 4.6*

A number of other comments of more technical nature were also addressed by amending the corresponding sections, or providing additional information where needed.

External expertise and consultation of interested parties

This impact assessment draws on knowledge and expertise on mercury built up over several years both in the EU and internationally. A broad range of studies have been taken into consideration, notably those commissioned by DG ENV[67], but also work done by UNEP within the framework of

[67] http://ec.europa.eu/environment/chemicals/mercury/studies_en.htm

the international negotiations for a global mercury convention, and other organisations (e.g. WHO, EFSA). References to the most important background work are provided in the above list of sources and evidence.

The Commission assessed in detail the impacts of various options for filling the legislative gaps and was supported in this through a study contract signed with ICF International in September 2013. The current impact assessment is to a great extent based on the conclusions of this study[68].

Sources used in the impact assessment

The main sources and evidence that have been used in the course of the elaboration of this Impact Assessment Report are listed in the appendix to this annex.

Whereas there was no single statistical and scientific model that could be used to assess the mercury issues addressed in this report, the robustness and quality of those sources and evidence has not been challenged by the experts and stakeholders who have been consulted throughout the IA process, including at the workshop organised on 7 July 2014 with MS authorities and stakeholders (see Appendix A to *Annex 2*).

APPENDIX - LIST OF SOURCES AND EVIDENCE

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EC (2014c): Proposal for a Directive of the European Parliament and of the Council on the limitation of the emission of certain pollutants in to the air from medium combustion plants – Information note. COM memo ST10976-EN14 Cion aggregation rule.

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EPBA (2015): Personal communication with Hans Craen, January 2015.

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Eurometaux (2014): Personal communication with Director Guy Thiran. December 2014.

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ANNEX 2 – STAKEHOLDER CONSULTATION

MS authorities and stakeholders, including major players (e.g. BASF, Lightening Europe, Eurelectric, CED) and environmental non-governmental organisations (e.g. the European Environmental Bureau) were consulted at a workshop held in Brussels on 7 July 2014. The basis for the consultation was the draft study contracted by the Commission and carried out by ICF/COWI/BiPRO/Garrigues. The objective was to ask and obtain from participants views, data and information that would help to strengthen the collective understanding of the nature, scale and distribution of the impacts of the various measures considered in the study. In complement to opinions raised at the workshop, written comments were submitted by stakeholders and several MS to follow-up on their interventions at the workshop. Input received was taken into account in in the consultants' report. All written contributions received were made publicly available on the Commission's website.

A summary of the main issues discussed in of the workshop is provided in *Appendix A* to this Annex.

A broad on-line public consultation was run from 14 August 2014 until 14 November 2014 and publicised on the *"Your voice in Europe"* webpage[69] using a questionnaire[70]. The objective of this survey was to get a better understanding of the views of the public and stakeholders concerning the ratification of the MC and specific issues related to the transposition and implementation of the MC and in particular in relation to the key areas where EU legislation may need to be amended. The target groups were citizens, public authorities, research organisations, academia, non-profit/non-governmental organisations, consultancies and private companies and their representative organisations. DG ENV informed major stakeholders (e.g. MS, Euro Chlor, EPBA, CED, EEB and various NGOs) of this consultation.

The results of the on-line public consultation are summarised and presented in *Appendix B* to this Annex.

[69] http://ec.europa.eu/yourvoice/consultations

[70] Questionnaire available at: http://ec.europa.eu/environment/consultations/pdf/MinamataConvention.pdf

Appendix A – Stakeholder Workshop of 7 July 2014

This Appendix summarises the issues raised by stakeholders in the workshop of 7 July 2014 on the basis of an interim draft report made available by the consultant. Each topic was introduced through a presentation with slides that were made available to all participants.

Mercury supply & waste

The contractor presented key findings on the impacts of measures to implement the Minamata Convention's provisions on the supply of mercury and environmentally sound management of mercury waste[71], especially the requirement of MC Art. 3(8) to introduce a binding obligation for the Parties to restrict the import of mercury from new primary mining and excess mercury of chlor-alkali facilities from Non-Parties and Art. 11(3) relating to recycling of mercury (etc.). While a minimal implementation of these Articles were assessed to have no major impacts within the EU, the presentation noted that a combination of a mercury import prohibition and prohibition of mercury recycling - in a scenario where the EU goes beyond the requirements of the MC - would in effect eliminate the supply of mercury to the EU. It also discussed the balance of the measures, impacts within the EU and elsewhere in the world, and the associated uncertainties in predicting the response of the world market.

The subsequent discussion centred on:

- the content, conclusions and availability of a study prepared for the German government on the environmental impacts of final storage of metallic mercury wastes above ground, in hard rock and in salt mines[72];
- the signalling effect of the EU allowing storage of liquid mercury in salt mines for third countries that might not have similar storage possibilities;
- the collaboration in progress on mercury waste management under the UNEP mercury storage partnership, which included a review of solidification technologies;
- what activities are being captured in EU data on trade in mercury and mercury compounds (e.g. reported mercury exports in 2012 and 2013);
- the challenges of making decisions in the face of the uncertainty about how EU action to restrict imports or impose restrictions on recycling would impact on the global mercury market;
- the need for prior informed consent, documentation and traceability to support any system of regulated imports, including distinguishing between mercury from recycled and other sources;
- the definition of high and low concentration mercury wastes;
- the presence of implementation and enforcement challenges of new and existing legislation.

The Commission noted the uncertainty associated with the some of the measures and that the margin for improvement is comparatively modest compared to the progress already made in the EU in reducing the environmental and health risks associated with mercury.

Mercury use in processes

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[71] Supply/imports covered in slides 16 to 27, waste in 28-39 and final disposal in slides 40-43 of the presentation available to download at http://ec.europa.eu/environment/chemicals/mercury/pdf/Final-Presentation-EU-Hg.pdf

[72] Hagemann et al. 2014: Study investigating the risks for operational and long-term safety of underground storages of metallic mercury in salt formations and their potential mobilisation by saline solutions. Available to download from https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_07_2014_behaviour_of_mercury_and_mercury_compounds_at_the_underground_disposal_in_salt_formations-summary.pdf

The contractor presented the analysis of the potential EU response to the Minamata Convention's regulation of mercury use in processes. Relevant terms here are Art. 5(3 and 6) and Part II of Annex B which covers VCM, polyurethanes and alcoholates. The presentation focused on alcoholates production where the most significant impacts were expected to arise. It was noted that general, but not specific coverage, is provided by the IED. The MC would require the EU to make efforts to phase out of mercury-based alcoholates production; an alternative 'beyond MC' option would be to introduce a new regulation that banned alcoholates production using mercury cells.

The ensuing discussion covered:

- The estimation of mercury releases avoided by cessation of such processes (as compared to the costs implicated);
- The implications for the EU economy of a ban on mercury-based processes, the availability of alternative processes for production of different alcoholates and the costs of any transition to such processes;
- The interpretation of the MC terms governing a phase-out of mercury in this production.
- That regulation of polyurethanes and VCM would also be needed.

Participants were again asked to supply information on: available alternatives especially regarding potassium ethylate; impacts on downstream users of cessation of potassium ethylate production; costs of reduction of emissions and releases from the mercury process.

Emissions and releases

The presentation on the study's findings in relation to mercury emissions and releases focused on MC Art. 8 and Annex D, noting also the option provided (Art. 8(2)) to "*establish criteria to identify the sources covered within a source category listed in Annex D so long as those criteria for any category include at least 75 per cent of the emissions from that category*". The target source categories are coal-fired power plants; coal-fired industrial boilers; smelting and roasting processes used in the production of lead, zinc, copper and industrial gold; waste incineration facilities; and cement clinker production facilities. The presentation highlighted the coverage in the EU provided by the IED and the forthcoming MCP Directive, but also that there was still work to be done to define aspects of the MC requirements and that the outcomes of those negotiations could potentially have impacts for the EU. The contractor flagged the lack of data on how much of the mercury emissions are currently covered by the IED for certain source categories. The ensuing discussion provided:

- Offers of data on mercury emissions and activity rates;
- Information of participants that representatives of the cement industry are working to establish EU BAT conclusions as the basis for definition of global standards in current global industry discussions on reducing the air pollution associated with cement production.

Products and processes

Art. 4(6) and 5(7), respectively, require the discouragement of the manufacture and the distribution in commerce of new mercury-added products, and the introduction of new mercury-based processes. The presentation of the study's work on regulation of mercury in products (for export and EU domestic consumption) looked in particular at the gaps between standards defined in the MC and EU law, and the absence of inventions and innovations dependent on mercury in recent decades. Meeting participants mentioned:

- Offers of data on current export of mercury-added products restricted in the EU and the MC, respectively;
- The EU's role as a source of the mercury that is used in artisanal gold mining in South America and elsewhere;
- The option of having a notification system for innovations that involved use of mercury;
- The reported emergence of some products containing mercury in the US (e.g. "tennis elbow" arm band with mercury).

Dental amalgam

The Convention requires parties to phase down the use of dental amalgam, taking into account their domestic circumstances and relevant international guidance. The contractor explained that the study was not tasked with developing new analysis on dental amalgam given the previous studies and work of the scientific committees. The shape of potential options for compliance and going beyond compliance with the Minamata Convention (via a ban on amalgam) had, however, been outlined.

In the discussion, various views were presented on the further regulation of dental amalgam, the relative merits (and costs) of amalgam and its substitutes, and implications of providing exemptions from a general ban on use of amalgam. The Commission noted that two scientific committees have been considering the amalgam question; the SCHER opinion (which focuses mostly on environmental issues) was published in March 2014 and the SCENIHR opinion (on the health risks) is in preparation.

APPENDIX B – RESULTS OF THE PUBLIC CONSULTATION

Summary

The on-line public consultation on the EU ratification of the MC reached a significant level of participation. In total 3 702 responses from individuals and organisations were received, including 6 405 comments. The questionnaire included 8 thematic questions, 6 questions concerning specific MC provisions (such as import restrictions, product exports, use of mercury in new products/processes, restrictions on certain processes using mercury and dental amalgam) and 2 general questions seeking feedback on current EU legislation (and in particular the Mercury Export Ban Regulation) and general suggestions on the implementation of the Convention.

Individuals from 28 MS and organisations from 18 MS, as well as respondents from 14 non-EU countries participated in this survey. The United Kingdom (937 responses), Germany (825) and France (654) were the countries with the highest participation rates, whereas MS which joined the EU after 2004 had the lowest response rates (2 responses from Lithuania, up to 45 from Poland). Whilst most of the participants (98%) were individuals, contributions were also received from 81 organisations representing a wide variety of stakeholders.

The categories of respondents, individuals and organisations, have been analysed in more detail concerning number, distribution and content of the responses and the comments provided. Additionally, 81 participating organisations were analysed according to their type, stakeholder and interest group aspects and then grouped in clusters.

Participants included organisations representing the traditional green and environmental sectors, representatives of the medical and health sector, medical industry, labour unions and the private sector, including the chemicals, waste and mining sectors, as well as representatives of governments. Hence, a wide range of interests and points of view is reflected in the responses received.

Significant differences between the interests of individual respondents and organisations can be observed. While individual respondents mostly focused on dental amalgam and the corresponding health issues, participating organisations were rather interested in a broad range of mercury-related issues and delivered substantial contributions concerning regulatory amendments needed vis-à-vis the MC. In this context, it should be mentioned that a significant number of participants did not answer all of the questions (On average, 40% the questions remained unanswered).

There were no significant differences in the content of the responses given by individual respondents and organisations. Most of them (39-85%) opted for a stricter approach in transposing and implementing the MC and the respective amendments to EU law. A rather small number of respondents (2-12%) preferred a less strict approach, but then justified their decision with detailed arguments in the comments area and only very few demanded exemptions for mercury use in products and processes. Nevertheless, also these participants, who were in favour of a less strict approach, shared the opinion that the use of mercury in the EU and world-wide should be phased down.

The vast majority of respondents expressed their serious concerns about the effects of mercury on the environment and health and requested a strict and consistent approach, as well as a phase out of the use of mercury in the short term. A large number of participants mentioned that they were affected by mercury poisoning either themselves or their friends or relatives. A significant number of dentists and people of the medical sector reported their negative experiences with mercury,

especially relating to dental amalgam. More than half of the representatives of the private sector were also in favour of an approach going further than the MC, while advocating for a consistent and well prepared regulatory implementation process.

1. Approach to the analysis of the survey

The information gathered through the online consultation was analysed and the results are presented in this report.

Regarding the quantitative representativeness of the responses, 3.702 responses from all over the EU and non-EU countries were received. Individuals from all 28 MS participated as well as organisations from 18 MS.

Answers that could be judged as biased (e.g. exactly the same responses and comments by several respondents) were studied, and their significance concerning the overall results of the survey was assessed. Certain obvious errors were corrected when analysing the results.

With regard to the representativeness of the stakeholder groups that took part to this consultation, the analysis of the data and comments differentiates between individual respondents and organisations while taking into consideration the type of organisation or sector. For questions 1 to 6 an analysis of the responses by organisations has been added concerning each of the following sectors: private (15), NGOs (43) and others (consultancy, research, educational, national government, regional/local authority and other; 26).

The only mandatory fields of the questionnaire were those related to identification, hence it was not compulsory to answer all of the 8 questions. The numbers or percentages of participants who did not answer to a question are indicated in the charts as N/A (No Answer).

Comments provided by the respondents, individuals and organisations were also examined. Hence, in addition to the quantitative results, comments to each of the questions were selected which explain, specify and/or reveal in more detail the individual motivation or points of view of the participants.

The selection criteria for comments retained were frequency, relevance concerning the specific question and range of opinions. Frequent and very frequent comments with similar content or expressing similar opinions where always taken into account. For each question only those comments were taken in consideration, which referred to the topic and content of this question. And in a final step, the selected comments to the respective question were revised under the aspect of the range of opinions expressed by the individuals and organisations, then classified on the base of topics and points of view and duplicates or very similar comments were reduced to one.

Less strict criteria were applied to feedback and comments to question 7 and 8, as the number of contributions was quite low and the quality of contributions high.

2. Descriptive analysis of the categories of respondents

A total of 3702 respondents from all over the EU (96%) and other countries (4%) participated in this public consultation. The distribution and number of respondents per country (see chart below) is uneven but correlates significantly with the total population of the MS. Respondents from all 28 EU MS participated. The United Kingdom (937), Germany (825), France (654), Italy (263) and Spain

(171) show the highest participation numbers while Bulgaria (5), Croatia (5), Malta (5), Estonia (4) and Lithuania (2) the lowest.

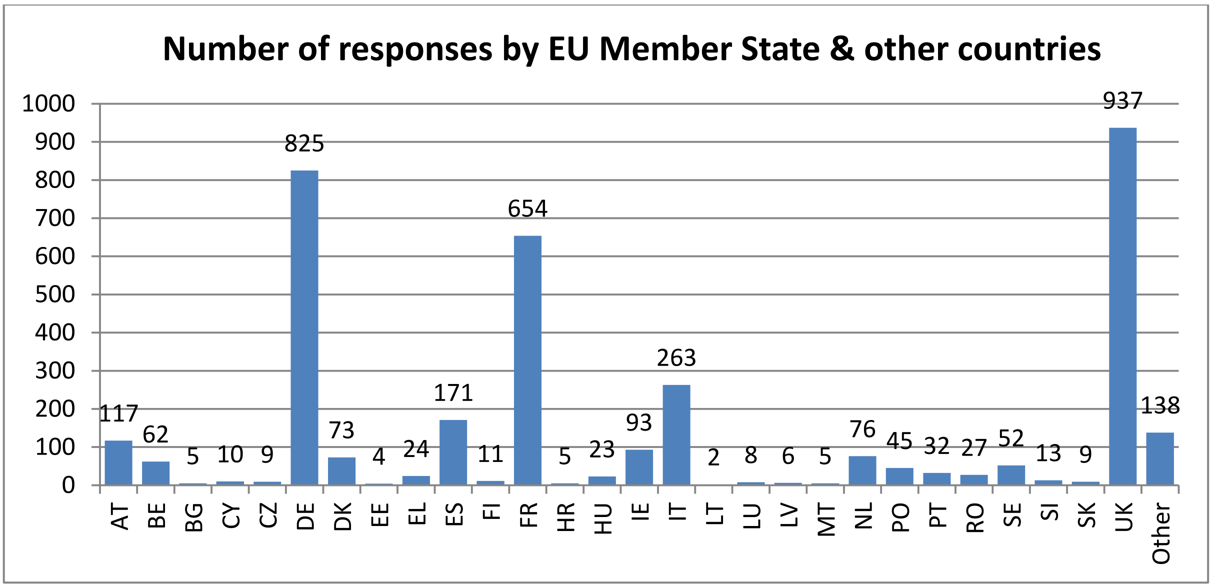


Figure 1: Distribution of the public consultation responses by EU Member State (in alphabetic order) and for other non-EU countries

Furthermore, individuals and organisations from all over the World and other European countries participated in this survey. A total of 138 responses from non-EU MS were received, including the USA (53), Switzerland (50), Canada (10), Australia (8), Norway (5), South Africa (3), Brazil (2) and Israel, Jordan, Lebanon, New Zealand, Pakistan, Singapore and Ukraine (1).

To organize the data of respondents by MS and according to the year of EU integration of each country (see chart below) shows a correlation with the respective dates of EU integration. Citizens and organizations from the founding and long life-time MS tend to participate more in public consultations launched by the EU while those from countries which joined the EU in 2004, 2007 and 2013 still have very low participation rates. Apart from a possibly different level of interest in the MS concerning EU issues and decisions in Brussels the significantly varying participation rates could also be based on the still existing regionally differing access to the internet and in consequence to the online public consultations itself. In addition to this, language barriers can also be a reason.

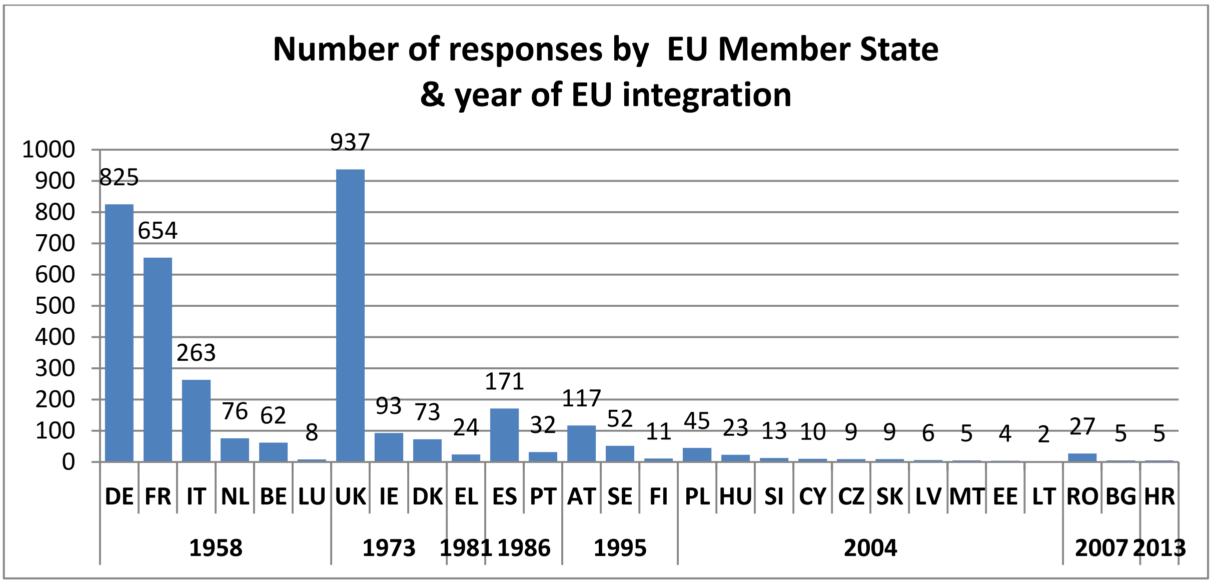
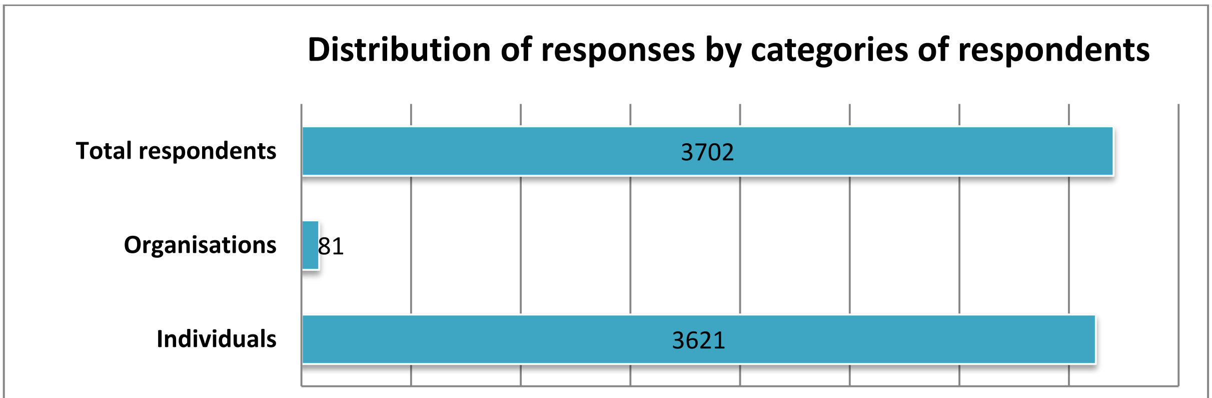


Figure 2: Distribution of the public consultation responses by EU Member State and year of EU integration

In the identification part of the questionnaire to this public consultation participants were asked, if they were responding on behalf of an organisation or as an individual. The chart below shows the participation due to these two categories of respondents. In total 3.621 individual respondents provided their opinion representing all 28 MS and 81 organisations from 18 MS as well as 138 individuals and organisations from other non-EU countries.



	Individuals	Organisations	Total respondents
% Total respondents	98%	2%	100%
Number respondents	3621	81	3702

Figure 3: Distribution of the public consultation responses by categories of respondents

Representatives of organisations were additionally asked to specify their type of organisation and thereby the sector and group of interest they represent. As shown below non-profit and non-governmental organisations (51%) and the private sector (18%) are the most represented organisation types in this survey, while the participation rates of consultancy firms, regional / local authorities and national governments as well as organisations belonging to the educational / academic and research sector do not even exceed 5% of the total number of organisations (81). As in this survey individual respondents were not asked if they had expert knowledge or represent a sector or interest group, hence a sector analysis for individual respondents is not available.

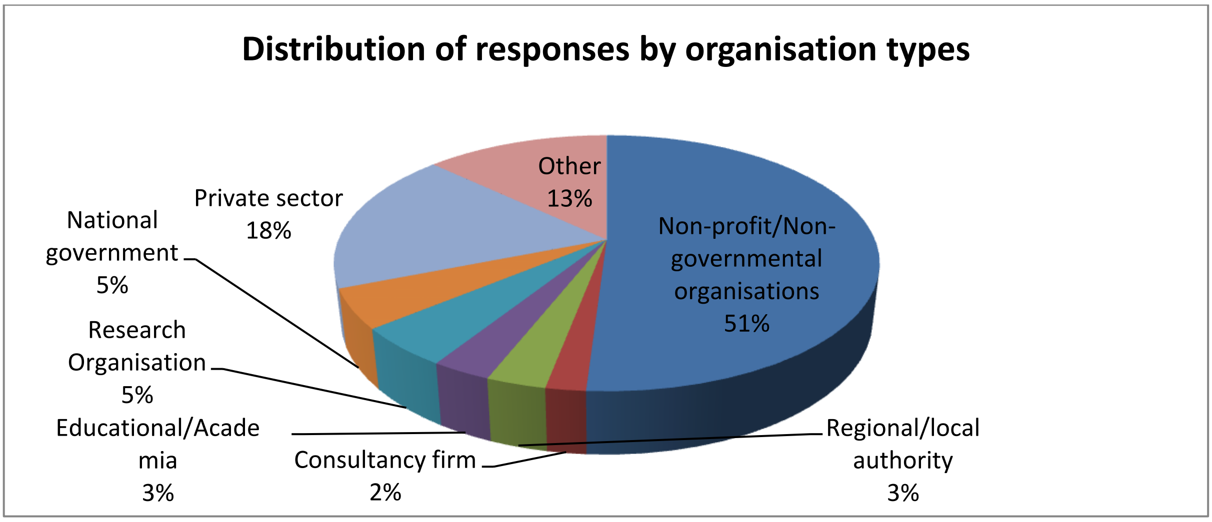


Figure 4: Distribution of the public consultation responses by organisation types (% of total organisations)

Apart from the sector analysis based on the organisation types the participating organisations were additionally examined more in detail and then grouped in clusters according to their focus of interest and expertise. The following table shows the clusters/interest groups which were identified through the analysis and examples are given for each of them.

Cluster / Interest Groups	Organisation Types / Stakeholders and Examples
1) Green / Environmental	NGOs, associations; **Examples:** Friends of the Earth Germany (BUND e.V.), France Nature Environnement, Ecologistas en Acción, EEB
2) Medical / Dental / Health (excluding Medical / Dental Industry and Medical Technologies)	Associations / chambers / organisations of doctors / dentists especially with focus on alternative / holistic / environmental medicine and chronic diseases / toxicology; **Examples:** Associazione Nazionale Dentisti Italiani, Irish Doctors' Environmental Association, Interdisziplinäre Gesellschaft für Umweltmedizin, CED
3) Medical / Dental Industry and Medical Technologies	Manufacturers, associations; **Examples:** Eucomed, German Medicines Manufacturers' Association, British Dental Industry Association
4) Private Sector / Industry	Manufacturers of scientific instruments; **Examples:** Russell Scientific Instruments, Ludwig Schneider Messtechnik
5) Chemical / Waste / Recycling	Environmental friendly chemistry, recycling solutions; **Examples:** Envirocat, Evonik Industries, Draon Recycling Solutions; European Union for Responsible Incineration and Treatment of Special waste
6) Mining Industry / Sector	Mining companies / industries, associations; **Examples:** Vattenfall Europe Mining, European Association of Mining Industries, Metal Ores and Industrial Minerals
7) Labour Unions	**Examples:** Industriegewerkschaft Bergbau, Chemie, Energie; Workers Council of Evonik

8) Government / Authorities	**Examples:** Department for Environment, Food and Rural Affairs (UK), Ministry of Agriculture (Hungary)

Table 1: Participation of organisations in the public consultation classified according to clusters / interest groups

Considering the results of the above stakeholder analysis, the Medical/Dental/Health cluster/interest group was predominating in terms of participation, followed by the clusters Green/Environmental and Medical/Dental Industry and Medical Technologies.

It has to be highlighted that organisations of very different sectors and interest groups participated in this survey and provided their opinion. This variety of contrasting points of view on mercury and the associated environmental and health impacts indicates that the survey results for organisations reflect the whole range of opinions and are representative.

3. Level of participation and focus of interest for question 1 to 6

Due to a significantly varying participation rate in the questions of this public consultation concerning the Ratification by the EU of the MC a more detailed analysis has been carried out for this survey differentiating between contributions of individual respondents and organisations. The number of responses to each of the questions has been compared with the contribution of comments per question and has been additionally compared with the total of participating individuals or organisations.

The results of the analysis for individual respondents can be seen in the chart below. Individual respondents obviously had a special interest in question 6 and the dental amalgam issue. Question 6 reached the highest scores of participation in this survey in terms of responses (3.518) as well as comments (2.117), which means that 97% of individuals participating in this survey answered to this question and additionally 2.117 of them contributed with individual comments. By contrast the participation ratio of individuals with respect to questions 1 to 5 was comparatively low. Just 1 out of 2 participating individuals responded to these questions and less than half of them provided comments. It is obvious that most of the individuals were not interested in mercury issues related to industry, industrial processes and products and the corresponding amendments under the MC. It has to be pointed out that individual respondents had a clear focus of interest on dental amalgam and mercury related health issues.

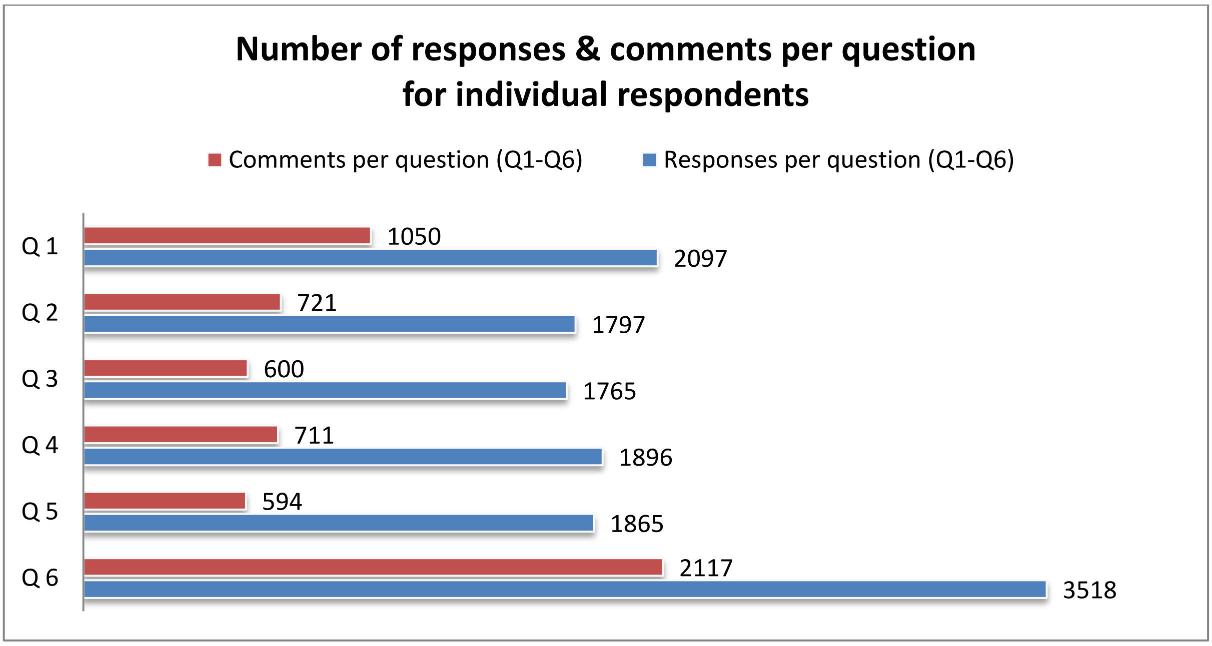


Figure 5: Comparison of the number of responses and comments for questions 1 to 6 for individual respondents

In contrast the results for organisations draw a completely different and more balanced picture as it can be seen in the chart below. About 80% of the participating organisations (81) responded to each of the six questions, a quite high participation ratio, and more than half of them (except question 6) additionally contributed with comments. Question 1, which related to the participants' support concerning the Ratification of the MC by the EU, received most of the responses from organisations and most of the comments as well. Organisations, which participated in this public consultation, obviously were interested in all of the questions and aspects on mercury and the MC revealed in this survey and additionally contributed with lots of comments reflecting the range of views of the participating stakeholder groups.

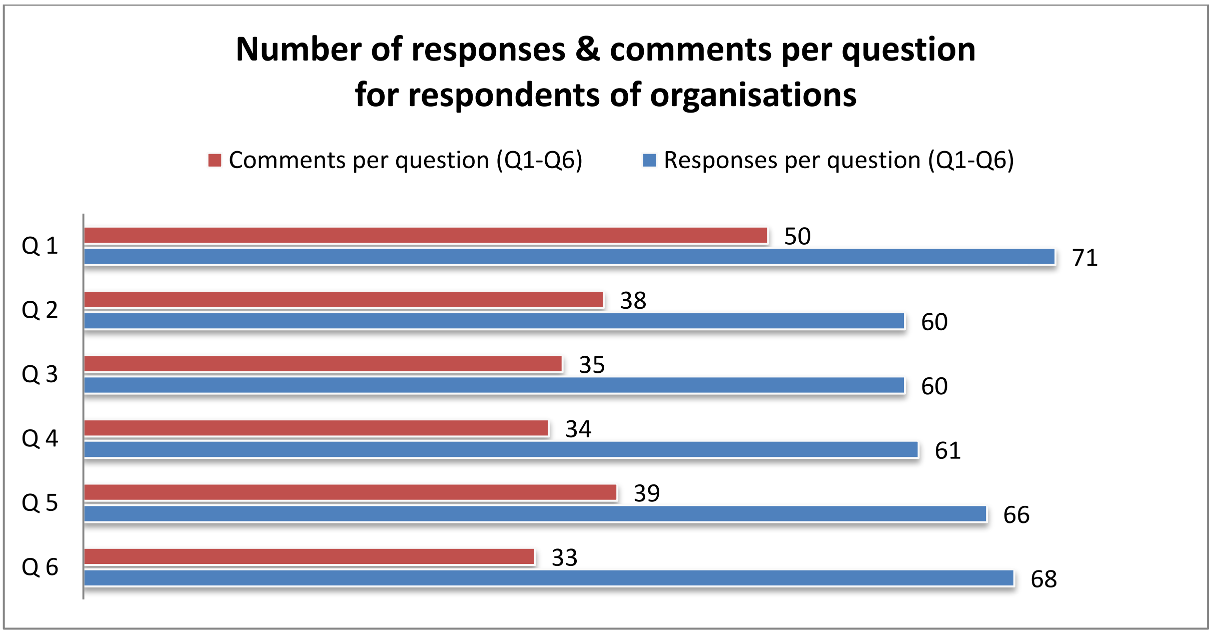


Figure 6: Comparison of the number of responses and comments for question 1 to 6 for organisations

4. Descriptive analysis by questions

Question 1. Ratification

The participants to the survey were asked their opinion concerning the intent of the EU to ratify the MC. As shown by the chart below a majority (57%) supports the intent of the EU to swiftly ratify the MC and voted with "Yes" whereas only a very small number (2%) of participants voted with "No".

Focussing on the categories of respondents the results differ significantly. Whereas 42% of the individuals did not answer this question, it is worth noting that 82% of the participating organisations, including the sectors of mining, chemical and medical industry expressed support for a swift EU ratification of the MC.

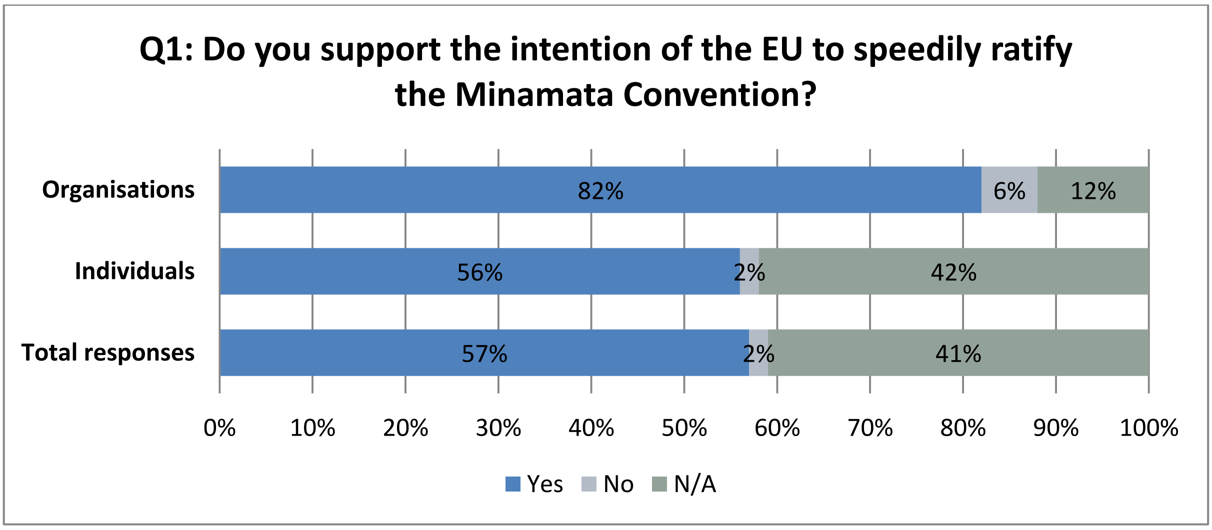


Figure 7: Distribution of the public consultation responses to question 1 by categories of respondents (% of total)

In addition 1100 respondents (1050 individuals, 50 organisations) provided comments in relation to this question. The analysis of the comments provided along with question 1 shows how different they can be when submitted by individuals or by organisations.

Most individuals are seriously concerned about the adverse effects of mercury on the environment and health particularly with regard to dental amalgam.

Frequent statements provided by individuals in the comments section were the following.

- Mercury is toxic and dangerous.
- Mercury is a health threat.
- We ALL have only ONE life and only ONE planet to live on!

Furthermore individual respondents requested EU leadership.

- This leadership is needed by the EU to meaningfully address the global mercury problem. In particular related to supply, demand and use of mercury globally.

Moreover a significant number of comments were received from individuals who were affected personally and feel deeply concerned by the adverse effects of mercury on health and especially of dental amalgam.

- It is time to restrict the use of mercury. I had all of my mercury fillings taken out around 10 years ago, and my health improved dramatically after that. Having mercury fillings is a health hazard.

- I have struggled with chronic health problems for 30 years, and these all disappeared after removal of my amalgam fillings and a heavy metal detox. Mercury is pure poison.

- I was poisoned after having mercury amalgam drilled out. My life has been ruined. I am unable to function in a normal way. I have severe cognitive, neurological and physical problems from mercury.

It has to be pointed out that in the comments to this question individual respondents clearly expressed their support for a ratification of the MC and a strict approach in all mercury related issues and frequently argued very emotionally. Nevertheless it has to be noted that whilst 56% of the individual respondents support the intention of the EU to speedily ratify the Convention, 42% did not even answer this question.

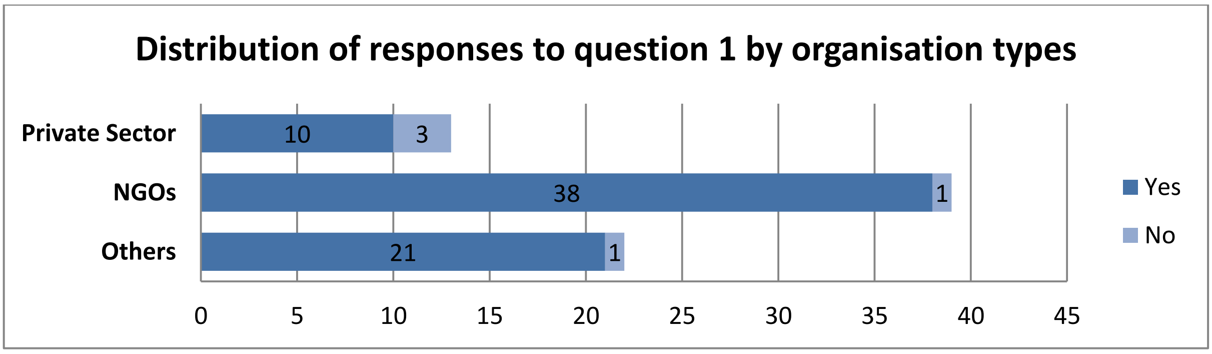


Figure 8: Distribution of the public consultation responses to question 1 by organisation types (number of responses for private sector, NGOs and all other organisations, total 84, N/A 10)

Regarding the distribution of responses by organisation types (see chart above), it is worth noting that the overwhelming majority of all organisation types / sectors strongly supports a swift ratification by the EU. An extract of general and EU focused comments submitted by organisations is listed below.

- The problems related to mercury are not going to vanish on their own. We have again the chance to lead with excellence.

- Rapid ratification and implementation of the MC is essential to enable coordinated action worldwide to reduce mercury emissions and protect human health and the environment.

- The convention is in line with the position of the World Dental Federation (FDI) to phase down the use of dental amalgam.

Furthermore specific comments from the industrial sector were received.

- Mercury is a valuable commodity which would be better recovered from existing products and processes rather than mined and recovered from Cinnabar.

- Environmentally sound management of mercury and mercury containing waste is one of the main concerns of the hazardous waste sector.

It is worth mentioning that organisations participating in this survey represented a very wide range of interest groups from the green, medical to the chemicals and mining sector. Nevertheless all these representatives mostly agreed in addressing all mercury related issues by a stricter approach than foreseen in the MC and especially for Question 1 the consensus is very high.

Question 2. Import restrictions

Under the EU acquis no import restrictions for metallic mercury exist. The MC establishes procedures for imports from non-Parties. In transposing and implementing the Convention, the EU can either restrict imports only from non-Parties as foreseen in the Convention or adopt a stricter approach consisting in a ban on imports from all non-EU countries.

As shown by the chart below, most respondents to Question 2 are in favour of such stricter approach. However, 26% of the organisations prefer to restrict import only from non-Parties but supported their decision with substantial arguments in the comments section.

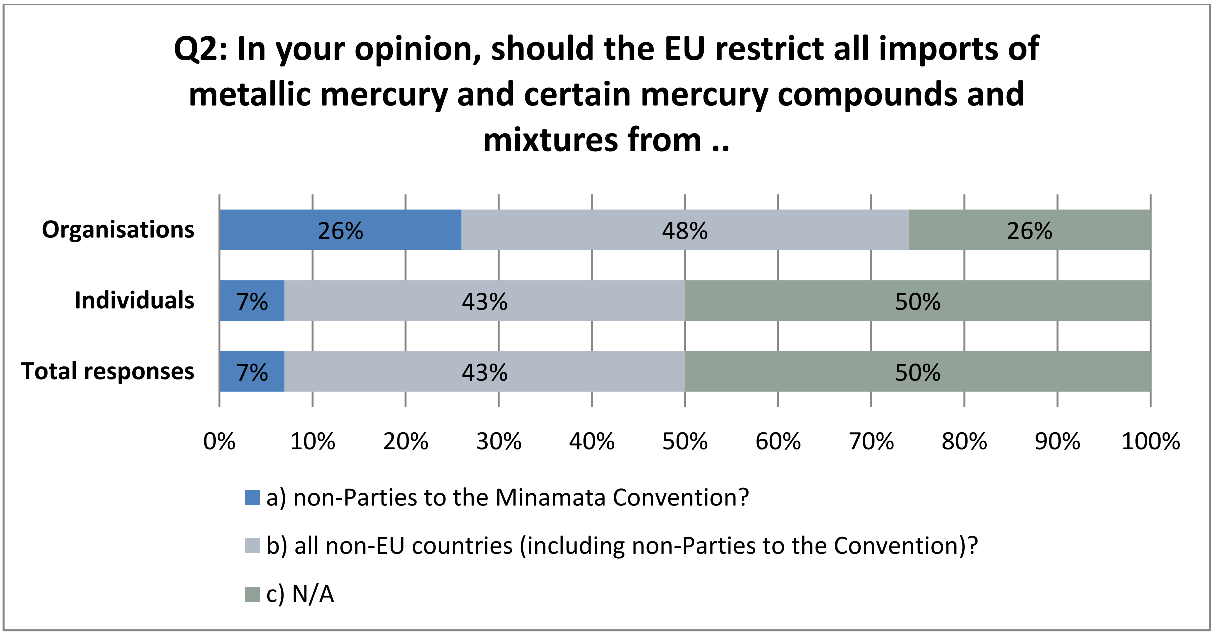


Figure 9: Distribution of the public consultation responses to question 2 by categories of respondents (% of total)

A total of 759 comments were received for Question 2, including 721 from individuals and 38 from organisations.

The predominating arguments and perceptions of individual respondents are reflected in the comments below.

- Zero tolerance.

- To force the world economy to search for healthy and thorough tested alternatives regarding mercury.

- If there's no market for mercury in the EU, this will discourage its production in non-EU states.

There is no doubt that individual respondents are in favour of a strict approach concerning import restrictions. They argue that mercury is a poison, a threat for health and environment and want the EU to be a mercury-free market.

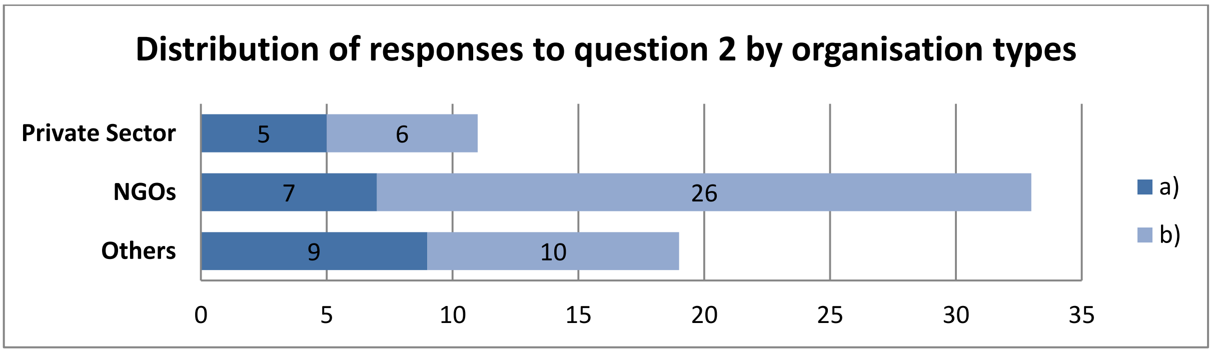


Figure 10: Distribution of the public consultation responses to question 2 by organisation types (number of responses for private sector, NGOs and all other organisations, total 84, N/A 21)

Focussing on the responses provided by organisations (see chart above) it can be seen that NGOs are clearly in favour of a stricter approach concerning import restrictions meanwhile the private sector and other organisations have a split view on this issue. Two central arguments given by organisations are the following.

- There will remain a demand for mercury for the next decades. It is very important to ensure that the demands are regulated at the international level.

