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Study on EU Implementation of the Minamata Convention on Mercury

FINAL REPORT

30 MARCH 2015

Contract ENV.C.3/FRA/2011/0030/11 under Framework Contract ENV.C.3/FRA/2011/0030

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A report prepared for DG Environment, European Commission by COWI, BiPro, ICF International and Garrigues Ambiental

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Acronyms and abbreviations

AT	Austria
ASGM	Artisanal and small-scale gold mining
BAT	Best available techniques
BAU	Business as usual (scenario)
BE	Belgium
BEP	Best environmental practice
BG	Bulgaria
BREF	BAT Reference Document
BMC	Beyond minimal implementation of the Minamata Convention (scenario)
CAK	Chlor-alkali
CAK-Hg	Chlor-alkali production with mercury cell technology
CAS	Chemical Abstracts Service
CCFL	Cold cathode fluorescent lamp
CFL	Compact fluorescent lamp
CH_4	Methane
CLP	Classification, labelling and packaging
CLM	Cement, Lime and Magnesium Oxide
CLRTAP	UNECE Convention on long-range transboundary air pollution
CN	Combined nomenclature
CNG	Cleaning of natural gas
CO_2	Carbon dioxide
COP	Conference of the Parties
CoRAP	Community Rolling Action Plan
CZ	Czech Republic
DE	Germany
DK	Denmark
ECHA	European Chemicals Agency
EEB	European Environmental Bureau
EEE	Electrical and electronic equipment
EEFL	External electrode fluorescent lamp
ELV	Emission limit value
EoLV	End-of-Life Vehicles
EMEP	European Monitoring and Evaluation Programme

E-PRTR	European Pollutant Release and Transfer Register
EQS	Environmental Quality Standards
ES	Spain
ESD	Environmentally Sound Disposal
EU	European Union
EUR	Euro
FI	Finland
GEF	Global Environment Facility
Hg	Mercury
Hg_2Cl_2	Mercury (I) chloride
HgO	Mercury (II) oxide
HPMV	High pressure mercury vapour (lamp)
HR	Croatia
hrs	hours
HU	Hungary
HWE	Hazardous Waste Europe
IE	Ireland
IED	Industrial Emissions Directive
IPPC	Integrated Pollution Prevention and Control
K	Potassium
kg	Kilogram
kWh	Kilowatt hour
LCP	Large combustion plants
LED	Light-emitting diode
LFL	Linear fluorescent lamp
Li	Lithium
LoW	List of Wastes
LRTAP Convention	Convention on Long-Range Transboundary Air Pollution
LT	Lithuania
LVOC	Large Volume Organic Chemicals
MI	Minimal implementation (scenario)
MC	Minamata Convention on Mercury
MCP	Medium Combustion Plants Directive
mg	Milligram
mm	Millimeter
ML	Maximum levels
MS	Member State
MW (th)	Megawatt (thermal)
Na	Sodium
NaOH	Sodium hydroxide
NEC Directive	National Emission Ceilings Directive
NFM	Non-ferrous metals
NH_3	Ammonia
NMVOC	Non-methane volatile organic compounds
NO_x	Generic term for the mono-nitrogen oxides nitric oxide (NO) and nitrogen dioxide (NO_2)
OECD	Organisation for Economic Cooperation and Development

OFC	Organic Fine Chemicals
PIC procedure	Prior Informed Consent procedure
PM	Particulate Matter
POL	Production of polymers
POP	Persistent organic pollutant
ppm	Parts per million
PPP	Plant protection products
PRTR	Pollutant Release and Transfer Register
PT	Portugal
PUR, PU	Polyurethane
R&D	Research and development
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
REFIT	Regulatory Fitness and Performance programme of the European Union
RO	Romania
RoHS	Restriction of Hazardous Substances
SE	Sweden
SO_2	Sulphur dioxide
SPSS	sulphur polymer stabilization/solidification
STOT RE	Specific target organ toxicity — repeated exposure
SVHC	Substances of very high concern
t	Tonne
TCLP	Toxicity Characteristic Leaching Procedure
TEC	Treaty establishing the European Community
UK	United Kingdom
UNEP	United Nations Environment Programme
UNECE	United Nations Economic Commission for Europe
VCM	Vinyl chloride monomer
VOC	Volatile organic compound
WFD	Water Framework Directive
WI	Waste incineration
WSR	Waste Shipment Regulation
y	Year

Executive summary

Introduction

In January 2013 negotiations were concluded on a global treaty to protect human health and the environment from the adverse effects of mercury. It was named the "Minamata Convention on Mercury" after the Japanese town that experienced severe mercury pollution in the 1950s. The Minamata Convention (MC) is the best prospect seen so far for reducing risks from direct and indirect exposure to mercury at a global level. Without the Convention, global releases of mercury are expected to rise, or at least not be reduced from their current levels.

The European Commission and many European Union (EU) Member States were leading advocates for the Convention and active participants in the negotiations. With the negotiations concluded and the Convention signed by the EU, the EU is preparing for becoming a party to the Convention. This study was commissioned by the European Commission to inform that process. Its objectives were to:

1 Assist Commission Services by identifying measures that would need to be taken at EU level in order to comply with the provisions of the Minamata Convention;

2 Assess the impacts of such measures, where needed, in view of internal procedures requiring an impact assessment for proposing new EU legislation, or amendments to existing legislation;

3 Maximise synergies in follow-up actions for the implementation of the Convention in view of relevant existing EU legislation by integrating the review of the Mercury Export Ban Regulation in the assessment.

The European Commission contracted ICF International, working with COWI, BiPRO and Garrigues Ambiental, to carry out the work.

Method

The study involved:

- A comparative analysis of the requirements of the Minamata Convention and those of existing and imminent EU legislation to identify any additional measures that would be required if the EU ratified the Convention;
- The identification of options for closing 'gaps' in EU law (as compared to requirements of the Convention) and a preliminary screening of those options on the basis of expected cost, environmental impact, etc.
- Detailed appraisal of a set of shortlisted measures that were identified as having the potential for significant impacts, drawing on evidence gathered through: review of literature; analysis of economic, environmental, trade and other official data, and consultations with stakeholders (including Member State governments, industry, and non-governmental organisations).
- Presentation of the findings to stakeholders at a workshop in Brussels and incorporation of additional input subsequently received into the analysis.

The new measures considered in the appraisal fall into two categories, those that provide conformity with the Convention, and those that go beyond strictly minimal conformity but which offer additional benefits in reduction of environmental and health risks. The study relied primarily on existing data and information provided by consultees.

The impacts of potential new measures were assessed by reference to a baseline defined by existing and imminent[1] EU legislation, and by existing trends in use of mercury.

Conclusions

The analysis has provided a set of conclusions that will help to inform decisions about the EU's approach to the Minamata Convention.

The primary conclusion is that achieving conformity with the Minamata Convention would require a limited number of adjustments and extensions to the EU acquis, rather than significant reform or extension of controls. This is because the EU already has a well-developed strategy and legislative framework for control of the risks posed by mercury. The overall goals of the Minamata Convention are in line with the EU Mercury Strategy and several of its provisions are similar to existing EU legislation on mercury.

There are a few areas where the EU's conformity with some of the requirements of the Minamata Convention cannot be determined with full confidence at this time.

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[1] Imminent legislation refers to initiatives still in the legislative process such as the proposed Medium Combustion Plant Directive. See an overview of current and forthcoming legislation in Appendix 1.

This is due to factors that include gaps in data and the fact that some of the elements of the Convention have yet to be defined in more detail. The associated uncertainties are deemed relatively minor.

The analysis suggests that the changes associated with signing the Convention are also likely to encourage further decline in use of a substance that is gradually being eliminated from the European market. The additional reductions in mercury releases in the EU flowing from ratification of the Convention will, however, be small compared to the very significant reductions seen in Europe over recent decades. The EU has already realised on its territory much of the potential for mercury release reductions that the Convention aims to achieve at a global level.

The major benefit to the EU of ratification is in helping to secure the global benefits of the Convention, in a context where the EU is dependent on the global cooperation on reduction of anthropogenic mercury releases in order to substantially reduce mercury exposure of humans and the environment in its own territory. There is, in this context, a potential cost of inaction: the 'do nothing' scenario in which the EU does not become a party to the Minamata Convention risks negative environmental and health impacts, both on the EU and at a global level. The EU emphasised the importance of global action in the communication entitled "Community Strategy concerning Mercury"[2] and has previously expressed support for the Convention. A decision by the EU not to ratify the Minamata Convention could reduce the Convention's prospects of being ratified by other countries given that the EU has been a driving force in securing a global agreement on mercury and a strong advocate of global cooperation. It could thus put at risk the reduction in global mercury releases that the Convention offers, with impacts on the EU as well as the world as a whole in a context where a significant part of the atmospheric mercury deposition in the EU originates outside its territories. The impact assessment concludes that in most cases the adjustments to EU law required to achieve conformity would have minimal impact. There are, however, some measures that could potentially have significant impacts on certain product markets and particular businesses.