- EU is the largest user of dental mercury in the world, consuming 90 tons in 2010. This is an international embarrassment. Phasing out amalgam is the only way to stop mercury pollution.

The range of views regarding import restrictions is reflected in the comments area. Though a significant part of the organisations opted for import restrictions from non-Parties to the MC they mostly would not reject a stricter approach but worry about the effects an import restriction from all non-EU countries could have on the global mercury market.

Question 3. Product exports

Mercury is still used in many products all over the World. The MC foresees an export ban of the products containing mercury listed in Annex A of the Convention. Under the EU acquis, these products are regulated under several regimes, which forbid their placing on the EU market. Nevertheless no export restrictions exist.

An EU export ban could apply to all products already prohibited on the EU market or only to those banned for export under the MC. One notes, that the current restrictions under EU law are often tighter than they would be under the Convention. In Question 3 the participants were asked their point of view on an EU export ban of mercury-added products.

As in previous questions, the majority of respondents opted for the stricter approach and implementation as can be seen in the chart below. The percentage of supporters of a stricter approach is even higher (51%) in organisations than in individuals. Reasons for this were given by the organisations in the comments section and are listed further down.

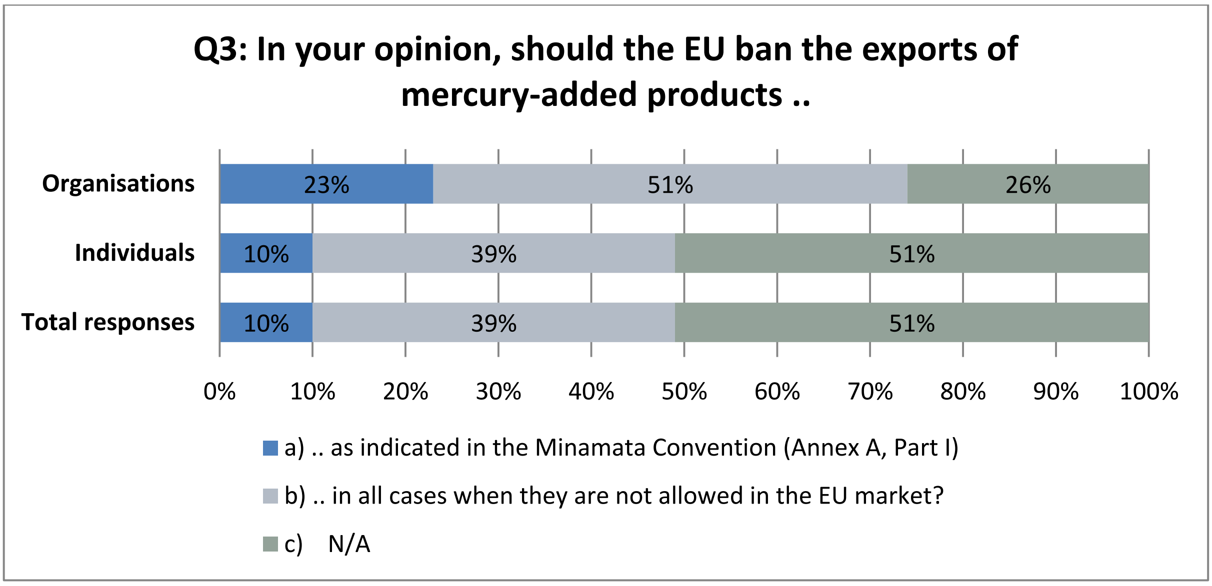


Figure 11: Distribution of the public consultation responses to question 3 by categories of respondents (% of total)

Additionally a total of 635 comments were given, 600 from individuals and 35 from organisations. The following main points of view concerning product exports were provided by individuals:

- Stricter rules already applied in the EU should remain valid. If the MC is less strict the Minamata Rules are not acceptable.
- Products which the EU does not allow in their own market should not be produced and exported to cause potential harm anyone in other countries!

Moreover some individuals mentioned that they would like to see the EU as a global leader.

- Europe should lead by example, as consumers demand more technical advanced and environmentally products this would place Europe as global leaders.

It has to be pointed out that although individuals contributed with 635 comments, 51% of them did not even answer this question.

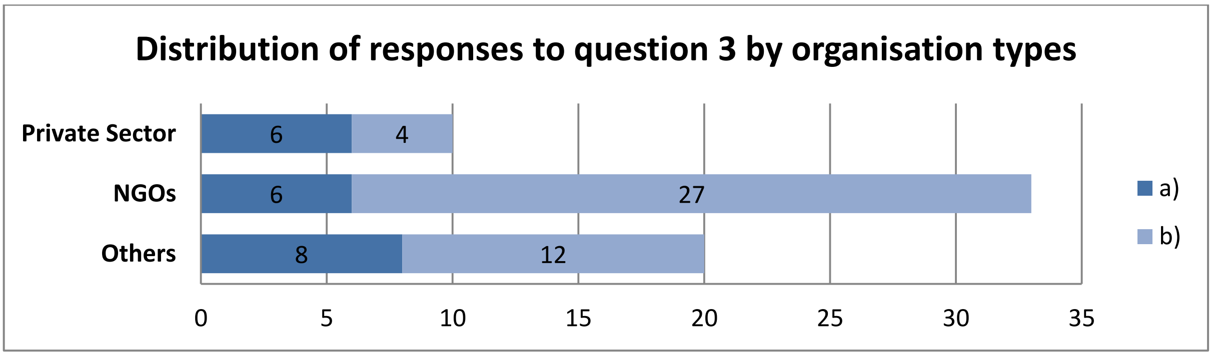


Figure 12: Distribution of the public consultation responses to question 3 by organisation types (number of responses for private sector, NGOs and all other organisations, total 84, N/A 21)

Regarding the distribution of responses by organisation type (see chart above) it can be stated that the results differ significantly. The majority of NGOs supports a strict approach, other organisations have a split view concerning exports of mercury-added products and the private sector favours an implementation as foreseen in the MC. Some aspects put forward by organisations are represented in the following comments.

- Given the fact that no export restrictions for mercury-added products currently exist, we are of the opinion that the EU should ban the export in all cases when they are not allowed in the EU market.
- When elaborating the scope of the EU ban, a very careful examination, deeper assessment of the potential/practical effects is proposed to be carried out.

Nevertheless, the majority of organisations agree with a stricter approach regarding product exports but lots of them, especially those from the private sector are very concerned about the future legal situation and possibly contradictory regulations.

Question 4. Mercury use in new products/processes

Question 4 focusses on the use of mercury in new products and processes. The MC obliges parties to take initiatives discouraging mercury use in new products and processes with some defined exemptions. The current EU law does not include such an obligation as foreseen under the Convention.

Implementing the MC would oblige economic actors to notify any use of mercury in new products and processes and be submitted to an assessment procedure. An alternative and stricter approach would be a complete ban of mercury use in new products and processes.

Regarding the results of the survey concerning question 4 (see chart below), again the majority of respondents opted for the stricter alternative, i.e. a complete ban of mercury use in new products and processes not yet placed in the market. And again the ratio of acceptance for the stricter implementation alternative of the MC is higher in the category of organisations (54%) than in individuals (47%). The corresponding arguments can be found in the extract of comments below.

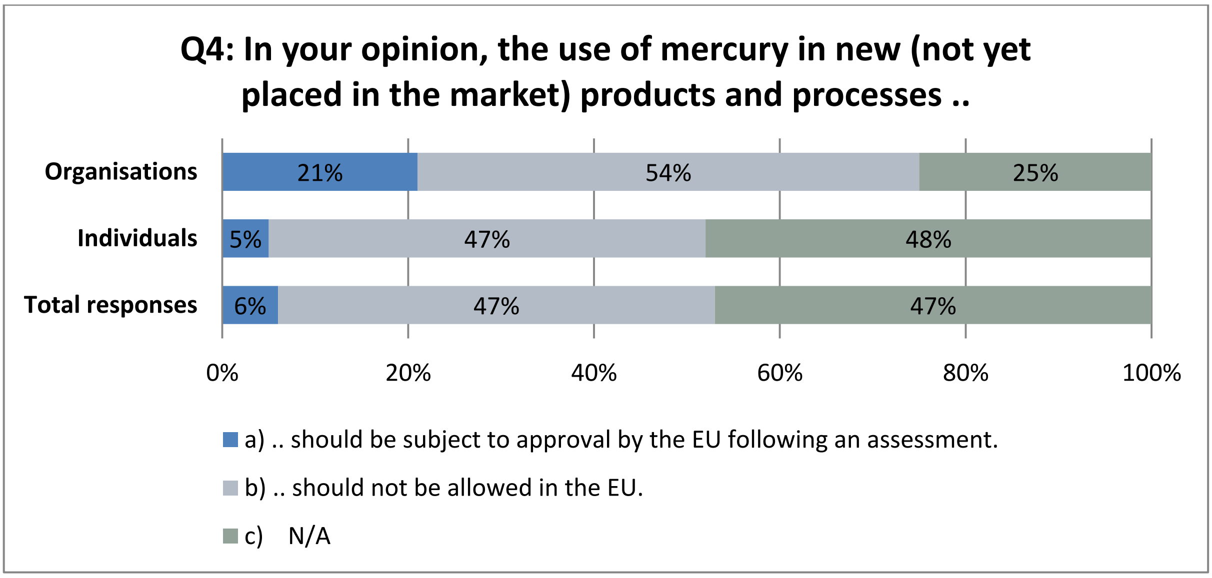


Figure 13: Distribution of the public consultation responses to question 4 by categories of respondents (% of total)

Plenty of comments were added by the respondents to this question, 711 by individuals and 34 by organisations. The main points of view of individual respondents are reflected in the following comments.

- We don't want toxic products anymore.
- New use should not be permitted - it only prolongs the problem
- Only products that have absolutely no alternative should be allowed, and only if they meet stringent safety criteria, and recyclability. If not, ban them outright.

Though individual respondents clearly support a strict approach concerning the use of mercury in new products and/or processes and only 5% are in favour of an approval by the EU following an assessment, it has to be taken into account that 48% of all participating individuals did not answer this question.

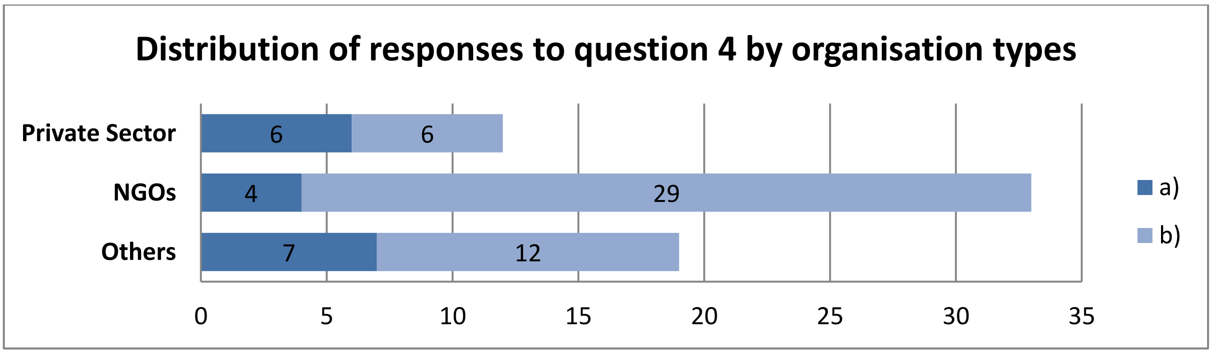


Figure 14: Distribution of the public consultation responses to question 4 by organisation types (number of responses for private sector, NGOs and all other organisations, total 84, N/A 20)

With regard to the responses provided by organisations (see chart above) they differ according to the sectors / organisation types as seen in the previous questions. NGOs strongly support a stricter approach meanwhile the private sector and other organisations have a split view. The following extract of comments presents the range of opinions provided by organisations to this question.

- Mercury use in new products and processes should be completely banned in order to achieve phase out soon and to implement the highest protection level.
- By preventing the use of mercury in new products, processes and facilities the EU will help prevent any increase in the market for mercury and will help drive a transition to mercury-free technologies.
- There may be applications with no feasible alternative to Hg/Hg compounds and where desired performance/properties are inherent to the physical/chemical properties of the material (see final section).
- Authorization procedures often impede real efforts from the industrial to look for substitution. Better to have both authorization procedures and compulsory obligation to substitute with a deadline.

Though a significant number of organisations (21%) opted for a less strict approach and 25% did not answer the question, it has to be noted that the majority of organisations (54%) believe that the use of mercury in new products and/or processes should not be allowed in the EU.

Question 5. Restrictions on certain processes using mercury

The MC foresees phase-out dates for mercury use in chlor-alkali and acetaldehyde production as well as a number of measures to be taken by the parties concerning the processes of vinyl chloride, sodium methylate and polyurethane production.

Industrial emissions are currently regulated under the IED. The obligations under the Convention are covered to a great extent by the present EU legislation and include measures such as reducing mercury use and emissions to the environment as well as a ban on the mercury use from primary mining.

Implementing the corresponding article of the MC the EU could opt for the restrictions as foreseen in the Convention or pursue a stricter approach by banning mercury use in these processes. The chart below reveals that the majority of all respondents to this question, individuals and organisations, would appreciate a stricter approach of implementation concerning the use of mercury in facilities located in the EU for certain industrial processes. Nevertheless, 7% of the individuals but 27% of the organisations favour a less strict approach as foreseen in the Convention and pros and cons were given in the comments row.

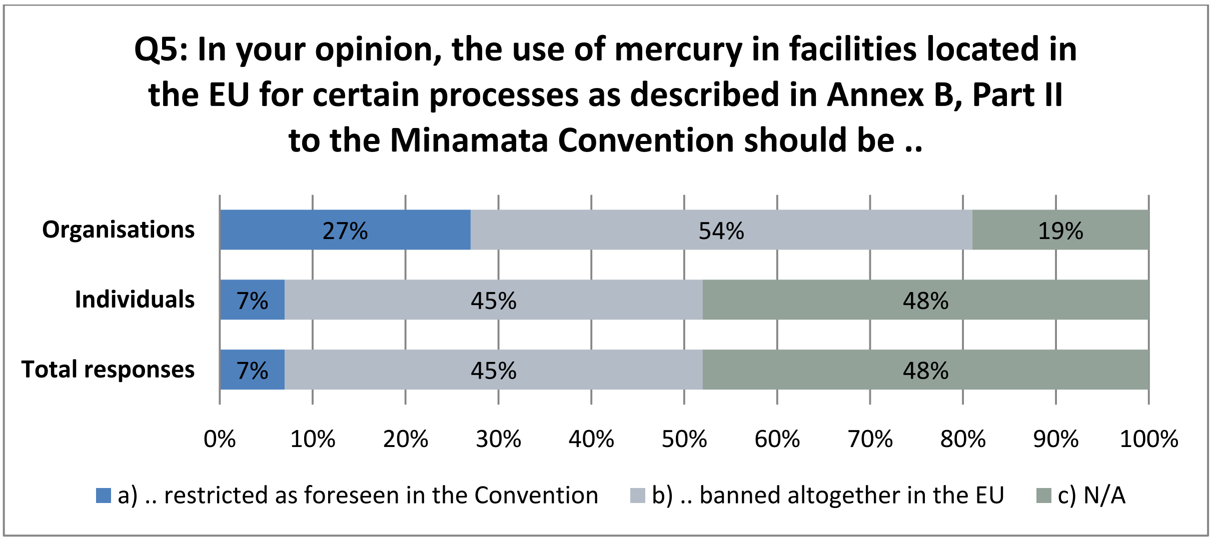


Figure 15: Distribution of the public consultation responses to question 5 by categories of respondents (% of total)

A total of 633 additional comments were received for this question, 594 from individuals and 39 from organisations. Individual respondents mainly expressed the following arguments in their comments and again demanded EU leadership.

- Complete ban. Require full pressure on industries to make the effort to promptly implement new techniques.
- Wherever alternative production processes are available, mercury should be banned.
- As a highly developed group of countries, the EU must provide leadership for the rest of the world including developing countries in demonstrating that mercury can be eliminated from use.

Individual respondents clearly support by their comments a strict approach regarding the use of mercury in facilities located in the EU. Nevertheless, it has to be noted that 48% of the participating individuals did not answer this question.

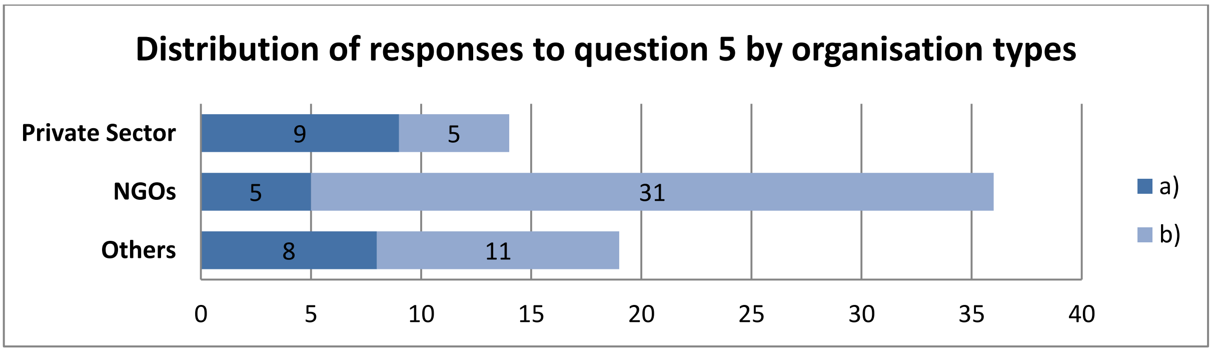


Figure 16: Distribution of the public consultation responses to question 5 by organisation types (number of responses for private sector, NGOs and all other organisations, total 84, N/A 15)

Focussing on the responses by organisation types / sector (see chart above) it can be recognized that the private sector rejects a strict approach and favours a restriction as foreseen in the MC meanwhile

NGOs clearly support the stricter approach and other organisations have a similar share in pros and cons. The following comments express some points of view provided by organisations.

- The use of mercury for processes in Annex B, Part I and II should be banned as alternatives exist. Such a ban will facilitate the promotion and transfer of mercury-free technologies globally.
- The EU law is very strict and there is a possibility to affect the productivity of certain industrial plants

Despite the significant differences between the private sector, NGOs and other organisations concerning this question it has to be stated that still the majority of organisations is in favour of a stricter approach regarding the use of mercury in facilities located in the EU.

Question 6. Dental amalgam

There is an ongoing debate in the EU concerning dental amalgam as it is one of the main remaining uses of mercury in products. Dental amalgam features among the products targeted by the MC and the parties are supposed to take measures in order to phase down the use of mercury as for example setting national objectives for minimising the use of mercury, promoting the use of mercury-free alternatives, insurance policies that favour the use of these alternatives and training of dental professionals.

The participants of the survey were asked to give their opinion concerning the dental amalgam and if they would be in favour of a phase down in line with the MC or prefer a phase out maybe with certain justified exemptions. As can be seen in the chart below an overwhelming majority (86%) of the individual respondents want dental amalgam to be phased out. Among organisations, 61% agree with this stricter approach and 23% prefer a phase down according to the MC.

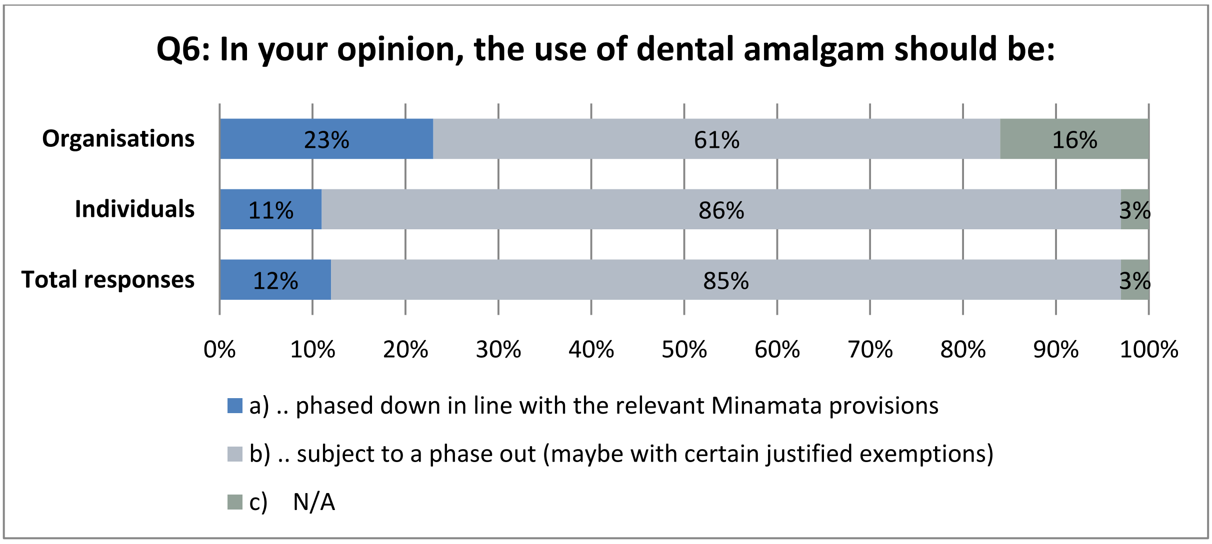


Figure 17: Distribution of the public consultation responses to question 6 by categories of respondents (% of total)

Furthermore the participants of this survey were asked to give comments concerning the dental amalgam issue and a very large number (2.150) of respondents to this question expressed their concerns and provided explanation. Especially the individual respondents were highly motivated to express their views regarding dental amalgam and submitted 2.117 comments, the highest participation ratio concerning comments in this survey. An extract of the variety of opinions and perspectives given by individuals is reflected in the following comments.

- I do not want amalgam in my teeth or my children's teeth. Amalgam is a toxic, polluting mercury product with no place in modern dentistry. Alternatives are available, affordable and effective.

- The health risks and costs and the environmental costs are already too high. We don't have time for a phase down. A phase out is long overdue.

- As a dentist, I do not need amalgam. Mercury-free filling materials are superior because they make teeth stronger and preserve more tooth structure – which saves patients money in the long-run.

- Dental amalgam is toxic to dentists and to patients. Alternative materials are available.

It has to be pointed out that in this public consultation an overwhelming majority (86%) of individuals supported the phase out of the use of dental amalgam, 11% were in favour of a phase down in line with the MC and only 3% did not answer the question.

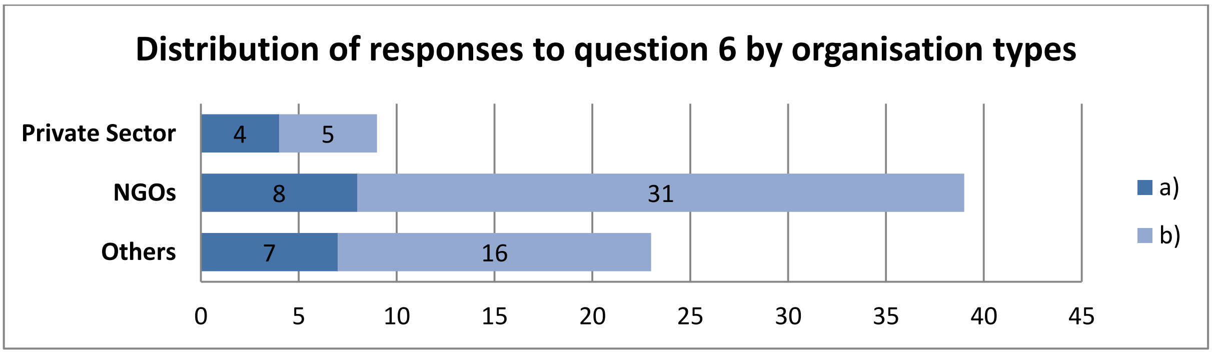


Figure 19: Distribution of the public consultation responses to question 6 by organisation types (number of responses for private sector, NGOs and all other organisations, total 84, N/A 13)

Regarding the results of the chart above showing the distribution of responses by organisation types it can be noted that all sectors private, NGOs and others support a stricter approach. The private sector is slightly in favour of a phase out of the use of dental amalgam and NGOs as well as all other organisations show a clear support for this stricter approach. Some arguments provided by organisations in the comments area (in total 33) are listed below.

- Phase-out. Period. No exceptions.

- Mercury-free dental restorations are available, affordable, effective and preferred by most EU citizens. Phase out is the most cost-effective way to prevent dental mercury pollution.

- EU is the largest user of dental mercury in the world, consuming 90 tons in 2010. This is an international embarrassment. Phasing out amalgam is the only way to stop dental mercury pollution.

- As far as there is a difference on costs between mercury fillings and mercury-free fillings, it is not fair to play on insurance policy because it will mainly impact the poorest population

Respondents to question 6 were additionally asked to provide their opinion regarding the proposed measures for a phase down of dental amalgam as mentioned in the MC and to give a ranking from 1 to 5 in terms of priority for each of the nine options.

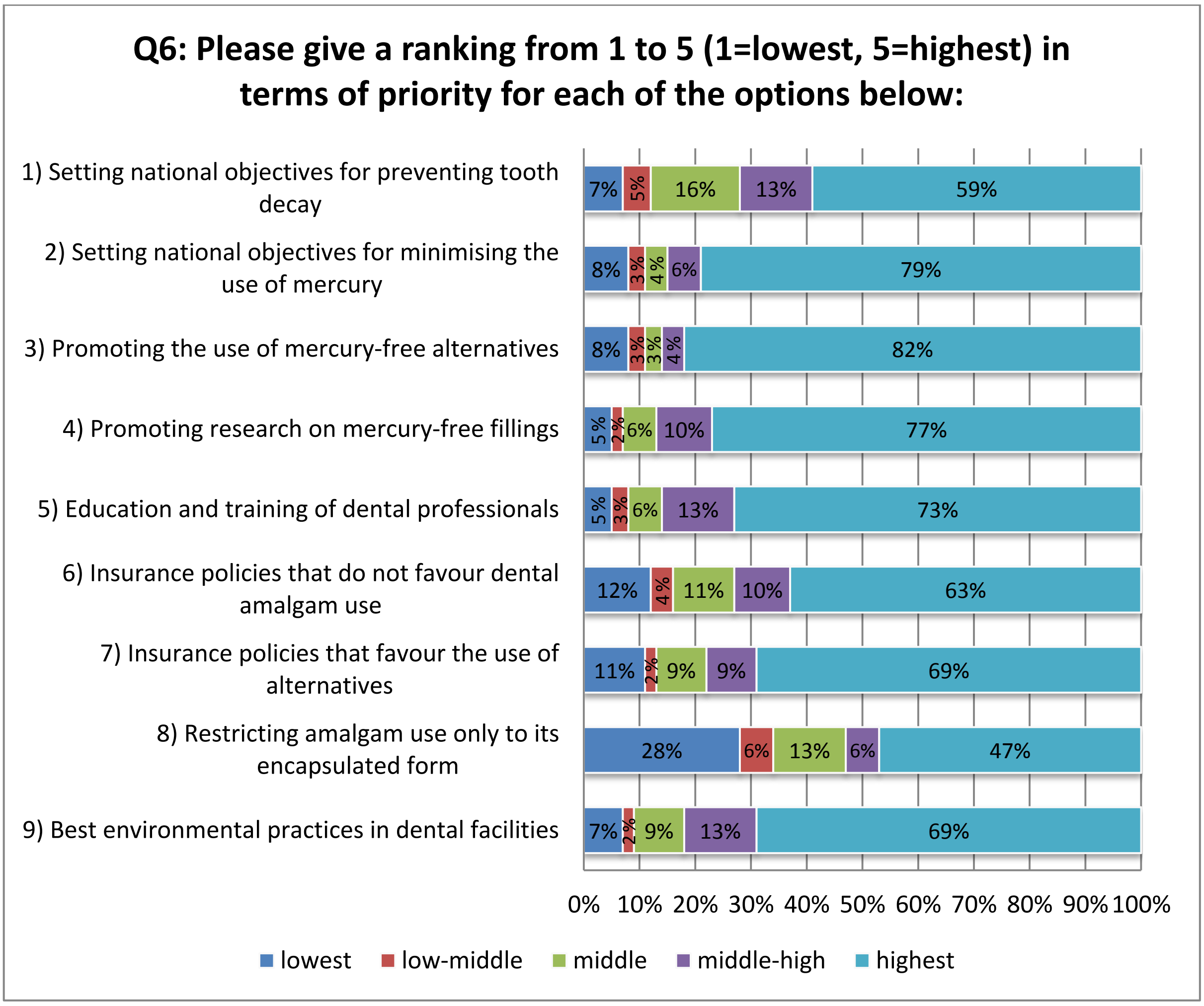


Figure 18: Distribution of the public consultation responses to the options 1 to 9 referring to question 6 (1=lowest, 5=highest; % of total responses per question, total number respondents 394)

Figure 18 shows the results of this more detailed request concerning the implementation of the Convention with regard to dental amalgam. All nine options received high scores (47% to 82%) in the highest priority level. The option with the highest acceptance was number 3 "promoting the use of mercury-free alternatives", while option number 8 "restricting amalgam use only to its encapsulated form" received the lowest consent.

5. Additional comments, provided by the respondents

Question 7. Feedback on current legal framework

The Commission is committed to make EU legislation simpler and to reduce regulatory costs. An evaluation and review of the Mercury Strategy already took place and a complementary assessment of the Mercury Export Ban Regulation is currently carried out. As the forthcoming "Minamata ratification package" will substantially amend the Mercury Export Ban Regulation and the Commission would like to take the opportunity to introduce improvements, the participants of this public consultation were asked in question 7 to contribute with their suggestions. The distribution of responses can be seen in the chart below and an extract of the provided comments further below.

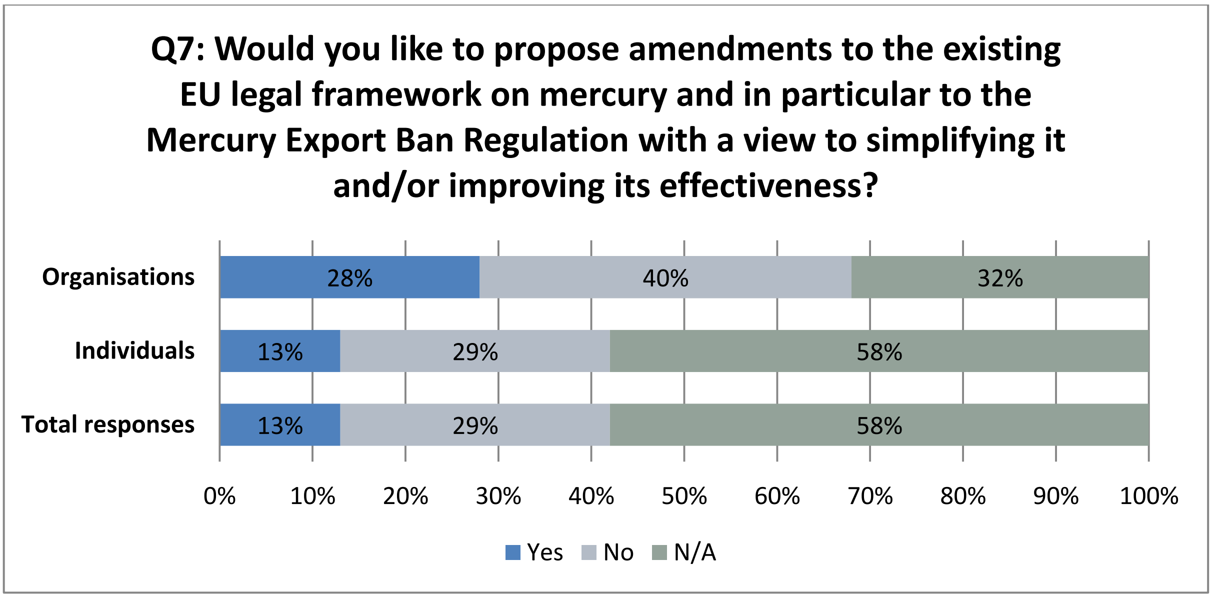


Figure 20: Distribution of the public consultation responses to question 7 by categories of respondents (% of total)

A total of 224 comments were received to this question, 201 by individuals and 23 by organisations. Some selected contributions by individual respondents are listed below.

- It is important in light of the findings and recommendations of the Minamata package to review and make the necessary changes to the legal framework to simplify and improve it so that objectives are met without unnecessary legal issues.

- The simpler a regulation the better understood by all, and easier to apply. It is better to produce a list of all products that use mercury now and that should look for alternative substitutes.

- MC related issues should come under one legal instrument. A legislative package should include the following in line with the convention:

  1. Immediate ban on new mercury mining
  2. Export ban all mercury compounds, and mixtures
  3. Ban on mercury trade except for ESM (Environmentally Sound Management) of mercury waste
  4. Mercury recycling for existing uses
  5. Banning mercury use in Artisanal Small Scale Gold Mining
  6. ESM (Environmentally Sound Management) and storage for mercury waste
  7. Emissions standards for coal fired power stations
  8. Request separate collection for non-electronic products/waste e.g. thermometers
  9. Contaminated sites to be addressed

- Make sure "opt out's" are very tight and very heavily policed.

- The thrust of the EU legal framework should be removal of mercury discharges to the environment and a progressive decline in background levels e.g. in tuna fish and other marine organisms. Amendments should have this as their ultimate goal rather than appeasement of different political positions. The environment does not respond positively to political and or bottom line driven directives.

The following extracts of comments received by organisations provide a brief overview regarding the proposed amendments to the existing EU legal framework on mercury.

All issues relevant to the MC could come under one legal instrument. References to emissions and releases could also be included in this instrument to avoid delays from need for revision of separate laws. Beyond the issues raised above, a legislative package should include the following:

1. Explicitly ban existing and new mercury mining.
2. Extend export ban to other mercury compounds, mixtures with a lower mercury content.
3. Set up a trade tracking system to record information from exports and imports of elemental and compound mercury between MS and between EU and external countries and also within the industry sector.
4. Ensure mercury used in porosimetry - pycnometry is recycled and eventually phased out.
5. Banning mercury use in Artisanal Small Scale Gold Mining.
6. Conditions for environmentally safe disposal of metallic mercury should be adopted with preference for solidified/stabilized mercury disposal in underground facilities.
7. Ensure products containing mercury are collected separately (thermostats, thermometers, etc.) with better labelling of products to facilitate separate collection.
8. Request separate collection for non-electronic products/waste e.g. thermometers.
9. Contaminated sites (former mining sites and others) should be classified according to contamination and urgency of remediation to be restored to a reasonable condition. 10. The revised National Emissions Ceiling directive should also include mercury. 11. The Medium Combustion Plants (MCP) directive should also include specific mercury requirements ...

- We propose amendments to the Mercury Export ban on the following issues: 1. permanent storage of metallic mercury, 2. extension of the export ban and 3. enforcement of traceability

1. *Metallic mercury considered as waste regarding art 2 of regulation 1102/2008 should not be allowed to be stored permanently. This mercury can't be re-used for allowed uses. Nevertheless, by keeping the mercury in metallic form, illegal traffic is eased. Consequently, by imposing transformation (solidification/stabilisation) of metallic mercury into more stable and less dangerous components, any illegal use is also more difficult or even impossible.*
   That is why we propose the deletion of all references to "permanent storage" in the regulation (see art 3.1.a, art 4.3, art 5.1, art 6.1.c and art 6.2.b).
2. *We consider that extension of the export ban to other mercury containing waste will not be efficient but that appropriate and stringent regulation concerning needs and uses (regulated market, for instance) and also reinforcement of traceability requirements will have a much higher efficiency.*
3. *Traceability is one of the key issues in order to ensure environmentally sound management of mercury. For that purpose, we suggest to add 2 items in article 6. The first item will refer to the extension of the traceability requirement to the installations receiving mercury as waste and the second item will define an EU record/registration system which will allow tracing mercury from the producer to the final destination.*

Question 8. Other issues

By implementing the MC the EU will have to amend its legislation and so the questions of this survey were focused on the needed amendments. Nevertheless in question 8 "other issues" the participants of this survey were asked to contribute with any other suggestion concerning the MC they would like to be considered by the EU in future. A total of 159 comments were received, 128 from individual respondents and 31 from organisations. The results to this question can be seen in the chart below and balanced extracts of the corresponding comments are presented further down.

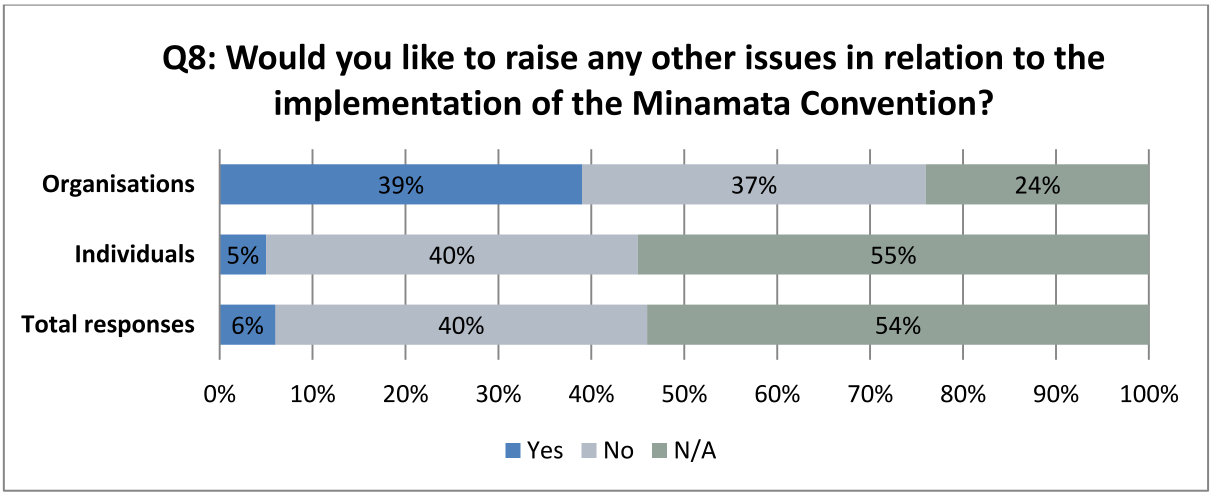


Figure 21: Distribution of the public consultation responses to question 8 by categories of respondents (% of total)

The following contributions concerning "other issues in relation to the implementation of the MC were provided by individual respondents.

- Please enforce a ban on ALL mercury use, and make sure there can be NO opt outs by any member country
- Do not forget medicines, which contain mercury as excipient named "Thiomersal", or "Thimerosal".
- Remove mercury from all vaccinations
- Sickness because of mercury should be acknowledged by health and other insurances. Universities should educate doctors about mercury diseases. Information about the danger of amalgam and mercury in certain products should be broadcasted more widely to everybody.
- Mercury should be banned in mascara (used close to the brain); even extremely small doses of mercury should be declared at the ingredient/composition list of any product containing mercury.
- What about crematoria - what is the current situation with this - especially for residents living close to such establishments - is this covered - are the risks available to be quantified. (Mercury in amalgams would presumably be vaporised during actual cremation.)

Furthermore organisations contributed with lots of suggestions and substantial input regarding "other issues". A selection of these contributions is listed below.

- We would like to raise 5 other issues we consider essential for the success of the implementation of the Minamata Convention at the EU level:

  1. Action plans

The EU set of legislations should promote drawing up action plans at Member State level as proposed in the Minamata Convention particularly for the control of emissions of mercury and the development of strategy for the identification of contaminated sites.

2. Emissions to air

The EU should strengthen the control of mercury air emission, particularly for relevant sources using BREFs and NEC Directive as tools to decrease the emissions of the main industrial contributors.

3. Threshold of mercury in waste

EU should launch studies in order to define threshold above which it is necessary to consider that a waste is a mercury containing waste and needs to be treated under the specific requirements of the Minamata Convention (as for POPs (Persistant Organic Pollutants)).

4. In relationship with the above remark, it is very important to ensure that mercury containing waste are permanently stored in specific dedicated areas either in aboveground storage or in underground storage. To avoid any risk of contamination, the total separation of the storage of mercury containing waste from other type of (hazardous) waste is essential.

5. EU should ensure that the mercury used (for remaining allowed uses) only comes from recycling facilities with the most stringent traceability procedures ensuring that there is no possibility of illegal traffic.

-

  1. *Restrict further the mercury use in light sources for certain categories.*
  2. *All Best Available Technique (BAT) Reference Documents (BREFs) for relevant industries should include measures to prevent mercury emissions and specific BAT Associated Emissions Limits (AELs) for mercury.*
  3. *Member States, European Parliament and the EC should ensure that consumers receive information about the presence of toxic mercury, and in particular concerning labelling of the mercury content of …*

- In general, we note that there are some important and life-saving technologies which continue to require the use of mercury such as use in reference standards, voltage reference sensors and sensor electrodes. The EU regulatory framework provides for exemptions under e.g. 'RoHS' Directive 2011/65/EU and such <u>exemptions</u> should be maintained. Use of mercury for the purpose of research and development should continue to be permitted. Manufacturing of permitted uses of mercury should likewise continue to be supported in the EU. …

- The current provision of Regulation (EC) No 1102/2008 of the European Parliament and of the Council of 22 October 2008 (Mercury ban) <u>excluding medicinal products</u> from the <u>export</u> prohibition (Art. 1.2) shall be kept also in future.

  Reason: Medicinal products containing mercury or mercury compounds in diluted form present a proven and essential part of the treasure of homeopathic and anthroposophic medicinal products. Due to the high dilution these products are safe which is evaluated during the official authorisation process by official authorities.
  The core of worldwide homeopathic and anthroposophic pharmaceutical industry is EU-based. Therefore, in order to support worldwide availability of these products, exports of these medicines have to be possible also in future.

-

  1. *Regarding dental amalgam: EU policy works best when it sets the challenge and allows Member States to decide how best to meet it.*
  2. *Regarding the Export Ban Regulation: the de-minimis threshold must be maintained to prevent disproportionate application of the ban in line with the Minamata Convention.*
  3. *Regarding ASGM: The EU has no competence to govern artisanal gold mining in the territory of individual Member States (e.g. France) - this aspect must therefore not be included in any EU instrument to ratify the Convention. All Member States must individually ratify the Minamata*

Convention to cover compliance with its provisions related to ASGM and any other matters related to Member State competence …

- To protect human health and ecosystems, the treaty and EU legal framework (where appropriate) should:

- Recognize particularly vulnerable populations such as children, women of child bearing age, indigenous peoples, Arctic communities, island and coastal dwellers, fisherfolk, small-scale gold miners, the poor, workers, and others

- Have a broad scope and address the entire mercury life-cycle

- Aim to control all anthropogenic mercury sources and all human activities that release significant quantities of mercury to the environment

- Establish an adequately funded and predictable financial mechanism with new and additional resources sufficient to enable developing countries and countries with economies in transition to fulfil their treaty obligations without compromising their poverty reduction goals

- Use elimination-based control measures subject to possible limited, time-bound exemptions to phase-out all products and processes that contain or use mercury, and in the interim, establish standards and controls for those products and processes that remain

- Reduce and minimize global commercial demand for mercury

- Reduce global mercury supply by banning primary mercury mining; mandating permanent, secure, monitored storage for existing mercury stockpiles and all mercury that is recovered from chlor-alkali plants

- Establish effective controls on international trade in mercury and mercury-containing products

- Mandate environmentally sound solutions for the management of mercury wastes including measures to prevent mercury from entering municipal, medical and industrial waste streams;

- Expedite the phase-out of mercury use in the health sector

- Prohibit new uses of mercury

- Promote research and development on sustainable, non-toxic, alternatives to products and processes

- Promote the use of renewable, alternative energy sources as a substitute for coal-fire power plants (release Hg)

6. Conclusions

This public consultation on the Ratification by the EU of the MC received responses from all over the world and showed a quite high participation rate. A total of 3 702 responses from individual persons and organisations were received and representatives of very different interest groups participated in the survey and contributed with an impressive number of comments. Thus the obtained results can be considered as representative in terms of numbers of responses, EU-wide contribution as well as concerning the variety of opinions expressed in this survey.

Taking into account the responses to the questions of this public consultation and the received answers and comments it can be concluded that a vast majority of the public, individual respondents as well as organisations, support a strict approach concerning the implementation of the Minamata Convention and all mercury related issues.

Nevertheless representatives of the private sector request to maintain exemptions for specific mercury-added products but at the same time are in favour of an improved monitoring on products containing mercury. Individuals and organisations hold the opinion that the EU legal framework should be in general as simple as possible, avoid overlap of regulations and be time- and cost-effective concerning the controls. Needed legal adjustments and improvements should be integrated in existing regulations as for example the IED and the corresponding BREFs before regulating under new legislation. With regard to the implementation of the Minamata Convention and needed amendments to the EU legal framework a consistent and well-prepared approach is requested especially by the organisations. Additionally it is criticised that the EU legal framework focuses on emissions of mercury and trade control but does not consider critical values for the environment and promotion of its continuous decline.

Participants expressed a strong support that mercury mining has to be stopped though there are different arguments supporting this position. Parts of the private sector argue that at present there is enough mercury in the market to satisfy the EU internal demand for years. It only has to be recycled. Most of the participants would also agree in extending the export and import ban on mercury, but some of them would even like to see a stricter approach and a total import and export ban, though others are concerned about the effects such a ban could have on the global mercury market and the illegal mercury traffic. Regarding the use of mercury in new products and processes not yet placed in the market most of the respondents to this survey consider that this should not be allowed.

Furthermore people agree that due to the high toxicity of mercury and environmental and health risks a strict monitoring of every mercury-added product or process is required, has to be improved and the implementation of a trade tracking system contributing to an enforced traceability of mercury is suggested. Respondents to this survey additionally recommended to the EC to revise the handling of mercury-added waste, to ensure separate collection and to adjust the regulations for permanent storage. Concerning transparency for consumers, some participants of this survey proposed an adequate labelling for all products containing mercury including those with very low concentrations of mercury.

It has to be pointed out that the majority of respondents to this survey had a clear focus on mercury related health issues and especially on the dental amalgam. There has been an extremely high motivation to respond to question 6 concerning the dental amalgam and to contribute additionally with comments. The majority of individual respondents including patients as well as dentists consider that the use of dental amalgam should be phased out on a short-term and that health and insurance politics should promote safe alternatives and acknowledgement of mercury related diseases. Furthermore they believe that adequate education and training for dentist is needed especially concerning the removal of amalgam fillings.

Experts from the health sector indicated that exemptions for the medical sector should continue whereas individuals tend to reject any exemption for mercury-added products. Some manufacturers of mercury based scientific instruments gave arguments to support the still existing exemptions for their products and other participants remarked that the use and handling of mercury-added devices generating light should be revised.

In this public consultation regarding the Ratification by the EU of the Minamata Convention on Mercury a total of 3.621 individuals and 81 organisations representing very different stakeholder groups participated, responded to the questions and expressed their opinion in more than 6.000 comments, which were revised, analysed and grouped according to topics and presented in this conclusions in brief.

As the comments represent a wide range of interests and stakeholder groups and additionally provide specific and expert recommendations and ideas for improvement concerning the implementation of the Minamata Convention by the EU these contributions by the European public are an excellent input basis for the EC regarding the implementation process of the Convention and the needed amendments to EU legal framework.

ANNEX 3 – WHO IS AFFECTED BY THE INITIATIVE AND HOW

Import restrictions on mercury

Art. 3(8) of the MC provides that each Party is not allowed to import mercury from a non-Party to whom it will provide its written consent unless the non-Party has provided certification that the mercury is neither from primary mining nor from excess mercury from the decommissioning of chlor-alkali facilities.

As specified in Section 4.1 of this Report, the preferred option **P1O1** consists in imposing import restrictions from non-Parties under the same conditions as those laid down in above-mentioned Art. 3(8). The implementation of this option would require making use of a prior informed procedure whereby the exporting country will have to provide the importing EU Member State with a relevant certification demonstrating the lawfulness of the export.

The practical implementation of this import restriction would rely upon existing EU rules on imports of chemicals, as laid down in Regulation (EU) No 649/2012, which regulates, *inter alia*, the export of certain mercury compounds. The applicability of Regulation (EU) No 649/2012 would imply that the national authorities designated by each Member State will ensure that imported mercury meets the applicable conditions. As to the relevant enterprises themselves, they would have to check that the imported mercury is accompanied by information certifying that it is neither from primary mining nor from excess mercury from the decommissioning of chlor-alkali facilities.

However, in practice, the probability that such imports take place is highly limited due to the combination of several factors, including the low number of countries that will not in fine be Parties to the MC, the decreasing of mercury use in the EU and the existence of sufficient stocks of mercury within the EU or available in countries that intend to ratify the MC.

The implementation of this import restriction would have to be ensured as from the date where the new EU legal instrument transposing and implementing the MC will become legally-binding upon MS.

The economic impact of implementing option **P1O1** is minimal (0-0,4 EUR of foregone imports but may be compensated by imports from allowed sources and for allowed uses). Equally low, if any, would be the associated social impact (e.g. job losses), given the limited trade concerned. A positive environmental impact is expected thanks to reduced releases from primary mercury mining globally. Low administrative burden is expected in view of the use of existing structures.

Export prohibition of certain mercury-added products

Under Art. 4(1) of the MC, Parties are not allowed to manufacture, import and export the mercury-added products listed in its Annex A (Part I) as from 1st January 2021.

As specified in Section 4.2 of this Report, the preferred option **P2O1** consists in imposing an export prohibition for all mercury-added products not meeting the technical specifications laid down in above-cited Annex A (Part I).

The practical implementation of this export restriction would be handled by the competent authorities of the MS that will have to ensure that mercury-added products not meeting the requirements of the MC are not exported outside the EU. However, the need for such authorities to undertake specific additional implementing measures is extremely limited due to the mere fact that the mercury-added products listed in Annex A (Part I) of the MC that are manufactured in the EU and exported from the EU are already in compliance with the requirements set out in that Annex. In any case, MS will be able to rely upon the control and enforcement mechanisms they have established to implement above-mentioned Regulation (EU) No 649/2012, which already sets an export ban on cosmetic soaps containing mercury. As a matter of fact, in practice the risk of imports into the EU of products not allowed on the EU market is far bigger than the risk of export from the EU of products not complying with the MC standards, which implies that market surveillance will continue prioritising controls on imports.

The implementation of this export restriction will have to be ensured as from 1 January 2021.

Option **P2O1** would have minor economic, environmental or social impacts, as the MC provisions are greatly covered by existing EU legislation on mercury-added products. Administrative burden is also minimal, as MS can rely on existing control and enforcement mechanisms.

Mercury use in new products and processes

Art. 4(6) and 5(7) of the MC provide that Parties shall discourage the manufacture and marketing of mercury-added products not listed in its Annex A (Part I) and the development of any facility/installation using a mercury-based process not listed in its Annex B, unless it is demonstrated that the concerned product or process will result in (significant) environmental or human health benefits.

As specified in Section 4.3 of this Report, the preferred option **P3O2** consists in imposing an *a priori* prohibition of mercury in new products and processes while leaving the possibility for such a product or process to benefit from derogation in case where an assessment demonstrates environmental and/or human health benefits.

The practical implementation of this conditional prohibition would primarily be assured both by the concerned economic operators (e.g. importers/manufacturers of new mercury-added products, operators of new mercury-based manufacturing processes) who would have to decide on the opportunity of developing new products or processes using mercury. If they engaged successfully in such development, they would have to undertake and provide to their competent authorities an assessment of the environmental and health risks. MS would provide the information it will have received to the Commission who would then exchange information with experts of MS and stakeholders with a view to evaluating the information so submitted and to deciding whether the new product or process has significant environmental and/or health benefits. Should this be the case, a notification may be addressed to the Secretariat of the MC and the Commission may prepare a proposal to allow the product or process.

However, in practice, the probability that such products and processes will be developed is considered low, but it cannot be ruled out completely. Overall it is likely the above process may never take place.

The implementation of this import restriction would have to be ensured as from the date where the new EU legal instrument transposing and implementing the MC will become legally-binding upon MS.

There is a limited economic impact associated with **P3O2** (due to authorisation costs and fees) but the probability of developing new uses of mercury in products and processes is minimal. Option **P3O2** has a strong signal value and will result in a virtually full elimination of mercury input to society via novel mercury uses.

Restrictions on certain processes using mercury

In accordance with Art. 5(2) and (3) and Annex B of the MC, Parties shall take measures that ensure, *inter alia*, that no acetaldehyde production in which mercury or mercury compounds are used as catalyst takes place after 2018 (no production in the EU in 2015) and that the production of vinyl chloride monomer (VCM only one installation in the EU (Slovakia) in 2015) and sodium or potassium methylate or ethylate - also known as alcoholates production - (only two installations in the EU (Germany) in 2015) complies with the operational requirements set out in its Annex B (Part II).

As specified in Section 4.4 of this Report, the preferred option **P4O1** consists firstly in prohibiting above-mentioned acetaldehyde and VCM production by 2018. In terms of practical implementation, this would imply that the Slovak installation using mercury in the production of VCM converts its mercury-based production line/unit to a mercury-free production line/unit and that this is verified by the concerned Slovakian authority. In this respect, the implementation of such an obligation should not raise particular difficulties nor should it result in significant costs. Indeed, as this is an installation covered by Directive 2010/75/EU, the control of its operating conditions will take place as part of the routine work performed by licencing and inspection authorities in the light, *inter alia*, of the monitoring data and information that must be provided on a regular basis by operators of installations covered by that Directive.

This preferred option consists secondly in prohibiting the use of mercury from primary mining and in requiring a reduction of mercury emissions per unit production of alcoholates by 50% by 2020 as compared to 2010. In terms of practical implementation, as primary mining is not used for such processes, this would imply only that the two German installations producing alcoholates reduce mercury emissions and releases to a sufficient degree and that this is verified by the concerned German authority. Alike the case of the above-mentioned Slovak installation producing VCM, the control of the correct implementation of those emission restrictions will be performed as part of the routine work carried out by the competent authorities in charge of regulating and monitoring installations falling under the scope of application of Directive 2010/75/EU. Furthermore, the Commission services would encourage Germany and the concerned companies to take further measures leading to the phase out of the mercury-based process in those two installations.

The preferred option **P4O1** was associated with an economic impact of 3-77 million EUR depending on whether an alternative process (technically and economically feasible) for the last of the four alcoholates is identified and implemented. A positive environmental impact is expected due to the expected reductions in mercury emissions and use. Negative social impacts are mainly due to potential job losses (estimated at 0-200).

Artisanal and small-scale gold mining

Under Art. 7 of the MC, Parties that host more than insignificant artisanal and small-scale gold mining and processing (ASGM) shall for that purpose develop and implement a national action plan in accordance with Annex C of the MC so as to reduce and, if feasible, eliminate the use of mercury and mercury compounds in and mercury emissions and releases from such an activity. Such a plan must be submitted to the Secretariat of the MC while reviews of the progress achieved in this field must be included in the implementation reports each Party must submit to the Conference of the Parties of the MC.

As specified in Section 4.5 of this Report, the preferred option **P5O1** consists simply in transposing the relevant requirements set out in the MC. This will only concern France. As France has already taken strict measures regarding ASGM and is committed to ratifying the Convention, France is expected to be in full compliance with the Convention at the time of entry into force of the new EU instrument. Hence, practical implementation would be limited to France communicating to the Commission information on the measures taken, which the Commission will include in its report to the Secretariat of the Convention.

The implementation of these restrictions will have to be ensured as from the date where the new EU legal instrument transposing and implementing the MC will become legally-binding upon MS.

No impacts associated to the implementation of option **P5O1**, as ASGM is hardly encountered within the EU.

Dental amalgam

Art. 4(3) and Annex A (Part II) of the MC provide that Parties shall take at least two measures listed in that Annex to phase down the use of dental amalgam.

As specified in Section 4.6 of this Report, the preferred options **P6O1a** and **P6O1b** consist in requiring the use of dental amalgam only in its encapsulated form and the use of amalgam separators. In terms of practical implementation (1) dentists not yet equipped with amalgamators and amalgam separators will have to acquire such devices. Dentists would have to ensure appropriate maintenance of the separators and deliver the waste amalgam to authorised collectors, (2) suppliers of bulk mercury would stop providing such mercury to dentists and would increase mercury supply to producers of encapsulated dental amalgam. As the use of mercury from several sources is already limited in the EU as a consequence of Regulation (EC) N° 1907/2006, the competent authorities of the MS in charge of surveillance of this market, would also be tasked with the surveillance of the obligations regarding marketing of mercury for the purpose of dentistry.

Implementation of the preferred options **P6O1a** and **P6O1b** entails an additional cost of 10-58 million EUR/y, mainly due to the installation and maintenance of amalgam separators by dental clinics. This will be counterbalanced to some extent by the expected positive economic impact to be enjoyed by the waste management and recycling sector. A positive environmental is expected due to the expected reduction of mercury pollution currently identified especially in urban wastewater treatment plants and associated to dental clinics. A positive social impact is expected mainly due to job creation in the waste treatment sector and the improved health and safety conditions for dental workers.

ANNEX 4A – MERCURY AS A GLOBAL ISSUE

This section aims at presenting a fairly brief overview of the mercury problem. Throughout the text the references will be made to the more detailed sources for the reader seeking a deeper understanding of the issues involved. A recent and comprehensive analysis of the problem can be found in the UNEP Global Mercury Assessment 2013.

Mercury is a natural element, represented chemically by the symbol **Hg**[73]. Pure mercury is rarely found in nature. Mercury is extracted mainly from cinnabar, a sulphide ore containing 86% of mercury that has been used since prehistoric times to produce a bright orange pigment. Extraction of mercury from cinnabar has been described, as early as 4th century BC, by the Greek philosopher Theophrastus in his treatise "On stones". Before the industrial revolution, mercury's main use was in gold extraction, while in the last two centuries it has been used extensively in the chlor-alkali industry, but also in the manufacture of electrical instruments, in agricultural fungicides, in the production of plastics, as well as in pharmaceuticals among others. Annual production of mercury has dropped significantly from 5000-7000 t in the 1990s to around 1900t in recent years (2013 and 2014). China is currently its major producer with around 1200 t in 2012, while Kyrgyzstan is practically the only other country producing mercury from cinnabar ore nowadays with an estimated production of 150t in 2012. China holds 21000t of the world's estimated 94000t of cinnabar reserves. Within the EU, Spain, once a leading producer of mercury from its centuries-old Almaden mine, stopped mercury extraction in 2003.

Due to its unique properties (heavy, shiny metal that is liquid at room temperature), mercury has been used in a variety of applications. It has been used in a number of industrial processes (e.g. chlorine/sodium hydroxide production, plastics industry, etc.) and in a variety of products (e.g. thermometers, dental fillings, energy-saving fluorescent lamps, batteries, etc.). It is also released unintentionally through the burning of fossil fuels (particularly in coal-fired power plants), during cement production, or as a by-product during the production of other metals (such as copper, zinc and lead). Due to its presence in several products, waste (especially medical waste) incineration is another important pathway of mercury to the environment. Perhaps the most widespread use of mercury nowadays is in Artisanal and Small-scale Gold Miming (ASGM), where mercury is used to extract gold from ore by forming an amalgam (a mixture of mercury and gold), which is then heated to evaporate mercury (usually in the open air) and recover gold. Due to its simplicity and low cost, this method of gold extraction is still used widely worldwide, particularly in Asia, sub-Saharan Africa and South-America.

Mercury is a ubiquitous environmental toxin, encountered in three chemical forms (elemental, inorganic and organic), each with its own profile of toxicity. Elemental mercury in the atmosphere can undergo transformation into inorganic mercury forms soluble in water[74], providing an important pathway for deposition through the rain. Elemental mercury released in the atmosphere can thus eventually be deposited in aquatic environments, where it can be converted through bacteria to methylmercury, its most toxic form. Global mercury emissions from human activity have been estimated at 1960t in 2010. This represents about 30% of annual mercury emissions to air. Another 10% comes from natural sources (e.g. volcanoes) and the rest 60% is from re-emissions, which again is largely due to mercury accumulated in the environment due to human activity over several centuries.

Depending on its form[75], mercury can stay in the air up to a year and can be transported throughout the hemisphere before it is deposited; therefore the mercury issue is a global problem and cannot be

[73] From its former name *Hydrargyrum* (stemming from Greek *Hydr*=water and *Argyros*=silver)

[74] e.g. ionic mercury (Hg^{ii})

[75] Ionic mercury is reactive and will therefore be readily deposited, while elemental mercury, which constitutes 95% of the total atmospheric mercury, has the longest residence time of up to one year.

addressed only at the national level. While mercury is mainly transported through the atmosphere, its environmental impact is not directly related to its atmospheric burden as it would be the case for several other major atmospheric pollutants. As mentioned, depending on its oxidation, deposition and conversion to methylmercury, mercury's primary environmental and health impacts may be identified thousands of kilometres away from its original source. Mercury released in the environment due to human activity, particularly over the last couple of centuries, presents a major challenge as a threat to human health and the environment already now and in the future. Over the last fifty years, mercury toxicity[76] has been well documented and high mercury levels in fish worldwide are the most important issue of concern. Methylmercury bioaccumulates in fish and enters the food chain. As larger fish eat smaller ones, methylmercury is concentrated up the food chain, a process known as biomagnification. As a result, predators in aquatic systems can have levels of methylmercury that are 100 000 times higher than methylmercury levels in the waters where they live.

As mercury is globally distributed, due to its long residence time in the atmosphere, fish in remote regions may be impacted by regional and global sources. Fish in and downstream of mercury hotspots (small scale gold mining operations, mercury cell chlor-alkali plants, coal-fired power plants, etc.) can contain high mercury concentrations[77], but fish in other regions (even in the Arctic where there is little or no local mercury pollution) are affected as well. Elevated mercury levels have been measured in many freshwater and marine species throughout the world. Factors that influence mercury levels in the fish include age, size, weight and length of the fish, as well the characteristics of the body of water (e.g. local contamination, pH, etc.). Mercury concentrations in fish generally range from about 0,005 to 1,4milligram of mercury per kilogram of tissue (mg/kg) depending on certain factors (e.g. type of fish, its age, origin, etc.). Smaller, younger or non-predatory fish will tend to have lower mercury levels than large, older, predatory fish. Large predatory fish are often migratory and thus fish from particular waters with high mercury contamination can be found anywhere. In fact, methylmercury concentration in fish can differ greatly even in adjacent water bodies (receiving practically the same deposition) due to ecosystem-specific factors affecting the bioavailability of inorganic mercury to methylating microbes (e.g. sulphide, dissolved organic carbon) or the activity of the microbes themselves (e.g. temperature, organic carbon, redox status).

Ingesting fish or aquatic/marine mammals that have built up high levels of methylmercury passes their toxic burden to those who consume them, including humans. More than 90% of the mercury/methylmercury in fish ingested is readily absorbed into the body through the gastrointestinal tract.

As methylmercury in fish is bound to tissue proteins rather than fatty deposits, there is little one can do to reduce exposure when eating fish (trimming/skinning of the fish does not reduce the mercury content of the fillet portion and no cleaning or cooking methods can reduce the amounts of mercury intake either). Fish remains an important source of protein, vitamins and micronutrients and is an important constituent of a balanced diet. Mercury intake depends obviously not only on the level of mercury and the type of fish, but also on the amount consumed and the frequency of consumption. People on a high-fish diet, pregnant and breast-feeding women and young children are at a higher risk. Mercury is a potent neurotoxin and once in the human body it targets mainly the brain and the nervous system, however the kidneys and the cardiovascular system are also affected. Fetuses and children, with still developing brain and rapidly absorbing nutrients, can be particularly vulnerable. Even at low doses, mercury may hinder development, delaying walking and talking, impairing attention and causing learning disability. High prenatal or infant exposure may cause mental retardation, cerebral palsy, deafness and blindness. The best known incident of acute high exposure to methylmercury took place in Minamata, Japan, in the 1960s due to direct contamination of the

[76] mainly in the form of methylmercury which is orders of magnitude more toxic than the inorganic forms

[77] even beyond the current EU legal limit of 1,00 mg/kg wet weight

Minamata bay by wastewaters from a local chemical factory. The up-to-then unknown ailment was named by the scientists *Minamata disease* and affected more than fifty thousand people in the area, some of them still suffering today from neurological symptoms, including tremors, dizziness, headaches, memory, vision and hearing loss, while most severe cases involve cognitive and motor dysfunction and physical abnormalities.

While acute exposure in Minamata and its devastating impacts drew the world's attention to the mercury problem, less severe mercury exposure is also problematic in the long term. The main source of mercury exposure for most people in developed countries is inhalation of mercury vapour due to the continuous release of elemental mercury from dental amalgam. Exposure to methylmercury mostly occurs via the diet.

Through their International Programme on Chemical Safety (IPCS), UNEP and WHO have classified mercury as one of ten chemicals of major public health concern.

The reference intake levels for methylmercury exposures range from 0,7 to 2 µg methylmercury per kilogram body weight (µg/kg body weight) per week. The EFSA Panel on contaminants in the food chain (CONTAM) has established tolerable weekly intakes (TWIs)[78] for inorganic mercury at 4 µg/kg body weight and for methylmercury at 1.3 µg/kg body weight.

EU legislation setting maximum levels for mercury in fishery products is already in place[79]. Limits are set at 0,50 or 1,00 mg/kg wet weight depending on the type of fish. In view of the actual levels of mercury detected in fish, there is very limited scope to reasonably reduce the limits. Alternative solutions for protecting vulnerable groups (e.g. targeted consumer advice) are necessary.

An information note[80] on methylmercury in fish and fishery products issued by the Commission in 2008 suggests that women who might become pregnant, women who are pregnant or breast-feeding and young children should not eat more than one small portion (<100g) per week of large predatory fish, such as swordfish, shark, marlin or pike. Also they should not eat tuna more than twice a week.

Detailed guidance on identifying populations at risk from mercury exposure has also been issued, in 2008, by UNEP Chemicals in cooperation with WHO[81] and by many national authorities.

While an accurate analysis of potential risks from fish consumption would require detailed information on fish species consumption patterns as well as methylmercury levels in the consumed fish, data on eating habits by the Food Agricultural Organisation (FAO) indicate that people in certain regions (e.g. islands) in Europe may be at particularly high risk of mercury exposure through fish consumption.

In its scientific opinion on the risk for public health related to the presence of mercury and methylmercury in food[82], the EFSA Panel on contaminants in the food chain (CONTAM) concluded that high fish consumers, which might include pregnant women, may exceed the tolerable weekly intake (TWI) by up to approximately six-fold. Unborn children constitute the most vulnerable group. While dietary inorganic mercury exposure in Europe does not exceed the TWI in most cases, parallel inhalation exposure of elemental mercury from dental amalgam is likely to increase the internal inorganic mercury exposure; thus the TWI might be exceeded. However, the contribution of dental amalgam to the total body burden, when compared to methylmercury from food, is limited. In fact, elemental mercury is a major component (ca. 50%) of dental amalgam in the form of an alloy that is

[78] The TWI is the amount of a substance that can be consumed weekly over an entire lifetime without an appreciable risk to health.

[79] Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs

[80] Information Note on Methylmercury in fish and fishery products, CEC/DG SANCO, 21 April 2008

[81] Guidance for Identifying Populations at Risk from Mercury Exposure, UNEP Chemicals/WHO, August 2008

[82] EFSA Journal 2012;10(12):2985 [241 pp.], http://www.efsa.europa.eu/en/efsajournal/doc/2985.pdf

solid at room temperature. Elemental mercury released into the mouth can be oxidised to inorganic mercury which may be transformed by bacteria to methylmercury after it is released into saliva. On the contrary, after oral intake, methylmercury[83] is much more extensively and rapidly absorbed than elemental or ionic mercury and accumulated in hair, the fetus and the brain. While the benefits of fish in human nutrition should be kept in mind, eating mercury-contaminated fish can have significant negative health impacts in the long-run.

Recent research[84] quantified the monetary benefits from control of methylmercury (MeHg) toxicity in the EU at between €8 000 and €9 000 million per year. This estimate results from research findings, on the basis of population biomarker data, that 1,5 to 2,0 million EU children are born each year exceeding exposure limits associated with long term IQ deficits. Unfortunately, due to the complexity of the issue, there are currently no models available to quantify the link between anthropogenic mercury releases with human exposure. However, the long timescales of mercury cycling in the environment suggest that any anthropogenic mercury releases persist and can affect biological exposures for centuries to millennia.

Mercury can enter our environment (and subsequently the food chain) in many different ways. Emissions of mercury can travel through air and water and end up thousands of kilometers away. Unless it is properly disposed of, mercury produced, used or discarded adds up to the global mercury pool, persists in the environment. The origin of atmospheric mercury deposition can differ substantially in different areas in the EU. Emission models predict atmospheric deposition originating from Europe to up to 60% of the total European depositions in certain industrialised areas, while in other areas, such as the Mediterranean, European emissions contribute only 20% or less. It is thus obvious, that the transboundary component of mercury pollution is very significant and can only be addressed by a global action.

Global emissions of mercury to air from human activities in 2010 were estimated at 1 960t[85], relatively stable since 1990. However, while emissions have been declining in Europe (and North America) thanks to legislation enacted, this is not the case in the rest of the world, as economic growth has resulted in increases of mercury emissions (e.g. through the burning of fossil fuels and biomass). On the basis of recent estimates, Europe contributed in 2010 around 5% to the global atmospheric mercury emissions, while Southern and Eastern Asia accounted for about half (50%) of the global mercury emissions to air. Given the ability of elemental mercury to travel long distances from the emission source, it is obvious that EU legislation alone cannot protect adequately the EU population and that a speedy and successful implementation of the MC is of paramount importance. Early ratification by the EU and its MS will contribute to an early entry into force of the Convention, complementing the effectiveness of EU legislation in tackling the mercury problem.

While EU legislation covers satisfactorily most aspects of the mercury issue, it cannot address the global dimension of the mercury problem. In fact, while mercury emissions declined in Europe, this has been counterbalanced by increase in emissions in other countries (particularly Southern and Eastern Asia) and as a result, global mercury emissions have remained stable during the last two decades. The international dimension is thus a key element of efforts to decrease exposure of humans and the environment to mercury.

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[83] e.g. from contaminated fish or seafood

[84] Bellanger M, Pichery C, Aerts D, Berglund M, Castano A, Cejchanova M, Crettaz P, Davidson F, Esteban M, Exley K, et al: Economic benefits of methylmercury exposure control in Europe: Monetary value of neurotoxicity prevention. *Environ Health 2013,* ***12****:3.*

[85] UNEP Global Mercury Assessment 2013

ANNEX 4B – MAJOR MERCURY PATHWAYS

Mercury is released to the environment from many different sources including: mining activities (whether dedicated to mercury or other metals); mercury-containing products (either during their production, use or disposal); industrial processes using mercury intentionally (e.g. in acetaldehyde production where mercury is used as a catalyst or in the chlor-alkali industry, where mercury is used as a cathode) or where mercury is emitted unintentionally (e.g. metal refining, cement kilns, coal combustion, etc.); waste dumps; contaminated sites; incinerators; crematoria and many others. Streets[86] has recently estimated historical mercury emission over all time to 350 000t, assessing that 61% of the emissions occurred after 1850.

It is thus obvious that in addressing the mercury problem, there are various possibilities in intervening at various points of the "mercury cycle".

For the intentional uses of mercury (e.g. in products and processes), measures should seek to reduce or even eliminate mercury use, by encouraging substitution with mercury-free alternatives. Products containing mercury (thermometers, barometers, batteries, electrical switches and many types of electronic equipment) are still widely produced and traded globally, although substitutes and alternatives are currently available for most of them. Mercury-use in products has declined dramatically in the last decade in most developed countries, including Europe. However, this may not be the case in the rest of the world and particularly in developing countries, as substitutes are often more expensive.

The main intentional industrial use of mercury in Europe is in the chlor-alkali industry, which uses an electrolysis cell with mercury serving as the cathode, a process that dates back to the 19th century. While alternative, cost effective mercury-free processes have been developed in the meantime, given the significant investment costs for converting, there are still more than 30 plants in the EU using the mercury process and employing around 7 000t of metallic mercury.

Global elemental mercury consumption in 2005 had been estimated by UNEP[87] at ca. 3800t annually, while the reported figure for EU25 was ca. 490t. In Europe, the chlor-alkali industry is the main consumer with 175t annually, with dental amalgam coming second with 95t/y on average[88].

Measures to restrict production, supply and trade of mercury can help minimise the intentional use of mercury in products and processes. Within the EU, MAYASA (Miñas de Almadén y Arrayanes S.A.) that had reached a production of 2800t in the 1950s stopped production in 2003. The EU and the USA, two major exporters of mercury have banned exports since 2011 and 2013 respectively. As a result, international supply of mercury has been restricted, which is of particular importance in addressing the ASGM problem, an activity not easy to regulate due to its diffuse character.

The main source of unintentional emissions of mercury to air is the burning of coal. Despite the low concentrations of mercury in coal (usually less than 2mg/kg) given the significant quantities of coal used, in particular for energy production, this source contributes around 25% of the global anthropogenic mercury emissions to air[87]. Depending on the plant and the type of coal used, substantial reductions of mercury emissions can be achieved with conventional air pollution control devices (primarily intended for other pollutants), while is some cases mercury-specific technologies may prove necessary.

Cement production is another important source of mercury pollution (around 10% of global mercury emissions to air)[87] due to mercury content in the fuel and the raw materials used. While there are

[86] Streets et al 2011

[87] UNEP (2013), Mercury: Time to Act

[88] COWI, Concorde East/West (2008). Options for reducing mercury use in products and applications and the fate of mercury already circulating in society (Dec 2008)

only traces of mercury in the raw materials, research has shown that in most cases they contribute more to emissions than the fuel.

Mercury is also emitted by almost all metallurgical processes (e.g. during the extraction of copper, zinc or lead), as mercury present both in the coal (fuel source) and in the ore is released during the smelting process.

Other mercury emission sources include chemical industries, contaminated sites, waste incineration facilities and crematoria.

ANNEX 5 – THE MINAMATA CONVENTION ON MERCURY

Due to the long range transport properties of mercury, the exposure of people living in the EU, as well as the exposure of the EU's environment, cannot be reduced to an acceptable level through domestic policies alone. Co-ordinated international action is therefore needed to address the mercury problem in a globally effective manner. The EU Mercury Strategy had this in mind when focusing seven of its actions (actions 14 to 20) on supporting and promoting international activities. The EU repeatedly requested the UNEP Governing Council to take a decision on the opening of negotiations on a global legally binding instrument on mercury. The Governing Council of UNEP decided in February 2009[89] to establish an intergovernmental negotiating committee (INC) with the mandate to prepare a global legally binding instrument on mercury. The INC started its work in 2010 and completed it, as planned, in January 2013.

The Convention's main objective, as stated in Art. 1, is "to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds". The MC includes provisions to cover all major uses and releases of mercury at a global level, in particular:

- to reduce the supply of mercury and enhance the capacity for its environmentally sound storage;
- to reduce the demand for mercury in products and processes;
- to address artisanal and small-scale gold mining;
- to reduce international trade in mercury;
- to reduce atmospheric emissions of mercury;
- to address mercury-containing waste and the remediation of contaminated sites;
- to increase knowledge through awareness-raising and scientific information exchange;
- to specify arrangements for capacity-building and technical and financial assistance;
- to address compliance.

The EU intended to become a Party to the MC along with its MS and signed the Convention in October 2013 in Japan. In view of its subsequent ratification by the EU, the Commission needs to propose an amendment to EU legislation accordingly.

The reader is referred to the Convention text[90] for a thorough understanding of its implications, however its key provisions are presented in this Annex.

<u>Article 3 – Mercury supply sources and trade</u>

- Prohibition of primary mercury mining with a grace period of fifteen years after the date of entry into force of the Convention, for already existing mines, while imposing restrictions on mercury use for this source.
- Excess mercury from the decommissioning of chlor-alkali facilities should be disposed of as waste.
- Exports are only allowed subject to the prior informed consent of the receiver country, while non-Parties would additionally need to guarantee compliance with certain Convention's provisions.
- Imports from non-Parties are only allowed subject to guarantees that the mercury did not originate from primary mercury mining of from the decommissioning of chlor-alkali facilities.

[89] UNEP Governing Council Decision 25/5

[90] Minamata Convention on Mercury

Article 4 – Mercury-added products

- Prohibition of the manufacture, import and export of certain categories of mercury-added products to be implemented by 2020 (possibility for an individual Party to postpone by 5 or exceptionally 10 years).
- Measures to phase down the use of dental amalgam (flexibility to select at least two among a list of nine measure proposed).
- Measures to discourage the manufacture and distribution of in new mercury-added products.

Article 5 – Manufacturing processes in which mercury or mercury compounds are used

- Phase-out of mercury use in chlor-alkali production by 2025 and acetaldehyde production by 2018 (possibility for an individual party to postpone by 5 or exceptionally 10 years).
- Restrictions on the use of mercury in vinyl-chloride monomer production.
- Restrictions on the use of mercury in sodium/potassium methylate/ethylate production aiming at the phase out as fast as possible and within 10 years of the entry into force of the Convention.
- Measures to discourage the development of new facilities using a mercury-based process.

Article 7 – Artisanal and small-scale gold mining

- Measures to reduce and where feasible eliminate the use of mercury in/and the emissions of mercury from artisanal and small-scale gold mining (ASGM).
- Obligation for Parties with more than insignificant ASGM activities on their territory to develop and implement a national action plan with specific measures to minimise the impact of this activity to mercury pollution and human health.

Article 8 – Emissions

- Within five years of entry into force of the treaty, the obligation to apply best available techniques (BAT) and best environmental practices (BEP) to control and, where feasible, reduce emissions, to new point sources in the following categories:
  - ✓ coal-fired power plants;
  - ✓ coal-fired industrial boilers;
  - ✓ smelting and roasting processes used in the production of non-ferrous metals;
  - ✓ waste incineration facilities;
  - ✓ cement clinker production facilities.
- Within ten years of entry into force of the treaty, the obligation to control emissions from existing sources (within the categories indicated above) by employing one or more of the following measures:
  - ✓ a quantified reduction target;
  - ✓ emission limit values;
  - ✓ BAT and BEP;
  - ✓ a multi-pollutant control strategy delivering co-benefits;
  - ✓ or other alternatives.

- Within five years of entry into force of the Convention, the obligation to establish an inventory of emissions from all sources (within the categories indicated above).

Article 9 – Releases

- Obligation to control releases to water and land by employing one or more of the following measures:
  - ✓ release limit values;
  - ✓ BAT and BEP;
  - ✓ a multi-pollutant control strategy delivering co-benefits;
  - ✓ or other alternatives.
- Within five years of entry into force of the Convention, the obligation to establish an inventory of releases from all significant anthropogenic sources.

Article 10 – Environmentally sound interim storage of mercury, other than waste mercury

- Obligation to take measures to ensure the environmentally sound interim storage in accordance with guidelines to be adopted by the Conference of the Parties.

Article 11 – Mercury wastes

- Measures to ensure that mercury waste is managed in an environmentally sound manner, in accordance with requirements to be adopted by the Conference of the Parties and the relevant guidelines developed under the Basel Convention.

ANNEX 6 – CURRENT EU LAW ON MERCURY AND MERCURY COMPOUNDS

Current EU law addresses already the use of mercury (hereinafter "mercury" or "Hg") and mercury compounds (hereinafter "mercury compounds" or "Hg compounds") in a comprehensive manner. In particular, besides Regulation (EC) No 1102/2008[91], several EU instruments contain provisions that regulate the Hg whole life cycle from supply to final disposal as waste. With a view to identifying the regulatory gaps affecting existing EU law *vis-à-vis* the MC (see *Annex 7*), this Annex provides a description of the provisions of the EU *acquis* that are relevant vis-à-vis the scope of application and the issues addressed in this Convention, i.e. mercury supply and trade, the interim storage of mercury and mercury compounds, the use of Hg and Hg compounds in mercury-added products and manufacturing processes and related mercury emissions and releases and the management of mercury waste.

Mercury supply and trade

Whereas the MC prohibits the establishment of new ***primary mining activities*** in the territories of the Parties and calls for existing ones to cease within 15 years after the date of entry into force of the Convention for the Party concerned, Regulation (EC) No 1102/2008 (Art. 2(d)) requires, since 15 March 2011, that metallic mercury extracted from cinnabar ore in the EU be disposed of as waste. Such mining activity in the EU is therefore considered as being deprived of any "*raison d'être*".

Regarding the ***export from the EU and the import into the EU*** of Hg, Hg compounds and of products containing Hg and/or Hg compounds (hereinafter "mercury-added products"), several EU instruments can be referred to. More specifically, whilst the MC sets restrictions on the international trade of mercury and of mixtures of mercury with other substances, the EU *acquis*, including notably Regulations (EC) No 1907/2006[92], 1102/2008 and 649/2012[93], regulates already the export and import of Hg, of certain Hg compounds and of specific mercury-added products.[94]

- Concerning ***exports***, Regulations (EC) No 1102/2008 (Art. 1) and 649/2012 (Art. 15(2) and Annex V (Part 2)) ban the export of cosmetic soaps containing mercury, of mercury and of mixtures of mercury with other substances as well as the export of three Hg compounds (cinnabar ore, mercury chloride and mercury oxide), saved when they are exported for research and development, medical or analysis purposes. As to the exports of other Hg compounds, Regulation (EC) No 649/2012 (Art. 7, 8, 14 and Annex I (Parts 1 and 3)) makes them subject to an export notification procedure or, in case when used in pesticides, to a prior informed consent procedure.
- As to ***imports***, Entries 18, 30 and 62 of Annex XVII to Regulation (EC) No 1907/2006 set, respectively, restrictions on the import: (i) of all Hg compounds when intended for some specified uses e.g. for the preservation of wood, (ii) of Hg as constituents of other substances or in mixtures, when destined for supply to the general public and when a given concentration limit is exceeded and (iii) of phenylmercury acetate, propionate, 2-ethyllexanoate, octanoate and neodecanoate with a mercury concentration equal or exceeding 0,01% by weight (as from 10 October 2017).

  Entry 18a of Annex XVII to Regulation (EC) No 1907/2006 establishes also a restriction on the import, with some exemptions, of certain mercury-containing measuring devices for industrial,

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[91] Regulation (EC) No 1102/2008**, OJ L 304, 14.11.2008, p. 75.**

[92] **Regulation (EC) No 1907/2006,** OJ L 396, 30.12.2006, p. 1.

[93] Regulation (EC) 649/2012, OJ L 201, 27.7.2012, p. 60.

[94] Note that "mercury" is classified under **Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures as a "substance of very high concern" with the following characteristics: Reproductive toxicity (Cat. 1B), Acute toxicity (Acute Tox. 2), Specific target organ toxicity – repeated exposure (STOT RE1), Hazardous to the aquatic environment (Aquatic Acute 1 and Aquatic Chronic 1). Mercury compounds are also classified as hazardous substances under Regulation (EC) No 1272/2008.**

professional and non-professional uses, including *inter alia* fever thermometers, barometers, manometers and hygrometers.

Interim storage of mercury and mercury compounds

The MC requires that the interim storage of individual stocks exceeding 50t of mercury, of mixtures of mercury with other substances and of six mercury compounds (mercury chloride, oxide, nitrate, sulphate, sulphide and cinnabar) is undertaken in an environmentally-sound manner.

Directive 2012/18/EU[95] on the prevention of major accidents involving, for instance, the storage of dangerous substances such as mercury and on the limitation of their consequences sets relevant requirements. In particular, with a view to ensuring a high level of human health and environmental protection, the paramount objective of Directive 2012/18/EU (Art. 1), operators who store over 50t of Hg and/or Hg compounds must draw up a major-accident prevention policy to be implemented notably by a safety management system that must prescribe the adoption and implementation of procedures and instructions for safe operation (Art. 8(5) and Annex III). In case where an operator stores over 200t of Hg and/or Hg compounds, it must also establish a safety report and emergency plans (Art. 10 and 12).

In addition, operators of industrial installations covered by IED[96] who store mercury and/or mercury compounds have to make sure that storage takes place on the basis of appropriate preventive measures taken against pollution (Art. 11(a)) and without causing "significant pollution" (Art. 11(c)). In this regard, Art. 14(1) and (2) requires that permit conditions be set in such a way as to ensure compliance with the requirements set out in Art 11(a) and (c), including in terms of prevention of emissions to soil and groundwater.

Placing on the (EU) market and use of mercury and mercury compounds as substances

The MC provides that ***mercury from primary mining*** can only be used in manufacturing of mercury-added products listed in its Annex A, in accordance with the conditions set out in Art. 4 and in that Annex (e.g. to cease the manufacture, import and export of products listed in Part I of Annex A by 2020, to discourage the distribution in commerce of mercury-added products not covered by any known use prior to the entry into force of the Convention).

Moreover, as stated before, Regulation (EC) No 1102/2008 provides that ***metallic mercury extracted from cinnabar ore*** in the EU must be disposed of as waste.

In addition to imports, Entries 18, 30 and 62 of Annex XVII to Regulation (EC) No 1907/2006 restrict also the placing on the (EU) market and the use of: (i) ***all mercury compounds when intended for*** some specified uses, e.g. use to preserve wood or to prevent the fouling by micro-organisms, plants and animals of the hulls of boat, of the equipment and appliances used for fish and shellfish farming and of any totally or partly submerged appliances or equipment, (ii) ***mercury*** as substances, as constituents of other substances or in mixtures, when intended for supply to the general public and when a given concentration limit is exceeded, and (iii) ***phenylmercury*** acetate, propionate, 2-ethyllexanoate, octanoate and neodecanoate with a mercury concentration equal or exceeding 0,01% by weight (as from 10 October 2017).[97]

Placing on the (EU) market and use of mercury-added products

The MC provides that the manufacture, import and export of mercury-added products listed in its Annex A (Part I), including batteries, switches and relays, compact fluorescent lamps (CFLs), linear

[95] Directive 2012/18/EU, OJ L 197 of 24.7.2012, p. 1.

[96] Directive 2010/75/EU, OJ L 334 of 17.12.2010, p. 17.

[97] Commission Regulation (EU) No 848/2012 prohibits also the manufacture itself of phenylmercury acetate, propionate, 2-ethyllexanoate, octanoate and neodecanoate.

fluorescent lamps (LFLs), high pressure mercury vapour lamps (HPMV), cold cathode fluorescent and external electrode fluorescent lamps (CCFLs and EEFLs), cosmetics, pesticides, biocides, topical antiseptics and certain non-electronic measuring devices, must cease as from 2020. All relevant mercury-added products are already addressed in the EU *acquis*.

Directive 2011/65/EU (Art. 4(1) and (2) and Annexes II, III and IV)[98] sets maximum mercury concentrations in compliance with those established in above-mentioned Annex A (Part I) and which must not to be exceeded notably in relevant ***switches and relays, CFLs, LFLs, CCFLs and EEFLs***. Those restrictions do not only apply to the first placing on the (EU) market, but also to their manufacture (when placed on the EU market) and import into the EU market (Art. 7(a) and 9(a)).

Directive 2006/66/EC (Art. 4)[99] prohibits the placing on the (EU) market and the import of ***batteries, button cells and accumulators*** containing more than 0,0005% of mercury by weight.

Alongside above-mentioned export ban on cosmetic soaps containing mercury as set out in Regulation (EC) No 649/2012, Regulation (EC) No 1223/2009 (Art. 14(a) and (d)) and Annexes II and V)[100] bans the placing on the (EU) market of ***cosmetic products*** containing mercury and/or mercury compounds, save in respect of two eye products that can be used provided that they contain a mercury and mercury compounds concentration not exceeding 0,007%.

Concerning ***pesticides***, Regulation (EC) No 396/2005 (Art. 18(a) and Annex II)[101] provides that fruits and nuts can only be placed on the (EU) market if they contain a maximum residue level of mercury compounds not exceeding 0,01 mg/kg. In addition, it results from Regulation (EC) No 1107/2009[102] read in combination with Regulation (EU) No 540/2011[103] that Hg and its compounds, as non-approved active substances to date for ***plant protection products*** ("PPPs"), cannot be placed in the EU market. Regarding ***biocides***,[104] alike PPPs, it derives from Regulation (EC) No 528/2012/EC that the placing on the EU market and the use of biocidal products containing Hg and Hg compounds have not been approved to date. Concerning ***topical antiseptics***, similarly to PPPs and biocides, it results from the implementation of Directive 2001/83/EC (Art. 6(1))[105] read in combination with Regulation (EC) No 726/2004 (Art. 3)[106] that no mercury- and mercury compounds-containing antiseptics have so far been authorised to be placed on the EU market.

Entries 18a and 62 of Annex XVII to Regulation (EC) No 1907/2006 establish also a restriction on the placing on the EU market, with some exemptions, of certain mercury-containing measuring devices for industrial, professional and non-professional uses, including *inter alia* fever thermometers, barometers, manometers and hygrometers and, as from 10 October 2017, of articles or any parts thereof containing one or more of the five defined phenylmercury compounds if the mercury concentration is equal or greater than 0,01% by weight.

The MC provides also that Parties must phase down the use of ***dental amalgam*** and, for doing so, take at least two of the measures listed in its Annex A (Part II). One can argue that several of these measures lie primarily within the competence of the MS, including to set national objectives on the prevention of dental carries, to encourage professional organisations and dental schools to educate and train dental professionals and students to use mercury-free dental restoration alternatives and to discourage insurance policies and programmes that favour the dental amalgam. Other measures,

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98 Directive 2011/65/EU, OJ L 174 of 1.7.2011, p. 88.

99 Directive 2006/66/EC, OJ L 266 of 26.9.2006, p. 1.

100 **Regulation (EC) No 1223/2009,** OJ L 342, 22.12.2009, p. 59.

101 **Regulation (EC) No 396/2005,** OJ L 70, 16.3.2005, p. 1.

102 Regulation (EC) No 1107/2009, OJ L 309, 24.11.2009, p. 1.

103 **Commission Implementing Regulation (EU) No 540/2011,** OJ L 153, 11.6.2011, p. 1

104 Regulation (EC) No 528/2012, OJ L 167, 27.06.2012, p. 1.

105 Directive 2001/83/EC, OJ L 311 of 28.11.2001, p. 67.

106 Regulation (EC) No 726/2004, OJ L 136, 30.04.2004, p. 1.

including the promotion of the use of best environmental practices in dental facilities to reduce emissions of mercury and mercury compounds to water and land may be considered as measures whereby EU action would have an added-value particularly in terms of establishing a level-playing field among dentists.

The EU *acquis* contains several provisions that address indirectly the use of dental amalgam in dental facilities and the potential adverse environmental impacts caused by the emissions of mercury residues. As explained in further details below, since mercury qualifies under WFD[107] as a "priority hazardous substance", MS must ensure that mercury emissions generated by dental facilities using dental amalgam do not lead to mercury concentrations in surface water bodies exceeding the environmental quality standard – between 0,05 and 0,07 µg/l – as set out in Directive 2008/105/EC[108]. Regarding EU waste legislation, Art. 13 of Directive 2008/98/EC[109] requires MS to ensure that waste, including mercury waste from dental facilities, be handled without impacting human health and the environment.

Use of mercury and mercury compounds in manufacturing processes

The MC provides that the use of Hg or Hg compounds in the ***production of acetaldehyde*** in which mercury or mercury compounds are used as catalyst and of ***chlor-alkali*** must cease respectively in 2018 and 2025 and that measures must be undertaken to address emissions of mercury to air and water.