The most significant issue is the Convention requirement on Parties to "take measures to restrict the use of mercury or mercury compounds in processes that include the production of sodium/potassium methylate/ethylate[3] (Article 5(3) MC), compounds used variously in the production of biodiesel, pharmaceuticals, food ingredients, crop protection products and other applications.

Most global production of sodium methylate, the most significant of the four products, uses a mercury-free process. There are two firms in the EU that use a mercury cell process in their EU facilities (but mercury-free processes elsewhere in their global operations). Non-mercury technologies are commercially available for production of sodium methylate and sodium ethylate while evidence of existence of

[2] Communication from the Commission to the Council and the European Parliament. Community Strategy Concerning Mercury. COM/2005/0020final

[3] Actually four substances, so-called alcoholates, produced in the same process facilities but with varying feedstock chemicals: Sodium methylate, sodium ethylate, potassium methylate and potassium ethylate.

alternatives processes for production of potassium methylate and potassium ethylate (which are produced at very small scale) is discussed.

The Convention requires Parties to take measures that include "the phase out of this use as fast as possible and within 10 years of the entry into force of the Convention", and "reduction in emissions and releases in terms of per unit production by 50 per cent by 2020 compared to 2010". The impact assessment considers: (i) the implications of an initiative that aims at the phase-out, including promotion of measures for making available alternative processes for the production of minority alcoholates; and (ii) a ban on production of alcoholates using mercury cells within 10 years.

It is concluded that the impacts will depend on the regulatory approach taken, the success of research and the strategic responses of the firms involved. If sufficient time is given, research into alternatives is funded and successful, and the replacement (mercury-free) production capacity integrated into company investment cycles, then the costs of transition could be minimised. If, on the other hand, the phase-out period is shortened and replacement capacity is to be installed quickly then incremental capital costs are potentially high.

The costs of substitution for all four substances is estimated at 60 – 76 million EUR[4] per year, of which about half relates to investments annualised over a 10 year period and the other half relates to operational costs. With an assumed *de minimis* expenditure of 2 million EUR/y on research, the substitution costs could therefore range between 2 and 76 million EUR/y. It is estimated that up to 200 jobs are potentially at risk. Meeting the MC's 2020 target for emission / releases reduction would cost an additional 0.6-1 million EUR/y.

If production of alcoholates using mercury cells ceased then mercury emissions to the air in Europe would fall by up to 190 kg/y and an estimated mercury input of up to 1 t/y would be eliminated.

Article 3(8) MC of the Convention requires Parties to prohibit the import of mercury from new primary mining and excess mercury of chlor-alkali facilities. This has no equivalent in EU law. The study evaluated a conditional restriction on imports from Non-Parties involving a procedure for checking imports from Non-Parties to the MC and imports being allowed if conditions similar to those for import from MC Parties are fulfilled. It concludes that the additional administrative burdens on importers and regulators could be minimised by integration with procedures for Regulation (EU) 649/2012 on export and import of hazardous chemicals. No significant impacts on the EU mercury market are expected as alternative supplies would be available. The measure provides global benefits in reducing mercury releases from mining and those associated with use of newly extracted mercury, but would not necessarily reduce EU mercury imports. It is recommended that import of mercury for environmentally sound disposal should remain possible in order to use the available capacity to assist other countries with environmentally sound disposal.

[4] Annualised investment costs assume a lifetime of 10 years and a discount rate of 4%.

The Convention's requirement (Article 4(1)) to restrict the export of specified products that contain mercury would, based on available data, have no major impacts, largely due to the existing controls on such 'mercury-added products' in the EU. Available data do not allow for a more precise estimation of impacts.

The discouragement of new products and processes with intentional mercury use required by the Convention (Articles 4(6) and 5(7)) would be consistent with overall EU mercury policy and, in the absence of any sign of significant emergent applications of mercury, have no direct or opportunity cost. A requirement for testing and approval of any such products and processes would have a dissuasive effect on introduction of new mercury applications that do not have significant benefits, by imposing additional costs on the proponent.

In summary, the additional measures required to ensure conformity with the Minamata Convention are estimated to:

- Deliver direct reductions in mercury use within the EU of around 0.5 – 1.5 tonnes/y, and 0 – 0.2 tonnes reductions of mercury emissions directly to air, plus expected larger (un-quantified) reductions in atmospheric inflow of mercury emitted outside the EU;
- Impose costs on specific firms of between 3 and 98 million EUR/y[5], mostly in the alcoholates production;
- Entail some incremental additional administrative burden for regulators and mercury importers.

Ratification would, however, help support a Convention that promises global reductions in mercury use and releases that will benefit the EU through lower deposition and exposure via environmentally translocated mercury and provide global environmental benefits. The projected costs of implementation should be seen in the context of a recent study that estimates the benefits of preventing loss of human IQ (Intelligence Quotient) points associated with mercury exposure[6] in the EU at 8,000 – 9,000 million EUR per year. This estimate does not include any other aspects of mercury's many adverse effects on health and the environment, so the total benefits from providing protection from mercury are likely to be higher.

Other potential measures

Additional benefits, in terms of reductions in use and releases of mercury and hence in the environmental and health risks, are available from other measures that go beyond the minimal implementation of the Minamata Convention. Some have minimal cost impact or cannot be fully evaluated with available data. Others have been examined in more detail, as described below.

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[5] About half of the upper range limit is investments annualised over 10 years; the other half are operational costs.

[6] This would include impacts of other mercury sources than those targeted by the Minamata Convention so its implementation is not expected to deliver these benefits in full.

Banning the use of mercury in alcoholates production would eliminate use of between 0.3 tonne and 1 tonne of mercury per year in the EU. It would have impacts on the EU producers of these substances. Replacement capacity based on non-mercury processes would result in costs estimated at up to 61-77 million EUR/y, depending on timing.

Regulating mercury supply via a general ban of mercury imports would result in additional costs to industry of 0-16 million EUR/y in the form of increased prices or substitution costs, plus some minor distributional effects. A conditional restriction on new commercial uses of mercury was also considered. This mainly has a signalling effect. Costs are expected to be small.

Requiring environmentally sound disposal of all mercury waste would result in costs for final deposition of the waste of an estimated 1-26 million EUR/y. Recyclers would incur losses of revenue of 2-7.8 million EUR/y. Compensating growth in mercury imports (unless restricted) would be expected to meet mercury demand, leading to increased revenues at mercury importers.

Article 4(1) prohibits manufacture, import and export of certain mercury-added products. Current EU legislation covers placing on the market (sales and import), but not manufacture and export for most of the products concerned. Restricting export of the products conforming to the current internal EU standards (but beyond Minamata Convention standards) would impact on some EU manufacturers. Industry consultations suggest annual exports of 143 million fluorescent lamps of the halophosphate type with an export revenue estimated at 240-360 million EUR/y would cease. The number of jobs at risk is not known. Also battery export may potentially be affected (lost export revenues estimated at 0-50 million EUR/y). Potential mercury input reductions 1.4-6.4 t/y.

Prohibition of dental amalgam, one of the largest remaining uses of mercury in the EU, was not considered in this study as the issue has been the subject of a separate study and is being examined in depth elsewhere under the auspices of the European Commission.

Financial assistance to developing country Parties and Parties in economic transition

The EU is a major group of developed country Parties to the Minamata Convention, and as such the EU may wish to make contributions to developing country Parties and Parties with economies in transition. As the size of such contributions are subject to political decisions within the EU, they cannot reasonably be estimated in advance. Results from a previous study can however be used to indicate the global funding needs for implementing the Minamata Convention in developing country Parties and Parties in economic transition:

› Financial needs for implementation of technical solutions; for example, implementation of BAT and substitution of mercury in products and processes may cost 3-26 billion EUR/y (globally except North America and the EU). For the measures expected to be most costly – those on coal fired power plants, batteries and dental amalgam – this estimate includes options which go beyond what was agreed on in the final Convention text, and the actual costs may thus be expected to be in the lower half of the estimated range (3-15 billion EUR/y).

- National administrative efforts in implementation, including: institutional capacity building; legal framework establishment; monitoring including analytical capacity; awareness raising and training. These have been estimated at 40-80 million EUR/y (globally except North America and the EU).