The case of the production of chlor-alkali is addressed in EU law under the IED read in combination with Commission Implementation Decision 2013/732[110], which bans Hg use for producing ***chlor-alkali*** in new installations while allowing it in existing ones until December 2017. Regarding mercury emissions generated by existing chlor-alkali installations, the IED (Art. 11 and 14(1) and (2)) requests the national competent authorities to set out in relevant permits or via general binding rules mercury control measures, including emission limit values (ELVs) or equivalent parameters or technical measures ensuring an equivalent level of environmental protection with a view notably to preventing any significant pollution and risks of non-compliance with mercury concentrations limits established in particular in Directives 2004/107/EC[111] (mercury target value for air quality set at 5 mg/m^3) and 2008/105/EC (mercury environmental quality standard for surface water quality set at 0,05-0,07 µg/l).

The MC establishes also mercury and mercury compounds-related production conditions applicable to three other manufacturing processes, including the production (i) of ***vinyl chloride monomer*** (hereinafter, "VCM"), (ii) of ***sodium or potassium methylate or ethylate*** and (iii) of ***polyurethane*** using mercury containing catalysts (hereinafter "polyurethane"). These conditions relate in particular to the duty to reduce the use of Hg, including mercury from primary mining and Hg emissions into air and water.

As an activity covered by the IED, operators of VCM production installations and national competent authorities must ensure that such installations operate on the basis of pollution prevention measures, including e.g. ELVs with a view to avoiding significant pollution (Art. 11 and 14(1) and (2)). Regarding polyurethane production, as highlighted above, Entry 62 of Annex XVII to REACH restricts, as from 10 October 2017, the placing on the EU market and use of the most common Hg compounds used for this type of production – phenylmercury acetate, propionate, 2-ethyllexanoate, octanoate and neodecanoate – with a mercury concentration equal or exceeding 0,01% by weight.

[107] Directive 2000/60/EC, OJ L 327, 22.12.2000, p. 1.

[108] **Directive 2008/105/EC, OL L** 348, 24.12.2008, p. 84.

[109] Directive 2008/98/EC, OJ L 213, 22.11.2008, p. 3.

[110] Commission Implementation Decision 2013/732/EU, OJ L 332, 11.12.2013, p. 34.

[111] **Directive 2004/107/EC,** OJ L 23, 26.1.2005, p. 3.

Emissions of mercury and mercury compounds to air, water and land

Art. 8 of the MC requests Parties to control and, where feasible, to reduce ***emissions into the air*** of Hg and of Hg compounds from the point sources falling within one of the five source categories listed in its Annex D (coal-fired power plants, industrial boilers, smelting and roasting processes used in the production of lead, zinc, copper and industrial gold, waste incineration and cement clinker production facilities). For doing so, the MC requires new installations to operate with the BAT and best environmental practice and existing installations to operate on the basis of ELVs and/or the BAT and/or other measures aimed at reducing emissions. The MC specifies that a Party may choose to apply these obligations only on a given set of installations within each source category, provided that the installations concerned account altogether for at least 75% of Hg and Hg compounds emissions generated by the relevant source category. Regarding emissions of mercury and mercury compounds to ***water and land***, Art. 9 of the MC requires that those emitted from point sources that are not addressed in other provisions of the Convention be controlled and, if feasible, reduced via ELVs and/or the use of the BAT and/or alternative measures. At last, the MC calls for Parties to establish an ***inventory*** of Hg emissions to air, water and land from all concerned point sources.

EU law addresses already Hg and Hg compounds ***air emissions*** from the relevant installations as all source categories listed in Annex D of the MC fall within the scope of application of the IED. In this respect, whilst this Directive covers installations that reach a given threshold (e.g. combustion of fuels in installations with a total rated thermal input of 50 MW or more), it still applies to over 55 000 industrial installations, which account for the most polluting in the EU. Hence, the above-mentioned 75% level is met with regard to each concerned source category. Regarding operating conditions, the IED, read together with Commission Implementing Decision 2013/163/EU[112] and Directive 2004/107/EC, sets requirements that meet those set out in Art. 8 of the MC:

- As a fundamental principle of action, all new and existing IED installations must make use of the BAT and operate according to BAT-based permit conditions, which must ensure that all appropriate preventive measures are taken against pollution and that "significant (air) pollution" is avoided (Art. 11(a), (b) and (c) and 14(1)(*chapeau*)).
- To this effect, the competent authorities must include in the permits or via general binding rules ELVs applicable to mercury emissions into the air and/or equivalent parameters or technical measures ensuring an equivalent level of environmental protection (Art. 14(1)(a) and (2) and Annex II (AIR (5) IED).

  Within this context, regarding waste incinerators and co-incinerators, the competent authorities must make sure that the ELVs that are set for Hg and Hg compounds comply with those established in Annex VI of the IED, i.e. 0,05 mg/m^3. In the same vein, those authorities must ensure, as far as installations producing cement clinker are concerned, that ELVs they set comply with the BAT-associated emission level established in Commission Implementing Decision 2013/163/EU, i.e. emissions of mercury from the flue-gases of kiln firing processes must not exceed 0,05 mg/Nm^3.
- Such ELVs and/or equivalent parameters or technical measures ensuring an equivalent level of environmental protection may even have to be made stricter when competent authorities are of the opinion that this is necessary to ensure compliance or contribute to compliance with above-mentioned 5 mg/m^3 mercury target value for ambient air established in Directive 2004/107/EC (Art. 18 IED).

[112] Commission Implementing Decision 2013/163/EU, OJ L 100, 9.4.2013, p. 1.

As to the control and reduction of Hg and Hg compounds emissions to ***water and land***, the IED, read in combination with the WFD and 2008/105/EC, is also the key applicable EU instrument that transposes Art. 9 of the MC, owning to its wide scope of application. In particular, requirements similar to those that are concerned with air emissions apply, including the duty to operate installations with BAT and according to BAT-based permit conditions or general binding rules with a view to avoiding "significant (water and soil) pollution" (Art. 11(a), (b) and (c) and 14(1)(*chapeau*)). Hence, the competent authorities must request from operators the implementation of appropriate requirements ensuring the protection of the soil (Art. 14(1)(b) and (e) IED) and set ELVs applicable to Hg and Hg compounds emissions into water and/or equivalent parameters or technical measures ensuring an equivalent level of environmental protection (Art. 14(1)(a) and (2) and Annex II (AIR (5) IED).

In establishing such ELVs, those authorities must take full account of the mercury-related requirements established in the WFD and in Directive 2008/105/EC on water protection and quality. More particularly, as "priority hazardous substances" (Annex X (21) WFD), MS must take appropriate measures that ensure the ceasing or phasing out of emissions, discharges and losses of Hg and Hg compounds into surface waters within 20 years at the latest (Art. 4(1)(a)(iv), 10, 11(3)(g) and (k), 16(6), (7) and (8) WFD and Art. 13 Directive 2008/105/EC). In the meantime, MS have to make sure that the concentration of Hg and Hg compounds in surface water does not exceed 0,07 µg/l (0,05 µ/l on annual average) or 20 µg/kg for Hg and Hg compound concentrations in sediment and/or biota (Art. 3(1) and (2)(a) and Annex I Directive 2008/105/EC).

EU law addresses also the obligation to establish and maintain an ***inventory*** of Hg and Hg compound emissions to air, water and land from all concerned point sources. In accordance with Regulation (EC) No 166/2006, operators of installations covered by the source categories listed in Annex D of the Minamata and that met a certain capacity threshold must report annually to their competent authorities emissions of Hg and Hg compounds to air (as from emissions exceeding 10 kg/year), water and land (as from emissions exceeding 1 kg/year). In addition, Directive 2008/105/EC requires MS to establish and regularly update an inventory of all emissions of Hg and Hg compounds to surface waters (Art. 5).

Management of mercury and mercury compounds as waste

The MC requires that mercury waste, i.e. substances or objects consisting of or containing or contaminated with Hg and Hg compounds in a quantity above relevant thresholds (to be defined by the Conference of the Parties) be ***managed in an environmental sound manner*** and, if this is the case, be recovered, recycled, reclaimed or re-used but only for a used allowed under the Convention. It calls also for mercury waste not to be transported from one country to another, save for environmentally sound disposal. The MC specifies that the definitions set out in the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal apply to mercury wastes.

EU law addresses already the management of mercury waste in accordance with the requirements set out in Art. 11 of the MC. Regarding the definition of mercury waste, it results from Decision 2000/532/EC[113] that substances or objects consisting of or containing or contaminated with Hg and Hg compounds qualify as "hazardous waste" under EU waste law. In addition, as Party to the above-mentioned Basel Convention, the EU has transposed the relevant definitions in the EU *acquis*, including via Directive 2008/98/EC[114] and Regulation (EC) No 1013/2006[115]. Concerning the management of mercury waste, Art. 13 of Directive 2008/98/EC sets the general principle and obligation according to which waste must be handled without endangering human health and

[113] Commission Decision 2000/532/EC, OJ L 226, 6.9.2000, p.3.

[114] Directive 2008/98/EC, OJ L 213, 22.11.2008, p. 3.

[115] Regulation (EC) No 1013/2006, OJ L 190, 12.7.2006, p. 1.

without harming the environment, i.e. without risk to water, soil, plants or animals. Within this context, Regulation (EC) No 1102/2008 (Art. 2) specifies that metallic mercury originating from the four main mercury waste sources, i.e. metallic mercury that is no longer used in the EU chlor-alkali industry, that is gained from the cleaning of natural gas and from non-ferrous mining and smelting operations and that is extracted from cinnabar ore cannot be recovered, recycled, reclaimed or re-used, but must be disposed of. It adds (Art. 3) that MS are allowed to temporarily store for more than one year metallic mercury waste in underground (adapted salt mines, deep underground hard rock formations) and above-ground (dedicated and equipped) facilities. In this respect, Directive 1999/31/EC (Annexes I, II and III), as amended by Directive 2011/97/EU, sets specific requirements for the temporary storage for more than one year of metallic mercury with a view to ensuring that they are landfilled without causing any harm to human health nor to the environment (e.g. duty to store metallic mercury in corrosion, shock-resistant and liquid tight containers, to make use of storage sites that are provided with engineered or natural barriers that are adequate to protect the environment against mercury emissions). Concerning the international transport of mercury waste, the EU, as Party to the Basel Convention, complies with the obligation not to transport internationally such waste unless this is done for final disposal according to the above-mentioned general principle of no harm to be caused to human health and to the environment.

ANNEX 7 – REGULATORY GAP ANALYSIS OF EU LAW

The Commission's Proposal for an European Parliament and Council Regulation on restrictions concerning trade and certain uses of mercury, and repealing Regulation (EC) No 1102/2008[116] (hereinafter, "Commission's Proposal") aims at the full alignment of EU law with the MC and enabling the EU, once adopted, to ratify it.

The Commission has taken full account of the mercury provisions already set out in EU law, including in Regulations (EC) No 1907/2006[117] and 649/2012[118] and in Directives 2010/75/EC[119] and 2012/18/EU[120]. The objective is to prevent double regulation and inconsistencies across the a*cquis* and to complement existing EU law requirements in a manner that ensures clarity, legal certainty and the achievement of all legally-binding requirements set out in the MC. For doing so, the Commission has carried out a regulatory gap analysis of EU law, which has identified two main types of MC provisions. The first category addressed in *Section 7.1* consists of MC provisions that do not require transposition as they are concerned e.g. with the work to be carried out by the Conference of the Parties to the Convention and those that do not set legally binding obligations upon Parties and which have not been considered by the Commission as needed to meet the objectives of the Convention. The second category addressed in *Section 7.2* is concerned with provisions of the MC that require transposition and which have already been transposed fully or partially into EU law or which have not yet been subject to transposition into the EU *acquis.*

7.1 The provisions of the MC that do not require transposition

7.1.1 MC provisions that do not have to be transposed by Parties

Art. 1[121] to the MC does not have to be transposed as it simply sets out the general objective being pursued. In addition, Art. 3(12), 8(8, 9, 10), 11(4), 15, 22, 23 and 24 to the MC do not need neither to be transposed as they are concerned with the tasks of the Convention's Conference of the Parties, of its Secretariat and of the Implementation and Compliance Committee in terms of evaluation of the effectiveness of Minamata, of the adoption of guidance and guidelines and of the cooperation with international organisations. The same conclusion has been drawn regarding Art. 13 to 19 and 25 to 35 and Annex E to the MC, which do not require transposition since they concern financial resources and mechanism, capacity-building, technical assistance and technology transfer, health aspects, information exchange, public awareness and education research, development and monitoring, the settlement of disputes, the adoption and entry into force of amendments to the Convention and its annexes and notably on the signature, ratification, acceptance, approval, accession and entry into force of Minamata.

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[116] COM(2015) XXX

[117] **Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC,** OJ L 396, 30.12.2006, p. 1.

[118] Regulation (EC) 649/2012 of the European Parliament and of the Council **of 4 July 2012 concerning the export and import of hazardous chemicals,** OJ L 201, 27.7.2012, p. 60.

[119] Directive 2010/75/EU of the European Parliament and of the Council on Industrial Emissions, OJ L 334 of 17.12.2010, p. 17.

[120] Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC, OJ L 197 of 24.7.2012, p. 1.

[121] References to Articles and Annexes in *Section 7* are references to Articles and to Annexes of the Minamata Convention, unless otherwise specified.

7.1.2 MC non-legally binding provisions whose transposition is not needed to meet its objectives and requirements

The regulatory gap analysis of EU law has also identified the Minamata provisions that do not contain legally-binding obligations, but voluntary options ("may", "are encouraged", "endeavour") and whose transposition has not been considered as necessary to ensure compliance of EU law with the Convention.[122]

The provisions concerned include Art. 3(7, 9, 10), 4(2, 7), 5(9), 6, 7(4), 8(3), 11(5), 12 and 20 to the MC on the ability to rely upon a general notification by a mercury importing Party, to implement strategies to address mercury-added products others than the one set out in Art. 4(1), to submit to the Minamata Secretariat proposals for listing new mercury-added products and/or new manufacturing processes to Annexes A and/or B, to apply Annexes A and B at a later stage, to cooperate on artisanal and small-scale gold mining and mercury waste management, to set a plan on the measures to be taken to control air emissions of mercury and mercury compounds, to address contaminated sites and to draw up a Minamata implementation plan.

7.2. The provisions of the MC that require transposition

The second phase of the regulatory gap analysis has focused on the MC provisions whose transposition into EU law is needed to ensure the meeting of the objectives and of requirements of the Convention.

7.2.1 MC provisions already transposed into EU law

As specified in *Annex 6* of this document and in the table in Section 7.2.3, a significant range of the MC provisions are already fully covered by the EU *acquis*, including Regulations (EC) No 1102/2008[123], 396/2005[124] and 1223/2009[125] and Directives 2006/66/EC[126] and 2011/65/EU[127]. It concerns Art. 3(3), (4)(1st sentence), (5)(a, b) and (6), 4(5), 5(5)(a, b), 8, 9, 10 and 11, as well as Annex D of the Convention regarding notably the production of mercury from primary mining, the identification of significant individual stocks of mercury and mercury compounds, the disposal of excess mercury from the chlor-alkali sector, the export of mercury from the EU, the prevention of the incorporation of mercury-added products into assembled products, the control and reduction of emissions and releases of mercury and mercury compounds into the air, water and land, the interim storage of mercury and mercury compounds, the handling of mercury waste and the provision to the public of relevant information.

[122] However, the Commission considers appropriate to transpose Art. 4(6) and 5(7) of the Minamata Convention into EU law on the duty to "discourage" the manufacture and distribution of mercury-added products not listed in Annex A and the development of any facility using a new manufacturing process that is not listed in Annex B and in which mercury and/or mercury compounds are intended to be used.

[123] Regulation (EC° No 1102/2008 of the European Parliament and of the Council of 22 October 2008 on the banning of exports of metallic mercury and certain mercury compounds and mixtures and the safe storage of metallic mercury, OJ L 304 of 14.11.2008, p. 75.

[124] Regulation (EC) No 396/2005 of the European Parliament and of the Council of 23 February 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC, OJ L 70, 16.3.2005, p. 1**.**

[125] **Regulation (EC) No 1223/2009 of the European Parliament and of the Council of 30 November 2009 on cosmetic products,** OJ L 342, 22.12.2009, p. 59.

[126] Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC, OJ L 266 of 26.9.2006, p. 1.

[127] Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, OJ L 174 of 1.7.2011, p. 88.

7.2.2 MC provisions not or partially transposed into EU law

The regulatory gap analysis has concluded that the remaining Minamata provisions are either not transposed into EU law or only partially, which therefore requires regulatory action by the EU to ensure full compliance with the Convention. In addition to Art. 4(6) and 5(7), the concerned Minamata provisions are Art. 3(4)(2nd sentence) and (8), 4(1 and 3) (read in combination with Annex A) and (6), 5(2, 3, 6, 7) (read in combination with Annex B) and 7 on the use of mercury from primary mining, the import of mercury into the EU, the 2020 ban on the manufacture, import and export of mercury-added products listed in Annex A (Part I), the 2025 ban on the use of mercury and mercury compounds in the acetaldehyde production sector, the operating conditions relating to mercury use and emissions of the three manufacturing processes listed in Annex B (Part II), the obligation not to allow the use of mercury and mercury compounds by new facilities operating one the manufacturing processes listed in Annex B (Part II) and on artisanal and small-scale gold mining.

In addition, the Commission considers it appropriate to provide for its ability to adopt Implementing and Delegated Acts to transpose and implement the Decisions that may be adopted by the Conference of the Parties in accordance with Art. 3(13), 4(8-9), 5(10-11), 10(3), 11(2)(c) and (3)(a) of the Convention and which concern the possible amendment of Annexes A and B, the establishment of requirements on the interim storage of mercury and mercury compounds and on the management of mercury waste, the setting up of thresholds defining whether contaminated waste with mercury or mercury compounds are covered by Minamata.

7.2.3 Conclusions of the regulatory gap analysis of EU law vis-à-vis Minamata

Six regulatory gaps have been identified, which require EU transposing provisions. Those gaps are concerned with the following issues:

- **Gap 1**: Import restrictions for metallic mercury from non-Parties
- **Gap 2**: Export ban of certain mercury-added products
- **Gap 3**: Mercury use in new products and processes
- **Gap 4**: Mercury use in certain manufacturing processes
- **Gap 5**: Mercury use in Artisanal and Small-Scale Gold Mining (ASGM)
- **Gap 6**: Restrictions on the use of dental amalgam

Each time one of those regulatory gaps is addressed in the below table, a reference to the gap concerned is included. The below table provides a description of the gaps, including when they are concerned with several items.

RELEVANT PROVISIONS OF THE MC	COVERAGE BY EU LAW / EU REGULATORY GAPS TO BE ADDRESSED
ARTICLE 3: MERCURY SUPPLY AND TRADE	
Art. 3(3) and (4)(1st sentence) MC **PRODUCTION OF MERCURY FROM PRIMARY MINING**	**FULL COVERAGE** • Regulation (EC) No 1102/2008 provides that mercury extracted from cinnabar ore in the (EU) must be disposed of as waste. • Accordingly, the EU *acquis* makes primary mercury mining in the EU an activity that has no "*raison d'être*", hence meeting the *effet utile* sought by the MC in respect of the production of mercury from primary mining.
Art. 3(4)(2nd sentence) MC **USE OF MERCURY FROM PRIMARY MINING**	**PARTIAL COVERAGE – ADDRESSED UNDER GAP 1.** • The EU *acquis* requires that mercury from primary mining generated in the EU be disposed of as waste (see above, transposition of Art.3(3) and (4)(1st sentence) of the MC) and prohibits the export of mercury to non-EU countries (see below, transposition of Art.3(6) of the MC). • Accordingly, the issues that still need to be addressed in EU law relate to the import into the EU of mercury from primary mining and to the use in the EU of such imported mercury, including by manufacturing processes and by those who undertake artisanal and small-scale gold mining (see below, transposition of Art.3(8) MC).
Art. 3(5)(a) MC **IDENTIFICATION OF INDIVIDUAL STOCKS EXCEEDING 50 TONS AND OF SOURCES OF MERCURY SUPPLY GENERATING ANNUAL STOCKS EXCEEDING 10 TONS.**	**FULL COVERAGE** • Art. 3(5)(a) of the MC sets out only a "soft" obligation ("endeavour") upon Parties in respect of the identification of relevant individual stocks and supply sources of mercury. • The identification of the most significant sources of individual stocks of mercury and mercury compounds is already provided for in the EU *acquis*, including in Regulation (EC) No 1102/2008 and in Directive 2012/18/EU (SEVESO III).

Art. 3(5)(b) MC **EXCESS MERCURY FROM CHLOR-ALKALI PRODUCTION**	**FULL COVERAGE** • The obligation to ensure that excess mercury from the decommissioning of chlor-alkali facilities, i.e. mercury no longer used in the chlor-alkali industry in the EU is disposed of as waste, is already set out in Regulation (EC) No 1102/2008. • This obligation must also be read in the light of Commission Implementing Decision 2013/732/EU[128] combined with Directive 2010/75/EC, which prohibits the use of mercury in the chlor-alkali sector in the EU as from 11 December 2013 for "new" installations or from 11 December 2017 for "existing" installations.
Art. 3(6) MC **RESTRICTIONS ON EXPORTS OF MERCURY**	**FULL COVERAGE** • The obligation not to allow export of mercury is transposed in Regulations (EC) No 1102/2008 and 649/2012, which set a ban irrespectively of the uses intended for exported mercury.
Art. 3(8) MC **RESTRICTIONS ON IMPORTS OF MERCURY**	**NO COVERAGE – ADDRESSED UNDER GAP 1.** • The EU *acquis* does not cover the import of mercury into the EU. • Accordingly, restrictions on the import of mercury into the EU are to be addressed in EU law. By doing so, EU law needs to distinguish imports from Parties to the MC from imports from imports from non-Parties to the MC and to restrict imports of mercury from primary mining, in accordance with the MC.
ARTICLE 4 AND ANNEX A : MERCURY-ADDED PRODUCTS	
Art. 4(1) and Annex A (Part I) **NOT ALLOWING THE MANUFACTURE, IMPORT AND EXPORT OF PRODUCTS LISTED IN ANNEX A (PART I) AFTER 2020**	**PARTIAL COVERAGE – ADDRESSED UNDER GAP 2.** • The EU *acquis*, including Directives 2006/66/EC and 2011/65/EU and Regulations (EC) No 396/2005, 1907/2006, 1223/2009 and 649/2012, addresses already the placing on the (EU) market of all the mercury-added products listed in Annex A (Part I) MC and sets limits on the maximum mercury content in line with those established in that Annex. • Accordingly, the issue that still needs to be addressed in EU law relates to the establishment of a post-2020 ban on the manufacturing, import into the EU and export to non-EU countries of the concerned mercury-added products, in accordance with Art. 4(1) of the MC.

[128] **Commission Implementing Decision 2013/732/EU of 9 December 2013 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions, for the production of chlor-alkali,** OJ L 332 of 11.12.2013, p. 34.

Art. 4(3) and Annex A (Part II) **TO TAKE AT LEAST TWO OF THE MEASURES LISTED IN ANNEX A (PART II) TO PHASE DOWN THE USE OF DENTAL AMALGAM**	**PARTIAL COVERAGE – ADDRESSED UNDER GAP 6.** • Annex A (Part II) MC provides a list of nine measures as means aiming at the phasing down of the use of dental amalgam and at the reduction of emissions of mercury into the environment. While the phasing down objective is not specified under the MC (no quantitative targets nor timetables), Parties have the duty to take at least two of those measures. • These measures mostly relate to matters falling under the primary competence of the MS (e.g. to set national strategies aiming at dental caries prevention, to encourage dental schools to educate and train students on the use of mercury-free dental restoration alternatives). • However, EU law transposes partially Annex A (Part II) of the MC as it provides directly and indirectly for measures and initiatives falling under item (iv) of that Annex on the promotion of research and development of quality mercury-free alternatives for dental restoration (the new EU Framework Programme for Research and Innovation Horizon 2020 (2014-2020) provides room for research programme on mercury-free alternatives for dental restoration. • Furthermore, under EU law on the protection of water quality and on the management of waste, including hazardous waste, national competent authorities must control and reduce emissions of mercury into surface water bodies and ensure that such emissions will cease by 2030 and must make sure that waste are handled in such a way as to prevent environmental and health adverse impacts. This does not exclude that dental amalgam could be released into the sewer for subsequent treatment in water treatment plants. Hence, this does not provide a clear incentive in favour of best environmental practices by dental practitioners using dental amalgam, i.e. the use and good maintenance of amalgam separators. • The above measures appear not to be sufficient to fully comply with the minimum requirements of the MC. Furthermore, the MC suggests that all measures should be taken into consideration when a Party to the Convention is designing the measures it will take.
Art. 4(5) **TO PREVENT INCORPORATION INTO ASSEMBLED PRODUCTS OF MERCURY-ADDED PRODUCTS LISTED IN ANNEX A (PART I) THE MANUFACTURE, IMPORT AND EXPORT OF WHICH IS PROHIBITED UNDER THE MC**	**FULL COVERAGE** • By restricting the placing on the EU market of the mercury-added products listed in Annex A (Part I) of the MC in line with the conditions and restrictions set out therein, the EU *acquis* (see above, transposition of Art. 4(1) and (3)) transposes Art. 4(5) of the MC. • The transposition into EU law of Art. 4(1) and Annex A (Part I) in respect of the manufacture, import and export of mercury-added products (see above, transposition of Art. 4(1)) will provide additional legal certainty on the duty to prevent the incorporation of mercury-added products into assembled products, in accordance with Art. 4(5) of the MC.

Art. 4(6) **TO DISCOURAGE MANUFACTURE AND DISTRIBUTION INTO COMMERCE OF "NEW" MERCURY-ADDED PRODUCTS**	**NO COVERAGE – ADDRESSED UNDER GAP 3** • The EU *acquis* does not cover the duty to discourage the manufacture and distribution into commerce in the EU of "new" mercury-added products not listed in Annex A.
ARTICLE 5 AND ANNEX B : MANUFACTURING PROCESSES	
Art. 5(2) and Annex B (Part I) **NOT ALLOWING THE USE OF MERCURY AND MERCURY COMPOUNDS IN ACETALDEHYDE AND CHLOR-ALKALI PRODUCTIONS AFTER 2018 AND 2025 RESPECTIVELY.**	**PARTIAL COVERAGE – ADDRESSED UNDER GAP 4** • The EU *acquis*, including Commission Implementing Decision 2013/732/EU read together with Directive 2010/75/EC, transposes fully Art. 5(2) and Annex B (Part I) MC as far as chlor-alkali production is concerned (see above, transposition of Art. 3(5)(b) of the MC). • Accordingly, the issue that still needs to be addressed in EU law relates to the use of mercury and mercury compounds in the production of acetaldehyde where such substances are used as catalysts.
Art. 5(3) and Annex B (Part II) **TO RESTRICT THE USE OF MERCURY OR MERCURY COMPOUNDS, INCLUDING MERCURY FROM PRIMARY MINING IN THREE MANUFACTURING PROCESSES**	**PARTIAL COVERAGE – ADDRESSED UNDER GAP 4** The EU *acquis* transposes partly Art. 5(3) and Annex B (Part II) of the MC. • Regarding vinyl chloride monomer production, the EU *acquis* does not provide for a reduction of the use of mercury per production unit by 50% by 2020 against 2010 use and of mercury from primary mining. • Concerning the production of sodium or potassium methylate or ethylate, the EU *acquis* needs to address the duty to reduce the use of mercury with the aim of phasing it out within 10 years and emissions of mercury to air, water and land per production unit by 50% by 2020 against 2010 use and the obligation to prohibit the use of mercury from primary mining by concerned installations. • As to the production of polyurethane using mercury containing catalysts, the EU *acquis* covers partially the conditions set out in Annex B (Part II) of the MC. Indeed, Entry 62 of Annex XVII to REACH[129] **restricts, as from 10 October 2017, the manufacture, placing on the market and use of five phenylmercury compounds as substances or in mixtures, known to be used as catalysts in polyurethane systems, if the concentration of mercury in the mixture is at least 0,01% by weight, as well as the placing on the market of articles or any parts thereof containing one or**

[129] **Commission Regulation (EU) No 848/2012 of 19 September 2012 amending Annex XVII to Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards phenylmercury compounds,** OJ L 253, 20.9.2012, p. 5.

	more of those compounds if the concentration of mercury is at least 0,01% by weight. Accordingly, EU law still needs to provide for a prohibition on the use of other mercury compounds by concerned installations.
Art. 5(5)(a) and Annex B **TO TAKE MEASURES TO ADDRESS EMISSIONS AND RELEASES OF MERCURY OR MERCURY COMPOUNDS FROM THE FACILITIES OPERATING A MANUFACTURING PROCESS LISTED IN ANNEX B**	**PARTIAL COVERAGE – ADDRESSED UNDER GAP 4.** • In respect of the two manufacturing processes listed in Annex B (Part I) MC: – Chlor-alkali installations: Commission Implementing Decision 2013/732/EU (see above, transposition of Art. 3(5)(b)) and 5(2) of the MC) prohibits the use of mercury and mercury compounds as from 11 December 2013 or 2017, which will therefore lead to zero emissions of mercury and mercury compounds to air, water and land as of those dates. – Installations producing acetaldehyde where mercury and mercury compounds are used as catalysts: the transposition of Art. 5(2) MC (see above) shall also lead to zero emissions of mercury and mercury compounds to air, water and land as from 2018. • With regards to the three manufacturing processes listed in Annex B (Part II) MC: – Installations producing vinyl chloride monomer: Whilst Directive 2010/75/EU requires operators to prevent any significant pollution, the EU *acquis* still needs to address the duty to reduce emissions of mercury to air, water and land, while taking into account that Annex B (Part II) does not set any reduction quantitative targets nor any timeline. – Installations producing sodium or potassium methylate or ethylate: The EU *acquis* needs to address the duty to reduce emissions of mercury to air, water and land per production unit by 50% by 2020 against 2010 use. – Installations producing polyurethane using mercury containing catalysts: the EU *acquis* needs to address the obligation to reduce mercury emissions to air, water and land generated by the use of mercury compounds other than those restricted by entry 62 of Annex XVII to REACH **(see above, transposition of Art. 5(3) and Annex B (Part II) of the MC).**
Art. 5(6) **TO NOT ALLOW THE USE OF MERCURY OR MERCURY COMPOUNDS BY NEW FACILITIES OPERATING A MANUFACTURING PROCESS LISTED IN ANNEX B**	**PARTIAL COVERAGE – ADDRESSED UNDER GAP 3.** • The prohibition to use mercury and mercury compounds by "new" installations producing chlor-alkali is already prohibited by Commission Implementing Decision 2013/732/EU (see above, transposition of Art. 3(5)(b) MC), 5(2) and 5(5)(a) of the MC). Such a prohibition shall also apply to installations producing acetaldehyde where mercury and mercury compounds are used as catalysts throughout the transposition of Art. 5(2) and Annex B (Part I) of the MC (see above).

	• Accordingly, the issue that still needs to be addressed in EU law relates to the use of mercury and mercury compounds by "new" installations producing vinyl chloride monomer, sodium or potassium methylate or ethylate or polyurethane using mercury containing catalysts.
Art. 5(7) **TO DISCOURAGE THE DEVELOPMENT OF ANY FACILITY USING A NEW MANUFACTURING PROCESS NOT LISTED IN ANNEX B IN WHICH MERCURY OR MERCURY COMPOUNDS ARE USED**	**NO COVERAGE– ADDRESSED UNDER GAP 3.** • The EU *acquis* does not cover the duty to discourage the development of new facilities that will intend to operate a manufacturing process not referred to in Annex B MC in which mercury or mercury compounds will be used.
ARTICLE 7 AND ANNEX C : ARTISANAL AND SMALL-SCALE GOLD MINING	
Art. 7 and Annex C **TO TAKE STEPS TO REDUCE AND, WHERE FEASIBLE, ELIMINATE, THE USE OF MERCURY AND MERCURY COMPOUNDS AND EMISSIONS AND RELEASES OF MERCURY AND TO DEVELOP AND MAINTAIN A NATIONAL ACTION PLAN IN ACCORDANCE WITH ANNEX C IN CASE WHERE MORE THAN INSIGNIFICANT ARTISANAL AND SMALL-SCALE GOLD MINING OCCURS**	**NO COVERAGE – ADDRESSED UNDER GAP 5.** • The EU *acquis* does not cover the reduction and elimination of the use of mercury and mercury compounds in artisanal and small-scale gold mining activities nor the reduction and elimination of mercury emissions and releases. • Whereas the EU *acquis* does not cover Art. 7(3) and Annex C of the MC, the transposition of the Convention into EU law will not address, in the light of the subsidiarity principle, this regulatory gap, provided that the only Member State concerned by such an activity, France, is the best placed to define whether artisanal and small-scale gold mining that occurs in French Guyana is more than insignificant and, if so, to develop and maintain a national action plan on the basis of Annex C of the MC.

ARTICLE 8 AND ANNEX D: AIR EMISSIONS	
Art. 8(1), (2), (3), (4) and (5) and Annex D **TO TAKE MEASURES TO CONTROL AND, WHERE FEASIBLE, REDUCE AIR EMISSIONS OF MERCURY AND MERCURY COMPOUNDS FROM THE POINT SOURCES FALLING WITHIN THE SOURCE CATEGORIES LISTED IN ANNEX D AND TO MAKE SURE, IN THAT RESPECT, THAT "NEW" SOURCES MAKE USE OF THE BEST AVAILABLE TECHNIQUES ("BAT") AND THE BEST ENVIRONMENTAL PRACTICES ("BEPS") WITHIN 5 YEARS AND THAT "EXISTING" SOURCES E.G. MAKE USE OF THE BAT AND BEPS OR ARE IMPOSED EMISSION LIMIT VALUES WITHIN 10 YEARS. PARTIES CAN DECIDE TO APPLY THIS PROVISION TO A RANGE OF POINT SOURCES, PROVIDED THAT THEY ACCOUNT FOR AT LEAST 75% OF THE EMISSIONS FROM THAT CATEGORY**	**FULL COVERAGE** • The EU *acquis* fully covers Art. 8(1, 2, 3, 4 and 5) and Annex D of the MC. In particular, Directive 2010/75/EU, which applies to more than 75% of the point sources falling under one of the categories listed in Annex D, requires that the BAT and BEPs are used to operate the concerned industrial installations, irrespectively of whether they qualify as "new" or "existing" point sources.
Art. 8(7) **TO ESTABLISH AND MAINTAIN AN INVENTORY OF EMISSIONS FROM RELEVANT SOURCES**	**FULL COVERAGE** • The EU *acquis* fully covers Art. 8(7) of the MC. In particular, Regulation (EC) No 166/2006[130] and Directive 2010/75/EU ensure that emissions of mercury and mercury compounds from the point sources falling under the categories listed in Annex D MC are reported via emission inventories.
ARTICLE 9 : WATER AND LAND RELEASES	
Art. 9(1), (2), (4) and (5) **TO TAKE MEASURES TO CONTROL AND, WHERE**	**FULL COVERAGE** • Art. 9(2)(b) of the MC specifies that the Parties identify themselves the significant anthropogenic point sources of

[130] **Regulation (EC) No 166/2006 of the European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC,** OJ L 33, 4.2.2006, p. 1.

FEASIBLE, REDUCE RELEASES OF MERCURY AND MERCURY COMPOUNDS TO LAND AND WATER FROM SIGNIFICANT ANTHROPOGENIC POINT SOURCES IDENTIFIED BY THE PARTIES AND NOT REFERRED TO ELSEWHERE IN THE MC AND TO MAKE SURE, IN THAT RESPECT, THAT CONCERNED SOURCES E.G. MAKE USE OF THE BEST AVAILABLE TECHNIQUES ("BAT") AND THE BEST ENVIRONMENTAL PRACTICES ("BEPS") WITHIN 5 YEARS AND THAT "EXISTING" SOURCES E.G. MAKE USE OF THE BAT AND BEPS OR ARE IMPOSED EMISSION LIMIT VALUES OR OTHER MEASURES	releases of mercury and mercury compounds to water and land. • The Commission considers that all those point sources located in the EU are covered by Directive 2010/75/EU, which applies to at least 55 000 industrial installations, including all the largest ones. In accordance with that Directive, these point sources must operate on the basis of the BAT and the BEPs.
Art. 9(6) **TO ESTABLISH AND MAINTAIN AN INVENTORY OF RELEASES FROM RELEVANT SOURCES**	**FULL COVERAGE** • The EU *acquis* fully covers Art. 9(6) of the MC. In particular, Regulation (EC) No 166/2006 and Directive 2010/75/EU ensure that releases of mercury and mercury compounds from the relevant point sources are reported via emission inventories.
ARTICLE 10 : ENVIRONMENTALLY SOUND INTERIM STORAGE OF MERCURY, OTHER THAN MERCURY WASTE	
Art. 10(1, 2) **TO TAKE MEASURES TO ENSURE THAT THE INTERIM STORAGE OF MERCURY AND OF THE MERCURY COMPOUNDS LISTED IN ART. 3(1)(B) MC AND THAT ARE INTENDED FOR A USE ALLOWED IS UNDERTAKEN IN AN ENVIRONMENTALLY SOUND MANNER**	**FULL COVERAGE** • Art. 10 of the MC read together with Art. 3(5)(a) applies to individual stocks of mercury and of certain mercury compounds (those listed in Art. 3(1)(b)) exceeding 50 t and to mercury supply sources generating stocks exceeding 10 t per year . • The EU *acquis* fully covers Art. 10(1, 2) of the MC, as it ensures that the interim storage of mercury or mercury compounds of at least 50 tonnes takes place in an environmental sound manner. In particular, Directive 2012/18/EU requires operators of establishments that store at least 50 t of mercury and mercury compounds to draw up a major-accident prevention policy and, in case of a storage of at least 200 t, a safety report. Those documents aim at ensuring a high level of environmental and human health protection within the meaning of Art. 10(1, 2) of the MC. In addition, Directive 2010/75/EU requires operators of installations hosting individual stocks of mercury and mercury compounds to ensure that such a storage is undertaken on the basis of preventive measures against pollution and does not cause any significant environmental pollution.

ARTICLE 11 : MERCURY WASTES	
Art. 11(1) **TO USE THE RELEVANT DEFINITIONS SET OUT IN THE BASEL CONVENTION ON THE CONTROL OF TRANSBOUNDARY MOVEMENTS OF HAZARDOUS WASTES AND THEIR DISPOSAL**	**FULL COVERAGE** • The EU, as a Party to the Basel Convention, is concerned with the obligation to make use of the definitions set out therein. In this respect, the EU *acquis* fully covers Art. 11(1) of the MC as the concerned definitions have been transposed notably into Directive 2008/98/EC[131] and Regulation (EC) No 1013/2006[132].
Art. 11(2) **DEFINITION OF MERCURY WASTE**	**FULL COVERAGE** • The EU *acquis*, including Directive 2008/98/EC (generic definition of "waste") and Commission Decision 2000/532/EC[133] fully covers Art. 11(2) MC.
Art. 11(3)(a) **TO TAKE MEASURES TO ENSURE THAT MERCURY WASTE IS MANAGED IN AN ENVIRONMENTALLY SOUND MANNER**	**FULL COVERAGE** • The EU *acquis* fully covers Art. 11(3)(a) of the MC. EU waste law is indeed governed by the overreaching obligation, set out notably in Directive 2008/98/EC, according to which MS must take the necessary measures to ensure that waste management is carried out without endangering human health, without harming the environment.
Art. 11(3)(b) **TO TAKE MEASURES TO ENSURE THAT MERCURY WASTE IS ONLY RECOVERED, RECYCLED, RECLAIMED OR DIRECTLY RE-USED FOR A USE ALLOWED UNDER THE MC OR FOR ENVIRONMENTALLY SOUND DISPOSAL**	**FULL COVERAGE** • The EU *acquis*, including notably Regulation (EC) No 1108/2008 which requires that the mercury waste generated by the four most important sources of mercury waste (chlor-alkali production, the cleaning of natural gas, non-ferrous mining and smelting operations and mercury extracted from cinnabar ore) be disposed of, fully covers Art. 11(3)(b) of the MC.

[131] **Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives,** OJ L 312, 22.11.2008, p. 3.

[132] **Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste,** OJ L 190, 12.7.2006, p. 1.

[133] Commission Decision 2000/532/EC of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste, OJ L 226, 6.9.2000, p. 3.

Art. 11(3)(c) **TO TAKE MEASURES TO ENSURE THAT MERCURY WASTE IS NOT TRANSPORTED ACROSS INTERNATIONAL BOUNDARIES, SAVE FOR ENVIRONMENTALLY SOUND DISPOSAL**	**FULL COVERAGE** • The EU *acquis*, including Regulation (EC) No 1013/2006 which transposes the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, fully covers Art. 11(3)(c) of the MC.
ARTICLE 18 : PUBLIC INFORMATION, AWARENESS AND EDUCATION	
Art. 18(1) **TO PROMOTE AND FACILITATE THE PROVISION TO THE PUBLIC OF RELEVANT AVAILABLE INFORMATION AS WELL AS EDUCATION, TRAINING AND PUBLIC AWARENESS RELATED TO THE EFFECTS OF EXPOSURE TO MERCURY AND MERCURY COMPOUNDS.**	**FULL COVERAGE** • The promotion and facilitation of the provision to the public of education, training and public awareness related to the effects of exposure to mercury and mercury compounds does not require the enacting of legislative measures and is primary a matter for which MS are best placed. • The EU *acquis,* including **Regulations (EC) No 1049/2001[134] and 1367/2006[135] on access to EU institution documents and to environmental information held by the EU institutions and bodies and Directive 2003/4/EC[136] on public access to environmental information held in MS, fully covers the obligation to promote and facilitate** the provision to the public of the information items listed in letter (a) of Art. 18(1) of the MC**.**
Art. 18(2) **TO USE EXISTING MECHANISMS OR TO GIVE CONSIDERATION TO THE DEVELOPMENT OF MECHANISMS FOR THE COLLECTION AND DISSEMINATION OF INFORMATION ON ESTIMATES OF ANNUAL QUANTITIES OF MERCURY AND MERCURY COMPOUNDS EMITTED, RELEASED OR DISPOSED OF.**	**FULL COVERAGE** • The EU *acquis* fully covers Art. 18(2) of the MC. In particular, Regulation (EC) No 166/2006 establishes an integrated pollutant release and transfer register at EU level in the form of a publicly accessible electronic database, which compiles information reported by operators of significant industrial installations, on quantities on pollutants, including mercury and mercury compounds emitted, released or sent off to waste treatment facilities.

[134] **Regulation (EC) No 1049/2001 of the European Parliament and of the Council of 30 May 2001 regarding public access to European Parliament, Council and Commission documents,** OJ L 145, 31.5.2001, p. 43.

[135] **Regulation (EC) No 1367/2006 of the European Parliament and of the Council of 6 September 2006 on the application of the provisions of the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters to Community institutions and bodies,** OJ L 264, 25.9.2006, p. 13.

[136] **Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC,** OJ L 41, 14.2.2003, p. 26.

ANNEX 8 – ASSESSMENT OF THE MERCURY EXPORT BAN REGULATION

The Mercury Export Ban Regulation has been adopted in 2010 and in 2015 a limited assessment has been undertaken on its achievements and functioning so far. The assessment was limited due to the fact that the Regulation had a relatively short time period for implementation (2011-2015) and therefore not all impacts of the ban could have materialised so far. Moreover, the resulting evidence base is also limited. As a consequence a full-fledged evaluation wasn't feasible at this moment in time and the assessment concentrated on the aspects of effectiveness, efficiency and coherence and has not assessed the evaluation criteria relevance and EU added value in detail. Below the key findings are summarised. Detailed information is available in the final study report[137].

Study methodology

For the assessment of the effectiveness and efficiency of the Mercury Export Ban Regulation, information from MS and relevant industry was collected using two questionnaires . Furthermore, Member State replies to the questionnaire undertaken as part of an assessment of the EU implementation of the MC have been included. The information collected by the questionnaires was combined with data from industry reporting under the Mercury Export Ban Regulation and international trade statistics from Eurostat and UN Comtrade, as well as export statistics reported as part of the implementation of the EU Waste Shipment Regulation and the EU PIC Regulation.

Effectiveness in reducing the global mercury supply

The Mercury Export Ban Regulation significantly reduces the global mercury supply. The total amount of mercury prevented from reaching the global market is estimated at approximately 650 t/y for at least the next ten years, corresponding to approximately 20% of the global mercury supply. The total prevented export of surplus mercury accumulated in the chlor-alkali sector is estimated at approximately 8000 t, as well as any prevented recovery of mercury from gas purification and non-ferrous mining and smelting operations (in total 33 t were reported as sent to storage during 2011-2013). Available data indicates that the decrease in supply may not have been replaced by increased mine production outside the EU, but the export of mercury from Switzerland has increased by an average of 100 t/y. The global prices of mercury have increased threefold over a few years, demonstrating the consequences of the decrease in the supply from the EU and later the USA (an export ban of mercury from the USA has been in effect since January 1, 2013).

The objective of preventing by-product mercury from gas purification and nonferrous mining and smelting to enter the global market has not been fully met, as the Mercury Export Ban Regulation does not prevent waste products from being exported for recovery of the mercury outside the EU. Waste statistics indicate that this takes place to some extent. Introduction of a ban on export of the waste products concerned could potentially improve the effectiveness of the Mercury Export Ban Regulation.

Only one incident of illegal export of mercury was reported in the stakeholder responses and there is an investigation related to infringement ongoing. Furthermore, the analysis of export data compared to import data of receiving countries indicate a few discrepancies.

[137] COWI, BiPRO (2015). Ratification of the Minamata Convention by the EU - Complementary Assessment of the Mercury Export Ban (June 2015).

Effectiveness in ensuring safe storage of surplus mercury within the EU

The responses to the study questionnaires indicate that the objective of the Mercury Export Ban Regulation to ensure safe storage of surplus mercury within the EU has still not been fully met. In 2013, the quantity reported as sent to off-site storage from the chlor-alkali industry was 655 t (about the same magnitude as the average prevented export), but it is not known whether the mercury was sent for temporary or permanent storage.

In general, representatives of the chlor-alkali industry consider storage capacities in the EU, both for temporary and permanent storage of mercury considered waste, as insufficient. Council Directive 2011/97/EU[138] foresees only temporary storage criteria[139] for metallic mercury considered as waste. In 2016 there may be stocks of metallic mercury considered as waste that will have reached the 5 years temporary storage limit. According to the stakeholders, specific conditions and criteria for environmentally safe permanent storage of metallic mercury have not been defined yet, even if this is required under the Mercury Export Ban Regulation. Due to the lack of clear definition of conditions for permanent storage no market has been created so far for solidifying and permanently storing excess mercury, which also negatively affected the mercury recycling companies.

Efficiency

The main cost elements for the implementation of the Mercury Export Ban Regulation are the costs of storage of mercury from the chlor-alkali sector and the lost revenues from sale and export of mercury from the sector. These had been analysed in the relevant impact assessment[140] when the Mercury Export Ban legislation was proposed. This study could not identify any ways for further reducing the costs caused by the restrictions on export.

The costs to the chlor-alkali industry of storage of surplus mercury is estimated at an average of 0,6-2,0 million EUR/y, while the lost revenue from sale of mercury is estimated at 3-5 million EUR/y. The industry stakeholders' responses indicate that they consider the costs of disposal ranking first and the lost revenue second. Some stakeholders pointed at the lack of common criteria for environmentally safe permanent storage of metallic mercury as a cause of disproportionate costs.

As per the requirements of Art. 3(3) of the Mercury Export Ban Regulation, criteria should be laid down in the Landfill Directive for the storage of metallic (liquid) mercury. Such criteria were agreed for temporary storage only as there was no majority of MS in favour of criteria for final storage. Until now mercury was disposed after solidification and no additional cost were incurred due to the lack of criteria for permanent storage. However, if mercury would need to be stored in liquid form, temporary storage would be more expensive than permanent storage in the long run. Therefore, introduction of clear criteria for permanent storage would be expected to improve the effectiveness (reducing costs for temporary storage) and efficiency of the Mercury Export Ban Regulation.

Following technological developments in two solidification processes of metallic mercury a solution now exists in Germany for its disposal and a further solution is expected in Spain. Furthermore, a review of recent studies has shown that permanent storage of metallic mercury in deep soft rock formations, such as salt mines, is also be environmentally sound subject to specific technical criteria that should now be adopted.

The most affected industry group is that of recyclers and exporters of mercury. The total lost revenues are estimated at an average of 5-7 million EUR/y i.e. of the same size as the lost revenue to the chlor-alkali sector from sale of mercury to the recyclers and exporters.

[138] Council Directive 2011/97/EU, OJ L328, 10.12.2011, p.49

[139] considered as appropriate for a time span for up to five years

[140] SEC(2006)1369, 26.10.2006

Compared to the direct costs, the administrative costs and costs for implementation and enforcement are estimated to be relatively small. MS estimated the time needed for the implementation of the Mercury Export Ban Regulation at, on average, one man-week per year per MS. It should be noted that much of the administration and enforcement is already done as part of the general procedures for export of hazardous substances and hazardous waste. Most stakeholders in the chlor-alkali industry stated that the administrative burden from the implementation of the Mercury Export Ban Regulation was small compared to the total administrative burden of the industry and estimated the time needed at, on average, of approximately one man-week per year per company. The responding recyclers indicated that the administrative burden from the implementation of the Mercury Export Ban Regulation was significant and estimated that, on average, more than two man-weeks per year per company was needed for administration.

The total benefits of preventing the 650 t/y in reaching the global mercury market cannot be estimated. In order to have a rough idea of the possible benefits an illustrative example can be given: assuming that the reduced export of mercury from the EU would result in a 10 % decrease in the expected impacts from lost IQ due to ingestion and inhalation of mercury (just one of the environmental and health impacts of mercury), and using available estimates of the costs of mercury impacts, the total benefits can be estimated to be at least 400 million EUR/y and more likely significantly higher. This indicates strongly that the mercury export reductions achieved with the Mercury Export Ban Regulation have been efficient.

Coherence

The Waste Shipment Regulation, the PIC Regulation and Council Directive 2011/97/EU amending the Landfill Directive (Directive 1999/31/EC) are all important instruments for the implementation and enforcement of the Mercury Export Ban Regulation. According to the MS' and stakeholders' feedback, overlaps or interfaces of the Mercury Export Ban Regulation exist with these instruments. The responses did, however, not specify any overlaps or contradictions with other EU legislation, and possible overlaps, e.g. in the reporting requirements, have not been identified.

The REACH Regulation restricts the manufacture, placing on the market and use of mercury and/or mercury compounds, as substance or in mixtures, or in articles containing them (Entries 18, 18a, 30 and 62 of Annex XVII to the REACH Regulation). Entry 62 restricts the manufacture, use and placing on the market of five phenylmercury compounds after 10 October 2017. As manufacture in the EU is restricted, in practice export will be restricted as well (apart from re-export). Entry 18 (restricting the placing on the market and use of mercury compounds) and entry 18a (restricting the placing on the market of various measuring devices containing mercury) do not restrict the manufacture and export of those compounds and articles. The objective of the restrictions is the protection of humans and the environment against mercury, and it seems to be incoherent with the objectives of the REACH Regulation and the Mercury Export Ban Regulation that these mercury compounds and articles can be exported and result in exposure of humans outside the EU and the global environment. In the context of the Mercury Export Ban Regulation, it is of particular significance that measuring devices with metallic mercury, both new and as waste, can be exported from the EU and thereby contribute to the global mercury supply.

APPENDIX 8.1 – MEMBER STATE RESPONSES

A questionnaire focusing on the impacts of the Mercury Export Ban Regulation and elaborated for the sole purpose of this study was sent to all MS in order to draw conclusions on its effectiveness and efficiency, and to get a more complete picture on any exports of mercury. This appendix provides a summary of the responses.

1. Which countries responded to the survey?

	Member States
Yes	17 (AT, BE, BG, DE, DK, ES, FI, HU, IE, LT, LU, MT, NL, PT, SE, SK, UK)

17 MS have responded to the survey.

2. Statistical data on exports of mercury and mercury compounds

2.1 Data on exports of mercury and mercury compounds addressed under Regulation (EU) No 649/2012 (former: Regulation 689/2008)

We extracted the data related to exports of mercury compounds for the period 2011 to 2013 from the reports your country sent to the Commission pursuant to Art. 10 of Regulation (EU) No 649/2012. In case you have any additional data or information regarding exports of mercury or mercury compounds could you please provide them (you can also provide additional data as attachment)?

	No. of Member States
Yes	5 (AT, BG, IE, NL, UK)
No	12 (BE, DE, DK, ES, FI, HU, LT, LU, MT, PT, SE, SK)

The majority of the responding countries did not provide any further information regarding exports of mercury or mercury compounds. Five countries included additional information, however mostly of rather general nature and referring to information already submitted. Bulgaria accentuated that no mercury has been exported from the country since 2011, and that there are no facilities or activities which might result in the generation of mercury as a product or by-product. Two countries (IE, NL) referred to the information already submitted in the context of their reporting obligations, whereas Austria pointed out that there are regular notifications by exporters concerning Art. 2 paragraph 3* of Regulation (EU) No. 649/2012. The United Kingdom stated that 2014 tonnages are not yet available.

2.2 Data on exports of metallic mercury considered as waste

According to Article 5 of Regulation 1102/2008 exporters with activities referred to in Article 2 (concerning specified mercury wastes) have to report volumes, originating country and destination country of metallic mercury considered as waste that is traded cross-border within the Community (an issue that was covered in the previous mercury questionnaire). Do you, in addition, have data on exports of metallic mercury considered as waste, which is exported outside the EU?

	No. Member States
Yes	1 (UK)
No	16 (AT, BE, BG, DE, DK, ES, FI, HU, IE, LT, LU, MT, NL, PT, SE, SK)

Only the United Kingdom provided further information on metallic mercury classified as waste being exported out of the EU. It indicated that in 2012, 135.1 tonnes and in 2011, 210.5 tonnes of waste containing metallic mercury were shipped to the United States. It was emphasized that these tonnages were for the total waste and did not necessarily equate to the tonnage of mercury.

2.3 Data on exports of waste containing mercury as required in the Basel Convention

We extracted the data related to exports of waste containing mercury reported by your country pursuant to Article 51(2) and Annex IX of Regulation 1013/2006 from the CIRCA webpage for the time period 2010 to 2012. In case you have any additional/newer data or information regarding exports of mercury or mercury compounds could you please provide them (you can also provide additional/newer data as attachment)?

	No. Member States
Yes	6 (BE, BG, DE, FI, HU, IE)
No	11 (AT, DK, ES, LT, LU, MT, NL, PT, SE, SK, UK)

About one third of MS responses to the questionnaire contained additional information regarding exports of mercury compounds under the Basel Convention.

Belgium indicated that exports of mercury containing waste from chlor-alkali installations in the Flemish region to other chlor-alkali plants and to DE for disposal took place and in the latter case will continue to take place in the future. Both Bulgaria and Hungary included data on mercury containing fluorescent tubes shipped to Germany and Romania. Moreover Finland, Germany and Ireland added information on other mercury-containing waste categories shipped from the respective country. All additional information provided refers to waste exported to other EU MS.

3. Complementary questions regarding the efficiency and effectiveness of Regulation 1102/2008

3.1 Has any illegal export of mercury and mercury compounds been observed?

	No. Member States
Yes	2 (AT, DE)
No	14 (BE, BG, DK, ES, FI, HU, IE, LT, LU, MT, NL, SE, SK, UK)
Not answered	1 (PT)

The vast majority of the respondents have not observed any illegal exports of mercury or mercury compounds. The two MS reporting such cases (AT, DE) both referred to illegal shipments of mercury from Dela GmbH in Germany to companies in Switzerland, the Netherlands and Greece between 2011 and 2014.

3.2 Have you experienced that the exemptions for research and development, medical and analytical purposes have acted as a loophole for actual exports of regulated mercury and mercury compounds?

	No. Member States
Yes	0
No	15 (AT, BG, DE, DK, ES, FI, HU, IE, LT, LU, MT, NL, SE, SK, UK)
Not answered	2 (BE, PT)

So far, none of the MS have experienced that exemptions for research and development, medical and analytical purposes granted by the Mercury Export Ban Regulation served as loopholes for any actual exports of regulated mercury and mercury compounds. However, the Belgian response included recommendations on a supplementary obligation in case of an application for export for the uses exempted by the export ban for quantities below 10 kg per year and exporter, namely a 'declaration of end-use' required from the importer. For further information on these recommendations please refer to question 10 of this appendix.

3.3 Have you experienced that the allowed export of mercury and compounds (other than cinnabar ore, mercury (I) chloride, mercury (II) oxide and mixtures with at least 95 % mercury) has acted as loophole for actual exports of regulated mercury and mercury compounds?

	No. Member States
Yes	0
No	15 (AT, BG, DE, DK, ES, FI, HU, IE, LT, LU, MT, NL, SE, SK, UK)
Not answered	2 (BE, PT)

So far, none of the MS have witnessed that the allowed export of mercury compounds has served as a loophole for the export of restricted mercury compounds. Again, Belgium included a comment indicating that no data on this issue is available and that there are no actual effective means to prove an intention to circumvent the export obligations (i.e. via transformation or mixture). Nonetheless the exclusion of mixtures containing less than 95 % mercury is regarded not proportionate and an exemption for mixtures with contents up to 5% of mercury is proposed instead. Moreover it is highlighted that there was no PIC specific entry for 'mixtures with at least 95 % mercury' until 2014, meaning that it is not clear, which code was used by industry before that time.

3.4 Have you experienced other loopholes regarding the exports of mercury and mercury compounds?

	No. Member States
Yes	1 (FI)
No	13 (AT, BG, DK, ES, HU, IE, LT, LU, MT, NL, SE, SK, UK)
Not answered/ No information available	3 (BE, DE, PT)

None of the responding MS has actually experienced any other loopholes for exports of mercury and mercury compounds in practice. However, Finland ticked 'Yes' in the questionnaire and indicated that for them a potential loophole in theory could be the export of mercury containing sludge. It was pointed out that operators could simply not purify the residues from non-ferrous mining and smelting operations to gain metallic mercury for disposal but to receive mercury containing sludge instead which might be exported as waste and could possibly end up on the market. Belgium justified its abstention with a lack of information on this point.

3.5. In case of illegal export activities, are any penalties foreseen in your national legislation (relating to the Mercury Export Ban Regulation's Article 7)?

If yes, please specify the kind (and extent) of penalties foreseen.

	No. Member States
Yes	10 (AT, BE, BG, DK, FI, IE, LT, LU, SE, UK)
No	3 (HU, MT, SK)
Not answered	4 (DE, PT, NL, ES)

More than half of the respondents indicated that penalties were foreseen in their national legislation for illegal export activities, including fines and imprisonment of different extents. Two countries (HU, MT) have no penalties foreseen, whereas Slovakia indicated that there were no penalties in direct relation with Art. 7 of the Regulation, but that other legislation covered the prosecution of threats or damages to human health and the environment. The Spanish response contained a reference to the Spanish Organic Law 12/1995 applying to the substances for which export has been banned by Regulations (EC) No 1102/2008 and No 649/2012. The penalties, if described, include fines from 1,500 up to 50,000 Euros or imprisonment from one month up to two years.

3.5.1 What kind of monitoring arrangements are established to ensure that illegal exports and storages are detected?

	No. Member States
Arrangements included	12 (AT, BE, DK, ES, FI, HU, IE, LT, MT, SE, SK, UK)
No arrangements included	5 (BG, DE, LU, NL, PT)

The majority of the respondents provided information on monitoring arrangements in place in the respective MS. In all of these MS, customs and different national and municipal authorities are responsible for monitoring and ensuring compliance with the Mercury Export Ban Regulation. The arrangements include the implementation of national legislation (namely mentioned by SE, FI, ES), regular transport/company inspections (AT, BE), harbour and border controls (DK, HU), checks on documentation relating to exports (UK, IE) and in general close cooperation of customs, authorities and police in order to detect breaches with the Regulation (DK, HU, SK). Lithuania's response included information on monitoring requirements set for temporary storage sites containing metallic mercury. In addition, Belgium provided information referring to its custom declaration database (PLDA database) which includes a control mechanism that identifies the PIC Regulation, also applying to metallic mercury and compounds and mixtures.

3.5.2 Do you have any recommendations for an improved/effective penalty regime or monitoring arrangement?

	No. Member States
Yes	1 (BE)
No	12 (BG, DK, ES, FI, HU, IE, LT, LU, MT, SE, SK, UK)
Not answered	4 (AT, DE, NL, PT)

Most of the respondents had no recommendations on this point. Suggestions for improved penalty regimes were not made at all. Two MS (BE, IE) provided additional input on monitoring arrangements. Belgium suggested to manage PIC and custom export data at EU level and to link the databases in order to identify illegal movements and to improve monitoring. Moreover, custom declaration forms were criticised, as no CAS number is given in order to identify the substances, meaning that the restricted compounds listed in the Mercury Export Ban Regulation cannot be distinguished comparatively to other compounds. Emphasis was also put on the difficulties in identifying companies that do not declare goods as substances targeted by PIC because customs do not perform physical controls on dangerous chemicals for safety reasons and due to a lack of appropriate expertise. Ireland ticked ‘No’ in the questionnaire, however stated that the lack of specific CN codes for each individual compound required investigations to identify the actual compounds being exported. The additional resource needs resulting from this enforcement of the Regulation were highlighted.

3.6. What is your estimate of the direct budgetary consequences your national competent authorities had regarding the implementation of the Regulation (one-time input)?

	No. Member States
No costs/input	2 (BG, LT)
Marginal (less than 1 man-week of work)	6 (BE, DK, LU, MT, SE, UK)
Moderate (1-2 man-weeks)	4 (AT, ES, FI, IE)
Substantial (2-4 man-weeks)	1 (SK)
Significant (more than 1 man-month)	0
Don’t know	2 (HU, NL)
Not answered	2 (DE, PT)

The majority of the respondents (ten MS) classified the direct budgetary consequences resulting from the implementation of the Regulation as marginal or moderate. Only one country (SK) reported substantial budgetary consequences whereas significant consequences were indicated by no MS at all.

No MS could provide information on specific costs from separate budget lines.

Belgium added as a comment that the implementation of the export ban under the Mercury Export Ban Regulation is organized on basis of the PIC regulation general process considering a few specific arrangements (substance banned similarly as it is the case for the POPs regulation and specific exemption). It is a major asset for BE to keep on the same basis for ensuring the fulfilment of the export ban as already established for the treatment of the overall PIC provisions.

3.7. What is your estimate of the incremental budgetary consequences your national competent authorities have annually (on average) in relation to the Regulation?

	No. Member States
No costs/input	3 (BG, LT, SE)
Marginal (less than 1 man-week of work)	6 (AT, BE, DK, IE, LU, MT, UK)
Moderate (1-2 man-weeks)	2 (ES, FI)
Substantial (2-4 man-weeks)	1 (SK)
Significant (more than 1 man-month)	0
Don't know	2 (HU, NL)
Not answered	3 (DE, PT)

Estimations of the incremental costs in relation with the Regulation were diverse with the majority of the MS estimating no (three MS) or marginal costs (seven MS). Two MS indicated moderate costs and only one respondent (SK) assessed significant costs. The remaining respondents either couldn't estimate the financial consequences or didn't provide any answer at all. Both Belgium and Denmark referred to answer six for additional information. Again, no country provided specific information on costs. This lack of precise information was justified by Denmark with uncertainties and case-by-case influences, making it impossible to estimate annual costs.

3.8. Have you experienced that any provision of the Regulation has been inefficient or a disproportionate source of costs (relatively)?

	No. Member States
Yes	1 (BE)
No	13 (AT, BG, DK, ES, FI, HU, IE, LT, LU, MT, SE, SK, UK)
Not answered	3 (DE, NL, PT)

Apart from Belgium, no other MS stated, that it considers provisions of the Regulation resulting in inefficiency or disproportionate costs. The Belgian response emphasized once again the reduced effectiveness due to potential loopholes such as the above mentioned mixtures of mercury with mercury concentrations of at least 95 % and suggested the improvement of data coherence in order to enhance the effectiveness of the Regulation. For further proposals and recommendations, reference to the previous questions is made.

3.9. Have you experienced any overlaps, discrepancies, contradictions or similar issues of the Regulation with other EU legislation?

	No. Member States
Yes	5 (AT, DK, IE, LT, MT)
No	8 (BE, BG, FI, HU, LU, SE, SK, UK)
Not answered	4 (DE, ES, NL, PT)

About one third of the respondents included information on this question. Two countries (DK and MT) pointed to overlaps of the mercury export ban with REACH. Austria addressed overlaps with Regulation (EC) No. 1013/2006 on shipments of waste. The Irish response made reference to question 5.2, stressing again the fact that in all substance/compound trade controls across different pieces of EU legislation, the lack of specific CN codes creates problems and additional efforts for investigations. Lithuania emphasised the fact that with the requirements for the export of mercury and mercury compounds and for the storage of metallic mercury considered as waste being scattered in several legal acts (namely Regulation No. 1102/2008, Council Directive 2011/97/EU on specific criteria for the storage of metallic mercury considered as waste, Regulation No. 649/2012), the implementation was troublesome. It was suggested to merge and streamline the existing EU legislation and forthcoming requirements on mercury.

3.10. If you have any additional comments regarding the efficiency and effectiveness of the Regulation, please comment here.

	No. Member States
Comments included	3 (BE, ES, SE)
No comments included	14 (AT, BG, DE, DK, FI, HU, IE, LT, LU, MT, NL, PT, SK, UK)

Three of the contacted MS made use of the opportunity to include further comments regarding the Regulation and its implementation. Throughout the whole questionnaire, Belgium suggested additional provisions going beyond the current EU legislation, especially concerning end uses and specific identification of exported mercury compounds. Belgian PIC competent authority has introduced simplified procedures for quantities below 10 kg per year, exporter, and importing country, obligating importers to declare the end use a mercury compound is directed to. Moreover it is criticised that customs use CN codes which allow no distinction between individual mercury compounds, meaning that banned compounds cannot be clearly identified. Obligatory declaration of the substances' CAS number would allow identification of illegal movements and facilitate monitoring. Moreover, an additional provision on the EU import of mercury is suggested, including an obligation of explicit consent (as required for chemicals included in parts two and three of Annex I to the PIC Regulation) also for the import of mercury and mercury compounds and clear identification of the intended use by the industry sector or other activity. This recommendation provided by Belgium was explained to be motivated by the needs related to the implementation of the MC. The suggestion aims at the identification of remaining uses in EU and the respective consumption, in order to achieve further reduction of emissions of mercury, and at simplified identification of potential uncompliant uses.

Spain remarked that EU legislation should resort to the wording of the MC on Mercury and thus require 'operations that do not lead to recovery, recycling, reclamation, direct re-use or alternative uses' for the disposal of metallic mercury considered as waste. Otherwise re-export of mercury wastes could result in mercury wastes re-entering the market. This observation was also included in one of the comments contained in the Belgian response.

APPENDIX 8.2 – OTHER STAKEHOLDER RESPONSES

A separate questionnaire was sent to specific stakeholders who may have been affected by the implementation of the EU mercury export ban. Companies involved in mercury commodity trade (36 companies identified earlier as mercury traders), recovery/recycling of mercury (the 5 key companies involved in this activity in the EU) and chlor-alkali production (23 companies) have been contacted[141]. This appendix provides a summary of the responses received as well as a list of companies contacted (see at the end of this appendix).

1. Which companies responded to the survey?

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Yes	13	4	1

18 companies responded to the survey by returning answered questionnaires. 13 of the respondents are active in chlor-alkali production, four either in mercury waste management or trade with mercury commodities or both, and one company does research on mercury treatment as waste as well as storage (hereinafter allocated to category 'other'). In addition, eight companies did not submit a questionnaire response, but replied by e-mail that they did not trade or otherwise deal with mercury.

2. Questions regarding the efficiency and effectiveness of Regulation 1102/2008

2.1 Before receiving this questionnaire, were you aware of the existence of the Mercury Export Ban Regulation?

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Yes	13	4	1
No	0	0	0

Without exemption, all responding stakeholders of all sectors had already been aware of the existence of the Regulation. Nevertheless, one mercury trade and waste treatment company stated that a lot of inquiries for mercury deliveries are still received both from European and international side, which indicates that the company's clients are not yet fully aware of the Regulation.

[141] Potential mercury trading companies were identified with the help from Peter Maxson of Concorde East/West, who have made surveys on this issue in earlier studies. The key mercury recyclers were identified in earlier studies performed by COWI and BiPRO. The chlor-alkali companies were contacted initially via Euro Chlor. Follow-up contacts were made by COWI/BiPRO.

2.2 In case your company is affected by the Regulation, how do you estimate the (one-time) effort you made regarding the implementation of the Regulation in your company procedures?

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Not affected	2	0	0
Marginal (less than 2 man-days of work input)	4	1	0
Moderate (2-5 man-days)	3	0	0
Substantial (1-2 man-weeks)	2	0	0
Significant (more than 2 man-weeks)	2	2	1
Don't know	0	1	0

Among the companies active in chlor-alkali industry, responses to this question were quite evenly distributed with a slight peak for marginal (four companies) and moderate (three companies) estimated one-time effort. Two respondents each indicated substantial, significant and no effects at all. Only one company added a further comment, indicating that the implementation of the Regulation had caused no one-off costs (0 EUR).

Waste management and trade companies seem to have made greater efforts in relation to the implementation of the Regulation, as two out of four companies reported significant one-time effort. This could possibly be connected with the market potential for final disposal required in the Mercury Export Ban Regulation or the additional requirements regarding mercury trade. One company active in waste treatment estimated only marginal efforts. None of the companies provided information on specific costs.

Also, the company responding in the category 'other' activities stated that they have made significant efforts due to the implementation of the Regulation. No specific values for these one-off costs were provided.

2.3 In case your company is affected by the Regulation, to what extent do you agree that your company's annual administrative burden related to complying with the Regulation is minimal compared to the other administrative work in your company?

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Not affected	3	0	0
Agree	6	1	1
Agree partly	2	0	0
Don't know	0	1	0
Disagree partly	0	1	0
Disagree	1	1	0
Not answered	1	0	0

More than half of the stakeholders involved in chlor-alkali production agreed (six companies) or agreed partly (two companies) with the statement that the company's annual administrative burden related to complying with the Regulation was minimal compared to the other required administrative work. Only one company disagreed, whereas the remaining ones did not answer the question or stated not to be affected.

The four waste management and mercury trade companies responding to the questionnaire all replied differently, ranging from agreement to disagreement. Therefore no general tendency can be determined.

The company operating in research agreed on the statement that, in comparison to other administrative work, the annual administrative burden related to complying with the Regulation is minimal.

2.4 In case your company is affected by the Regulation, what is your estimate of the annual administrative burden your company has because of the Regulation?

	No. Chlor-alkali industry	**No. Mercury waste management and trade**	**No. Other**
Not affected	2	1	0
Marginal (less than 2 man-days of work input/y)	5	0	1
Moderate (2-5 man-days/y)	4	0	0
Substantial (1-2 man-weeks/y)	0	0	0
Significant (more than 2 man-weeks/y)	2	2	0
Don't know	0	1	0

Among the companies belonging to the chlor-alkali sector, a majority of nine respondents reported marginal (five companies) or moderate (four companies) annual administrative consequences from the Regulation. Two companies each stated that they were not affected at all or that, on the contrary, significant administrative burden had to be dealt with because of the Regulation. Again, one company included a value of zero EUR for the resulting annual cost. The response of another company pointed out that arrangements were still being set up meaning that time requirements were still uncertain.

As to the waste management and mercury trade business, two out of four companies reported significant annual administrative burden. Response patterns suggest that increased administrative efforts apply especially for trade companies dealing with mercury and mercury compounds rather than for waste treatment companies recycling/recovering mercury. None of the respondents included information on specific costs.

The remaining company stated to have experienced marginal additional administrative burdens due to the Regulation. Specific values were not provided.

2.5 In case your company is affected by the Regulation, have you experienced other relevant costs related to the implementation of the Regulation?

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Yes	5	3	0
No	7	1	1
Not answered	1	0	0

Five of the thirteen respondents from the chlor-alkali industry stated that they had experienced other relevant costs resulting from the implementation of the Regulation; see details below.

Three out of four companies active in waste treatment and mercury trade indicated to have dealt with other costs due to the implementation of the Regulation.

The company belonging to the category ‘other’ indicated not to have experienced further costs.

Cost types:

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Cost for storage of mercury and compounds (…)	4	1	0
Lost profits from sales of mercury or compounds	3	3	0
Other costs	2	2	0

Regarding the types of costs, costs for storage of mercury and compounds considered as waste in the Regulation played the most important role for the representatives of the chlor-alkali sector (indicated by four companies). In this context, one company stated that corresponding costs resulted from material and man-hours for packaging of the mercury waste, whereas another company ascribed the additional costs to the upgrading of temporary storage sites. Lost profits from sales of mercury or compounds ranked second (three companies), whereas two companies stated that these costs were difficult to determine. In addition, two companies indicated other costs related to the implementation of the Regulation, however only one of them specified these costs, namely as treatment/disposal costs for metallic mercury which can no longer be sold as commodity.

Among the representatives from waste management and mercury trade, lost profits from sales of mercury or mercury compounds were reported most frequently. They were specified to amount to at least 500,000 EUR/y by one company previously mostly exporting to African countries, whereas another company indicated lost profits of approximately 200,000 EUR/y. Moreover, one company stated to have made storage investments of approximately 500,000 EUR for the construction of an appropriate warehouse offering capacity for 500 tonnes of metallic mercury. In addition, different other types of costs were experienced by the responding companies of these sectors, such as lost investments made earlier for special machines in relation with the production of capsules for dental amalgam (stated by two companies). One respondent specified such lost investments at a cost of approximately 260,000 EUR. Moreover, one company had to deal with unpaid invoices from customers after further mercury deliveries had to be stopped (creating a loss of 92,046 EUR). They had with attorney costs arising from issues with the competent authorities concerning Art. 2 of the Regulation, regarding the issue whether mercury gained from sludge, scraps, dust and other waste products from chlor-alkali industry or natural gas cleaning recovered by recycling companies has to be considered as waste or commodity.

2.6 In case your company is affected, have you experienced that any provisions of the Regulation have been unclear, inefficient, or sources of disproportionate costs (relatively) from your point of view?

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Yes	2	3	0
No	9	1	1
Not answered	2	0	0

Only two of the contacted chlor-alkali producers provided further information on provisions of the Regulation which have been unclear, inefficient, or sources of disproportionate costs. One company highlighted final storage of mercury, lacking decisions concerning the handling of mercury and costs for temporary storage and stabilization as problematic provisions of the Regulation; however, specific proposals for simplification were not given. The response provided by the other company indicated that UK companies suffer from competitive disadvantages due to the national authorities' decision to classify mercury recovered from the treatment of waste streams that originate from the chlor-alkali industry as waste. They stated that according to their information, competent authorities of other MS regard this type of mercury as a commodity which is not covered by Art. 2(a) of the Regulation. It is therefore recommended in the company's response to clearly define whether Art. 2(a) applies to metallic mercury in use or stored in plants only, or also to mercury recovered from waste treatment activities.

Two representatives of the waste management and mercury trade sector again criticized Art. 2 of the Regulation, stating that it is not clear which substances are covered by this provision. They state that it is required to clarify whether mercury still contained in sludge, scraps, dust or other waste products is to be considered as waste. Disparate interpretation of this provision in the different MS is criticized as well. Two other companies emphasized the fact that from their point of view, mercury for dental use in amalgams should be excluded from the ban. One respondent questioned the entire export ban, arguing the fact that mercury is still used in many applications within and outside the EU and whether foreign authorities are not regarded able to enforce reasonable use of mercury. The same respondent also added that many inquiries from international and European clients for the delivery of mercury are still received, showing the so-far insufficient awareness of the Regulation both globally and in Europe.

2.7 Have you experienced any overlaps, discrepancies, contradictions or similar issues between the Regulation and other EU legislation?

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Yes	1	3	0
No	11	1	1
Not answered	1	0	0

Only one stakeholder of the chlor-alkali industry provided information regarding this question. It reported the Industrial Emissions Directive and the Best Available Techniques (BAT) Reference Document for the Production of Chlor-alkali as potential sources of overlaps, discrepancies or contradictions without mentioning further explanations.

Three of the four representatives from waste management and mercury trade companies stated that the Regulation interfered with other EU legislation. However, the corresponding legislation was not specified.

The remaining company did not share any experiences on this point.

2.8 Have you experienced changes in the possibilities of selling mercury and mercury compounds (apart from the specifically banned substances/materials) since the Regulation entered into force (for example changes in the trade patterns, in the demand, in the type of mercury compounds sold, etc.)?

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Yes	2	3	0
No	10	1	1
Not answered	1	0	0

Among the chlor-alkali producing stakeholders, only two companies have witnessed changes in the possibilities of selling mercury and mercury compounds since the Regulation entered into force, see details below.

Three out of four respondents operating in waste management recycling/recovering mercury or in trade of mercury and its compounds stated to have experienced such changes.

The company allocated to the category ‘other’ reported not to have noticed changes.

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Change in prices	2	2	0
Change in demand	2	2	0
Change in trade patterns	1	1	0
Change in types of mercury compounds sold	0	1	0
Other changes	0	2	0

Regarding the types of changes, changes in prices (reported by two companies), in demand (two companies) and in trade patterns (one company) have been experienced by two chlor-alkali producing firms. One company attributed changes in prices to limited use of mercury, changes in demands to decreasing application of mercury electrolysis and changes in trade patterns to the export ban in general and the transition of mercury from product to waste. Change in types of mercury compounds sold or other changes were not reported from the chlor-alkali sector in the scope of this survey.

Among waste management and mercury trade companies, increasing price of mercury due to reduced availability of mercury on the world market has been noticed as a consequence of the export ban. As far as changes in demand are concerned, two companies stated that the demand for mercury is decreasing in Europe, but that it is still considerable outside the EU (one company). In particular the demand for dental amalgam capsules seems to have increased in non-EU countries according to one representative of the sector, resulting in an increased demand for so-called mercury pillows (a semi-manufacture) used for the production of dental amalgam capsules. The reason for the increased demand is the decreased production of dental amalgam capsules by European manufacturers due to the mercury export ban. The same respondent stated that the ban might restrict the access of socially weak citizens to dental treatment and that studies do not prove harmful effects of dental amalgam on human health. Moreover, one respondent indicated other changes due to the Regulation. A change he specified is the production of Hg outside the EU and the fact that products of non-EU origin are still sold to non-EU countries in the same quantities as before the mercury export ban.

2.9 In case you experienced changes as mentioned above, have you experienced other factors than the Regulation that may have caused these changes?

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Yes	2	0	0
No	7	4	1
Not answered	4	0	0

The two respondents of the chlor-alkali sector which had experienced changes in the possibilities of selling mercury and its compounds both attributed those changes also to factors going beyond the Regulation. Whereas one company referred to the Best Available Techniques (BAT) Reference

Document for the Production of Chlor-alkali, another company identified a general decrease in the application of mercury electrolysis as well as the upcoming phase-out date for mercury in the chlor-alkali production (closure or conversion of mercury cell plants no later than 2017) as potential causes.

None of the other industry representatives identified further causes for the experienced changes.

2.10 In case you have needed to store mercury or mercury compounds considered as waste in the Regulation after its entry into force, is it your experience that there is sufficient storage capacity in the EU?

		No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
For temporary storage	Yes	2	1	0
	No	6	0	0
For final storage	Yes	2	0	0
	No	6	1	0
Not answered		5	3	1

The majority of the chlor-alkali producers answering the question on storage capacity in the EU believe that there is neither enough temporary (six companies answered with ‘No’) nor final storage capacity (again six companies ticked ‘No’). Also in the comment section related to this question, several companies emphasized the fact that, from their point of view, available storage and treatment facilities were insufficient.

Three out of four companies involved in mercury trade and waste management activities did not answer this question. However, two of them justified their abstention with a lack of experience on these issues. One respondent highlighted the fact that there seems to be insufficient capacity for the transformation of mercury into a disposable compound such as mercury sulphide, as many inquiries concerning this measure were received. According to the one company answering the question, capacity for temporary storage is sufficient, but final storage of mercury waste is a huge problem and needs to be solved. It was added that local authorities set up all sorts of formal hurdles, and that they should ‘combine forces’ in order to get things organised swiftly.

2.11 Does your company export out of the EU mercury compounds mentioned in the Regulation as exempted uses (R&D, medical uses, analysis), or other mercury compounds or mixtures of metallic mercury not banned according to the Regulation?

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Yes	1	0	0
No	12	4	1
Not answered	0	0	0

Among the companies active in the chlor-alkali sector, only one company stated to export other mercury compounds or mixtures of metallic mercury not banned according to the Regulation out of the EU. Again, the response emphasized the fact that the company would like to export mercury containing waste to treatment facilities outside the EU, as already explained in question 3.6.

None of the companies belonging to the other sectors indicated corresponding export activities.

2.12 Has any export of mercury and mercury compounds been observed, which is illegal according to the Regulation?

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Yes	1	1	1
No	11	2	0
Not answered	1	1	0

Only one chlor-alkali producing company provided information on illegal exporting activities of mercury or mercury compounds, referring to the well-known case of Dela in Germany.

Also one representative of the waste management and mercury trading companies cited this example, stating that some 500 tonnes of liquid mercury have been shipped from Dela in Germany to Batrec in Switzerland.

2.13 If you have any further comments to the Regulation or to this questionnaire, please insert them here.

	No. Chlor-alkali industry	No. Mercury waste management and trade	No. Other
Comments included	4	4	0
No comments included	9	0	1

Four of the respondents belonging to the chlor-alkali industry added further comments regarding the Regulation and its implementation. One company once again made reference to the uncertainties in relation with the interpretation of Art. 2(a) of the Regulation. Also another company addressed legal uncertainties in Switzerland concerning the import and export of mercury between Swiss and EU chlor-alkali plants. Two other companies commented on the fact that with Dela GmbH in Germany, the only company authorized to treat mercury was shut down, resulting in a lack of adequate treatment facilities. The offer of appropriate alternatives for chlor-alkali producers wishing to dispose of or treat mercury is requested.

Comments added by companies operating in mercury waste management or trade include criticism concerning the Regulation in general, which is even regarded partially illegal by one representative, and concerning the ban of mercury exports for the use in dental amalgam outside EU in particular. In addition, one comment included the recommendation that Switzerland should commit itself to complying with EU legislation concerning mercury, in order to prevent further illegal exports of mercury, as those observed in the case of Dela GmbH in Germany.

Contacted companies

Company	Country	Trade	Recycling/Re-covery	Chlor-alkali	Other	Quest-ionnaire returned	Not/no longer involved in activities related to mercury
A&M Minerals & Metals	UK	x					x
A.H.Knight	UK	x					
Acros Organics BVBA	BE	x					
AkzoNobel	NL			x		x	
Alex Stewart International	UK	x					
Ampere Alloys	FR	x					
Arkema France	FR			x		x	
BASF SA	DE			x		x	
Bayer MaterialScience AG	DE			x		x	
BMT Begemann Milieutechniek BV - Dordrecht	NL	x	x			x	
BOME, s.r.o.	CZ	x	x			x	
BorsodChem RT	HU			x		x	
BRGM	FR	x					
BSI Inspectorate	-	x					
CABB AG	CH			x		x	
Cfm Oskar Tropitzsch GmbH	DE	x				x	
Chemos GmbH	DE	x					
Dragten Metaux	FR	x					
Ercros SA	ES			x		x	
Euro-Rijn	NL	x					
Evonik Industries AG	DE			x		x	
Floridienne SA	BE	x					x
Fox Chemicals	DE	x					
Gimat S.A.S	IT	x					
GMR Gesellschaft für Metallrecycling mbH	DE	x	x			x	
Gomensoro Instrumentación Científica	ES	x					
Hellenic Petroleum SA	EL			x			
Hollands Veem BV	NL	x					x
HydroChem Italia Srl	IT			x		x	
INEOS ChlorVinyls Ltd	BE			x		x	
INEOS ChlorVinyls Ltd	UK			x		x	
INEOSCHLOR	DE			x			

Company	Country	Trade	Recyclin g/Re-covery	Chlor-alkali	Other	Quest-ionnaire returned	Not/no longer involved in activities related to mercury
INEOSCHLOR	SE			x			
Johnson Matthey Ltd.	UK	x					x
Kem One	FR			x		x	
Lambert Metals International Ltd.	UK	x					
Lippmann Walton	UK	x					x
M&R Claushuis	NL	x	x				
METALLUM Metal Trading AG	UK	x					
MINAS DE ALMADÉN Y ARRAYANES, S.A. – COMMERCIAL AREA MAYASA	ES	x			x	x	
OltChim SA	RO			x		x	
Panreac Quimica	ES	x					
Remondis NQR	DE	x	x				
RJH Trading	UK	x					x
Rokita SA	PL			x			
Sanab Ltd	UK	x					
Schartab SL	ES	x					
SFP Metals (UK) Ltd	UK	x					x
Sigma-Aldrich Chemie Gmbh	DE	x					
Solvay SA	BE			x			
Spolana as	CZ			x			
Spolchemie AS	CZ			x		x	
Syndicat Halogènes & Dérivés Chimie Minérale	FR			x			
Tessenderlo	BE			x			
Tessenderlo	IT			x			
THOR GROUP LIMITED	UK	x					
Trademet UK (Trademet SA)	UK	x					
Vertellus Chemicals SA	BE	x					
Wogen Resources	UK	x					x

ANNEX 9A – DETAILED IMPACT ASSESSMENT OF P2 (PRODUCTS)

This annex summarises the impacts for the following mercury-added product categories:

- Switches and relays
- Batteries
- Non-electronic measuring devices
- Cosmetics
- Pesticides, biocides and topical antiseptics

As the EU has legislation regulating all of the above product categories, the implementation of the MC will not require any additional measures.

Switches and relays

For mercury-added switches and relays (whose use has been declining for decades in the EU), the MC requirements are similar to existing EU law. Thus, the impacts of the two options would be similar.

Under the baseline scenario (EU does not ratify the MC), EU exports might be negatively affected by import restrictions imposed by Parties to the Convention.

COWI and Concorde East/West (2008) estimated a total mercury consumption for switches, relays and similar products in the EU at 0,3 – 0,8 t/y, and exports of about 0,3 t/y. It is not known whether this export trade still exists and if it would be affected by either option, but any potential impact would by minimal.

Batteries

Mercury containing batteries are regulated within the EU by the Batteries Directive[142] that has prohibited their placing on the EU market, with certain exemptions for mercury-containing[143] button cells. Thanks to a recent amendment[144] such exemptions expire on 1 October 2015.

The relevant mercury-added battery types are mercury oxide batteries (banned in the EU since 2006) and silver oxide, air-zinc and alkaline button cells (allowed with mercury concentration up to 2% until October 2015), as mentioned above.

Eurostat data on battery production were checked, but were not sufficiently detailed to provide information on production of these specific batteries (all primary cells are aggregated under one industry code). A check of Eurostat data for the extra-EU28 trade in t/y of the relevant battery showed a net import into the EU28 of the following three types for all years in the period 2011-2013: mercury oxide (average 248 t/y), silver oxide (average 110 t/y) and zinc-air batteries (average 1 326 t/y)[145]. No trade data were available for alkaline button cells. For mercury oxide batteries the reported data showed an average export in 2011-2013 of 0,55 million EUR/y, whereas for silver oxide batteries it was 30 million EUR/y, and for zinc-air batteries it was 50 million EUR/y. According to EPBA[146], of these battery types only zinc-air batteries are produced in significant amounts within the EU today. EPBA explained that the same production lines can produce batteries

[142] Directive 2006/66/EC, OJ L266, 26.9.2006, p.1

[143] Mercury content up to 2% by weight

[144] Directive 2013/56/EU, OJ L329, 10.12.2013, p.5

[145] For silver oxide and zinc-air batteries, a net export in EUR/y was reported. As the physical characteristics of the trade (in tonnes/y) is deemed a more precise indicator of actual trade (than value in EUR), it is assumed that an actual net import of silver oxide batteries is taking place.

[146] The EPBA (2015) states that a transition period of at least 12 months will be needed in case legal changes for the battery production are introduced.

with or without mercury. Only the material composition differs and can be adjusted according to the customer order.

The standard EU mercury concentration in zinc-air batteries has been stable for many years at well below 2% (before mercury-free types were introduced; see also UNEP, 2013). We can therefore assume that the current EU based production of batteries is in conformity with the MC requirements; option **P2O1** is expected to have no negative impacts for EU-based battery production.

Regarding option **P2O2**, it is possible that some small scale manufacturing of mercury-added zinc-air batteries could continue for customers outside the EU after October 2015, when the exemption for button cell batteries with mercury concentration below 2% ceases, and such production may thus be affected by option **P2O2**, with possible losses of export revenues of 0–50 million EUR/y.

However, the European Portable Battery Association (EPBA) has supported option **P2O2** and alignment of a restriction on export and production of mercury containing button cells with the existing deadline in the Batteries Directive (EPBA, 2014). The EPBA was asked for data on exports of EU produced mercury-added batteries that would be affected under options **P2O1** and **P2O2** respectively, but was not in a position to supply such data. However, its support for option **P2O2** for production and export indicates that negative impacts on EU battery producers may be small.

COWI and Concorde East/West (2008) estimated the mercury exported from the EU within batteries in 2007 at 12-14 t/y. Other data reported by that study indicate that much of this was likely to have been in mercury oxide batteries. Taking into account the above information from EPBA, the potential for reducing mercury exported from the EU within batteries is estimated at zero (0) for the option **P2O1** and 0-5 t/y for option **P2O2**. Mercury releases from EU based battery production are not known, but are expected to be minimal in this context.

Non-electronic measuring devices

Measuring devices containing mercury for use by the general public have been banned within the EU since 2006[147], while since 10 April 2014[148] the ban has been extended to devices intended for industrial and professional uses.

Barometers, hygrometers, manometers, thermometers and sphygmomanometers are targeted in the MC with a phase-out date of 2020. As this group of products is severely restricted in the EU, mercury consumption associated with these products has been declining steadily over the last decade. COWI and Concorde East/West (2008) estimated a total mercury consumption for the whole product group of approximately 7-16 t/y, and an export of about 8 t/y. Current consumption is expected to be substantially lower, and probably below 3 t/y. The current export tonnage is not known. Nor is it known whether this export will be affected by either option **P2O1** or **P2O2**.