- International administration of the Convention (for the Secretariat, COPs and other meetings, administration of financial mechanisms, etc.), estimated at 15-30 million EUR/y.

Data gaps

The study found gaps in the data available to inform analysis on some topics. Priority areas for further investigation are:

- Current export revenue and mercury export tonnage with switches/relays and non-electronic measuring devices.

- The share of any such exports that would be affected by the MI or BMC scenarios, and their associated mercury inputs and releases.

- Information on available alternatives to potassium methylate and potassium ethylate (in the processes where these substances are used), and the consequences of terminating their production in the EU.

- Updated mercury input and release inventories for various mercury source categories of relevance for this assessment.

- Detailed updated data on mercury supply from recycling in the EU.

1 Introduction

Mercury is recognised as a chemical of global concern due to its long-range transport in the atmosphere, its persistence in the environment, its ability to bio-magnify in ecosystems and its significant negative effect on human health and the environment. For many years the European Union (EU) has been advocating strong international action to address the problems posed by mercury's release into the environment.

A recent study underlines the relevance of targeting mercury pollution. Based on measurements of mercury concentrations in human hair from most EU Member States (indicating the exposure levels), the study estimates the lost IQ (Intelligence Quotient) points in the EU due to mercury exposure and use. The total benefits of mercury exposure prevention in the EU are estimated to be 8,000 – 9,000 million EUR per year. Values about four times higher were obtained when using the logarithmic response function, while adjustment for productivity resulted in slightly lower total benefits. The estimate does not include the less tangible advantages of protecting brain development against neurotoxicity or any other of mercury's many adverse effects on health and environment (Bellanger *et al*., 2013).

Since 2003, when mercury was acknowledged as a global pollutant by the Governing Council of the United Nations Environment Programme (UNEP), a process has been underway under the auspices of UNEP to forward global cooperation to reduce the impacts of mercury pollution.

In February 2009 negotiations on a global legally binding instrument on mercury were launched. The negotiation process was concluded in Geneva on 20 January 2013. The agreement was named the "Minamata Convention on Mercury" after the Japanese town where severe mercury pollution happened in the 1950s.

The European Commission and many EU Member States were leading advocates for the Convention and active participants in the negotiations. With the negotiations now concluded and the Convention signed by the EU, the EU is preparing in detail for implementation. This study was commissioned by the European Commission to inform that process.

Its objectives are:

- To assist Commission Services in view of the EU becoming a party to the Minamata Convention on Mercury by identifying measures that would need to be taken at EU level in order to comply with its provisions.

- To assess the impacts of such measures, where needed, in view of internal procedures requiring an impact assessment for proposing new EU legislation, or amendments to existing legislation.

- To maximise synergies in follow-up actions for the implementation of the Convention in view of relevant existing EU legislation by integrating the review of the Mercury Export Ban Regulation in the assessment.

The European Commission contracted ICF International, working with COWI, BiPRO and Garrigues Ambiental, to carry out the study under the Framework Contract No ENV.C.3/FRA/2011/0030.

This report was prepared by Jakob Maag (COWI), Ferdinand Zotz and Alexander Potrykus (BiPRO) and Andrew Jarvis (ICF International).

The report is accompanied by an internal background document[7] containing specific information on:

1 the performed gap analysis of EU legislation vis-à-vis the Convention, with initial proposals for options, and

2 a preliminary comparative assessment of the proposed options.

[7] "Study on EU Implementation of the Minamata Convention on Mercury – Gap analysis and preliminary assessment, Internal background document, January 2015"

2 Gap analysis of EU legislation vis-à-vis the Convention and proposals for options

The EU has an extensive body of environmental legislation that regulates the use and release of mercury in many contexts and anticipates many of the requirements of the Minamata Convention (MC). There is not, however, a full and complete alignment of EU with the obligations placed upon Parties to the MC. This chapter identifies gaps between the requirements of the MC and the provisions of the relevant existing and imminent EU laws (based on the internal background document on the issue).

2.1 Summary of the gap analysis

2.1.1 Overview of the provisions of the Convention and coverage of EU legislation

The gap analysis, which is summarised in Table 2-1, shows that:

› A number of MC provisions are fully met in the EU acquis;

› Many provisions are partially met but adjustments may be necessary to achieve full conformity;

› In a few cases conformity cannot be determined with currently available information;

› A number of MC provisions are not covered by current EU law.

Table 2-1 Overview of the provisions of the Minamata Convention and coverage by existing and forthcoming EU legislation.

Article and para. in MC	Impact of MC provision	Soft or firm? (F/FS/S)*	EU legislation addressing the provision/[obligation]	Summary of assessment	Covered by EU law?
3(3)	Restriction on new primary mercury mining	F	Regulation (EC) 1102/2008	*De facto* ban, but not explicit: mercury extracted from cinnabar ore is considered as waste and subject to waste disposal. Cinnabar ore is the only economically viable mercury ore. With the Convention's wording "shall not allow" in mind, this is expected to suffice to demonstrate conformity	Yes
3(4)	Phase out of existing primary mercury mining	F	Regulation (EC) 1102/2008	*De facto* ban, but not explicit; see above	Yes
3(5) lit. (a)	Identification of mercury stocks	S	None		No
3(5) lit. (b)	Disposal of excess mercury from decommissioned chlor-alkali facilities	F	Regulation (EC) 1102/2008	"Metallic mercury that is no longer used in the chlor-alkali industry" is considered waste and subject to waste disposal	Yes
3(6)	Restriction on mercury exports	F	Regulation (EC) 1102/2008	Export ban for mercury	Yes
3(8)	Restriction on mercury imports	F	None		No
4(1)	Prohibition of manufacture/import/ex-port of certain mercury-added products (Annex A, Part I)	F	Batteries Directive, RoHS Directive, REACH, Cosmetics Regulation, PPP Regulation, Biocides Regulation	Restrictions on placing on the market / imports of the specific mercury-added products are in place. Yet, manufacturing and export is not addressed by the EU acquis.	No
4(3)	Measures with respect to dental amalgam	F	None		No

Article and para. in MC	Impact of MC provision	Soft or firm? (F/FS/S)*	EU legislation addressing the provision/[obligation]	Summary of assessment	Covered by EU law?
	(Annex A, Part II)				
4(5)	Preventing the incorporation of mercury-added products in assembled products	F	REACH, RoHS Directive, other market-based product legislation	EU acquis features restrictions regarding the placing on the market / import of relevant products which are themselves destined to be used in assembled products	Yes
4(6)	Obligation to "discourage" the manufacture and distribution of new mercury-added products	FS	None		No
5(2)	Prohibition of mercury use in the processes listed in part I of Annex B	F	IE Directive	According to the BAT-conclusions on the production of chlor-alkali (CAK), adopted by the Commission in 2013, the use of mercury cells cannot be considered BAT under any circumstances. Acetaldehyde production is subject to the IED regime but mercury use is not specifically addressed in the Directive nor in BAT conclusions	Partly (yes for CAK, no for acetal-dehyde)
5(3)	Obligation to restrict the use of mercury in the processes listed in part II of Annex B	F	IE Directive	Two relevant processes (VCM, Na/K-ethylate / methylate process) are subject to the IED regime but mercury use is not specifically addressed in the Directive nor in BAT conclusions. For PUR, it is partially covered by explicit REACH restrictions.	No
5(5)	Obligation to take measures to "address" emissions and releases from all processes / to	FS/S	IE Directive	The relevant processes are all covered by the IE Directive (see above); the obligation to “address” emissions and releases is complied with. With the exception of chlor-alkali production with mercury cells (covered by Reg. 1102/2008), this soft-law commitment of Article 5(5) lit. (c) MC is not fulfilled by	Partly

Article and para. in MC	Impact of MC provision	Soft or firm? (F/FS/S)*	EU legislation addressing the provision/[obligation]	Summary of assessment	Covered by EU law?
	endeavour to identify facilities			maintaining the register according to E-PRTR Regulation, since the E-PRTR Regulation does not require reporting of the amounts used of any substance, as required by Article 5(5) lit. (c) MC.	
5(6)	Prohibition of using mercury in new facilities for the processes listed in Annex B	F	IE Directive	The chlor-alkali process is the only one among the processes listed in Annex B where the issue is currently addressed in BAT conclusions.	No
5(7)	Discourage "the development of new facilities using any other mercury-based manufacturing process"	FS	None		No
7(2)	Reduce/eliminate emissions from Artisanal and small-scale gold mining (ASGM)	F	None	Mercury use in ASGM is not addressed in the EU acquis	No
7(3)	Determination of significance of ASGM / Developing and implementing a national action plan if applicable	F	None		No
8(3)	Controlling emissions: Develop a national plan	S	None	Since the obligation for developing a national plan is of a soft-law nature there is no need to amend the EU acquis in order to comply with those provisions.	Yes