Three thermometer manufacturers, which have experienced impacts from the introduction of EU regulation in this field, made submissions in the context of the stakeholders' consultation[149]. Two (Ludwig Schneider and Berman) focused on mercury-filled precision thermometers (used for calibration, etc.) and would thus not suffer incremental impacts from option **P2O1**, but could potentially be affected under option **P2O2** (depending on the specific uses of the thermometers). The third (Russel Scientific) advised that even under the current EU law their production would need to be terminated (in accordance with entry 18a of Annex XVII to REACH). Ludwig Schneider stated that about 400 jobs are at stake in Germany alone if mercury use in thermometers was fully prohibited (a strategy not considered in this study). According to Ludwig Schneider about 50-60%

[147] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), as amended by Commission Regulation (EC) No 552/2009

[148] Commission Regulation (EU) No 847/2012

[149] Stakeholder contribution from Ludwig Schneider, Berman and Russel Scientific (available at http://ec.europa.eu/environment/chemicals/mercury/ratification_en.htm)

of the EU production of thermometers is exported, meaning that about 40-50% is marketed within the EU, and thus presumably complies with EU regulation. This indicates that neither option **P2O1** nor option **P2O2** would affect this production significantly. Ludwig Schneider[150] estimates that the European thermometer manufacturers in total use less than 1 t of mercury per year. But, as mentioned above, this consumption would not be affected at all under option **P2O1** and any impact under option **P2O2** is likely to be minimal.

COWI and Concorde (2008) reported that, at that time, 25-45 persons were employed in the manufacture of mercury sphygmomanometers that were exported out of the EU. The report also indicated that a ban of the export of mercury sphygmomanometers would significantly impact the manufacturers because some overseas customers would switch to non-EU mercury sphygmomanometers. However, mercury sphygmomanometers were at that time manufactured by at least four SME manufacturers in the EU. These all produced mercury-free sphygmomanometers as well, and consequently industry costs for substitution were expected to be negligible.

Since then significant efforts have been made globally to develop substitutes for mercury instruments in hospitals. The World Health Organisation (WHO, 2011) has issued guidance recommending the general use of mercury-free thermometers and sphygmomanometers. There is therefore a global move away from use of these mercury-added products even before the introduction of the MC. With the exemption for precision instruments in the MC, (some of) the export from the EU may continue after implementation of the MC.

Cosmetics

Both marketing and export of mercury-added cosmetics have long been banned in the EU, and an exemption for a low-concentration mercury compound preservative in eye drops is expected to also be exempted under the MC. Therefore no impacts are expected under option **P2O1** or **P2O2**.

Pesticides, biocides and topical antiseptics

Mercury and mercury compounds are not approved as active substances for plant protection products or biocides under EU legislation. No uses of mercury-added pesticides were identified by COWI and Concorde East/West (2008), but a mercury consumption of 4-10 t/y was estimated for biocide/preservative in water-based paints. The report did not specify how much of this was exported.

[150] Stakeholder contribution from Ludwig Schneider (available at http://ec.europa.eu/environment/chemicals/mercury/ratification_en.htm)

ANNEX 9B – DETAILED IMPACT ASSESSMENT OF P4O2 (PROCESSES)

Baseline conditions

Two companies in the world produce the alcoholates in question with mercury-dependent technology. Both production sites are in Germany. The same companies - which are reported to be significant players in the global market - produce sodium methylate (the one of the four alcoholates with largest volumes) with mercury-free technology in other parts of the world[151], as do all other known global producers. The mercury process is reported to have about 20% lower production costs than existing alternatives, but is dependent on the presence of an existing local demand for co-produced chlorine. In the existing production, the facilities are situated on the same sites as mercury cell chlor-alkali plants. Industry has stated that the production is not covered by the voluntary industry commitment to abandoning the mercury cell chlor-alkali process by 2020, nor covered by the IED deadline for cessation of the chlor-alkali process.

The registration status of the four substances as of April 2014 in ECHA's registration of joint submissions, and the registrants, are shown in *Table 9B-a*. The registration bands give an indication of the scale of production of each substance.

Table 9B-0-a Registered volumes (production + imports) of the four alcoholates in the EU targeted by the Minamata Convention, and the companies which have submitted the registrations (ECHA, 2014a).

Substance name	CAS No	Registered volume, t/y (volume band)	Registrants
Sodium methanolate (Sodium methylate)	124-41-4	100 000 – 1 000 000	BASF SE (DE) Evonik Degussa GmbH (DE) Desatec GmbH (DE) DSM Nutritional Products (UK) Ltd (UK) DSM Nutritional Products GmbH (DE) DuPont Nutrition Biosciences ApS (DK) EnviroCat (FR)
Sodium ethanolate (Sodium ethylate)	141-52-6	1 000 – 10 000	BASF SE (DE) Evonik Degussa GmbH (DE)
Potassium methanolate (Potassium methylate)	865-33-8	1 000 – 10 000	BASF SE (DE) Evonik Degussa GmbH (DE) Suomen Muurahaishappo Oy (FI)
Potassium ethanolate (Potassium ethylate)	917-58-8	Currently not registered, i.e. the volume is <100	The substance is pre-registered (ECHA, 2014b)

Sodium/potassium methylates (also called methoxides) are compounds used primarily for "cracking" of plant/animal oils for biodiesel. The methyl alcoholate induces a transesterification (partial "decomposition") of the fatty acid glycerides, forming linear mono-alkyl esters, which is the biodiesel, and the alcohol glycerol. Sodium/potassium methylates are the major substances used for this purpose (Biodiesel Magazine, 2012). Sodium methylate is primarily used for plant oils, while potassium methylate is primarily used for animal fat and used cooking oils. Animal fat and used cooking oils are used in much lower amounts than fresh plant oils in biodiesel production.

According to BASF (stakeholder consultation input), the trends in the methylates market are mixed, with an overall stagnant tendency for bio-diesel production, but growth in some regions and for some uses. High growth is observed in production of Omega-3 fatty acids - a large consumer of sodium ethylate – and in agrochemicals.

The trade press identifies BASF, Dupont, SMOTEC Plus and Evonik as suppliers of alcoholates for biodiesel production (Biodiesel Magazine, 2012). SMOTEC Plus is a Germany-based catalyst

[151] Because according to Evonik (2014), there is no local demand for the co-produced chlorine in these production sites.

manufacturer which produces sodium methylate with a mercury-free process in its production plant in Saudi Arabia. The mercury-free process was, according to Biodiesel Magazine (2012), chosen because the product is then suited for the food, pharmaceutical and nutraceutical markets, and because, as SMOTEC Plus is cited: "Unless you're in the chlorine [supply] chain, you can't get the feedstock" for the mercury-based alcoholate production process. Depending on feedstock type and quality, also acid catalysts like sulphuric acid and methanesulfonic acid are used in biodiesel production.

Sodium methylate is also used for pharmaceuticals, food ingredients and pigments (Envirocat, 2014 and Jackson, 2006). A broader range of alcoholates, including sodium/potassium ethylate and sodium/potassium methylate, are used for a number of different purposes in synthesis of organic chemicals (BASF, 2013).

Sodium ethylate is mainly used for pharmaceutical applications, which is a small market in the EU according to registrations and Envirocat (2014). According to BASF/Evonik (2012) and Evonik (2014), potassium ethylate and sodium ethylate are used as catalysts in the synthesis of pharmaceuticals, pesticides, aroma substances, coatings, edible fats and fine chemicals, partly in internal production, partly externally.

The submission from Evonik (2014) advised that sodium ethylate is an ingredient for syntheses of high-value products such as pharmaceuticals, crop protection products, aroma substances, coatings, edible fats and fine chemicals. Evonik suggests that there would be impacts on these markets if sodium ethylate was no longer available, e.g pharmaceutical companies would have to develop (and obtain approval for) new formulations, leading to additional costs.

Evonik also advised that potassium ethylate is essential in providing ethylate functionality alongside the alkaline strength of potassium in a ready to use, non-aqueous form. This is an advantage in the manufacture of nutritional supplements (analogous to Omega 3) and pharmaceuticals, as well as novel automotive lubricants.

The market

Based on information from Evonik (2014) and Envirocat (2014) the total annual production of sodium methylate in the EU is estimated at 250 000-300 000 t of 30% sodium methylate solution (in methanol), of which about 160 000-200 000 t/y are consumed in the EU, while the rest is exported. The export production is currently based solely on the mercury process.

Evonik (2014) assesses the global market at around 480 000 t/y of 30% sodium methylate solution.

According to BASF (2014), the general market price range for undiluted sodium methylate is between 2 100 and 2 800 EUR/t 100 % sodium methylate. Envirocat (2014) states that the bulk supply price for sodium methylate for biodiesel production in Europe in 2013 was around 700 EUR/t of a 30% solution in methanol (ready for use) and slightly higher for high quality sodium methylate from the non-mercury process. Some five years ago, the price was around 600 EUR/tonne 30% solution. The price is very dependent on the methanol price. Evonik (2014) mentions an average sales price of 850 EUR/t of solution.

Envirocat (2014) states that it does not see any market preference for sodium methylate produced with a mercury vs. non-mercury process. Price differentiation is instead an effect of the grade of the product; fine chemicals and pharmaceutical production requires a purer sodium methylate quality, which is supplied from both technologies.

Based on information from biodiesel producers who produce crude potassium methylate themselves, Envirocat (2014) quotes an internal production price of around 600 EUR/t 30% methanol solution. The resulting potassium methylate is not marketed, but used by the companies themselves.

Envirocat (2014) advised that, "in the fine chemistry, potassium methylate "mercury process" was sold at 1.60 EUR/kg" (1 600 EUR/t).

The total value of the EU production of sodium methylate in 2013 is estimated at some 180–260 million EUR, of which around 90% was from the mercury-based process.

Sodium methylate exports are currently 100% mercury process based, yet the same EU-based companies are already engaged in non-mercury process production of sodium methylate outside the EU (North and South America). Such activity contributes to the global income of these companies that are headquartered in the EU.

Table 9B-0-b Estimated market volume and value of sodium methylate, 2013

Amounts; t/y 30% sodium methylate solution (in methanol):	**Low**	**High**
Global market	480 000	480 000
EU production	250 000	300 000
- Hereof mercury based	225 000	275 000
EU market	160 000	200 000
Extra-EU export	90 000	100 000
Unit price		
Average market price, EUR/t 30% solution	700	850
Value, Million EUR/y (rounded):		
Global market	340	410
EU production	180	260
-Mercury based only	160	230
EU market	110	170
Extra-EU export	63	85

Sodium dithionite production

Besides the four alcoholates, BASF also produces sodium dithionite with the mercury-based process. This compound is also produced with several other methods (by BASF and others), but the product produced with the mercury-based process has a higher quality and therefore longer shelf life. If the mercury-based production of alcoholates was terminated, the sodium dithionite production would also have to be substituted for. This would require investments in the order of 50 million EUR plus variable costs of 7 million EUR/y for BASF according to the firm's own figures[152]. This is a distributional effect and is therefore not dealt with further in this study.

Economic impacts

Option P4O2

With the regulation of mercury-based sodium methylate production required under the MC, mercury-based production may initially become more expensive due to investments in emission abatement techniques triggered by the requirement for a 50% emission reduction (unless substitution is preferred from the start), and later may be eliminated within the deadlines prescribed by the Convention (i.e. 2020, or up to 2030 if exempted).

Higher production prices could have the consequence that the physical export of sodium methylate would be reduced following the EU's (and Germany's) ratification of the Convention. On the other hand, the relevant EU companies are major global players on the sodium methylate market, and elimination of the low-cost mercury process might not necessarily reduce the market share for these firms. It has the potential to reduce their profit, especially if a total phase-out occurs before the investment in existing mercury-based production is fully depreciated.

[152] See the stakeholder consultation contribution from BASF (available at http://ec.europa.eu/environment/chemicals/mercury/)

Envirocat (2014), has quoted an establishment price of 6 million EUR for a non-mercury production capacity of 25 000 t/y sodium methylate solution (plus off-site storage and pipeline infrastructure of another 8 million EUR in total). According to Process Worldwide (2012), BASF invested an amount "in the low double-digit million euro range" for the establishment of a 60 000 t/y production capacity plant in Brazil using the reactive distillation process for sodium methylate production (non-mercury), which started operation in 2011. This is in the same range as the Envirocat investments.

Evonik (2014) states that it considers the production of the four alcoholates (in the same process) inter-dependent, and that if production of sodium methylate, sodium ethylate and potassium methylate with the mercury process had to stop, then it would probably end the mercury process production of all four alcoholates. BASF (2014) makes a similar statement: *"Since we currently do not have a process for the production of all four alcoholates, the phase out would lead to a cessation of supply of 3 of the four alcoholates […]. We could only supply sodium methylate from the above mentioned alternative source. This would severely hit customers who need these alcoholates e.g. as intermediates and catalysts"*.

If a technically and economically feasible alternative production process for the fourth and least used substance, potassium ethylate, is not developed, it would perhaps no longer be available on the market. The same could happen for potassium methylate. The potential to substitute these substances with other chemicals in their possible uses has not been investigated here.

Substitution costs were assessed, and a submission on the topic was received from BASF. To provide the background for the final estimates, the derivation of both estimates is presented here: Substituting the remaining mercury-based sodium methylate production of some 255 000 – 275 000 t solution/y would require investments of around 60–140 million EUR depending on the infrastructure available (based on Envirocat (2014) numbers). These numbers do not include any additional need for sodium metal production capacity. The current market situation for sodium metal has not been investigated. Additionally, the production costs (annual operational costs) with the alternative production process are estimated to be 20% higher than those for the mercury-based process, equalling perhaps some 10-30 million EUR per year (estimated at about 20% of half of the sales revenues) at the current production rates. Annualising the investment costs over a 10 year period gives 10 to 23 million EUR per year and combined with the increased operational costs the total additional annual costs can be estimated at 17 – 47 million EUR[153].

Similar quantitative assessment for the substitution of the production process for the other three alcoholates in question is not possible with available data, though the current production rates indicate expenses a factor 10-100 lower than for sodium methylate. Taking the lower annual production volumes for the other three alcoholates into consideration, total costs of substitution for all four substances could be assumed to not exceed 160 million EUR for investments plus a maximum of 40 million EUR/y for increased production costs. Annualising these investments over 10 years using the same assumption as above, the annualised investment costs amount to about 20 million EUR and hence, the total additional annual costs for substitution are not expected to be above 60 million EUR[154] in this cost scenario.

In its stakeholder submission to the Commission for this study BASF states that it finds the above estimates too low. The firm has presented alternative estimates for its own production (*Table 9B-c*). Evonik has rejected the above estimate (<60 million EUR) as speculative.

[153] The investment costs have been annualised using a discount rate of 4% over 10 years.

[154] Using 4% as discount rate over 10 years.

Table 9B-0-c BASF's estimate of investments and variable costs for substitution of their own mercury-based alcoholates production process

Substitution of mercury in production of	Investment, Million EUR	Min. variable cost (e.g. energy), Million EUR/a
Sodium methylate[155]	110	14
Sodium ethylate and potassium alcoholates[156]	10 to 20	4-8
Na-dithionate (non-alcoholate[157])	50	7
Total	180	25

The distribution of the market for the four alcoholates produced with the mercury-based process between BASF and Evonik is not known. Therefore the BASF substitution estimates cannot be transferred directly to an estimate of total substitution costs for the two companies. However, in the hypothetical case that a 50/50 distribution of the production between the two companies prevailed, the resulting substitution costs - for the four alcoholates only[36] - would be 240-260 million EUR in investments (or 30 to 32 million per year over 10 years[158]) plus 36-44 million EUR/y in variable production costs, equalling total annual costs of between 66 and 76 million EUR.

As more detailed data on substitution costs are not available, the range of the presented estimates for substitution, 60 – 76 million EUR/y, is used in the further assessment of impacts. There is significant uncertainty attached to this estimate.

As regards the possible costs of reducing the mercury emissions and releases by 50% by 2020 compared to 2010, Evonik (2014) has chosen to interpret the MC requirement for 50% emission and release reductions as applying to the whole production site, meaning that it considers this goal at least partially fulfilled when the expected 2017 closure/conversion of the mercury-cell chlor-alkali plant on the site is implemented. BASF (2014) addresses emissions from alcoholates production only and states that it finds the 50% reduction goal challenging, but it will "take every effort to achieve the target concerning emission reduction to air, water and products."

The costs for emission/releases reductions are difficult to assess quantitatively. Based on experience from well operated mercury cell chlor-alkali production, such reductions are most likely to be met with further improved operational mercury management practices. This was confirmed by BASF; it also found the associated costs difficult to estimate. According to Evonik[159], such further improvements would be possible but challenging, and would be expected to cost between 300 000 and 500 000 EUR/y for their facility.

Assuming that these costs would secure a 50% mercury emission reduction from the alcoholates production alone, and assuming that the costs for BASF would be similar, a total cost of 0.6 – 1 million EUR/y could be anticipated for reducing mercury emissions by 50% as required in the Convention.

[155] BASF's note: Incl. expansion of the existing membrane process for caustic (alkali hydroxides)

[156] BASF's note: Educated guess: process under development, estimation based on projected capacity.

[157] A fifth non-alcoholate chemical produced by BASF with the amalgamation process; not treated further; see text above.

[158] The annualising of the investment costs is done assuming a lifetime of 10 years and a discount rates of 4%.

[159] See the stakeholder consultation contribution from Evonik (available at http://ec.europa.eu/environment/chemicals/mercury/)

ANNEX 10A – DENTAL AMALGAM SUMMARY

This Annex presents in summary the findings of the study on 'Potential for reducing mercury pollution from dental amalgam and batteries' carried out for the Commission (DG Environment) which was concluded in year. It consists of the assessment of policy options to reduce the environmental impacts from dental amalgam.

The health and environmental risks associated with mercury (Hg) are well known and have led the Commission to adopt an EU Mercury Strategy in 2005[160], with the aim to '*reduce mercury levels in the environment and human exposure, especially from methylmercury in fish'*. The review of the Strategy's implementation[161], in 2010, acknowledged the progress made with regard to a number of actions proposed in 2005 such as the adoption of the Mercury Export Ban Regulation[162], the phase-out of mercury use in certain measuring devices under the REACH Regulation[163], the submission of additional mercury use restriction proposals under REACH, and the EU's contribution to the progress of international negotiations on the global mercury treaty. The review also highlighted areas for further improvement, among which the remaining uses of mercury in several applications where Hg-free alternatives exist and are already used to some extent; this concerns in particular dental amalgam.

Assessment of policy options to reduce environmental impacts from dental amalgam use

Dental amalgam is a combination of metals, containing about 50% of mercury in the elemental form, the other metals being silver (about 35%), tin, copper, and other trace metals. Dental amalgam has been used for over 150 years for the treatment of dental cavities and is still used due to its specific mechanical properties and the long-term familiarity of many dental practitioners with this material. Dental amalgam has been controversial ever since it was introduced, early in the nineteenth century, because of potential risks due to its mercury content.

Mercury releases from the use of dental amalgam occur at different stages of its life cycle, in particular during the placement of new fillings or the removal of old ones at dental practices, at the end of life of persons with amalgam fillings (via cremation or burial), and during the progressive deterioration of amalgam fillings in people's mouths due to chewing, ingestion of hot beverages and corrosion (mercury excreted by humans).

Problem definition

Dental amalgam is one of the main remaining uses of mercury in the EU. In 2007, dental amalgam was the second largest mercury use in the EU after chlor-alkali production and it is expected to become the largest mercury use once mercury cell-based chlor-alkali production is phased out in the EU. In the present study, the EU mercury demand for dentistry was estimated to range between 55 and 95 t Hg/year in 2010 (75 t Hg/year on average).

[160] Communication from the Commission to the Council and the European Parliament – Community Strategy Concerning Mercury – COM (2005) 20 final

[161] Communication from the Commission to the European Parliament and the Council on the review of the Community Strategy Concerning Mercury, COM(2010)723final. The EC's Communication was informed by a report by BIO Intelligence Service prepared for DG ENV in 2010 (http://ec.europa.eu/environment/chemicals/mercury/pdf/review_mercury_strategy2010.pdf)

[162] Regulation (EC) No 1102/2008 of 22 October 2008 on the banning of exports of metallic mercury and certain mercury compounds and mixtures and the safe storage of metallic mercury

[163] Commission Regulation (EC) No 552/2009 of 22 June 2009 amending Regulation (EC) No 1907/2006 on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards Annex XVII

Although dental use of mercury seems to have been declining over the last few years, it remains a significant contributor to overall environmental mercury releases in the EU.

It is roughly estimated that 45 t Hg/year from EU dental practices end up in chairside effluents, with only a part of which being captured and treated as hazardous waste in compliance with EU legislation. Mercury in dental waste represents about 50 t Hg/year. Estimates developed in this study suggest that dental amalgam is a significant contributor to overall EU environmental emissions of mercury from human activities. Mercury emitted to the air can be partly deposited into other environmental compartments (soil, surface water, vegetation). Emissions to soil and groundwater are also significant, although their contribution to overall mercury releases to this environmental compartment is more difficult to quantify. It is estimated that about half of the mercury released from current and historical dental amalgam use remains potentially bioavailable, with the potential to contaminate fish in particular, the other half being either sequestered for long-term (stored in hazardous waste landfills) or recycled for new purposes.

All individuals are exposed to mercury pollution to some degree; however, some groups are particularly exposed and/or vulnerable to the health effects of mercury pollution (principally in the form of methylmercury through diet), such as high-level fish consumers, women of childbearing age and children. This presents a risk of negative impacts on health, in particular affecting the nervous system and diminishing intellectual capacity. There are also environmental risks, for example the disturbance of microbiological activity in soils and harm to wildlife populations. More than 70% of the European ecosystem area is estimated to be at risk today due to mercury, with critical loads for mercury exceeded in large parts of western, central and southern Europe [164,165].

The problem of mercury pollution from dental amalgam is twofold: in the first place, pollution is caused by the historical use of dental amalgam, while the current use of dental amalgam adds up to mercury releases from historical practice. The drivers of the problems identified can be described as a combination of market and regulatory failures.

Pollution due to historical use of dental amalgam mainly results from non-compliance of dental facilities with EU waste legislation and a lack of anticipation with regard to EU legislation on water quality.

Some of the emissions associated with the historical use of dental amalgam, e.g. emissions from burial and emissions from amalgam deterioration in mouths, are difficult to tackle due to their diffuse nature. However, a significant part of these emissions can be minimised through proper waste and wastewater management in dental facilities and the use of efficient mercury abatement devices in crematoria.

The handling of dental amalgam waste as hazardous waste (which usually involves the use of efficient amalgam separators, the segregation of amalgam waste from other waste types and its treatment as hazardous waste) is a matter of enforcing EU legislation on waste[166]. Adequate handling of dental amalgam waste is also necessary to achieve certain goals of EU legislation on

[164] This concept is mainly based on ecotoxicological effects and human health effects via ecosystems. It is generally defined as a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur.

[165] Hettelingh, J.P., J. Sliggers (eds.), M. van het Bolcher, H. Denier van der Gon, B.J.Groenenberg, I. Ilyin, G.J. Reinds, J. Slootweg, O. Travnikov, A. Visschedijk, and W. de Vries (2006). Heavy Metal Emissions, Depositions, Critical Loads and Exceedances in Europe. VROM-DGM report, www.mnp.nl/cce, 93 pp.; CEE Status Reports 2008 (Chapter 7, http://www.rivm.nl/thema/images/CCE08_Chapter_7_tcm61-41910.pdf) and 2010 (Chapter 8, http://www.rivm.nl/thema/images/SR2010_Ch8_tcm61-49679.pdf)

[166] Waste Framework Directive (2008/98/EC). The Directive does not prescribe specifically dental clinics to install dental amalgam separators, however this is a means to comply with the ban on mixing hazardous waste.

water quality[167]: mercury is considered as a priority hazardous substance, requiring a cessation of emissions, discharges and losses within 20 years after adoption of measures. The present study estimated that around 25% of EU dental facilities are still not equipped with amalgam separators. Besides, a significant proportion of separators are not adequately maintained, which reduces significantly their mercury capture efficiency. Although it is much easier to capture mercury at dental facilities than once it is mixed with other urban effluents or municipal solid waste, the installation and maintenance costs of an amalgam separator are borne by dentists, while local authorities (i.e. EU citizens through local taxes) bear the cost of removing mercury from urban sewage sludge and municipal waste.

In the absence of further EU policy action, environmental impacts due to the historical use of dental amalgam will continue to occur for several decades since they are due to the removal of old fillings, the loss of teeth, the progressive deterioration of existing fillings and the end of life of amalgams when people decease. Mercury releases from dental practices may decrease progressively along with the modernisation of dental practices, as new dental practices are generally equipped with amalgam separators. It is, however, highly unlikely that 100% of dental practices become compliant with the relevant requirements of EU waste legislation in the short term without any further enforcement actions from public authorities. With regard to the end of life of amalgams, future mercury releases from burial are likely to remain stable and will occur for several decades. Concerning mercury emissions from cremation, a stabilisation seems to have occurred since 2005, but future trends are difficult to predict.

With regard to the current use of dental amalgam, solutions are available to phase out mercury use in most medical conditions.

Although Hg-free alternatives to dental amalgam exist and can be used in most medical conditions[168], they are still not widely used in a number of MS (e.g. FR, PL, UK, CZ, RO, ES, and GR). The main reasons behind this situation are as follows:

- Hg-free dental restorations are more expensive for patients, as compared with dental amalgam restorations, in many MS. This is both due to the higher actual cost of most Hg-free restorations (the Atraumatic Restorative Treatment or ‘ART’ being an exception) and the fact that the reimbursement of Hg-free restorations by the existing national health insurance schemes is not always as advantageous for patients as in the case of dental amalgam.
- Not all EU dentists are properly trained and skilled in conducting Hg-free restorations and insufficiently trained dentists may be more reluctant to propose Hg-free restorations to patients.
- Many dentists are not aware of the benefits of ART (Atraumatic Restorative Treatment), a cost-effective and environmentally-friendly Hg-free restoration technique using hand tools and glass ionomers, already widely used in developing countries but also increasingly used in developed countries (for restorations not requiring a high longevity).

[167] In particular: Water Framework Directive (2000/60/EC), Decision 2001/2455/EC and Directive 2006/11/EC on dangerous substances and Directive 2008/105/EC on priority substances.

[168] Currently the most commonly used alternatives to dental amalgam are composite resins, glass ionomer cement, compomers, giomers, sealants, and dental porcelain.

- While glass ionomers have a shorter durability, some dentists consider that Hg-free fillings using composite materials also have a lower durability than amalgam fillings, in spite of recent technical improvements.
- Some dentists are reluctant to change their current practice and to invest in new equipment required to handle Hg-free fillings. In parallel, they may not be fully aware of the seriousness of the environmental impacts caused by dental amalgam and of the extent of societal benefits of reducing mercury emissions.
- Not all patients are fully aware of the pros and cons associated with the different types of filling materials. In particular, many patients are not aware of the presence of mercury in dental amalgam and the extent of the associated environmental impacts.
- Some dentists consider that, although Hg-free materials have been used in some countries for many years, the absence of long-term environmental and health effects of these materials has not been fully demonstrated.

The fact that Hg-free dental restorations are more expensive than dental amalgam restorations can be seen as a market failure in the sense that negative externalities associated with the use of dental amalgam (e.g. management of dental waste and effluents) are not factored in the market price of dental amalgam restorations. If these externalities were included, it has been shown – for the US market – that the market price of an average amalgam restoration would be equal to or up to about 15% higher than the price of a composite restoration[169].

If no further EU policy action is taken, the current use of dental amalgam will continue to generate environmental impacts that will occur over the whole lifetime of the amalgam fillings; a large part of the associated environmental emissions would occur during a period of 10 to 15 years after the placement of amalgam (this is the average lifetime of an amalgam filling)[170] but the actual environmental impacts (adverse effects to ecosystems) and possible indirect human health effects will occur for several decades.

In the absence of further EU policy action, dental amalgam may continue to be progressively substituted with Hg-free materials, mainly as a result of growing aesthetic concerns, although it is difficult to predict the speed of this decline. Dental amalgam may well continue to be used for many years in some of the less wealthy MS. In the present study, it is estimated that EU demand for dental mercury will decrease and will stabilise around 27 to 43 t Hg/year in 2025 (2010-2025 being the time horizon for the present assessment). This represents an annual decrease of approximately 5% over a 15-year time horizon.

In the absence of any changes to national health insurance schemes, it is expected that Hg-free dental restorations will continue to be more expensive for patients than amalgam restorations in the future, however the cost difference will tend to decrease due to innovation and increased competition concerning the production of Hg-free filling materials as well as improved dentists' skills in the handling of Hg-free materials.

Possible direct human health impacts of dental amalgam are still a subject of scientific controversy.

While there is a common viewpoint among stakeholders that the adverse environmental effects of dental amalgam use need to be addressed, there is currently no scientific consensus on the *direct*

[169] Concorde (2012) The real cost of dental mercury – Report prepared for the European Environmental Bureau (EEB), the Mercury Policy Project and Consumers for Dental Choice (http://www.zeromercury.org/index.php?option=com_phocadownload&view=file&id=158:the-real-cost-of-dental-mercury&Itemid=70)

[170] Some amalgam restorations will last shorter (many of them last less than 2 years) while others have been reported to last up to 40 to 50 years (WHO (2010) Future use of materials for dental restoration).

health effects of dental amalgam (except with regard to possible allergies caused by dental amalgam). For this reason, future policy actions concerning dental amalgam addressed in this study focus on the *environmental side* of the problem and *indirect* health effects. However, because direct health impacts are relevant to the overall assessment, a short review of the scientific literature on such aspects has also been included.

Policy objectives and options

The general objective of any future policies in relation to mercury in dental amalgam will be to reduce the environmental impacts from the use of mercury in dentistry and to reduce the contribution of dental amalgam to the overall mercury problem. In the long-term, this should contribute to achieving reduced mercury levels in the environment, at EU and global level, especially levels of methylmercury in fish. This long-term policy objective can be achieved through specific policy actions aiming to 1) minimise mercury emissions from current and historical use of mercury in dentistry and 2) minimise and, where feasible, eliminate the source of pollution, i.e. phase out dental amalgam use.

Four policy options have been selected for analysis:

- **'No policy change' option** (baseline scenario)
- **Option 1: Improve enforcement of EU waste legislation regarding dental amalgam –** The Commission would ask MS to report on measures taken to manage dental amalgam waste in compliance with EU waste legislation (i.e. as hazardous waste) and to provide evidence of the effectiveness of the measures in place. Usual steps taken to comply with these requirements are the presence of amalgam separators in dental practices, an adequate maintenance of these separators in order to ensure a minimum 95% efficiency and to have the amalgam waste collected and treated by companies with the adequate authorisation to handle this type of hazardous waste.
- **Option 2: Encourage Member States to take national measures to reduce the use of dental amalgam while promoting the use of Hg-free filling materials –** The Commission would encourage MS to take national measures aiming to reduce the use of dental amalgam (for example via a Communication to be adopted in 2013) and MS would have to report annually to the Commission on the measures taken and their effect. Such measures would include, in particular, measures aiming to: improve dentists' awareness of the environmental impacts of mercury and the need to reduce its use; review dental teaching practices so that Hg-free restorations techniques are given preference over dental amalgam techniques; improve dentists' awareness and skills with regard to the Hg-free and cost-efficient Atraumatic Restorative Treatment (ART) approach so that it is used in all cases where it is adequate (such as in children and elder people); and improve public dental health to reduce the occurrence of cavities.
- **Option 3: Ban the use of mercury in dentistry** – One possibility[171] would be to add the use of mercury in dentistry to Annex XVII of the REACH Regulation[172], with the possibility to define limited exemptions to take into account specific medical conditions where dental amalgam cannot be substituted at present[173]. In the present study, it was assumed that a decision to submit a REACH Restriction Dossier could have been made in 2013, on the basis of which a legal ban could be adopted and become applicable 5 years later, i.e. in 2018.

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[171] In case an unacceptable risk to human health or the environment could be established (REACH, Article 68(1))

172 Regulation (EC) No 1907/2006 on Registration, Evaluation, Authorisation and Restriction of Chemicals – Annex XVII of the REACH Regulation contains the list of all restricted substances, specifying which uses are restricted.

173 Another possibility to implement Option 3 could be to amend the Medical Devices Directive (93/42/EEC). At the time of writing this report, the feasibility of using the REACH Regulation or the Medical Devices Directive as legal instruments to implement Option 3 is still being studied by the Commission.

Analysis of impacts

Information sources include previous studies, recent mercury emission data and information from stakeholders.

The evidence base for the analysis of impacts first includes findings from previous studies on the dental amalgam issue[174]. In order to fill the information gaps highlighted in previous studies and obtain up-to-date data, recent publications and recently published emission data were reviewed in a second stage[175]. Tailored questionnaires were then sent to about 300 stakeholders including environmental and health authorities within MS, industry stakeholders (dental associations, dental fillings suppliers, waste treatment industry, crematoria businesses and water treatment industry) as well as NGOs and academic experts. About 40 questionnaire replies were received, with varying levels of detail, including responses from 20 MS[176]. Finally, follow-up telephone interviews were conducted with several dental fillings manufacturers, national dental associations and researchers. Additional information was provided by some stakeholders, following the consultation workshop held in March 2012.

One major challenge is a lack of reliable and up-to-date data in many MS on dental amalgam use, related mercury emissions, and dental restoration costs, which required a number of assumptions and extrapolations.

Environmental and socio-economic impacts of the policy options are closely related to the projected trends for dental amalgam use in the EU, over the next 15 years.

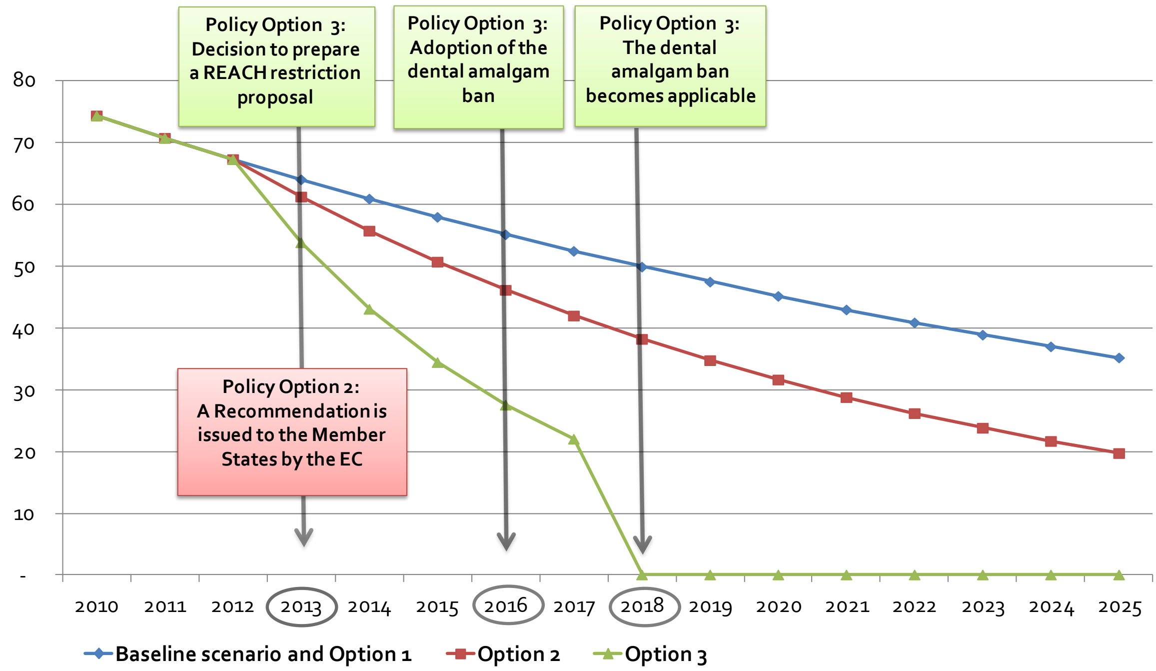
A comparison of the different mercury demand projections developed in this study, for the different policy options, is presented in *Figure* 10A-a below. The assumptions used to develop these projections are based on the limited information currently available concerning the expected decline of dental amalgam demand in the EU and they carry a large part of uncertainty.

[174] In particular: SCHER (2008) Opinion on the environmental risks and indirect health effects of mercury in dental amalgam; Summary of Member States responses to 2005 EC survey on management of dental amalgam waste; COWI/Concorde (2008) Options for reducing mercury use in products and applications, and the fate of mercury already circulating in society; EEB/Concorde (2007) Mercury in dental use: environmental implications for the EU

[175] In particular: Emission data from the European Pollutant Release and Transfer Register; OSPAR (2011) Overview assessment of implementation reports on OSPAR Recommendation 2003/4 on controlling the dispersal of mercury from crematoria

[176] AT, BE, BG, CZ, CY, DE, DK, EE, FI, HU, IE, LT, LV, MT, PL, SE, SI, SK, UK. In addition, LU and RO advised that they were not able to provide any valuable information in relation to the study.

Figure 10A-a: Projected annual demand for dental mercury in the EU (t Hg)



While the baseline scenario assumes a gradual decrease in dental amalgam demand over the next 15 years (approximately –5% demand per year) until a threshold of about 35 t Hg/year to be reached in 2025, Option 3 would result in a sharp decrease (approximately 20% annually) of dental amalgam demand from 2013 (i.e. the year when a decision to prepare a REACH restriction proposal could be made) to reach zero demand in 2018 once the ban becomes applicable (in fact, very small amounts could still be used after 2018, in accordance with the allowed exemptions, but these are considered to be negligible). Option 2, as an intermediate option between the 'no policy change' and Option 3, would result in a more rapid decline in dental amalgam demand than in the baseline scenario (approximately –9% demand per year) until a threshold of about 19 t Hg/year to be reached in 2025.

Environmental impacts

While the quantities of dental amalgam waste produced are expected to decrease in all options, with a much stronger positive effect under Options 2 and 3, only Option 1 could influence the management of amalgam waste and allow a reduction of mercury releases to air/water/soil associated with this waste stream in the short term. More specifically, Option 1 would avoid the release of approximately 7 t Hg/year to urban wastewater treatment plants (WWTPs) in the EU (30% reduction of the mercury load with regard to the baseline situation for 2015).

Mercury releases to air/water/soil due to dental amalgam use are also expected to decrease in all options, due to the progressive substitution of dental amalgam with Hg-free materials; however only Option 2 and – to a greater extent – Option 3 would allow a significant decrease of these emissions in the long term, with an almost complete cessation of mercury releases in the case of Option 3.

Under Option 2, the expected decrease in dental amalgam use would lead to a reduction of mercury releases to the environment (air/water/soil) by at least 3% with regard to the baseline scenario for year 2025.

Under Option 3, when the ban starts to apply in 2018, the avoided mercury use is estimated at approximately 50 t Hg/year with regard to the baseline scenario. This option, once implemented, will lead to an immediate decrease in environmental mercury releases. However, because there will still be mercury releases due to old amalgam fillings, it is estimated that, at the time the ban becomes applicable, mercury releases to the environment (air/water/soil) would only be reduced by approximately 15% with regard to the baseline scenario. Mercury releases will progressively decrease over the years in line with the decrease of mercury stocks in people's mouths. Given that the average lifetime of amalgam fillings ranges from 10 to 15 years, it is expected that mercury releases from historical amalgam use would have significantly decreased 15 years after the ban takes effect[177]. The actual environmental impacts (e.g. adverse effects to ecosystems) would however continue to be observed for several decades, given the potential for elemental mercury to be transformed into methylmercury and to accumulate in biota.

- **Economic impacts**

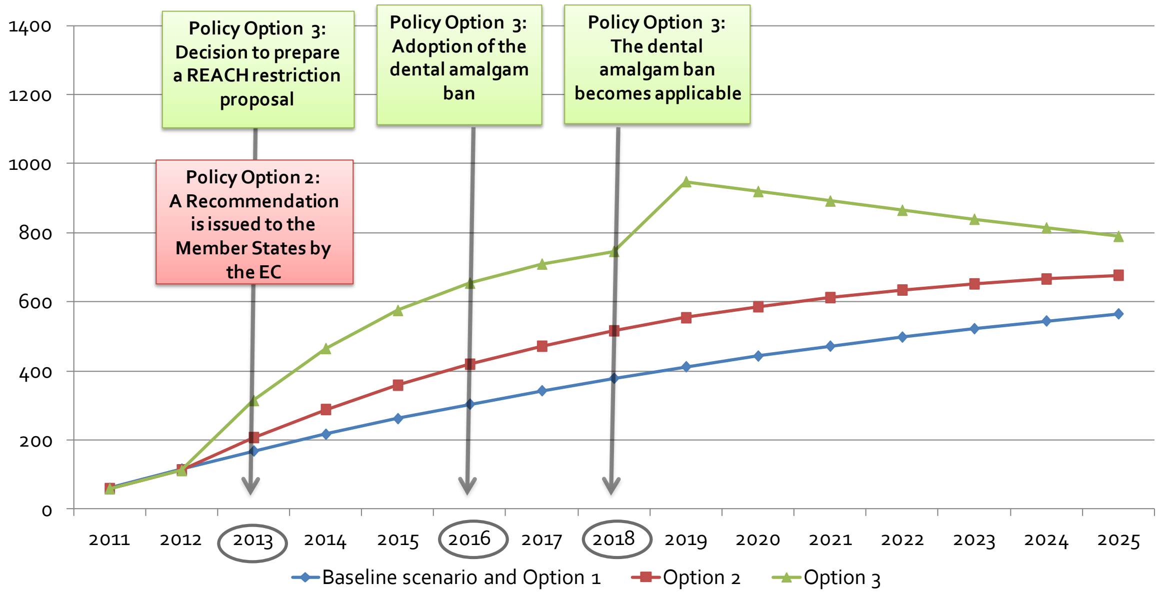
The cost of dental amalgam substitution by Hg-free materials (composite resins or glass ionomers) for EU dental patients is an important aspect of the analysis, for Options 2 and 3. The projected evolution of such costs is shown in *Figure 10A-b* below (costs of Option 1 would be similar to the baseline scenario). Projections shown below take into account a progressive decrease in the cost of Hg-free restorations, which was considered as the most realistic scenario. The graph shows that, in all policy options, the annual costs would increase (due to higher numbers of Hg-free restorations); however, this increase would progressively slow down in the baseline scenario and Option 2 (due to the decreasing price difference between amalgam and Hg-free restorations). The annual costs tend to converge towards the end of the time period considered (2025).

While the costs for dental patients are likely to increase under Options 2 and 3, the costs borne by local taxpayers for the management of mercury pollution (tax contribution to mercury abatement costs in urban WWTPs and waste management facilities) would be reduced, especially under Option 3, due to reduced mercury releases from dental facilities. For example, a lower mercury content of dental effluents may reduce the need for municipalities to invest in expensive mercury abatement devices in sewage sludge incineration plants[178]. In certain cases, it may also increase the possibilities of using sewage sludge for agricultural purposes, a cheaper management option for sewage sludge.

[177] Residual mercury releases would be mainly due to amalgam fillings borne by immigrants to the EU and possibly also some specific cremation practices such as the ones reported in Italy (according to the Italian crematoria association Federutility, in Italy approximately 20% of cremations are carried out on human remains and can take place 10 to 20 years after a burial).

[178] As an illustration, one large wastewater treatment plant in Bilbao, Spain, reported that the presence of high mercury levels in sludge required significant investment in 2010-2011 in order to comply with legislation, in the order of 4.5 million EUR.

Figure 10A-b: Annual costs borne by EU dental patients due to the substitution of dental amalgam according to different policy options (million EUR)



Key assumptions – Figure 10A-b:

These costs correspond to the average costs actually borne by the patients going to dental practitioners having an agreement with the public sector, i.e. taking into account the amounts possibly reimbursed by national health insurance schemes. They correspond to average restoration costs, considering the different types of restorations which may be performed (front teeth/rear teeth; 1, 2 or 3 surfaces; etc.).

Baseline scenario and Option 1: Assumes a slow substitution of dental amalgam restorations with Hg-free methods and a 1% annual decrease in the price difference between amalgam and composite restorations.

Policy option 2: Assumes a progressive substitution of dental amalgam restorations with Hg-free methods, and a 2% annual decrease in the price difference between amalgam and composite restorations.

Policy option 3: Assumes a quick substitution of dental amalgam restorations with Hg-free methods, leading to almost zero dental amalgam restorations from 2018, and a 3% annual decrease in the price difference between amalgam and composite restorations.

With regard to economic impacts on crematoria, Option 2 would only have a minimal impact while Option 3 would have a positive economic effect in the long term, by avoiding the need for installing mercury abatement devices in new EU crematoria or for operating the systems that are already in place.

An increase in the revenues of the EU dental fillings industry is likely to occur in all options, due to the progressive substitution of dental amalgam with the more sophisticated Hg-free filling materials. This positive effect would be more significant in the case of Options 2 and 3 as the rate of substitution would be increased. Besides, Option 2 and – to greater extent – Option 3 are expected to promote competitiveness and innovation of the EU dental fillings industry.

The administrative burden associated with Options 1 and 3 is expected to remain limited as a legislative framework is already in place in both cases[179]. Option 2 could generate higher administrative burden due to significant communication and awareness raising efforts required to achieve a shift in dental restorations practices.

[179] EU waste legislation for Option 1 ; REACH Regulation for Option 3

Social impacts

Options 1, 2 and – to a greater extent – Option 3 would bring significant health-related benefits by reducing occupational exposure of dental personnel and exposure of the general public to environmental mercury emissions resulting from dental amalgam use.

With regard to possible *direct* health risks due to dental amalgam, it is not possible to draw any conclusions given the diverging scientific results obtained to date. If more expensive restoration techniques are used, there is a risk of deteriorating dental health in disadvantaged communities due to higher treatment costs of cavities, if appropriate dental decay prevention programmes are not in place and if dental care is not subsidised for the most vulnerable and disadvantaged categories of the population, which depends largely on the public health policy of the Member State. However, this issue goes somewhat beyond the debate on dental amalgam. Public spending to ensure affordability of dental care also needs to be put in perspective with the currently high environmental and indirect health impacts and costs of mercury pollution caused by dental amalgam use, and the benefits associated with a reduction of these impacts for the society at large, as mentioned above.

With regard to EU employment, the impact of the policy options is expected to be negligible. In particular, as the vast majority of EU dental fillings manufacturers already produce Hg-free materials[180], a greater substitution of dental amalgam with Hg-free filling materials would not significantly affect employment in this sector.

Conclusions

The most effective way to reach the policy objective, i.e. reducing the environmental impacts of dental amalgam use, would be a combination of Options 1 and 3. While Option 1 tackles environmental impacts from both historical and current dental amalgam use, it focuses on releases from dental practices and is not sufficient in itself to address the whole range of mercury releases from the dental amalgam life cycle (it does not address mercury releases from the natural deterioration of amalgam fillings in people's mouths, from cremation and burial, and residual emissions to urban WWTPs). Option 3 would allow a significant reduction of dental mercury releases within the next 15 years and would virtually eliminate the environmental impacts of dental mercury in the longer term. However, because the cessation of mercury releases, under Option 3, would only be significant after about 15 years, Option 3 needs to be coupled with Option 1 in order to reduce mercury releases from historical use of amalgam in the short term.

Option 2 leaves more flexibility to MS to implement national measures aimed at reducing dental amalgam use, which would allow them to take into account national specificities (e.g. current level of oral health, cost aspects, specificities of national health insurance schemes); however, the effectiveness of this option is subject to high uncertainty since there would be no binding targets to achieve. In order for this option to be effective in reducing environmental impacts, the administrative costs incurred by public authorities may be higher than in the case of Option 3 (significant awareness raising required in some MS in order to induce a change in dental restoration practices).

The 'no policy change' option cannot achieve a significant reduction of mercury pollution from dental amalgam. Even if the progressive substitution of dental amalgam with Hg-free materials is expected to continue in the future, a complete phase-out of dental amalgam is very unlikely to happen. In this regard, it is interesting to note that, in Sweden, dentists' organisations and the National Board of Health and Welfare initially claimed that no legislative measures were needed to reduce amalgam use because it would vanish by itself; however, this did not happen after more than a decade, hence the decision of the authorities to introduce a ban. Following implementation of the ban, the use of dental amalgam was rapidly phased out without any problems.

[180] Out of the 61 EU main companies identified, only three companies (in CZ, in NL and in IT) produce solely mercury for dental amalgam preparation

The preferred combination of options is therefore Option 1 + Option 3. It would achieve the highest effectiveness, while the associated costs are considered to be reasonable for the various stakeholders, especially as they are considered to be outweighed by the associated environmental and health benefits. The cost efficiency of Option 3 improves with: the improvement of dentists' skills in Hg-free restoration techniques (resulting in reduced placement durations and therefore reduced labour costs); a gradual decrease in the price of Hg-free filling materials thanks to continuous innovation and increased competitiveness within this industry sector; good awareness of EU citizens on the fact that amalgam fillings in good condition do not require substitution (national health authorities will have to implement clear communication on this point); and the active promotion of cheaper Hg-free restoration techniques such as ART, where adequate (especially in children). Implementing Option 1 should be relatively feasible from a political point of view as it is about enforcing existing legal requirements (rather than creating new requirements) and it is the logical follow-up of Action 4 of the EU Mercury Strategy[181]. The implementation of Option 3 may be more challenging, not because of the actual costs of the changes required, but mainly due to the changes in professional habits that need to occur among dentists, especially in some MS, and the time required for all EU dentists to be well skilled at performing Hg-free restorations. The implementation of Option 3 can also be considered as a logical follow-up of Action 8 of the EU Mercury Strategy[182] and seems necessary to achieve mercury-related requirements of EU legislation on water quality.

[181] '*The Commission will review in 2005 Member States' implementation of Community requirements on the treatment of dental amalgam waste, and will take appropriate steps thereafter to ensure correct application*'

[182] '*The Commission will further study in the short term the few remaining products and applications in the EU that use small amounts of mercury. In the medium to longer term, any remaining uses may be subject to authorisation and consideration of substitution under the proposed REACH Regulation, once adopted'*

ANNEX 10B – EMISSIONS FROM DENTAL AMALGAM

The objective of this Annex is to provide a good evidence base in order to assess the extent to which dental amalgam use contributes to the overall mercury problem in the EU. In particular, this Annex presents information and data necessary to assess current situation.

Following a description of the methodology employed, this section provides an overview of mercury releases from dental amalgam use and end of life phases and discusses the main aspects of the life cycle for which data was lacking or needed to be updated in order to provide a full and up-to-date EU picture of the problem. The additional data collected is then presented and analysed. Existing data from previous studies and newly collected data are compiled to estimate mercury releases to the various environmental compartments. A comparison with contributions from other sources is finally carried out in order to estimate the scale of pollution caused by dental amalgam.

10B.1 – Methodology

The objective of this part was to identify and assess the potential environmental impacts associated with the use of dental amalgam, focusing on key stages of its life cycle.

A thorough review of existing literature and data was first carried out. Some key information sources are listed below:

- Summary of MS responses to 2005 EC survey on management of dental amalgam waste
- SCHER (2008) Opinion on the environmental risks and indirect health effects of mercury in dental amalgam
- COWI/Concorde (2008) Options for reducing mercury use in products and applications, and the fate of mercury already circulating in society
- Concorde/European Environmental Bureau (EEB) (2007) Mercury in dental use: environmental implications for the EU[183]
- Report from the conference 'Dental sector as a source of mercury contamination' organised by NGOs (2007)[184]
- DEFRA consultation documents on mercury emissions from crematoria (2003, 2004)
- Latest mercury emission data from E-PRTR (2007, 2008, 2009)[185]
- Some waste data covering amalgam waste: data reported under the Basel Convention (2004-2005-2006)[186]
- OSPAR (2011) Overview assessment of implementation reports on OSPAR Recommendation 2003/4 on controlling the dispersal of mercury from crematoria[187].

Other data sources reviewed are mentioned in the following sections of this Annex.

Following a comprehensive review of existing literature on the topic, opportunities for updating and complementing estimates developed in previous studies were identified. Hence, the data collection

[183] Concorde/EEB (2007) Mercury in dental use: environmental implications for the EU. Available from: http://www.zeromercury.org/index.php?option=com_phocadownload&view=file&id=17%3Amercury-in-dental-use-environmental-implications-for-the-european-union-&Itemid=70

[184] Dental sector as a source of mercury contamination, Conference report, Brussels, 2007

[185] European Pollutant Release and Transfer Register (http://prtr.ec.europa.eu/PollutantReleases.aspx).

[186] http://www.basel.int/natreporting/2005/compII/index.html

[187] http://www.ospar.org/documents/dbase/publications/p00532_Rec_2003-4_Overview_report.pdf

and analysis tasks focused on data necessary to update and complement findings of previous studies, taking into account the gaps mentioned in the 2008 SCHER opinion.

Following the review of publicly available information, tailored questionnaires were sent to various types of stakeholders in order to fill the information gaps:

- Environmental and health authorities within MS
- Industry stakeholders: dental associations, dental fillings suppliers, waste treatment industry, crematoria businesses and water treatment industry
- NGOs and academic experts.

In total, about 300 organisations/institutions were sent questionnaires and some follow-up telephone calls were also made. To date, we have received:

- Responses from environmental and/or health authorities from 20 MS[188], with varying levels of detail
- 5 responses from national dental associations
- 2 responses from dental fillings suppliers
- 4 responses from cremation organisations
- 5 responses from water treatment organisations
- 4 responses from NGOs and academic experts.

In addition, several dental fillings manufacturers, national dental associations and researchers were contacted by telephone to obtain additional information and a telephone interview was also held with CED. Relevant findings extracted from previous studies have been summarised and references are provided in order for readers to have access to further details, the focus being placed on presenting updated and new information to inform future policy decisions.

Further information and comments were provided by stakeholders during and after a workshop held in Brussels in March 2012.

One major challenge encountered is the general lack of reliable and up-to-date data on dental amalgam use in many MS. Stakeholders active at the EU level (CED, FIDE[189], ADDE[190]) advised that they do not hold data on dental amalgam use in the EU or on the size of the EU market for dental amalgam.

10B.2 – Overview of mercury flows associated with dental amalgam

The main mercury flows investigated as part of this study are illustrated in *Figure 7B-d* at the end of this Annex. As shown below, this study mostly focuses on mercury releases associated with current and historical mercury use in dentistry and the fate of mercury released by dental practices or by old fillings. Upstream releases associated with the supply of mercury for dental amalgam preparation have not been investigated in detail, considering that environmental issues related to these upstream steps (mercury supply and trade, production of mercury for dental applications) are less critical and better managed

[188] AT, BE, BG, CZ, CY, DE, DK, EE, FI, FR, HU, IE, LT, LU, LV, MT, PL, SE, SI, SK, UK. In addition, RO and CY advised that they were not able to provide any valuable information in relation to the study.

[189] Federation of the European Dental Industry

[190] Association of Dental Dealers in Europe

Mercury is consumed by dental practices in the form of pre-dosed capsules (containing approximately 50% elemental mercury) or in the form of elemental mercury sachets that are then mixed with alloy powder in a 1:1 ratio.

Mercury releases mainly occur during the following steps:

- Use of new amalgam: carved surplus of triturated amalgam is generated during the preparation of the amalgam while carved surplus of amalgam is generated during the placement of the filling
- Removal of old amalgam filling
- Loss or extraction of teeth with amalgam fillings
- Cremation/burial of people with amalgam fillings
- Deterioration of amalgam fillings due to chewing, consumption of hot beverages and corrosion (mercury ending up in human waste).

Most dental mercury waste results from the removal of previous fillings from patients' teeth. Together with waste from new fillings, removed teeth, etc., these dental wastes, in the form of solid dental amalgam particles, typically follow several main paths. They may be captured by the saliva pump (vacuum pump system) that leads to the general municipal wastewater system, they may be collected for subsequent recycling or disposal, they may be placed in special containers as medical waste, or they may be discarded in the waste bin as municipal waste[183].

As shown in the above diagram, next to each dental chair most dental facilities have a basic chairside filter (or trap) in the wastewater system to capture the larger amalgam particles, and some have secondary vacuum filters just upstream of the vacuum pump. An increasing number of clinics are also equipped with amalgam separators to capture dental amalgam particles.

Additional mercury releases to the wastewater occur as a result of amalgam deterioration due to chewing, ingestion of hot beverages and corrosion (mercury excreted by humans), although quantities of mercury released from these deterioration processes are supposed to be smaller than those emitted by dental practices.

The main atmospheric emissions associated with the life cycle of dental amalgam occur during the cremation of deceased persons with mercury fillings. Some air emissions may also occur at dental practices during the handling and placement of amalgam and as a result of mercury discharged to the wastewater.

Finally, direct mercury releases to soil and groundwater may occur due to the burial of deceased persons with mercury fillings.

Further details on the main mercury flows are presented in the sections below.

10B.3 – Main data gaps to be addressed

The SCHER (2008) report used a number of previous studies on dental amalgam as a basis for their estimates. A number of data gaps were identified, which prevented the SCHER from conducting a comprehensive assessment of the environmental risks associated with dental amalgam. The purpose of the present study is therefore to fill the data gaps related to the estimation of mercury use, releases and fate. Additionally, because there are some expected changes in the use and releases of dental mercury across MS due to changing behaviours, improved legal compliance or new policy initiatives, it was necessary to obtain up-to-date information on some of these aspects.

Consequently, the main aspects which needed to be investigated in further detail in this study, at Member State and EU level, are as follows:

- Latest data and trends on dental mercury use
- Latest data and trends on the percentage of dental practices equipped with amalgam separators
- Actual efficiency of amalgam separators
- Treatment options for solid dental amalgam waste
- Options for managing sewage sludge from urban wastewater treatment plants (WWTPs), in particular agricultural spreading practices
- Latest data and trends on mercury air emissions from crematoria.

Concerning the other aspects of the dental amalgam life cycle, estimates from previous studies have been used, as long as they were considered to be based on reliable data and reasonable assumptions.

10B.4 – The human inventory of dental amalgam

The quantity of mercury contained in people's mouths in the EU-27 was estimated to be **over 1,000 tonnes** in previous studies. This is based on the assumption that three-quarters of the EU population (500 million citizens) have an average of 3 g of mercury in their mouths, or that the **entire EU population has an average of 2.0-2.5 g of mercury in their mouths**. Amounts of mercury per citizen have been derived from figures previously estimated by several countries (BE, DK, DE, FR, NL, NO, SE, CH, UK, USA).

10B.5 – Mercury use in dental practices

There are two main ways to prepare dental amalgam: by using pre-dosed capsules or by mixing dental alloy and mercury purchased as separate products.

Plastic capsules contain two compartments, one with the alloy in the form of powder (alloy containing silver, tin, copper and other trace metals) and one with pure elemental mercury (400-800 mg in general, contained in a small plastic sachet called a 'mercury spill'). The membrane between the two compartments is broken during the process of mixing in a mechanical amalgamator used by the dentist. By mixing the capsule, the sachet breaks and metallic mercury reacts with the dental alloy to form dental amalgam, which can be used to treat a patient within 10-12 minutes. This system ensures the exact mixing ratio between mercury and the dental alloy (1:1 in weight). Mercury spills present in the capsules are produced by specialised manufacturers and are supplied to the producers of dental amalgam capsules.

Alternatively, dentists can buy dental alloy in powder (standard packing 50-1,000 g) and dental metallic mercury (standard packing 100-1,000 g) as separate products. Metallic mercury is purchased in the form of a 'mercury spill' (plastic sachet) and produced by specialised manufacturers. A special mixer is then used by the dentist where both components are placed into separate compartments with the exact alloy/mercury ratio. The reason why some dentists still use this system is that buying alloy powder and mercury separately is cheaper than buying the easy-to-use capsules.

Mercury use for dental amalgam preparation in the EU-27 is estimated to range **between 55 and 95 t/year**, based on the most recent data collected as part of this study (further details are provided in the market review in Annex E). There is however significant uncertainty on this range of values.

10B.6 – Mercury releases from dental practices

10B.6.1 – Mercury releases to water

The removal of old amalgam fillings is the main source of dental amalgam released to wastewater via the clinic vacuum pump or similar systems. During the placement of new amalgam fillings, there is also some surplus of amalgam that is discharged to wastewater.

The technical development of dental equipment with high-speed drills replacing more slowly rotating drills in the last decades in technically advanced nations has increased mercury emitted to air or released to water when removing or replacing amalgam fillings. This is caused by smaller particles created by the high-speed drills. In addition, the higher speed results in higher temperatures, increasing the emission rate. The temperature may to some extent be controlled by cooling with e.g. water. However, this results in larger amounts of mercury in the water leaving the clinic.

Mercury discharged in dental wastewater is present in many forms, including elemental mercury bound to amalgam particulate, inorganic (ionic) mercury, elemental mercury, and organic mercury (monomethyl mercury (MeHg)); the vast majority (>99.6%) of dental mercury discharges are in solid form (elemental mercury bound to amalgam particulate)[191].

Out of the total amount of mercury used by dentists in EU-27 (~ 75 t/year on average), it is generally assumed that approximately 56 t/year (i.e. 75%) end up in patients' teeth while 19 t/year (i.e. 25%) is wasted.

From the amount of amalgam ending up in patients' teeth, it has been previously estimated that about 70% is used to replace previous amalgam fillings (i.e. ~ 39 t Hg/year) while 30% is used to make new fillings (i.e. ~ 17 t Hg/year).

From the 19 t/year of wasted mercury, it can be estimated that approximately 11 t/year end up as solid waste (surplus of mixed amalgam) while 8 t/year are discharged to the wastewater (carved surplus of amalgam during placement) and 0.5 t/year is emitted to the air [192].

Since approximately 39 t/year of 'new' mercury are used to replace old fillings, it can be estimated that the removal of old fillings releases almost the same amount of mercury (estimated here at 38 t) which goes into the waste stream[193]. In total the mercury content discharged to the wastewater comprises some 8 t of carved surplus amalgam plus some 38 t of removed amalgam, totalling about 46 t/year of mercury.

In addition to releases from current dental restoration works, the past accumulation of mercury in piping systems of the dental clinics over many years may constitute another source of continuous releases to wastewater. The slow dissolution and re-release of this mercury may be sufficient, even after dental clinic emissions have been greatly reduced, to exceed wastewater discharge standards, and may serve as a long-term source of mercury to urban WWTPs[183]. For example, large amounts of mercury were recovered (average 1.2 kg per clinic) during the remediation of 37 abandoned dental

[191] USEPA (2008) Health Services Industry Detailed Study – Dental amalgam (http://water.epa.gov/lawsregs/lawsguidance/cwa/304m/upload/2008_09_08_guide_304m_2008_hsi-dental-200809.pdf)

[192] Assumptions taken from the Concorde/EEB report (2007)

[193] It is assumed that previous fillings contained slightly less mercury at the time of removal, assuming some of the mercury has vaporised and the previous fillings were slightly smaller

clinics in Stockholm in 1993–2003[194]. Similar accumulations were observed during more recent work in several Swedish dental clinics[195].

Treatment devices in dental facilities

Most dental practices are equipped with chairside traps and vacuum filters able to capture a fraction of the larger amalgam particles.

An increasing number of dental practices are also equipped with amalgam separators, the use of which is necessary in order to segregate dental amalgam waste (considered as hazardous waste) from other types of waste, collect it separately for appropriate treatment and avoid its discharge into from aqueous effluents, in accordance with EU waste legislation[196].

According to a survey carried out by the Commission in 2005 and the COWI/Concorde study (2008), no more than 30-40% of EU dental practices were equipped with amalgam separators in 2005 and the proportion of dental practices equipped with amalgam separators was much higher in northern MS than in southern and eastern MS. According to the latest survey by the Council of European Dentists (CED, 2010), 14 out of the 28 European countries surveyed had 99% of dental practices equipped with amalgam separators, while in a further 5 countries 80 to 99% of practices were equipped. The survey did not however specify which countries these values referred to, since it was anonymous (it was based on questionnaires sent to national dental associations).

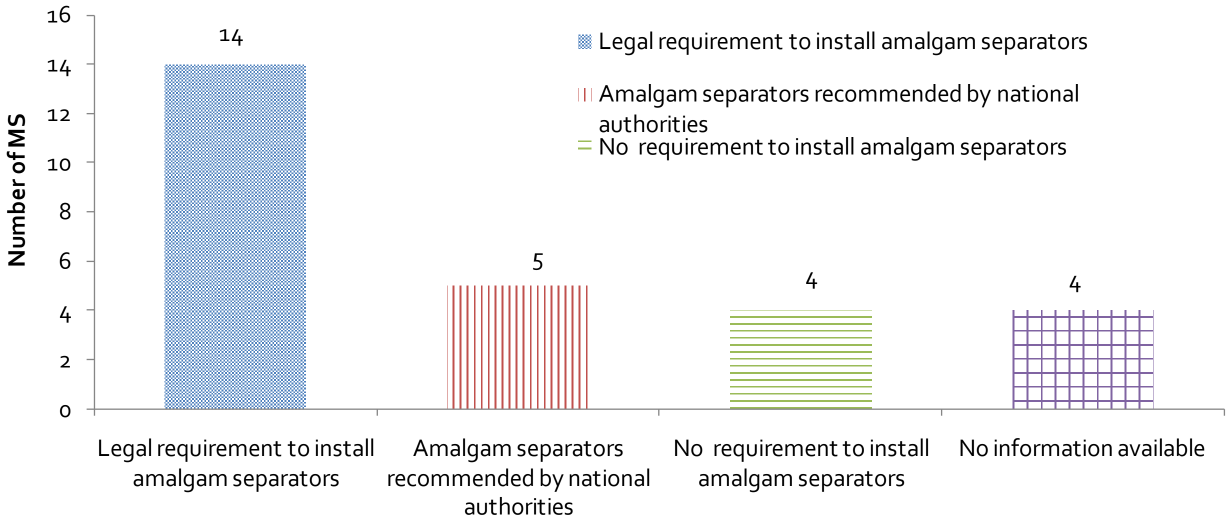
As part of the present study, information on possible legal requirements concerning amalgam separators was obtained for 23 MS (responses to the study questionnaires or data obtained from other sources, see Annex H). Among these 23 MS, amalgam separators are required by law in 14 MS (*Figure 10B-a*). Usually, this requirement applies to both new and existing practices and a 95% minimum efficiency is required. Some MS also impose Hg limit values in the effluent (usually between 0.005 and 0.03 mg Hg/l), documented evidence of proper maintenance and/or periodic inspections by local authorities. In some other MS, amalgam separators are installed voluntarily under guidance provided by the national authorities (e.g. IE, DK). All MS that responded to the study questionnaire reported that recently installed dental facilities are generally equipped with amalgam separators regardless of whether there are legal requirements in place.

[194] Engman (2004) Kvicksilverförorening i avloppsrör i Lunds kommun. (Mercury contamination in wastewater pipes of Lund municipality). MSc thesis. Stockholm University, Stockholm, Sweden

[195] Hylander LD, Lindvall A and Gahnberg L (2006) High mercury emissions from dental clinics despite amalgam separators. Sci. Total Environ. 362:74-84

[196] The Waste Framework Directive (2008/98/EC) does not prescribe specifically dental clinics to install dental amalgam separators, however this is a means to comply with the ban on mixing hazardous waste.

Figure 10B-a: Requirements concerning installation of amalgam separators



An estimate of the share of dental facilities equipped with amalgam separators is available for 16 MS (see *Table 10B-a* below).

Table 10B-0-a: Share of dental facilities equipped with dental amalgam separators

Share of dental facilities equipped with amalgam separators	Member States
~100%	10 MS: AT, CZ, DK, FI, DE, LV, MT, PT, SE, UK
90-100%	5 MS: BE, CY, FR, IT, NL, SI
Unknown	11 MS: BG, EE, ES, GR, HU, IE, LT, LU, PL, RO, SK

It is difficult to provide a reliable estimate of the average share of dental facilities equipped with amalgam separators at EU27 level as information is still missing for MS with large population (e.g. Poland, Spain). However, if one assumes that, in the 11 MS where no data is available, only 20% of dental facilities are equipped with amalgam separators, the EU27 average would be in the order of **75% dental facilities equipped**[197]. This result suggests that there has been a significant increase in the proportion of dental facilities equipped with amalgam separators since the 2005 EC survey. Apart from the new legislation adopted is some MS, this could also be explained by the fact that most new chairs on the market are equipped with separators.

In terms of the level of maintenance of the existing separators, several MS reported that periodic inspections of the efficiency of equipment are undertaken by public authorities (CY, DE (every 3-5 years), DK, IE, MT (every year), SE, SI). Reportedly, an inspection programme is also being put in place in the UK.

[197] This average has been weighted by the number of dentists per MS (assumed to be proportional to the number of dental practices)

Based on available information, the following assumptions have been made for the purposes of this assessment:

- 95% of the mercury discharged to the vacuum pump system goes to chairside filters (and vacuum pump filters, if present), while 5% goes directly to the sewer (as most dental practices are equipped with chairside filters)
- Chairside filters and vacuum pump filters together have an average mercury removal efficiency of 45%[198]
- From the mercury present in the outflow of chairside filters, 70% goes to an amalgam separator while 25% goes directly to the sewer (assuming that, on average, 75% dental practices are equipped with amalgam separators in the EU)
- Amalgam separators have an average mercury removal efficiency of 70% (standard efficiency is usually higher, i.e. 95%, but actual efficiency is assumed to be lower due to a lack of proper maintenance observed in many cases[199])
- Approximately 3 t Hg/year are released from filters/separators to the atmosphere[200].

With the above assumptions, it can be roughly estimated that 30 t Hg/year are captured in filters and separators and potentially collected as solid waste, while 13 t Hg/year remain in the wastewater stream and enter urban WWTPs.

With regard to mercury concentration in the effluents, the SCHER report (2008) used information from Swedish studies (Hylander 2006)[201,202] and a US study (Stone 2003)[203] to estimate releases of mercury to the wastewater system, in 'best case' conditions (properly operating separators) and 'worst-case' conditions (inefficiently working separators or no separator use): Hg concentration in the WWTP inflow due to dental practices was estimated to be in the range of 3.5 to 918 µg Hg/l with an average value of 159 µg/l.

10B.6.2 – Mercury in solid waste

Solid mercury-containing waste generated by dental practices includes:

- Surplus amalgam from the preparation phase, which is directly discarded as waste (estimated above at approximately 11 t/year)

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[198] Assumption based on Concorde/EEB study (2007) and on a research article sent by the CED: Adegbembo et al. (2002) The weight of wastes generated by removal of dental amalgam restorations and the concentration of mercury in dental wastewater. J Can Dent Assoc; 68(9):553-8.

[199] See e.g. Hylander LD, Lindvall A and Gahnberg L (2006) High mercury emissions from dental clinics despite amalgam separators. Sci. Total Environ. 362:74-84

[200] 4 t/year were estimated by Concorde/EEB in 2007, but this was in relation to a higher dental amalgam use (125 t Hg/y)

[201] Hylander LD, Lindvall A and Gahnberg L (2006) High mercury emissions from dental clinics despite amalgam separators. Sci. Total Environ. 362:74-84

[202] Hylander, L. D., Lindvall, A., Uhrberg, R., Gahnberg, L., & Lindh, U. (2006). Mercury recovery in situ of four different dental amalgam separators. Sci. Total Environ. 366:320– 336

[203] ME Stone, ME Cohen, L Liang and P Pang (2003) Determination of methyl mercury in dental-unit wastewater, Dental Materials 19, 675–679, Elsevier Ltd

- Dental amalgam sludge recovered from the cleaning of chairside traps, vacuum filters and possible amalgam separators (estimated above at approximately 30 t/year), as well as from the cleaning of wastewater piping, during any maintenance activities
- Lost and extracted teeth, which are directly discarded as waste (estimated at approximately 11 t/year by a previous study[183]).

This represents a total of approximately **52 t Hg/year present in solid waste streams** from dental facilities.

10B.6.3 – Mercury releases to air

Air emissions from amalgam handling

Some air emissions may occur at dental practices during the handling of amalgam. This may include releases from accidental mercury spills, malfunctioning amalgamators, leaky amalgam capsules or malfunctioning bulk mercury dispensers, trituration, placement and condensation of amalgam, polishing or removal of amalgam, vaporisation of mercury from contaminated instruments, and open storage of amalgam scrap or used capsules[204].

However, the increasing use of pre-dosed capsules contributes to reducing emissions occurring during amalgam storage and preparation, and the exposure of dental personnel to these mercury vapours.

The Concorde/EEB study (2007) estimated up to 1 t/year of dental mercury emissions to the air for all of the EU-27, based on the assumption that occupational air concentrations of mercury inside dental clinics average about 15-20 µg/m^3 (derived from Echeverria et al. 1998)[205]. Given the lower dental amalgam use estimated in the present study and the increasing use of capsules in recent years, such air emissions have been estimated at approximately **0.5 t Hg/year.**

Air emissions from the wastewater system

Mercury vapours may be emitted from the dental clinic effluents passing through the vacuum pump system. This system must be vented to the air, therefore mercury contained in the effluents has the potential to vaporise and be released into the atmosphere outside the dental clinic or into the sewer system, depending on the type of equipment used. Research carried out in the US in 1996[206] measured mercury releases from the wastewater system per dentist at about 60 mg/day. This value was extrapolated to EU27 by Concorde/EEB (2007), suggesting air releases in the order of 4 t/year. Given the lower dental amalgam use estimated in the present study, such air emission releases have been estimated at approximately **3 t/year.**

10B.7 – Mercury releases associated with solid waste from dental practices

In accordance with the EU waste legislation[207], mercury-containing solid waste and sludge from dental clinics are considered as hazardous waste (EU waste code 18 01 10[208]). Such waste is to be

[204] JADA (2003) 'Dental mercury hygiene recommendations,' ADA Council on Scientific Affairs, American Dental Association, Journal of the American Dental Association Vol. 134, November 2003 (as cited by Concorde/EEB)

[205] D Echeverria, HV Aposhian, JS Woods, NJ Heyer, MM Aposhian, AC Bittner, Jr., RK Mahurin, and M Cianciola (1998) Neurobehavioral effects from exposure to dental amalgam Hgo: new distinctions between recent exposure and Hg body burden. The FASEB Journal Vol. 12 pp971-980

[206] PG Rubin and M-H Yu (1196) Mercury Vapor in Amalgam Waste Discharged from Dental Office Vacuum Units, Archives of Environmental Health Vol51 No.4, pp335-337

[207] Directive 2008/98/EC of 19 November 2008 on waste and repealing certain Directives

[208] Commission Decision of 3 May 2000 establishing a list of wastes, as amended

collected separately from non-hazardous waste and treated in specific facilities dedicated to hazardous waste.

In practice, even if the situation is improving, previous surveys have shown that not all dental clinics manage the waste in compliance with the legislation, i.e. it is sometimes mixed with municipal waste and/or with medical waste. For example, a study in Greece reported that dental wastes were not managed properly by 80% of dentists in the Thessaloniki municipality in 2006[209]. While mercury emissions from hazardous waste treatment operations can be considered as negligible (since such treatment operations are designed for hazardous compounds like mercury), inadequate treatment of mercury-containing waste with non-hazardous waste or with medical waste may generate significant mercury emissions to air, water and soil/groundwater, as explained below.

A French study[210] estimated that, in 2005, a dental chair in France generated in the order of: 1 kg/year of wet sludge from amalgam separators with an average Hg content of 6%; 0.1 to 0.2 kg/year of dry solid waste (surplus mixed amalgam from preparation phase, assumed to contain 50% Hg); and some packaging waste that is mostly empty (1 to 1.5 kg/year of empty pre-dosed capsules).

There are no publicly available statistics on EU waste production for the waste code 18.01.10 ('dental amalgam waste'). Latest data available on dental amalgam waste production and treatment is provided in Annex I. Quantities of mercury contained in dental amalgam waste produced by the 17 MS for which data is available amount to approximately 38 to 48 t Hg/year, with a high uncertainty on this range of values given the different information sources and the different methodologies used to estimate the mercury content of amalgam waste. This sample of MS is not representative enough of the EU situation to allow an extrapolation for EU27. The estimate developed through the mass balance (i.e. 52 t Hg/year) is considered to be more reliable than an extrapolation of reported waste data; it is therefore used in the rest of this study.

The following assumptions are made in this study with regard to the destinations of dental amalgam waste:

- Surplus amalgam from the preparation phase: 70% managed as hazardous waste and 30% as non-hazardous waste (i.e. collected in mixture with general municipal waste);
- Dental amalgam sludge recovered from the cleaning of chairside traps, vacuum filters and possible amalgam separators: 80% managed as hazardous waste and 20% as non-hazardous waste;
- Lost and extracted teeth: 40% managed as hazardous waste, 30% as biomedical waste and 30% as non-hazardous waste[211].

With the above assumptions, it can be estimated that, out of the 52 t Hg/y of waste produced, around 36 t/y (i.e. 69%) are managed as hazardous waste, 3 t/y (i.e. 7%) as biomedical waste and 13 t/y (i.e. 24%) as non-hazardous waste (i.e. mixed with municipal waste).

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[209] Kontogianni S, Xirogiannopoulou A and Karagiannidis A(2008). Investigating solid waste production and associated management practices in private dental units. Waste Management 28: 1441-1448

[210] ASTEE (2005) Vers une meilleure gestion des déchets mercuriels d'amalgames dentaires (http://www.astee.org/conferences/2005_paris/diaporamas/40.pdf)

[211] Assumption taken from Concorde/EEB study (2007)

Waste managed as hazardous waste

Treatment options for mercury-containing waste mainly include recycling or landfilling in storage facilities for hazardous waste, and possibly also incineration.

In the case of mercury recycling (to recover elemental mercury), typical mercury recovery efficiency is around 99% according to the Waste Treatment Industries BREF document[212]. The remaining 1% mercury is mostly released to the air, while smaller amounts may be found in treatment residues, filters from flue gas cleaning, etc.

In the case of landfilling as hazardous waste (above or underground storage), environmental emissions of mercury are considered to be negligible as storage facilities are designed to be sealed and to minimise releases to the environment.

In the case of incineration as hazardous waste, environmental emissions of mercury can also be considered as negligible. According to the Waste Incineration BREF document[213], in a typical hazardous waste incinerator, 99.88 % of Hg present in hazardous waste is captured in solid residues for disposal.

Waste managed as municipal waste (non-hazardous waste)

At EU level, treatment methods for municipal waste include landfilling (for 38% of municipal waste produced in 2009), incineration (20%), recycling (24%) and other methods including composting (18%)[214].

In the case of dental waste, these may be either landfilled or incinerated. Considering the above statistics, one can roughly assume that 70% of dental wastes ending up in the municipal waste stream are landfilled and 30% incinerated.

A French study[215] estimated that, in a typical municipal waste incinerator, 7 to 10% of the mercury contained in waste is emitted to the atmosphere. A large part of the mercury (around 90%) remains in the slag or is captured by the flue gas cleaning systems (e.g. electrostatic filter, scrubber). The study estimated that the fraction discharged to water was very small (0.5-1%). Flue gas cleaning residues are usually stabilised and sent to hazardous waste landfills; short-term emissions from stabilised residues in such landfills are avoided, however there is limited knowledge on the behaviour of these residues over a long timeframe (several hundreds or thousands of years)[216]. Slag may be sent to landfills for hazardous or non-hazardous waste, and possibly also used for road backfilling works, leading to further possible emissions to water and soil. Values derived from this French study are given here as an example, which may not be representative of the whole EU (in some MS, the proportion of mercury emitted to air from non-hazardous waste incinerators may be higher).

With regard to dental mercury-containing waste sent to municipal waste landfills, its behaviour is difficult to predict as it is very much dependent on the storage conditions. Mercury emissions to air, surface water, soil and groundwater may occur, as these landfills are not designed for the storage of such hazardous waste.

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212 EC(2006) Reference Document on Best Available Techniques for the Waste Treatment Industries, Chap. 4.3.3.3

213 EC(2006) IPPC - Reference Document on the Best Available Techniques for Waste incineration. Table 3.2 (http://eippcb.jrc.es/reference/)

214 Sources: Eurostat, 2009 data ; EC (2010) Environmental statistics and accounts in Europe – 2010 edition (p. 121)

215 AGHTM (2000) Rapport de synthèse des travaux du groupe de travail « Déchets mercuriels en France »

216 COWI/Concorde (2002) Heavy metals in waste – Report for the European Commission (DG ENV)

According to Concorde/EEB[183], a rough estimate of mercury emissions to the different environmental compartments arising from the presence of dental mercury in the municipal waste stream can be given as follows: 30% of mercury in waste emitted to the atmosphere; 10% emitted to surface water and 60% emitted to soil and groundwater. The same allocation rule has been used in the present study, in the absence of more accurate and up-to-date information.

- **Waste managed as medical waste**

A survey in the USA in 2000 discovered that 25-30% of dentists disposed of much of their dental amalgam waste as medical waste due to the potential presence of pathogens[217]. Typically, medical waste is disposed of by incineration, or sometimes by a sterilisation process known as 'autoclaving' (common in Ireland, for example). Medical waste incinerators are now supposed to operate according to EU regulations limiting emissions of mercury, although autoclaving remains less regulated and could result in mercury vapour releases, discharge of effluents to the wastewater system and/or eventual landfilling of autoclaved waste[218]. The Concorde/EEB study roughly estimated mercury emissions to the different environmental compartments arising from the presence of dental mercury in the biomedical waste stream, as follows[183]: 25% of mercury in waste emitted to the atmosphere; 5% emitted to surface water and 20% emitted to soil and groundwater; the remaining 50% are considered to be sequestered and no longer bioavailable (because handled as hazardous waste). The same allocation rule has been used in the present study, in the absence of more accurate and up-to-date information.

10B.8 – Mercury emissions from urban wastewater treatment plants

Most dental practices are connected to the municipal wastewater system, therefore mercury present in the dental effluents ends up in urban WWTPs. The **quantity of mercury entering urban WWTPs** was estimated above at approximately **13 t Hg/year**.

In addition to mercury discharges from dental practices, the deterioration of mercury fillings in people's mouths – due to chewing and consumption of hot beverages – also contributes to the mercury load received by WWTPs. This contribution was estimated at **2-3 t Hg/year** by Concorde/EEB[183], which is also the value used in the present study. As an example, for the city of Stockholm only, this mercury load was estimated in 2008 at 13-14 kg per year, which is about 40% of the total load entering the WWTP[219]. A previous study conducted on a sample of Swedish individuals in 1994 showed that the amounts of mercury excreted by each individual were comprised between 1.4 and as much as 209 µg Hg/day (median value of 62 µg Hg/day) and were correlated to the number of amalgam surfaces in the mouths[220]; extrapolating these values to the EU27 population gives a range of 0.3 to 38 t Hg/year (median of 11 t Hg/year) excreted by individuals and released to sewers, however it is unknown which exact proportion of this mercury is due to dental amalgam (the other main factor being the consumption of contaminated fish).

[217] KCDNR (2000) – 'Management of Hazardous Dental Wastes in King County, 1991 – 2000,' King County Department of Natural Resources, Hazardous Waste Management Program, Water and Land Resources Division, Washington State, USA

[218] HCWH (2002) – 'Stericycle: Living Up To Its Mission? An Environmental Health Assessment of the Nation's Largest Medical Waste Company' Health Care Without Harm

[219] Response from the Swedish Chemicals Agency to the Consultation on SCHER preliminary report on 'The environmental risk and indirect health effects of mercury in dental amalgam' (http://europaem.eu/politics/Response_Swedish_Chemical_Agency.pdf)

[220] Skare I et al. (1994) Human Exposure to Mercury and Silver Released from Dental Amalgam Restorations. Archives of environmental health, 49: 384–394

10B.8.1 – Efficiency of treatment

Urban WWTPs are not specifically designed to capture mercury or other heavy metals. If mercury solids enter a treatment plant, they eventually wind up in the grit (the initial coarse screen/filter on incoming wastewater) and/or the sludge/biosolids. Treatment plant grit is typically landfilled, leading to possible problems with leaching and/or volatilization. Sludge is often incinerated, landfilled or applied to land as fertilizer or compost.

Mercury removal efficiencies of municipal WWTPs are usually higher than 95% (i.e. more than 95% of Hg is captured in the sewage sludge while less than 5% remains in the water)[221]. Applying this 95% efficiency ratio to the estimated mercury inflow (i.e. 16 t Hg/y), it can be roughly estimated that **15 t Hg/year are captured by the sewage sludge** and **1 t Hg/year is found in the WWTP effluent discharged to surface water**.

According to the latest data from the European Pollutant Release and Transfer Register (E-PRTR)[222], **urban WWTPs released 2.5 t Hg to surface water, 0.21 t Hg to the soil (via agricultural spreading of sewage sludge) and 0.04 t Hg to the air in 2009**. These should be considered as minimum values, as not all urban WWTPs may have been reporting data and data are only reported if above certain thresholds[223]. As a comparison, another information source estimated at 6 t the amount of mercury released to surface water from EU urban WWTPs in 2005[224].

Not all the mercury released by urban WWTPs comes from dental amalgam use: a study from 1996 estimated the contribution of dental clinics to total Hg load entering WWTPs at 13 to 78%[225]; more recent studies in the USA estimated the contribution of dental clinics to be around 50% [226,227].

In 2008, the SCHER estimated the concentration of mercury in sludge as a consequence of releases from dental clinics ranged between 0.001 and 2.4 mg Hg/kg in dry weight with an average value of 0.42 mg/kg in dry weight[228]. Considering an average Hg concentration in sludge of 1.5 mg Hg/kg in the EU[229], the SCHER suggested that the contribution of dental clinics represented about one third of the Hg total releases to the terrestrial compartment. However, in certain MS such as Sweden, the use of mercury in dental amalgam has been identified as the single largest source of mercury in sewage sludge.

The sludge can be managed in several different ways, as described below. In most cases, sludge management operations will only result in mercury being moved from one environmental medium to another and will not enable mercury to be sequestered for long-term.

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[221] Balogh S and Nollet Y (2008). Mercury mass balance at a wastewater treatment plant employing sludge incineration with offgas mercury control. Science of the total environment 389: 125-131.

[222] European Pollutant Release and Transfer Register (http://prtr.ec.europa.eu/PollutantReleases.aspx).Data reported under the E-PRTR covers industrial facilities (including urban WWTPs) with individual Hg water releases above certain thresholds: 10kg/year for Hg releases to air; 1 kg/year for Hg releases to water and 1 Hg kg/year for releases to soil.

[223] Available data comes from 221 facilities across the EU and the reporting thresholds for Hg are 10 kg/year for releases to the air, 1 kg/year for releases to water and 1 kg/year for releases to the soil.

[224] Sundseth K, Pacyna JM, Pacyna EG, Panasiuk D (2011) Substance flow analysis of mercury affecting water quality in the EU. Water Air Soil Pollut. 223: 429-442

[225] Arenholt-Bindslev D and Larsen AH (1996). Hg levels and discharge in waste water from dental clinics. Water, Air Soil Pollut. 86: 93–99 (as cited by Concorde/EEB)

[226] ADA (2003) – Draft ADA Assessment of Mercury in the Form of Amalgam in Dental Wastewater in the United States, Environ report to the American Dental Association (as cited by Concorde/EEB)

[227] CCCSD (2006) – Dental Offices and Mercury Pollution, Central Contra Costa Sanitary District, Contra Costa, California, USA (as cited by Concorde/EEB)

[228] Taking a default average production of 0.071 kg of sludge per person per day at the WWTP

[229] EC 2004 web site: http://ec.europa.eu/environment/chemicals/mercury/summary of_legislation.pdf

10B.8.2 – Releases from sewage sludge management

Different options exist for the management of urban sewage sludge, in particular agricultural use as fertilizer, incineration (either in dedicated facilities within WWTPs or in large coal combustion plants), digestion (to produce biogas) or landfilling.

According to a study by Pancon (2009)[230], EU sewage sludge is managed as follows: 45% is used for agriculture, 23% is incinerated, 18% is disposed of in the sea, 7% is landfilled and 7% is disposed of in other ways. However, sludge management options vary widely across MS (see Annex J). Another recent study by Milieu[231] projected the following management options for 2010 and 2020 under a business as usual scenario:

Table 10B-0-b: Projections on sewage sludge management options in EU27 (in % of total sludge produced)

Year	Agricultural use	Incineration	Landfill	Other
2010	42%	27%	14%	16%
2020	44%	32%	7%	16%

According to the above projections, in a business as usual scenario the overall proportion of treated sludge recycled to agriculture across the EU will remain more or less the same up to 2020 while the share sent to incineration will rise slightly and the share going to landfills will be halved (due to EU legislation restricting organic waste going to landfill as well as public disapproval).

Agricultural use of sludge

In some MS, a significant proportion of sewage sludge appears to be used for agricultural purposes, e.g. Bulgaria (56% of total sludge produced in 2009), Czech Republic (47% in 2008), Denmark (59% in 2007), Ireland (69% in 2007), Spain (83% in 2009), France (47% in 2008), Cyprus (50% in 2007), Lithuania (61% in 2009), Luxembourg (56% in 2008), Hungary (57% in 2007) or Portugal (87% in 2007) (for further details, please see Annex J).

The presence of mercury in sewage sludge can make it more difficult to use it as agricultural fertilizer. This option has been less and less favoured by operators of WWTPs, due to the presence of various potential contaminants – mercury among others. However, the wastewater treatment organisations consulted during this study did not report that mercury was a significant limiting factor in itself for the agricultural use of sewage sludge.

According to a recent report for the EC (Milieu 2010)[232], the mercury content of sewage sludge recycled to agriculture ranges from **0.2 to 4.6 mg/kg dry matter**; the highest concentrations being observed in Poland (4.6 mg/kg), Latvia (4.2 mg/kg), Cyprus (3.1 mg/kg) and Slovakia (2.7 mg/kg) (see further data in Annex K). Another report mentions average mercury contents between 0.3 and 3 mg/kg dry matter across the MS (Pancon 2009)[233].

[230] Pancon (2009) The EU sludge management (http://140.115.123.119/980626/sppt/2.pdf)

[231] Milieu, WRC, RPA (2010) Environmental, economic and social impacts of the use of sewage sludge on land – Report for the EC, Part 1

[232] Milieu, WRC, RPA (2010) Environmental, economic and social impacts of the use of sewage sludge on land – Report for the EC, Part 2 (http://ec.europa.eu/environment/waste/sludge/pdf/part_ii_report.pdf)

[233] EC (2001) Disposal and recycling routes for sewage sludge – Scientific and technical report (http://ec.europa.eu/environment/waste/sludge/sludge_disposal.htm)

In Sweden, the phase-out of mercury use, the installation of amalgam separators in all dental clinics and the cleansing projects of mercury contaminated sewer pipes from dental clinics had led to a significant decrease in the mercury content of sewage sludge from approximately 1.1 mg/kg in 1995 to 0.6 mg/kg in 2008[234].

In 1999, the average mercury content of sludge spread on EU agriculture soils was estimated at 1.5 mg/kg of dry matter, implying the introduction of **4.3 t Hg to EU agricultural land annually** (European Commission 2004)[235]. A new calculation based on more recent data shows that this mercury amount has remained stable (approximately 4.4 t Hg/year as estimated in Annex K).

Once the sludge is spread onto the soil, mercury present in the sludge may partly volatilise (some 30 to 60% of the mercury added to the soil, occurring in open field conditions)[236]. It may also be captured by the vegetation grown on the soil, immobilised in the soil or drained by surface runoff.

Sludge is regulated by Directive 86/278/EEC of June 1986, which dictates that MS must prohibit the application of sewage sludge to soil where the concentration of one or more metals in the soil exceeds certain limit values. For mercury, the limit value in soil is 1 to 1.5 mg/kg of dry matter for spreading on soils with a pH higher than 6 and lower than 7. MS must also regulate the use of sludge such that the accumulation of heavy metals in soil does not exceed the limit values; they can do this in one of two ways: a) by laying down the maximum quantities of sludge which may be applied per unit of area per year while observing limit values for heavy metal concentration in sludge – for mercury this limit value is 16 to 25 mg/kg of dry matter; or b) by observing the limit values for the quantities of metals introduced into the soil per unit of area and unit of time – for mercury this limit value is 0.1 kg/ha/yr.