Article and para. in MC	Impact of MC provision	Soft or firm? (F/FS/S)*	EU legislation addressing the provision/[obligation]	Summary of assessment	Covered by EU law?
	(optional)			Certain aspects are however already addressed in the EU Mercury Strategy.	
8(3) / 8(4)	Require BAT/BEP for new sources	F	IE Directive	The IE Directive is considered to cover the MC obligations.	Yes
8(3) / 8(5)	Emission control measures for existing sources	FS	IE Directive	See directly above	Yes
8(7)	Establish emissions inventory	F	E-PRTR Regulation	E-PRTR Regulation covers mercury emissions above the specified threshold values.	Yes
9(3)	Identify relevant sources for releases (to water and land)	F	IE Directive	The IE Directive identifies significant anthropogenic point sources of mercury releases.	Not deter-mined
9(4)	Releases control	FS/S	IE Directive, Water Framework Directive	IE Directive regime and EU Water Framework Directive approach are considered to cover releases from mercury adequately.	Yes
9(6)	Establish release inventory	F	E-PRTR Regulation	Given the discretion that Article 9 MC allows the Parties, the obligations of that Article are satisfied in the EU acquis via Annex I to the E-PRTR Regulation which covers the most important sources of emitted mercury.	Yes
10(2)	Storage of non-waste mercury	F	Seveso Directive, Waste Framework Directive	Interim storage of mercury (as storage of hazardous material that is not considered waste under EU law) is not fully covered by the EU acquis. For material that is considered waste in the EU but not under MC, EU waste law covers the requirements of Article 10(2) MC regarding interim storage. There are some minor differences in definitions for mercury waste between the EU acquis and the MC (which partly refer to guidelines under Basel Convention), which may need to be clarified further (see background document).	Not deter-mined

Article and para. in MC	Impact of MC provision	Soft or firm? (F/FS/S)*	EU legislation addressing the provision/[obligation]	Summary of assessment	Covered by EU law?
11(3)	Mercury waste	F	Waste Framework Directive, Waste Shipment Regulation	Fit of EU acquis to MC needs to be assessed against the future requirements of the MC (which partly refer to guidelines under Basel Convention). With regard to MC11(3b), other "mercury wastes" under MC than those addressed in Article 2 of Regulation (EC) 1102/2008 are not explicitly covered by EU law.	Not deter-mined
12(1)	Contaminated sites	S	None		No
16(1)	Health aspects	S	Diverse legal acts in the following policy fields: • Fish consumption guidelines • Water • Drinking Water • Food Safety • Occupational health and safety aiming at protecting general public, vulnerable groups, and workers	Since the obligations of Article 16(1) MC are of a soft-law nature there is no need to amend the EU acquis in order to comply with those provisions. The exposure of the population and vulnerable groups, and occupational exposure are addressed at EU level to an extent which - in our understanding - does not make it necessary to take further action.	Yes

Note:

* Soft or firm? (F/FS/S): F = firm; FS = firm, but gives the choice between several measures; S = soft (see definition of firm and soft in Appendix 2).

2.1.2 Preliminary comparative assessment of policy options

In the assessment of the differences between the Minamata Convention requirements and EU legislation on mercury, options were suggested which could close the identified gaps. All options have been subject to a preliminary evaluation in order to identify options which should be investigated in more detail in the impact assessment. Table 2-2 gives a summary of the preliminary evaluation of the suggested options categorised by MC article. The gap assessment and the detailed preliminary comparative assessment are reported separately in an internal background document.

Based on an extensive background knowledge on the mercury issue, among others from work with all the recent reports on the mercury issue in the EU context: the EU mercury strategy, the reports from COWI (2012 and 2008), BiPRO (2010), BIOS (2010 and 2012), Concorde East/West (2006 and 2004), as well as UNEP's three Global Mercury Assessments and other relevant UNEP reports, the suggested options were given preliminary scores taking the following aspects into consideration:

- Socio-economic costs/impacts such as investments in BAT, substitution costs, etc. as relevant, on a societal basis (coded “C” and scored as : 0 = minimal, -1 = moderate, -2 = potentially significant costs);
- Administrative/political efforts needed (by EU and MS authorities) to implement the option: (coded as “A” and scored as 0 = minimal, -1 = moderate, -2 = potentially significant efforts);
- Environmental benefits from implemented option (coded “E” and scored as 0 = minimal, 1 = moderate, 2 = potentially significant benefits);
- Signal effect towards other Parties of the MC (coded “S” and scored as 0 = neutral, +1 = signalling high-ambitious implementation of the MC, -1 = signalling low-ambition implementation of the MC.

Some measures are shown in Table 2-2 with several sets of scores because several options were assessed for each measure. A question mark (“?”) indicates that a score is particularly uncertain due to lack of data.

These preliminary scores, based on expert estimates, were used for prioritisation in the study; for articles assessed in more detail see the detailed assessments in Chapter 3.

Table 2-2 Summary of the preliminary comparative assessment of the suggested options by MC article.

Article and para. in MC	Impact of MC provision	Covered by EU law?	Preliminary comparative impact scores*	Remarks and summary of potential impacts
3(3)	Restriction on new primary mercury mining	Yes	C0,A0,E0,S0	No action or simple law text adjustment with no impacts
3(4)	Phase out of existing primary mercury mining	Yes	C0,A0,E0,S0	No action or simple law text adjustment with no impacts
3(5) lit. (a)	Identification of mercury stocks	No	C-1,A-1,E0,S0	Minor administrative burdens (for companies and authorities) of establishing an inventory of existing mercury stocks
3(5) lit. (b)	Disposal of excess mercury from chlor-alkali facilities as waste	Yes	C0,A0,E0,S0	No action or simple law text adjustment with no impacts
3(6)	Restriction on mercury export	Yes	-	No action needed
3(8)	Restriction on mercury import	No	C-1,A-1,E1,S0 //C-2,A-2,E2,S1	See Section 3.3 below
4(1)	Restriction on manufacture/import/export of mercury-added products (Annex A, Part I)	No	C-1,A-1,E1,S1 //C-1,A-2,E1,S1	See Section 3.4 below
4(3)	Measures with respect to mercury-added products (Annex A, Part II): Dental amalgam	No	C-2,A-2,E2,S1 //C0,A1,E0,S-1	Impacts of a MI scenario would be negligible; impacts of a BMC scenario such as a restriction on dental amalgam use could be substantial. The issue was not dealt with in detail in this study, as dental amalgam was excluded from the scope of this study. See BIO IS (2012) for an assessment on dental amalgam.
4(5)	Preventing the incorporation of mercury-added products in assembled products	Yes	-	No action needed
4(6)	Obligation to "discourage" manufacture and distribution of new products	No	C-2?,A0,E2?,S1	See section 3.5 below

Article and para. in MC	Impact of MC provision	Covered by EU law?	Preliminary comparative impact scores*	Remarks and summary of potential impacts
5(2)	Restriction on mercury use in the processes listed in part I of Annex B	No	C0,A0,E0,S0	Introduce explicit ban on acetaldehyde production with mercury catalysts (an obsolete process in the EU, so it has no impacts)
5(3)	Restriction on the use of mercury in the processes listed in part II of Annex B	No	C-2,A-2,E2,S1 //C0,A0,E0,S-1	See Section 3.6 below
5(5)	Identify Annex B facilities within its territory and quantify amounts used (soft law)	Partly	C0,A-1,E0,S1	Administrative (minor) costs for performing a study
5(6)	Restriction on using mercury in new Annex B facilities	No	C-2,A-2,E2,S1	See Section 3.7 below
5(7)	Discourage "the development of new facilities using any other mercury-based manufacturing process	No	C-2?,A0,E2?,S1 //C-2?,A-2+, E2?,S1	See Section 3.5 below
7(2)	Reduce/eliminate emissions from Artisanal and small-scale gold mining (ASGM)	No	C-1,A-1,E1,S1	Introduce explicit EU restrictions on mercury use in gold mining. Potential impacts on miners in one MS (French Guyana) and administrative burdens for authorities for implementation and enforcement. Use of mercury is already prohibited in French Guyana, so incremental impacts may be nil or minor.
7(3)	Determination of significance of ASGM / Developing and implementing a national action plan if applicable	No	C0,A0,E0,S-1 //C-1,A-1,E1,S1	Administrative costs (minor) for authorities for establishing significance/non-significance and potential development of an action plan
8(3) / 8(4)	Require BAT/BEP for new sources	Yes	-	These MC provisions are considered to be covered in existing and planned EU legislation. See Section 3.8 below.
8(3) / 8(5)	Emission control measures for existing sources	Yes	-	These MC provisions are considered to be covered in existing and planned EU legislation. See Section 3.8 below.
8(7)	Establish emissions inventory	Not determined	C-1,A-1,E0,S1 //C0,A0,E0,S-1	Administrative burden for industry and authorities of establishing an inventory, if necessary (possibly by adjusting reporting