Directive 86/278/EEC is currently under review and a study was carried out to analyse the impacts of several policy options to modify legislation on sewage sludge (Milieu 2010)[237]. Some of the options investigated by the study involve lowering the limit value for heavy metals in sludge used for agricultural purposes; for mercury, the proposed new limit values would be 10 or even 5 mg/kg of dry matter. In practice, several MS have already implemented stricter limit values for mercury in sludge, for precautionary reasons. For the other MS, considering the respective mercury contents of sludge currently used for agricultural purposes (0.2-4.6 mg/kg in dry weight, as presented above), the implementation of a lower limit value would not be a problem in most cases.

Sludge incineration

The incineration of sewage sludge is becoming more widespread in the EU. Mercury present in sludge is partly captured by flue gas cleaning devices (depending on the abatement devices in place), the remainder being discharged to the atmosphere. Part of the mercury may be captured by conventional multi-pollutant abatement devices (e.g. dust filters, scrubbers), with varying efficiencies with regard to mercury removal. In order to improve the capture of mercury – among other micro-pollutants – some WWTPs have invested in activated carbon filters. For example, one large WWTP in Bilbao, Spain, reported that they recently invested in two activated carbon filters (4.3 million EUR investment) and two mercury emissions analysers (140 kEUR investment)[238]; it is

[234] Information provided by Sweden via the study questionnaire

[235] EC (2004) EU Legislation and Policy Relating to Mercury and its Compounds. Working Document of the European Commission, DG Environment. Prepared to inform the development of an EU strategy on mercury.

[236] EC (2001) Disposal and recycling routes for sewage sludge – Scientific and technical report (http://ec.europa.eu/environment/waste/sludge/sludge_disposal.htm)

[237] Milieu, WRC, RPA (2010) Environmental, economic and social impacts of the use of sewage sludge on land – Report for the EC (http://ec.europa.eu/environment/waste/sludge/pdf/part_ii_report.pdf)

[238] Information provided by the Bilbao wastewater treatment company via the study questionnaire

however not clear whether the Bilbao example should be regarded as best practice or as a common feature of many WWTPs in the EU.

As an example, a mercury mass balance was performed in 2007 by Balogh and Nollet[239] at a large metropolitan WWTP employing sludge incineration, which had been recently upgraded to provide for greater mercury control. The upgrade included a new fluidized bed sludge incineration facility equipped with activated carbon addition and baghouse carbon capture for the removal of mercury from the incinerator offgas. The results showed that mercury discharges to air from the plant represented less than 5% of the mass of mercury entering the plant, while the remaining mercury was captured in the ash/carbon residual stream exiting the new incineration process. It should be noted that such an example represents best practice rather than the average EU situation.

Solid residues from WWTP incinerators generally follow the same disposal routes as residues from non-hazardous waste incinerators (see Section C.7).

- **Sludge landfilling**

Landfill disposal of sludge has been the most widely used and lowest cost method of sludge disposal in Europe, but it is now widely recognised as being an unsustainable outlet due to concerns over pollution, loss of recyclable materials and loss of void for those wastes which cannot be recycled. The EC Landfill Directive (1999/31/EC) requires all MS to develop national strategies to reduce biodegradable wastes going to landfill. In fact, a number of MS have already introduced such measures, which when fully implemented in the next few years will effectively ban the disposal of sludge in landfill, unless it is as ash.

The behaviour of mercury contained in sludge going to landfill is difficult to predict as it is very much dependent on the storage conditions. Mercury emissions to air, surface water, soil and groundwater may occur, as these landfills are not designed for the storage of mercury-containing waste.

10B.8.3 – Overall environmental releases from wastewater treatment and sludge management

According to Concorde/EEB[183], a rough estimate of mercury emissions to the different environmental compartments arising from the presence of dental mercury in the inflow of WWTP can be given as follows: 10% of mercury entering urban WWTPs is finally released to the air, 40% to surface water and 50% to soil and groundwater; none of this mercury can be considered as being sequestered for long-term. The same allocation rule has been used in the present study, in the absence of more accurate and up-to-date information.

10B.9 – Mercury emissions from crematoria

10B.9.1 – Estimates of atmospheric mercury releases

According to previous studies, cremation represents a significant contribution to mercury air emissions associated with the life cycle of dental amalgam.

The Extended Impact Assessment (ExIA) of the EU Mercury Strategy provided an estimate of EU mercury emissions cremation in the order of 2 to 2.3 t Hg/year in 2002. The ExIA commented that '*although cremation is not an especially large source of emissions in relative terms, it is significant in some countries, and unlike the main industrial emissions it is not subject to any EU legislation*'; it

[239] Balogh, S. J., & Nollet, Y. H. (2008) Mercury mass balance at a wastewater treatment plant employing sludge incineration with off gas mercury control. Science of the Total Environment, 389, 125–131

was furthermore stated that '*mercury fillings are the larger reservoir of mercury in society behind the chlor-alkali industry, highlighting the possibility of significant total emissions over a period of many years*'. The Concorde/EEB report provided an estimate of 4.5 t Hg/year in 2004 on the basis of information from the Cremation Society of Great Britain[240]. A report by AMAP/UNEP provided an estimate of 3.5 t in 2005, noting the high uncertainty associated with this figure[241].

Mercury emissions from this sector are not covered by current EU legislation but they are regulated in several MS (Emission Limit Values (ELVs) for mercury and/or requirement for mercury abatement devices). In addition, Parties to the OSPAR Convention, which include twelve MS, have proposed using Best Available Techniques to reduce mercury air emissions (OSPAR Recommendation 2003/4, as amended). Parties to the HELCOM Convention have also proposed to apply ELVs for mercury emissions from crematoria (HELCOM Recommendation 29/1). A summary of existing legislation in MS is provided in Annex B.

Policy options to reduce mercury emissions from crematoria were investigated in the ExIA of the Mercury Strategy in 2005. It was concluded that Community-level action was not appropriate at that stage, mainly because such emissions were covered by an OSPAR Recommendation and by legislation in some of the remaining MS that are not parties to the OSPAR Convention. The ExIA also noted that available data on the extent of emissions from cremation were limited and that future reporting required by the OSPAR Recommendation would provide an initial indication of the extent to which the Recommendation is being applied.

As part of this study, the following new data has been reviewed:

- Latest emission data reported under the OSPAR Recommendation 2003/4 (overview report issued in August 2011)[242]
- Data provided by the stakeholders contacted for this study (replies to the questionnaires)
- Latest cremation statistics243.

According to international cremation statistics[244], the use of cremation has increased in EU countries over the last few years: in 2009 approximately 51% of deceased persons were cremated[245] vs. approximately 42% in 2005[246]. Countries with the highest rates of cremations in 2009 were the Czech Republic (80%), Sweden (77%), Slovenia (75%) and the UK (73%). The use of cremation has increased in all EU countries for which data is available, with significant increases noted in some MS such as Portugal (+13% between 2005 and 2009) or Slovenia (+7.5%). In Poland, the rate of cremation is expected to double between 2006 (5%) and 2020 (10%)[247]. In Greece, Lithuania and Cyprus, there are no crematoria.

[240] Cremation Society of Great Britain, 2004 statistics

[241] AMAP/UNEP (2008) Technical background report to the global atmosphere mercury assessment

[242] OSPAR (2011) Overview assessment of implementation reports on OSPAR Recommendation 2003/4 on controlling the dispersal of mercury from crematoria (http://www.ospar.org/documents/dbase/publications/p00532_Rec_2003-4_Overview_report.pdf)

[243] Cremation Society of Great Britain (http://www.srgw.demon.co.uk/CremSoc4/Stats/index.html)

[244] Cremation Society of Great Britain (http://www.srgw.demon.co.uk/CremSoc4/Stats/index.html)

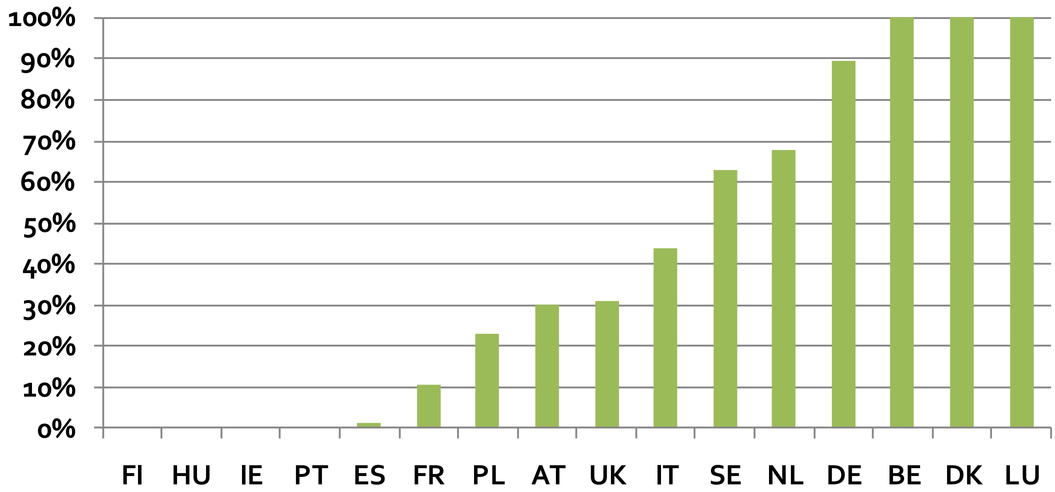
[245] Based on data from 14 MS

[246] Based on data from 18 MS

[247] NILU Polska (2010) Cost-benefit analysis of impact on human health and environment of mercury emission reduction in Poland – Stage 1 (http://www.gios.gov.pl/zalaczniki/artykuly/etap1_20101022.pdf)

Recent estimates of mercury air emissions from crematoria in MS are presented in Annex L, covering 25 MS[248]. Some of these estimates correspond to data reported under the OSPAR Convention while others were obtained through the study questionnaires or were estimated by BIO using the most recent cremation statistics. In these 25 MS, there are **about 2,700 crematoria**. Based on data for 16 MS, it can be estimated that **approximately 40% crematoria are equipped with mercury abatement devices**, but this proportion varies greatly across MS as shown in *Figure 10B-b* below.

Figure 10B-b: Share of crematoria equipped with mercury abatement devices in 16 MS[249]



It is difficult to know how EU emissions have evolved over the last few years, due to a lack of data in a number of MS. However, the following national trends can be noted based on information reviewed to date:

- **UK:** Reported emissions have more than doubled between 2002 (~400 kg) and 2010 (~940 kg)[250]. In 2004, the UK Department for Environment, Food and Rural Affairs (DEFRA) estimated that the amount of mercury from cremations would increase in the UK by two-thirds between 2000 and 2020, accounting for over 25% of the national mercury emissions to the air in 2020, in the absence of further abatement measures[251].
- **France:** Reported data shows an increase in emissions between 2002 (200 kg) and 2009 (307-407 kg)[252].
- **Sweden:** Although the number of crematoria applying mercury removal techniques has increased between 2004 and 2009[253], overall mercury emissions from crematoria have increased

[248] MS not included are BG, MT

[249] CY, GR, LT: no crematoria. For other MS, no information is available on the share of crematoria equipped with Hg abatement devices.

[250] Sources: 2002 value from OSPAR overview report published in 2003; 2010 value provided by CAMEO (Crematoria Abatement of Emissions Organisation) for this study. In addition, the value reported for 2009 was 730 kg (according to OSPAR overview report published in 2011)

[251] DEFRA (2004) Mercury emissions from crematoria. Second consultation on an assessment by the Environment Agency's Local Authority Unit

[252] Source: OSPAR overview reports published in 2003 and 2011, respectively

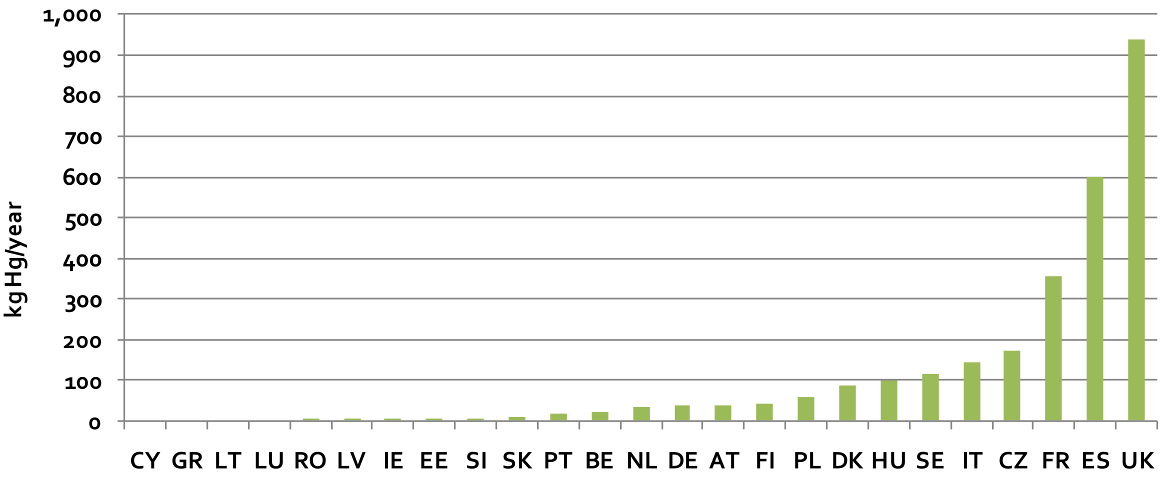
[253] 2004 data for Sweden available here: http://cdr.eionet.europa.eu/resultsdataflow?dataflow_uris=http%3A%2F%2Frod.eionet.eu.int%2Fobligations%2F492

during this time period (from 58 kg in 2004 to 114 kg in 2010), partly due to a higher number of cremations occurring in crematoria not equipped with abatement devices.

- **Netherlands:** A significant decrease can be observed between 2002 (80 kg) and 2010 (33 kg)[254], with an increasing share of crematoria equipped with mercury abatement devices.
- **Germany:** A decreasing trend is observed between 2002 (42-168 kg) and 2008 (39 kg)[255], although there was significant uncertainty on the 2002 estimate.
- **Denmark:** Emissions were estimated at 60 kg in 2002 and 70-104 kg in 2008[256] but are expected to have significantly decreased in 2011, as all crematoria are now fitted with mercury abatement devices to comply with national legislation (compliance deadline was January 2011).
- **Belgium:** Between 2006 and 2009, mercury emissions have remained stable (while the number of cremations has slightly increased both in crematoria with and without mercury abatement).

For the 25 MS for which data is available or could be estimated, it is roughly estimated that total mercury air emissions are **in the order of 2.8 t Hg/year**[257] (for the OSPAR Convention area alone, the 2011 OSPAR overview report provided a rough and provisional estimate of between 1 and 2 t Hg/year). This should be considered only as a rough estimate, as there is significant uncertainty on national mercury emission estimates. As mentioned by the OSPAR overview report, several measurement/estimation methodologies are currently used and the reliability of some these methodologies is questionable. In spite of some upwards trends observed in some MS, this result suggests that overall EU mercury emissions have not increased since 2005. Estimated emissions per Member State are presented in *Figure 10B-c* below:

Figure 10B-c: Estimated annual Hg emissions from crematoria in 25 MS



The three MS with the greatest emissions and showing significant increases in emissions over the last few years are the UK, Spain and France. For the UK and France, more stringent legislation has been implemented recently:

&years%3Aint%3Aignore_empty=&partofyear=&country=&sort_on=reportingdate&sort_order=reverse; 2010 data provided by KEMI as part of this study

254 Source: OSPAR overview reports published in 2003 and recent data provided by the Ministry of Environment for this study

255 Source: OSPAR overview reports published in 2003 and 2011, respectively

256 Source: OSPAR overview reports published in 2003 and 2011, respectively

257 MS for which no estimates could be made, due to a lack of data, are: BG, MT

- **UK:** Requirement for abatement to be fitted covering 50% of cremations by end 2012, plus all new crematoria to have abatement from 2005[258].
- **France:** A Ministerial Order from January 2010 introduced an emission limit value of 0.2 mg Hg/Nm^3 applicable as of 2010 for new crematoriums and as of 2018 for existing ones[259].

No information is available on the actual or projected environmental impacts of the above regulations, however it can be assumed that the more stringent legal requirements implemented in these two countries would greatly contribute to stabilising emissions (or at least slowing down emissions increase) within the OSPAR Convention Area, after 2020.
In spite of the decreasing emission trends that can be expected from these measures, there are two main parameters that tend to counteract emission abatement efforts:

- A growing trend towards the use of cremation (rather than burial), particularly in big cities, as mentioned in the OSPAR report of 2011[260]. Crematoria companies who responded to the study questionnaire also reported upward trends[261].
- An increasing proportion of deceased people having amalgam fillings.

10B.9.2 – Mercury deposition from crematoria

Little data is currently available on the possible impacts resulting from mercury deposition around crematoria. A study was conducted in the UK in 2008, on behalf of the UK Food Standards Agency[262], which demonstrated that, based on a highly conservative risk assessment, the potential exposure of members of the public to mercury arising from crematoria stack emissions via foodstuff consumption is almost certainly indistinguishable from the existing background concentrations of mercury existing in the UK population diet. The study concluded that there is no observed impact of mercury emissions from crematoria on human health via foodstuff consumption.

10B.10 – Mercury emissions from other sources

Emissions from people's mouths

A rough estimate of around **2 t Hg/year** exhaled by EU-27 citizens was given by a previous study[183].

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[258] Environment Permitting Regulations 2007 (January 2005)

[259] Ministerial Order of 28 January 2010 concerning emissions from crematoriums

[260] OSPAR (2011) Overview assessment of implementation reports on OSPAR Recommendation 2003/4 on controlling the dispersal of mercury from crematoria

[261] In Italy, the Federal Utility company estimated an increase by about 4,000 to 5,000 cremations per year in the next 5 years. In Portugal, the national funerals association estimated an increase from 14 crematoria and 8,752 cremations in 2010 to approximately 25 crematoria and 15,000 cremations/year in 2016. In the Netherlands, a slight increase in the number of cremations, in the order of 0.5% per year, is expected by the Facultatieve Technologies group.

[262] Michael D. Wood, Adrian Punt and Richard T. Leah (2008) Assessment of the mercury concentrations in soil and vegetation, including crops, around crematoria to determine the impact of mercury emissions on food safety. Report for the UK Food Standards Agency (http://foodbase.org.uk/admintools/reportdocuments/323-1-574_C02070_27_april_09.pdf)

Emissions from burial

The burial of deceased persons with mercury fillings eventually leads to mercury releases to the soil and groundwater, however it is difficult to estimate the magnitude of such releases in the absence of any data.

It is assumed that deceased persons have an average of 1.5 g Hg in the mouth (older people are supposed to have slightly less mercury in their mouth than the average EU population, due to fewer remaining teeth). Given the number of deceased persons in EU27 (approximately 4.9 million in 2010)[263] and considering that about half are buried[264], this corresponds to approximately **3.7 t of Hg/year**.

Considering that the other half of deceased people are subject to cremation, a similar amount of mercury would be emitted from crematoria if there were no mercury abatement devices (the total amount of mercury air emissions from crematoria, estimated using another methodology is approximately 2.8 t Hg/year).

10B.11 – Contribution to overall mercury releases

By summing up amounts of mercury released to air/water/soil as estimated in the previous sections, it can be concluded that the current and historical use of dental amalgam leads to[265]:

- ~ 16 to 23 t Hg/year emitted to the air
- ~ 2 to 4 t Hg/year emitted to surface water
- ~ 16 to 24 t Hg/year emitted to the soil and groundwater
- ~ 31 to 46 t Hg/year sequestered for long-term or recycled.

The above estimates suggest that **34 to 50 t/year of mercury from current and historical use of dental amalgam are emitted to the environment with some potential for becoming bioavailable**, while **31 to 46 t/year** can be considered as being either **sequestered for long-term (i.e. no longer bioavailable) or recycled**.

Once in the environment, changes in pH, oxygen availability, temperature, presence of other ions and actions of abrasion and corrosion can allow the mercury in amalgam to be used by bacteria, which are able to convert it to the more toxic organic methyl-mercury[266,267]. Organic mercury is readily bioavailable and once entering the food web, it tends to accumulate in the organisms. The organism concentrations of methyl mercury increases (biomagnifies) when passing the food web to reach highest concentrations in top predators such as certain birds and piscivorous fishes, being popular for human consumption[268,269]. Methylation to methylmercury already starts in the wastewater before reaching its recipient[270].

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[263] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Number_of_deaths,_EU-27,_(1)_(million).png&filetimestamp=20111018093516)

[264] International cremation statistics 2009 (http://www.srgw.demon.co.uk/CremSoc5/Stats/Interntl/2009/StatsIF.html)

[265] The figures below take into account a +/-20% uncertainty range

[266] Kao RT, Dault S and Pichay T (2004). Understanding the mercury reduction issue: the impact of mercury on the environment and human health. J Calif Dent Assoc 32: 574–9.

[267] Jones DW (2004). Putting dental mercury pollution into perspective. Br Dent J 197: 175–7.

[268] UNEP (2002) Global mercury assessment report

Mercury emission estimates from dental amalgam use can then be compared with available estimates of overall mercury releases to air/water/soil in the EU, in order to assess the relative contribution of dental mercury to the overall mercury problem in the EU. This comparison is presented in *Table 10B-c* below. It is important to note that available estimates of overall mercury releases to air/water/soil in the EU should be considered as low-end estimates, due to limitations in the scope of Hg emissions covered (given the wide range of anthropogenic mercury emission sources, some of the reported data only covers certain emission sources). Consequently, estimates of dental amalgam use contribution to EU releases that are presented in the table below may be over-estimated and should be considered as high-end estimates.

Table 10B-0-c: Comparison between dental Hg release estimates and overall Hg releases in the EU

Environmental media	Hg releases from dental amalgam use (t/year) (1)	Available data on overall anthropogenic Hg releases in the EU (t/year) (low-end estimates)	Dental amalgam use contribution to EU releases (high-end estimates)
Air	16 - 23	EU report under UNECE Convention on LRTAP (2): 73 t in 2009 E-PRTR (3): 31.3 t in 2009 (only industrial facilities). The main contribution is from coal combustion plants (16.1 t, i.e. 51%) Sunseth et al.(4): 105 t in 2005	Based on LRTAP data: 21 - 32% (5)
Surface water	2 - 4	E-PRTR (6): 6.33 t in 2009 from industrial facilities (including urban WWTPs contributing 2.52 t, i.e. 40%) Sunseth et al. (4): 27 t in 2005 (urban WWTPs estimated to contribute 6 t, i.e. 22%)	Based on Sunseth et al. data: 9 - 13% (7)
Soil and groundwater	16 - 24	E-PRTR (8): 0.26 t in 2009 from industrial facilities (including urban WWTPs contributing 0.213 t, i.e. 82%), however this value only covers a very small proportion of overall Hg releases to soil	Not quantifiable

(1) Estimates developed in the present study include a +/- 20% uncertainty range.

(2) EEA (2011) European Union emission inventory report 1990–2009 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP), Table 2.13 (http://www.eea.europa.eu/publications/eu-emission-inventory-report-1990-2009). Covers a wide range of emission sources: energy production and distribution / energy use in industry / industrial processes / solvent and product use / commercial, institutional and households (energy use) / road transport / non-road transport / agriculture / waste management

(3) European Pollutant Release and Transfer Register (http://prtr.ec.europa.eu/PollutantReleases.aspx). Covers facilities releasing more than 10 kg/year of Hg to the air

[269] Zhao X, Rockne KJ, Drummond JL, Hurley RK, Shade CW and Hudson RJM (2008) Characterization of Methyl Mercury in Dental Wastewater and Correlation with Sulfate-Reducing Bacterial DNA. Environmental Science & Technology 42: 2780 -2786

[270] Zhao X, Rockne KJ, Drummond JL, Hurley RK, Shade CW and Hudson RJM (2008) Characterization of Methyl Mercury in Dental Wastewater and Correlation with Sulfate-Reducing Bacterial DNA. Environmental Science & Technology 42: 2780 -2786

(4) Sundseth K, Pacyna JM, Pacyna EG, Panasiuk D (2011) Substance flow analysis of mercury affecting water quality in the EU. Water Air Soil Pollut. 223: 429-442. This study covers a much wider range of human activities in the EU than the EPRTR.

(5) The LRTAP value is chosen to estimate this ratio, because it is the most recent value available for overall EU air emissions from anthropogenic activities.

(6) European Pollutant Release and Transfer Register (http://prtr.ec.europa.eu/PollutantReleases.aspx). Covers facilities releasing more than 1 kg/year of Hg to water, hence the scope of the reported values is limited.

(7) The value from Sunseth et al. (2011) is chosen to estimate this ratio, because it covers a wider scope than the E-PRTR value for direct mercury discharges to the aquatic environment.

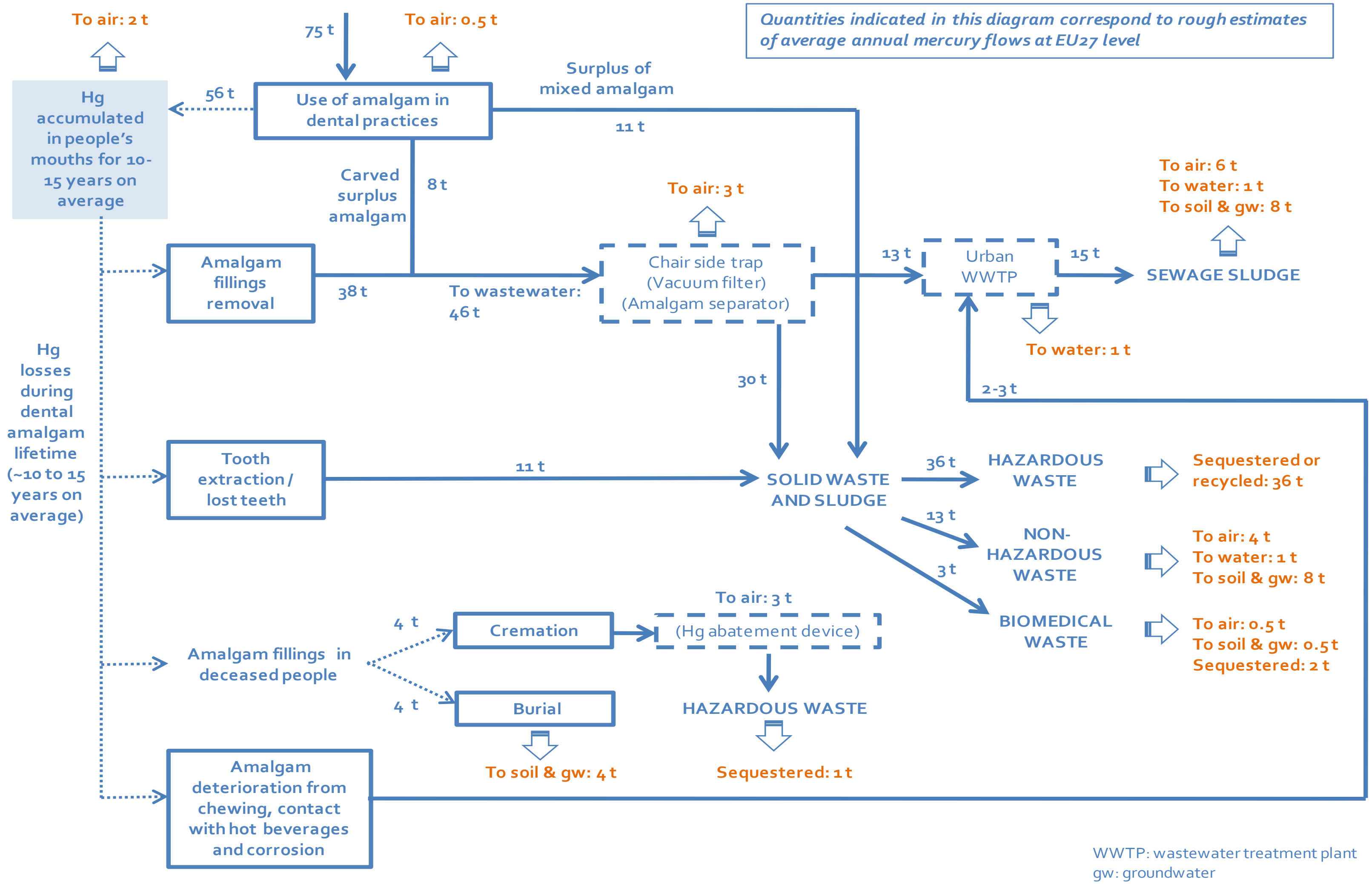
(8) European Pollutant Release and Transfer Register (http://prtr.ec.europa.eu/PollutantReleases.aspx). Covers facilities releasing more than 1 kg/year of Hg to soil.

The above comparison suggests that mercury emissions from the current and historical use of dental amalgam, expressed in terms of total Hg concentrations, still represent a significant contribution to overall EU mercury releases to air and surface water. Part of the mercury emitted to the air may actually be deposited after some time, and may enter other environmental compartments (surface water, soil and groundwater, vegetation). Contribution of dental amalgam use to mercury releases to soil and groundwater is difficult to quantify in the absence of any relevant data concerning total EU releases to soil and groundwater.

One important limitation to the assessment of environmental impacts from dental mercury is that mercury uses and releases can only be estimated in terms of total elemental Hg loads, while the actual environmental impacts depend on the mercury species involved and, in particular, the quantities of bioavailable methylmercury released in the environment (methylmercury is one of the most toxic forms of mercury, which also accumulates and biomagnifies in the food chain). Because the mercury methylation and demethylation processes are not very well understood at present, it is not possible to accurately model the possible biochemical transformations of mercury originating from dental amalgam and its environmental impacts. However, the comparison presented above shows that dental amalgam is a significant contributor to overall anthropogenic mercury releases in the EU. According to calculations based on the critical load concept (mainly based on ecotoxicological effects and human health effects via ecosystems), more than 70% of the European ecosystem area is estimated to be at risk today due to mercury levels, with critical loads for mercury exceeded in large parts of western, central and southern Europe[271]. As a significant source of mercury in the environment, the current and historical use of dental amalgam contributes to this environmental risk.

[271] Hettelingh, J.P., J. Sliggers (eds.), M. van het Bolcher, H. Denier van der Gon, B.J.Groenenberg, I. Ilyin, G.J. Reinds, J. Slootweg, O. Travnikov, A. Visschedijk, and W. de Vries (2006). Heavy Metal Emissions, Depositions, Critical Loads and Exceedances in Europe. VROM-DGM report, www.mnp.nl/cce, 93 pp.; CEE Status Reports 2008 (Chapter 7, http://www.rivm.nl/thema/images/CCE08_Chapter_7_tcm61-41910.pdf) and 2010 (Chapter 8, http://www.rivm.nl/thema/images/SR2010_Ch8_tcm61-49679.pdf)

Figure 10B-d Main mercury flows associated with dental amalgam use (t Hg/year)



ANNEX 10C – USE OF SEPARATORS IN DENTAL PRACTICES

Country	Legal requirement to install amalgam separators	Estimated % dental clinics equipped with amalgam separators	Additional requirements	Maintenance requirements and actual efficiency levels	Information source
Austria	Yes	100%	Required in new and existing dental offices; 95% min efficiency; documented evidence of proper maintenance required; max concentration of Hg: 0.01 mg/l	Maintenance required by law, with documented evidence and periodic inspections of authorities concerning the management of waste.	Questionnaire 2011 (Dental Chamber and Ministry of the Environment)
Belgium	Yes	'near 100%'	Flanders: certification; max concentration of Hg: 0.01 mg/l Walloon Region: max concentration of Hg: 0.3 mg/l Brussels: max concentration of Hg: 0.03 mg/l	In Brussels: Maintenance required by law.	Questionnaire 2011 (IGBE Brussels; DGARNE - DPEAI – DCC)
Bulgaria	No		Amalgam separators are advised but are not yet mandatory. However, all modern dental chairs are equipped with amalgam separators.		Questionnaire 2011 (Ministry of the Environment)
Czech Republic	Yes	100%	Required for new and existing practices. Min efficiency: 95% Hg limit value: 0.05 mg/l		Questionnaire 2011 (Ministry of the Environment) and EC 2005 survey
Cyprus	No	Most dental clinics have modern equipment and therefore amalgam separators		Periodic inspections are carried out by public authorities.	Questionnaire 2011 (Ministry of the Environment) and EC 2005 survey
Denmark	No	100%	No obligatory legal requirement; however in practice there are separators in every dental clinic due to a guidance document from the Ministry of The Environment. All municipalities follow this guidance, as they are in charge of the waste water treatment and surface water quality within their municipality.	Periodic inspections are carried out by public authorities.	Questionnaire 2011 (Danish EPA)
Estonia	No	Amalgam separators and filters installed only in a few			EC 2005 survey

Country	Legal requirement to install amalgam separators	Estimated % dental clinics equipped with amalgam separators	Additional requirements	Maintenance requirements and actual efficiency levels	Information source
		facilities.			
France	Yes	'near 100%'	95% min efficiency		French authorities (stakeholder consultation 2012)
Finland	Yes	100%	Required for new and existing dental practices. 95% min efficiency		Questionnaire 2011 (SYKE) and EC 2005 survey
Germany	Yes	100%	95% min efficiency; ISO 11143; max concentration of Hg: 0.005 mg/l	Inspection by qualified technicians of national authorities is carried out every 3-5 years.	Questionnaire 2011 (German Dental Association)
Greece	No	Amalgam separators installed in most recent facilities		A survey conducted in the Thessaloniki urban area in 2006, it was noted that none of the dental units used amalgam chairiside traps or amalgam separators. Some had the appropriate equipment, but used the traps only to avoid clogging in the pipes, and the contents were washed out in the washstands of the dental units. Hg-bearing dental wastes were not managed properly by 80% of dentists and metalbearing waste was handled in accordance with internationally established best management practices by less than 50% of dentists[272].	EC 2005 survey; Kontogianni et al. 2008 (Survey on dental waste management in the Thessaloniki urban area)
Hungary	No	New and modern dental clinics tend to be equipped with amalgam separators.	The installation of amalgam separators is only recommended and therefore not uniformly applied.		Questionnaire 2011 (Ministry of the Environment)

[272] Dental waste mismanagement was found to be primarily due to the lack of general awareness among dentists that their waste is hazardous and should be managed properly and a lack of regulatory control and support by governmental agencies and dentistry associations.

Country	Legal requirement to install amalgam separators	Estimated % dental clinics equipped with amalgam separators	Additional requirements	Maintenance requirements and actual efficiency levels	Information source
Ireland	no (but voluntary initiatives)			Periodic inspections by public authorities are carried out.	Questionnaire 2011 (Ministry of the Environment)and EC 2005 survey
Italy	Yes	90%	Required in existing and new dental practices	Yearly Inspections by ASL (local health authority) on the waste procedures is requried by law	Questionnaire 2011 (Italian Dental Assoc.)
Latvia	Yes	100%	Required in existing and new dental practices	Maintenance required by law, with documented evidence.	Questionnaire 2011 (Ministry of the Environment)
Lithuania	No				Questionnaire 2011 (Ministry of the Environment)
Luxembourg	?	?			
Malta	Yes	100%		Documented evidence of amalgam separators' maintenance required by law. Yearly inspections by authorities are carried out and the results obtained show a good level of compliance. If a clinic does not comply it is shut down until it complies with specifications.	Questionnaire 2011 (Ministry of the Environment)
Netherlands	Yes	90% (in 2005)	95% min efficiency		EC 2005 survey
Poland	No		Recommended by the national authorities. A regulatory proposal was drafted to make it obligatory but has not been adopted to date.		Verbal information from the Polish Chamber of Physicians and Dentists
Portugal	Yes	90% (in 2005)			EC 2005 survey
Romania	?	?			
Slovakia	No	New facilities only			EC 2005 survey
Slovenia	Yes	95%	Required for new and existing dental practices. 85% min efficiency Hg limit value: ,01 mg/L.	Periodic inspections are carried out by the public authorities.	Questionnaire 2011 (Ministry of the Environment)
Spain	?	?			

Country	Legal requirement to install amalgam separators	Estimated % dental clinics equipped with amalgam separators	Additional requirements	Maintenance requirements and actual efficiency levels	Information source
Sweden	Yes	100%	95% min efficiency	The dentists in Sweden have an obligation to inspect their own equipment. Inspections are also made by the local authorities and by the suppliers of amalgam separators.	Questionnaire 2011 (KEMI)
United Kingdom	Yes	99%	Required for new and existing dental practices 95% min efficiency Separators should meet the requirements of British Standard ‘Dental Equipment – Amalgam Separators’ (BS ISO EN 111:43 as amended by Cor. 1:2000) Documented evidence of proper maintenance required.	Adequate maintenance is required by law, with documented evidence of it. Periodic inspection of waste management in separators is already in place across most of the UK and steps are being taken to bring this into scope where it is not yet part of current monitoring arrangements.	Questionnaire 2011 (DEFRA)

ANNEX 10D – ENVIRONMENTAL COST OF DENTAL AMALGAM USE

This annex provides a compilation of data on costs associated with the environmental impacts of dental amalgam.

Environmental costs incurred by dentists

Environmental costs incurred by dentists mainly include costs for the installation and maintenance of amalgam separators and costs for the collection and treatment of amalgam waste as hazardous waste. These costs result from the need for dental practices to comply with EU waste legislation, which considers dental amalgam waste as hazardous waste. It can be assumed that such costs are to some extent included in the dentists' fees.

Cost of amalgam separators

A study carried out by the US Environment Protection Agency (EPA)[273] estimated the cost of amalgam separators through their life-cycle, including purchase or lease, installation, maintenance, replacement, transportation and recycling costs. *Table 10D-a* below shows the estimated costs, per size of dental office and per life-cycle stage. The distribution of costs indicates that costs of amalgam separators are very much dependent on the size of dental offices as well as the installed model. In addition, the amount of wastewater discharged determines the needs for maintenance and replacements (e.g. of traps and filters).

Table 10D-0-a: Estimated annual costs for amalgam separators by size of dental office (2008)

Type of cost	Small (1-4 chairs)	Medium (5-12 chairs)	Large (+12 chairs)
Purchase	$228–$1,370 (€159-€955)	$760–$2,510 (€530-€1,749)	$2,850–$10,000 (€1,986-€6,969)
Installation	$114–$228 (€79-€159)	$143–$297 (€100-€207)	$228–$1,140 (€159- €794)
Maintenance	$0–$228 (€0-€159)	$0–$228 (€0-€159)	$0–$228 (€0-€159)
Replacement	$57–$856 (€34-€597)	$86–$856 (€60-€597)	$571–$2,400 (€398-€1,673)
Estimated annual cost	**$211–$1,073** **(€147-€748)**	**$293–$1,110** **(€204-€767)**	**$1,990–$4,630** **(€1,387-€3,227)**

Source: US EPA (2008), Health Services Industry Detailed Study – Dental Amalgam

[273] US EPA (2008), Health Services Industry Detailed Study – Dental Amalgam (http://water.epa.gov/lawsregs/lawsguidance/cwa/304m/upload/2008_09_08_guide_304m_2008_hsi-dental-200809.pdf)

A report for the Commission in 2008[274], estimated the cost of amalgam separators at EUR 400-500 per year, including installation, servicing, in-situ evaluation of filter efficiency and accreditation, based on information from Denmark.

Costs of hazardous waste management

The current and historical use of dental amalgam results in the need to separately collect and treat dental amalgam waste as hazardous waste. This mainly includes surplus amalgam waste from sludge accumulated in amalgam separators and chair-side traps and, to a lesser extent, solid waste from the preparation of new amalgam. Indicative annual waste management costs provided by some MS as part of this study are shown in *Table 10D-0-b*.

Table 10D-0-b: Cost of dental amalgam waste management for dentists

Country	Average cost per year
Austria	100 EUR
Germany	0-600 EUR
Ireland	500 EUR
Malta	250 EUR
Sweden	100 EUR
UK	600EUR
Average	258 - 358 EUR

It is important to point out that these costs cannot be attributed solely to dental amalgam waste, since amalgam separators also trap waste from Hg-free materials.

[274] COWI/Concorde (2008) Options for reducing mercury use in products and applications, and the fate of mercury already circulating in society. Report for DG ENV

Environmental costs incurred by crematoria

Environmental costs incurred by crematoria correspond to the installation and maintenance of technical devices to capture mercury in flue gases and disposal of captured mercury as hazardous waste. According to Defra[275], such costs are partly or fully passed on to crematoria's customers.

Estimates of costs for different abatement measures are presented in the *Table 10D-c*.

Table 10D-0-c: Cost of strategies to avoid Hg pollution related to cremation

Option	Geographical scope/ year	Cost (EUR /kg Hg)	Reduction potential	Reference
Remove dental amalgam fillings at death	Sweden, estimated 2004	400	Large	Hylander et al, 2006[276]
Flue gas cleaning with carbon at crematoria	Sweden, estimated 2004	170,000–340,000	Medium/Large	Hylander et al, 2006
Flue gas cleaning with carbon at crematoria	UK, estimated 2004	29,000	Medium/Large	Hylander et al, 2006
Remove mercury from crematoria gases (cold start furnace)	OSPAR Convention Area, 2003	25,000 to 37,000	Medium/ Large	Derived from OSPAR 2003[277]
Remove mercury from crematoria gases (warm start furnace)	OSPAR Convention Area, 2003	25,000 to 37,000	Medium/ Large	Derived from OSPAR 2003

The report conducted by COWI/Concorde[278] for the Commission provides estimates on the cost of bag filters with carbon injection in Denmark (considered as one of the most relevant technologies). The cost of this type of installation is more expensive in comparison to similar industrial installations due to additional costs that arise from works that are carried out to improve the aesthetics. For crematoria that already have bag filters installed, COWI/Concorde estimated the cost of adding a carbon dispenser at approximately EUR 8,000 per kg Hg (EUR 22 per cremation) in Denmark and approximately EUR 17,000 per kg Hg in the UK (EUR 45 per cremation) for a 90% Hg removal efficiency.

[275] Public consultations organised by Defra in 2003 and 2004 concerning mercury abatement from crematoria in the UK

[276] Hylander LD and Goodsite ME (2006) Environmental costs of mercury pollution. Science of the Total Environment, 368: 352-370 (http://www.elsevier.com/authored_subject_sections/P09/misc/STOTENbestpaper.pdf)

[277] OSPAR (2003) Mercury emissions from crematoria and their control in the OSPAR Convention Area. OSPAR Commission, London

[278] COWI/Concorde (2008) Options for reducing mercury use in products and applications, and the fate of mercury already circulating in society

A study carried out in 1999[279] in the UK estimates the additional cost per cremation if gas-cleaning techniques are installed in crematoria within the range £47-67 (EUR 33-46) per cremation. The exact value depends on the number of cremations carried out.

According to Federutility-SEFIT[280], in Italy a common technique for reducing mercury air emissions from crematoria is the injection of chemicals (normally sorbalite) before the filtration process. The additional average cost of such a system is estimated at EUR 80,000-100,000 (excl. VAT) whereas the total cost of a filtration system is estimated at EUR 250,000-300,000 (excl. VAT) per cremator. The costs of maintenance are not included. The cost of sorbalite is approximately EUR 3 per cremation.

The Dutch manufacturer of cremators Facultatieve Technologies[281] estimates the costs for the installation of FGT (Flue Gas Treatment) at about EUR 350,000 per cremator (excl. VAT).

The use of activated carbon or specific chemicals for capturing mercury in flue gases results in a significant increase in the volume of hazardous waste and thereby in the disposal cost, as compared to the same weight of mercury disposed of as mercury waste in dental clinics.

Environmental costs related to sewage sludge management options

Estimates on the cost of switching from agricultural use of sludge (landspreading) to other disposal routes are presented in *Table 10D-0-d* below.

Table 10D-0-d: Costs to switch from agricultural use of sludge (landspreading) to other sludge management methods (EUR/t dry solids)

Member State	From land-spreading to landfill	From land-spreading to co-incineration	From land-spreading to mono-incineration
Austria	124	146	222
Belgium	130	152	233
Denmark	163	183	286
Finland	146	167	258
France	130	152	233
Germany	122	145	220
Greece	111	135	202
Ireland	148	169	261
Italy	124	146	222
Luxembourg	136	157	242
Netherlands	121	144	218

279 FBCA (2000) The Federation of British Cremation Authorities Statistics 1999, Resugram 43. 27-30, cited in DEFRA (2003) Mercury Emissions from crematoria, Consultation an assessment by the Environment Agency's Local Authority Unit

280 Questionnaire sent in the context of this study.

281 Questionnaire sent in the context of this study.

Member State	From land-spreading to landfill	From land-spreading to co-incineration	From land-spreading to mono-incineration
Portugal	104	128	190
Spain	114	137	206
Sweden	133	155	238
United Kingdom	117	140	211
Bulgaria	64	91	126
Cyprus	107	131	195
Czech Republic	87	113	163
Estonia	93	118	172
Hungary	85	111	160
Latvia	90	116	168
Lithuania	81	107	154
Malta	94	119	174
Poland	84	110	158
Romania	76	102	145
Slovakia	85	111	160
Slovenia	99	124	183
EU average	**110**	**134**	**200**

Source: Milieu et al (2010), *Environmental, economic and social impacts of the use* of *sewage sludge on land, Part II, Table 47. Report for DG ENV (*http://ec.europa.eu/environment/waste/sludge/pdf/part_ii_report.pdf)