Article and para. in MC	Impact of MC provision	Covered by EU law?	Preliminary comparative impact scores*	Remarks and summary of potential impacts
				requirements of the existing E- PRTR, and thereby incremental impacts would be minor)
9(3)	Identify relevant sources for releases (to water and land)	Not determined	C-1,A-1,E0,S1	Administrative burden for industry and authorities for identifying sources and maintaining an inventory (possibly just based on the existing E- PRTR, and thereby incremental impacts would be minor)
9(4)	Releases control	Yes	C0,A0,E0,S-1 //C-2?,A-2?,E2?,S1	No action or designate relevant sources and target any gaps identified; the latter with potential impacts on involved stakeholders; not further assessable at present
9(6)	Establish release inventory	Yes	C0,A0,E0,S-1 //C-1,A-1,E1,S1	No action or adjust E-PRTR to meet MC obligations (minor impacts)
10(2)	Storage of non-waste mercury	Not determined	C-1,A0,E1,S1 //C-1,A-1,E1,S1	Implement/build out standards for interim storage of mercury. Costs for involved industry stakeholders and administrative burdens for authorities for establishment and enforcement; total impacts are expected to be minor.
11(3)	Mercury waste	Not determined	C-2,A-2,E2,S1 //C-1,A-1,E1,S1 //C-1,A0,E1,S1	See Section 3.9 below
12(1)	Contaminated sites (soft law)	No	C0,A-1,E0,S1 //C0,A-2,E0,S1	No action, or administrative costs for authorities and data owners for inventory development (minor impacts)
16(1)	Health aspects	Yes	-	No action needed

Notes: * See scoring system above table in bulk text. Note that these were preliminary scores used for prioritisation in the study; for articles assessed in more detail, see instead the detailed assessment.

*

3 Analysis of impacts

3.1 Introduction

This impact assessment focuses on the societal implications of closing existing gaps between EU law and the Minamata Convention. In selected cases it also considers options that go beyond the obligations of the Minamata Convention where these could offer additional benefits.

The assessment considers the impacts of proposed means of addressing the issues flagged in Section 2, considering each of the relevant articles of the Minamata Convention in turn. Economic, social and environmental impacts, administrative burdens and simplification are considered. It focuses on the impacts of the changes required rather than the mechanism by which obligations can be incorporated into EU law.

The impact assessment is structured as follows:

- Section 3.2 considers the consequences of following a business as usual path ("No EU action path") that implies no changes in EU law beyond what is already implemented or planned;
- Sections 3.3 - 3.9 examine options individually, organised in order of the relevant Minamata Convention article numbers and focusing on options that were identified as having potentially significant cost impacts (i.e. score C-2) in the preliminary comparative assessment presented in Section 2.1.2; Section 2.1.2 also summarises impacts of other MC options which were deemed to have minor impacts in the preliminary comparative assessment.
- Section 3.10 and 3.11 summarise information on final mercury disposal and financial need, respectively.

The basic implementation scenario represents a strictly minimal implementation ('MI') of the Minamata Convention in EU law. Some options have been identified that go beyond the strictly minimal obligations of the Minamata Convention on certain aspects. These are tagged as 'Beyond MC' or 'BMC'. The impact assessment was performed in March 2014 to January 2015 and reflects the situation as it was at that time. Any later changes to the EU legislation, plans or other factors have not been included. The assessment addresses the most significant issues, making best use of existing information within the constraints of available project resources.

An integrated analysis of all investigated measures and comparison of scenarios is given in Section 4.

3.2 Baseline scenario

For the purposes of this assessment the baseline scenario is provided by the existing and imminent EU legislation relevant to mercury. This 'policy off' scenario provides the reference point against which the impacts of the Minamata Convention (the 'policy on' scenario) are assessed.

The particular circumstances of this case mean that there are impacts associated with the EU deciding to stay with the legislative *status quo*. A decision by the EU not to ratify the Minamata Convention, and so to stay on the existing legislative baseline:

› would be in conflict with the EU Mercury Strategy and the stated intention of the EU to ratify the Minamata Convention;

› is likely to significantly reduce the Convention's prospects of being ratified by other Parties given that the EU has been a driving force in securing a global agreement on mercury and is considered a major player in such global cooperation;

› would thus risk jeopardising the achievement of the reduction in global mercury pollution that the MC offers, with impacts on the EU, as well as the world as a whole, in a context where a significant part of the atmospheric mercury deposition in the EU originates outside its territories.

The Minamata Convention is the best prospect seen so far for reducing risks from direct and indirect exposure to mercury at a global level. Without the Convention, global releases of mercury are expected to rise, or at least not be reduced from their current levels. Global failure to implement the Minamata Convention could therefore have significant consequences for populations at risk from mercury exposure all over the world. Most countries lack the level of protection against exposure to mercury and other hazardous chemicals provided in the EU. It would also have impacts for EU citizens: the EU is dependent on the global cooperation on reduction of anthropogenic mercury releases to substantially reduce mercury exposure of humans and the environment in its territory.

3.3 MC Article 3: Mercury supply sources and trade

3.3.1 Problem definition and specific objectives

Article 3(8) of the MC introduces a binding obligation for the Parties not to allow the import of mercury from new primary mining and excess mercury from the decommissioning of chlor-alkali facilities. The gap analysis showed that there is no equivalent provision in current EU law.

The options assessed[8] are application of:

- A conditional import restriction relating to Non-Parties, with a procedure for checking if imports from Non-Parties to the MC are from allowed sources and securing the prior consent of the importing country (MI scenario); and
- A general import ban on imports from all countries outside the EU (whilst allowing imports for environmentally sound disposal) (BMC scenario).

3.3.2 Baseline conditions

Mercury supply

Mercury supply into the EU market is estimated at around 200 tonnes per year based on trade data and other data sources. The main current mercury sources are:

- recycling activities within the EU of waste[9] (~ 100 t Hg/y);
- imports of metallic mercury and mercury compounds reported by statistics (~ 100 t/y).

The derivation of these estimates is described below.

EUROSTAT data suggest current EU annual imports of mercury and mercury compounds ("whether or not chemically defined, excluding amalgams"[10]) of 104 tonnes (year 2013, CN categories 28054090, 28521000, 28529000).

Until relatively recently, excess mercury from the chlor-alkali sector was available to be sold into the EU market but this would today need to be disposed of due to

[8] Details of the preliminary appraisal of these options are provided in the internal background document.
[9] More specifically "recycling of mercury waste" means "recycling of mercury from treatment of mercury containing waste".
[10] The wording refers to the description of the corresponding custom code numbers (CN numbers)

the requirements of Regulation 1102/2008[11]. Besides mercury import, the other major source of mercury is recycling operations in the EU, which currently supply approximately 100 tonnes of mercury per year (see Section 3.9.3.1 on mercury recycling).

Figure 3-1 illustrates the possible import flows of mercury and mercury waste into the EU and which of these flows are in principle available to satisfy the EU demand for mercury today.

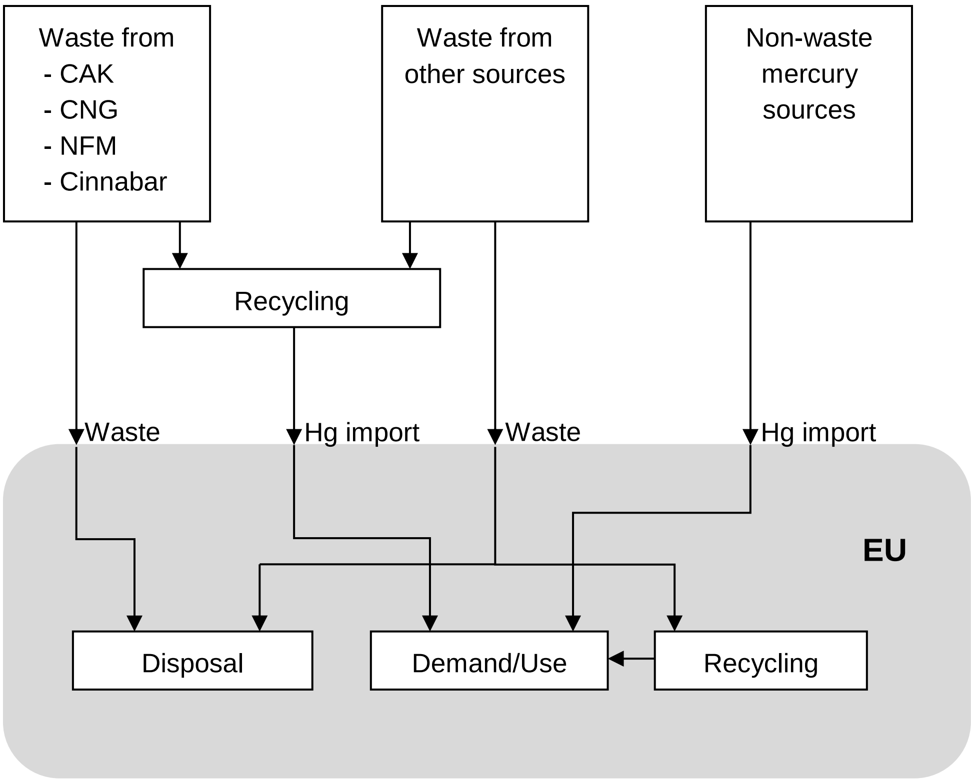

Figure 3-1 Possible import flows of mercury and mercury waste into the EU and their possible fate inside the EU (shaded in grey).
Key to abbreviations: CAK =from the chlor-alkali industry; CNG = from the cleaning of natural gas; NFM = from non-ferrous mining and smelting operations. Cinnabar = from cinnabar ore.

According to Article 11(3) MC, transport across borders (which covers import) is only allowed for environmentally sound disposal in the sense of lit. (a) of Article 11(3), i.e. taking into account the definitions of the Basel Convention (the issue may also be dealt with in planned future requirements to be elaborated under MC). "Environmentally sound disposal" here is to be understood as described in the Basel technical guidelines for the environmentally sound management of wastes consisting of elemental mercury and wastes containing or contaminated with

[11] Regulation (EC) No 1102/2008 defines the following as waste be disposed of (and not be recycled/recovered): Metallic mercury that is no longer used in the chlor-alkali industry; metallic mercury gained from the cleaning of natural gas; metallic mercury gained from non-ferrous mining and smelting operations; metallic mercury extracted from cinnabar ore in the EU as from 15 March 2011.

mercury. Whereas the MC's requirements are not yet adopted, the Basel Guidelines include (para 146 ff.) recycling of mercury waste. As a consequence it is considered that imported waste can be recycled within the EU except for those wastes specified in Article 2 of Regulation (EC) No 1102/2008.

Mercury demand

No aggregated analysis of the mercury demand by sector has been established for the EU since 2008. Consumption in 2007 was estimated at 320-530 tonnes (COWI and Concord East/West (2008), see Table 3-1). The largest application was chlor-alkali production, the second largest was dental amalgams. Current consumption for uses which will be allowed under the Minamata Convention is estimated at 260-400 tonnes/y, and projected consumption in 2025-2030 after entry into force of MC requirements is estimated at 40-220 tonnes/y (see Table 3-2).

A significant decline in mercury demand in the EU has been observed over the last two to three decades and that trend is expected to continue. Mercury consumption for chlor-alkali production, the major use of mercury in the EU, is gradually reducing as facilities are converted or decommissioned. Industry compliance with the IE Directive will see EU consumption for this purpose vanish as of 2017, as the mercury cell technology is not considered as BAT by the IE Directive. Much of the product-related substitution of mercury has already taken place.

The key drivers for the change in future mercury consumption in the business as usual scenario are:

› for products: Consumer preference for amalgam substitutes, existing products/chemicals legislation, digital solutions, phase-out of measuring equipment using mercury, energy saving campaigns/strategies, and a transition from fluorescent to LED lighting.

› for processes: Voluntary industry commitment, IE Directive requirements (and OSPAR recommendation) for phase-out of mercury use in the chlor-alkali sector in the EU.

It is estimated that EU annual demand in 2025-2030, if the Minamata Convention is implemented, would be 40 – 220 tonnes/y (Table 3-2). Part of this mercury may be imported inside mercury-added products and not as metallic mercury or mercury compounds and is thus not included in metallic mercury supply numbers. The major remaining metallic mercury uses in the EU are porosimetry[12] and dental amalgam (likely to be partly imported in encapsulated form). The majority of the future EU demand may thus be needed as metallic mercury rather than imported inside mercury-added products.

[12] Porosimetry is an analytical technique used to determine various quantifiable aspects of a material's porous nature, such as pore diameter, total pore volume, surface area, and bulk and absolute densities.

Table 3-1 Mercury consumption in industrial processes and products in the EU (2007); Source: COWI and Concord East/West (2008).

Application area	Mercury consumption tonnes Hg/y	Percentage of total
Chlor-alkali production *2	**160 - 190**	**41.2**
Light sources	**11 - 15**	**3.1**
Fluorescent tubes	*3.3 - 4.5*	*0.9*
Compact fluorescent tubes	*1.9 - 2.6*	*0.5*
HID lamps	*1.1 - 1.5*	*0.3*
Other lamps (non-electronics)	*1.6 - 2.1*	*0.4*
Lamps in electronics	*3.5 - 4.5*	*0.9*
Batteries	**7 - 25**	**3.8**
Mercury button cells	*0.3 - 0.8*	*0.1*
General purpose batteries	*5 - 7*	*1.4*
Mercury oxide batteries	*2 - 17*	*2.2*
Dental amalgams	**90 - 110**	**23.5**
Pre-measured capsules	*63 - 77*	*16.5*
Liquid mercury	*27 - 33*	*7.1*
Measuring equipment	**7 - 17**	**2.8**
Medical thermometers	*1 - 3*	*0.5*
Other mercury-in-glass thermometers	*0.6 - 1.2*	*0.2*
Thermometers with dial	*0.1 - 0.3*	*0*
Manometers	*0.03 - 0.3*	*0.04*
Barometers	*2 - 5*	*0.82*
Sphygmomanometers	*3 - 6*	*1.1*
Hygrometers	*0.01 - 0.1*	*0.01*
Tensiometers	*0.01 - 0.1*	*0.01*
Gyrocompasses	*0.005 - 0.025*	*0.004*
Reference electrodes	*0.005 - 0.015*	*0.002*
Hanging drop electrodes	*0.1 - 0.5*	*0.1*
Other uses	*0.01 - 0.1*	*0.01*
Switches, relays, etc.	**0.3 - 0.8**	**0.1**
Tilt switches for all applications	*0.3 - 0.5*	*0.09*
Thermoregulators	*0.005 - 0.05*	*0.01*
Read relays and switches	*0.025 - 0.05*	*0.01*
Other switches and relays	*0.01 - 0.15*	*0.02*

Application area	Mercury consumption tonnes Hg/y	Percentage of total
Chemicals	**28 - 59**	**10.2**
*Chemical intermediate and catalyst (excl PU) *1*	*10 - 20*	*3.5*
Catalyst in polyurethane (PU) production	*20 - 35*	*6.5*
Laboratories and pharmaceutical industry	*3 - 10*	*1.5*
Preservatives in vaccines and cosmetics	*0.1 - 0.5*	*0.1*
Preservatives in paints	*4 - 10*	*1.6*
Disinfectant	*1 - 2*	*0.4*
Other applications as chemical	*0 - 1*	*0.1*
Miscellaneous uses	**15 - 114**	**15.2**
Porosimetry and pycnometry	*10 - 100*	*12.9*
Conductors in seam welding machines (mainly maintenance)	*0.2 - 0.5*	*0.1*
Mercury slip rings	*0.1 - 1*	*0.1*
Maintenance of lighthouses	*0.8 - 3*	*0.4*
Maintenance of bearings	*0.05 - 0.5*	*0.1*
Gold production (illegal)	*3 - 6*	*1.1*
Other applications	*0.5 - 3*	*0.4*
Total (round)	**320 - 530**	**100**

Notes to table above:

*1 In order to avoid double counting, the mercury used as chemical intermediates and catalysts (excluding PU elastomers) is not included when calculating the total.

*2 Represents the amount added each year to the cells including mercury recycled internally within the plants.

Table 3-2 Estimated EU mercury consumption in 2007, around 2014-2015 (current consumption = baseline) and expected trends for allowed uses by 2025-2030 (projected consumption).

Intentional mercury use	**Hg consump-tion in 2007 *1, EU25, t/y**	**Estimated Hg consumption (2014-2015) t/y, corrected for existing changes in legislation, etc.*2**	**Estimate of EU Hg demand by 2025-2030, t/y *3**
Batteries	7-25	"0" by year 2015	0
Switches and relays	0.3-0.8	0.3-0.8	0.3-0.8
Lamps	11-15	11-15 (perhaps higher)	11-15 (perhaps higher due to higher lamps consumption)
Barometers, hygrometers, manometers, thermometers, sphygmomanometers	7-17	<3 in exempted products	"0" a little in exempted products
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 (perhaps lower due to completed conversions/decommissioning)	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 VCM part unknown, but likely minor	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 (*4)	10-50
Other miscellaneous uses	1-14	1-14	1-14
Total (rounded and adjusted for double counting of intermediates)	320-530	~260-400	~40-220

Table-notes:
*1: Data source COWI and Concorde East/West (2008).
*2: Legislation (see **Error! Reference source not found.**) in combination with expert assessment. For dental amalgam the reference is BIO IS (2012).

*3: Expert estimates based on MC and EU legislation requirements and background knowledge of trends and technical considerations.
*4: Porosimetry represents most of this consumption. The numbers cited is the estimated amount of mercury used each year for porosimetry around 2010 according to ECHA (2010), of which some is re-used internally in the laboratories; the actual purchase of new mercury may therefore likely be smaller.

Mercury trade

The following tables and Figure 3-2 give an overview of the EU's external trade for relevant mercury products for 2002 to 2013 based on current EUROSTAT data. An EU export ban for mercury has been in place since 15 March 2011 (per Article 1 of Regulation (EC) No 1102/2008). Negative numbers in the balance of the figure signify that exports exceed imports.

Table 3-3 EU 28 external trade for relevant mercury products – average annual quantities of import and export from 2002 to 2013.

CN code	**Customs code text (product group)**	**Import (average, t/y)**		**Export (average t/y)**	
		2002 to 2011	2012 to 2013	2002 to 2011	2012 to 2013
2805 4010	MERCURY IN FLASKS OF A NET CONTENT OF 34,5 KG "STANDARD WEIGHT", OF A FOB VALUE PER FLASK OF <= EURO 224	37.2	n.d.	395	35.0
2805 4090	MERCURY (EXCL. IN FLASKS OF A NET CONTENT OF 34,5 KG "STANDARD WEIGHT", OF A FOB VALUE PER FLASK OF <= EURO 224)	208.5	39.0	334,7	18.5
2852 1000	COMPOUNDS, INORGANIC OR ORGANIC, OF MERCURY, CHEMICALLY DEFINED (EXCL. AMALGAMS)	n.d.	8.5	n.d.	100.5
2852 9000	COMPOUNDS, INORGANIC OR ORGANIC, OF MERCURY, NOT CHEMICALLY DEFINED (EXCL. AMALGAMS)	n.d.	32.5	n.d.	81.0

Source: EC Market Access Database[13] 2014, last update 20.10.2014, data extracted 22.10.2014

Table 3-4 gives an overview of EU 28 external trade for relevant mercury products in 2011, 2012 and 2013. Most relevant exports concern inorganic or organic compounds of mercury – not chemically defined (CN 28529000; exports 120 t/y; increasing trend). Exports of mercury in flasks (CN 28054010) were almost zero in

[13] http://madb.europa.eu

2012 (1 t/y), but are reported to have significantly increased in 2013 (69 t/y), despite the EU mercury export ban[14].

In consultations EEB questioned how exports of mercury can occur under the existing export ban and provided specific information on reported (illegal) incidents of export of mercury from the EU to Switzerland.[15]

Table 3-4 EU28 extra trade for relevant mercury products – annual quantities of imports and exports in 2011, 2012 and 2013 (source: EC Market Access Database 2014, last update 20.10.2014, data extracted 22.10.2014).

CN code	Customs code text (product group)	Import (t/y)			Export (t/y)		
		2011	2012	2013	2011	2012	2013
28054010	MERCURY IN FLASKS OF A NET CONTENT OF 34,5 KG "STANDARD WEIGHT", OF A FOB VALUE PER FLASK OF <= EURO 224	8	n.a.	n.a.	65	1	69
28054090	MERCURY (EXCL. IN FLASKS OF A NET CONTENT OF 34,5 KG "STANDARD WEIGHT", OF A FOB VALUE PER FLASK OF <= EURO 224)	30	28	50	240	19	18
28521000	COMPOUNDS, INORGANIC OR ORGANIC, OF MERCURY, CHEMICALLY DEFINED (EXCL. AMALGAMS)	n.a.	1	16	n.a.	114	87
28529000	COMPOUNDS, INORGANIC OR ORGANIC, OF MERCURY, NOT CHEMICALLY DEFINED (EXCL. AMALGAMS)	n.a.	33	32	n.a.	42	120

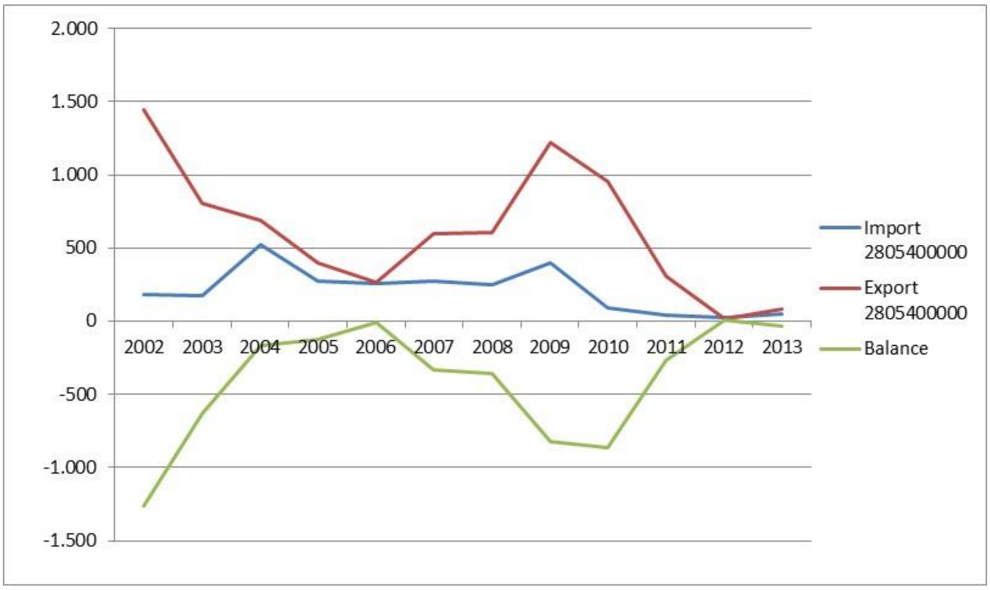

Figure 3-2 Imports, exports and trade balance of mercury - (CN code 2805400000) from 2002 to 2013 (quantities in t/y).

[14] The European Commission launched in November 2014 a complementary assessment of the Mercury Export Ban.
[15] See stakeholder contribution EEB from 31.07.2014 (available at http://ec.europa.eu/environment/chemicals/mercury/)

As a result of the Minamata Convention, capacity for environmentally sound disposal of mercury will be required globally but is not possible in all countries (globally) and all Member States (within the EU). As a consequence, trade in mercury for environmentally sound disposal should preferably remain possible (at least at EU level) under an import ban or import restrictions. Parties to the Basel Convention are allowed to transport mercury waste across international borders only for the purpose of environmentally sound disposal (Article 11(3) MC).

3.3.3 Impact assessment

The impacts on stakeholders are summarised in the following table.

Table 3-5 Stakeholders affected by options in question, and impacts in summary.

Options assessed	**Stakeholders affected**	**Impacts**
Conditional import restriction (MI): Imports from non-Parties allowed if conditions similar to those for import from MC Parties are fulfilled.	Importers in the EU	Costs of extra administration (administrative burden) to secure the written consent of import country and certification that the mercury is not from sources identified as not allowed under paragraph 3 (new mercury mines) or paragraph 5 (b) (decommissioning of chlor-alkali facilities) Foregone revenues of mercury import from Non-Parties
	Competent authorities	Costs for control of the import restriction. The additional administrative input of relevant authorities would be minimal, as the relevant provisions are similar with those of Regulation (EU) 649/2012 concerning the export and import of hazardous chemicals and can be implemented by the designated national authorities foreseen in Article 4 of the latter.
	Global and EU population and environment	Benefits of reduced mercury releases from mining and from the lifecycle of newly extracted mercury
Ban on imports from all countries outside the EU (BMC)	Industry	Costs of increased mercury prices due to lower supply
		Costs of mercury substitution (perhaps even for uses allowed under the MC) in case of insufficient mercury supply from recycling within the EU, this being the only remaining mercury source in the EU under this option
	Importers in the EU	Foregone revenues of mercury import from all countries
	Competent authorities	Costs for control of the import ban
	Global and EU population and environment	Benefits of reduced mercury releases from mining and lifecycle of mercury from all extra-EU sources

3.3.3.1 Social impacts

Projected employment impacts are mixed but modest. Negative impacts arising from the constraints on trade will be offset to some degree by incremental activity associated with administering the controls.

Implementing the import restrictions related to non-Parties (MI scenario) would require some additional labour capacity at importers of mercury and national competent authorities to handle the additional administration associated with introduction and operation of a procedure of written consent and certification of mercury sources (see Section 3.3.3.2). For a general import ban (beyond MC) a corresponding procedure will not be required.

For both options it will be necessary to implement procedures to oversee the import controls. The incremental administrative input to implement corresponding controls within existing import control procedures at competent authorities is expected to be limited and not lead to significant increase in workload at competent authorities.

Imports may be reduced under both options, but to varying degrees (see Section 3.3.3.2). This may lead to a (modest) loss of jobs at mercury EU importers. Job losses at importers may be outweighed by the need for extra employees for administrative work at importers and authorities.

Increases in the costs of mercury, in a high mercury demand scenario which may occur for the ‘beyond MC’ option (see Section 3.3.3.2), could lead to impacts on employment. However, if supply and demand change at the expected rate, no significant cost impacts on industry and thus no employment impacts are foreseen.

Combining a requirement that all mercury waste would need to be environmentally soundly disposed (BMC option for waste) with a general ban on imports (BMC option for import) would eliminate the supply of mercury into the EU. This would potentially have additional (negative) effects on the employment in the sectors affected.

3.3.3.2 Economic impacts

Administrative burdens

The additional administrative burden for mercury traders and the coresponding administrative burden for competent authorities may be higher under the MI option than for the BMC option, as the MI option requires the establishment and operation of a system of certification and consent and a system to control the import restriction.

Under the MI scenario, the origin of mercury import could be verified by establishing a certificate of origin for each quantity of mercury imported to the EU from non-MC-Parties. Additional efforts would consist of increased administration work at mercury suppliers/importers (in order to document the origin of traded mercury) and at competent authorities within countries (in order to check whether imported mercury originates only from allowed uses and to control the documentation). The administrative costs will depend on the number of actors involved in the supply chain of mercury and the diversity of mercury import sources to the EU. Corresponding systems for international trade in certain hazardous compounds / products are already established under the Basel Convention and the Rotterdam Convention (notification procedure and prior informed consent respectively). It can be assumed that the effort to run in parallel a similar procedure for international mercury trade, which is far less complex compared to other international trade, is comparatively low.

Foregone revenues from mercury imports

The effects on mercury prices of reductions in supply are not well described in the literature. COWI (2012) illustrate that the world market price for mercury has varied extensively over the last decades. In the period 2002-2010 annual average import prices ranged from 67 to 687 EUR/flask[16] , based on EU trade statistics, with an average price for the period of 221 EUR/flask. The annual average export prices ranged from 207 to 739 EUR/flask, with an average export price of 457 EUR/flask. Average prices based on US data in 2009-2011 were 13-43 EUR/kg mercury.

Table 3-6 World market prices for mercury 2006-2013, based USD/Hg flask prices.

Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013***
Average price, USD/flask	670	530	600	600	1076	1850	1850	1850
Exchange rate EUR/USD	1.2558	1.3704	1.4709	1.3942	1.3275	1.3924	1.2585	1.3280
Calculated price in EUR/t	15,464	11,210	11,824	12,474	23,494	38,511	42,609	40,379

Note *: Estimated by USGS (2014).
Source: USGS (2011, 2012, 2014) citing Platts Metals Week.

The value of traded mercury products (metal and compounds) has been calculated based on an estimate of the price of mercury in flasks of 38,900 EUR/t reflecting recent prices. Prices calculated on the basis of EUROSTAT for 2012 and 2013 export data for all CN categories listed in Table 3-4 indicate an average value of approximately 35,000 EUR/t of the listed mercury products. This is close to the applied market value of 38,900 EUR/t for mercury in flasks stated above.

The total value of the 2014/15 estimated mercury consumption of around 260-400 tonnes of mercury is, based on prices reported by the USGS (2014), about 10-16 million EUR/y (Table 3-7).

[16] 1 flask = 34.5 kg mercury

The response of EU mercury prices to EU implementation of the Minamata Convention is not certain. Significant stocks of mercury are expected to be available on the world market (e.g. from previous decommissioning and conversion of chlor-alkali plants). The changes in prices during 2009-2013 could indicate that much of the price increase associated with a decline in supply has already happened. In the period until 2025-2030, both demand and supply are expected to decrease as the effects of the global implementation of the Minamata Convention (with opposing effects on the mercury price). By 2025-2030 much of the current global demand would be eliminated if the Minamata Convention is successfully implemented, while mercury would still be supplied by recyclers and from by-product virgin mercury production (the latter from outside the EU). 2025-2030 prices that are -50% to +100 % of the 2012 price level seem feasible based on recent price fluctuations. The value of the 2025-2030 supply of mercury to the EU on this basis is 1-18 million EUR (Table 3-7). Mercury imported as mercury-added products would not be affected directly by restrictions on import of mercury metal.

Table 3-7 EU Hg sales value calculation in a current and a 2025-2030 scenario.

	Low	High
Consumption around 2014-2015 t/y	260	400
Hg price in 2014-2015 (assumed equal to 2011-2014 price), EUR/t Hg	38,900	38,900
Total value of 2014-2015 consumption, EUR/y	10,114,000	15,560,000
Expected consumption around 2025-2030, t/y	40	220
Hg prices in scenario of -50 to +100% of 2012 price, EUR/t Hg (rounded)	19,000	78,000
Total value of 2025-2030 consumption in scenario, EUR/y	760,000	17,160,000

The MI option would only restrict imports from Non-MC Parties. Data facilitating a disaggregation of current imports from MC Parties and Non-Parties are not available. It is here assumed that 90% of imports to the EU originates from future Parties to the MC and 10% originates from countries that will not become Parties to the Convention. Imports from Non-Parties in this scenario would thus be worth approximately 0.39 million EUR/y[17].

In such a scenario, EU importers would see annual revenue losses of ~0.39 million EUR/y for the MI option and ~3.89 million EUR/y for the BMC option. Depending on mercury demand, imports from allowed sources and for allowed uses may increase and outweigh or even overcompensate the possible losses of revenues under the MI option. Further down in the supply chain these effects may be partly outweighed by compensation measures (particularly substitution) in the corresponding use areas.

Corresponding revenue losses related to the same market value will occur at global level for suppliers exporting mercury into the EU, depending on how mercury demand changes.

[17] 10t/y * 38,900 EUR/t; rounded to 0.39 million EUR/y.

Costs to industry due to changed mercury prices and to lower supply

The MI option is not expected to impose additional costs on industry. The BMC option could, but much depends on how the demand for mercury changes in the years ahead.

Both options will potentially lead to a lower supply of mercury. The MI option could lead to a small fall 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). The BMC scenario 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 MI option, while some shortage may occur under beyond MC option if demand for mercury remains high (see Table 3-8).

Table 3-8 Expected supply, demand and balance of supply and demand for business as usual (no import restrictions), MI and BMC scenarios.

	BAU (no import restrictions)	MI scenario	beyond MC scenario
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 to 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 for mercury free alternatives are not significantly above those of the mercury use. Substitution costs cannot be estimated. If prices fall, additional costs for substitution would not become relevant (at least not due to increased mercury prices). Based on these considerations, any actual costs for substitution will be similar to the costs for the corresponding mercury use, unless the alternatives provide added functional benefits (which represent an added value).

In a foreseeable future (2025-2030), industry needs – as per projections of demand in this study - to purchase between 40 and 220 t mercury/y at an average price of 38.900 EUR/t, equalling a value of 1.6 to 8.6 million EUR/y (average 5.1 million EUR/y). In case of an average demand of 130 tonnes/y, the incremental costs of the **BMC scenario** are estimated at 0 – 5.1 million EUR/y. If demand would be in the lowest end of the projected interval, cost savings for industry are possible. If demand would be in the top of the interval, estimated cost increases (compared to BAU) would be 9.0 – 16 million EUR/y. Ergo, across the whole range of possible developments, the incremental costs interval would be 0 – 16 million EUR/y.

In the MI scenario it is expected that supply meets demand and there will be no additional costs for industry. If demand was low and prices halved, the industry would enjoy cost savings (worth 0.8 million EUR/y for 40 tonnes).

A couple of examples demonstrate the economic impacts that can arise from trade and market restrictions: The project specific questionnaire contains a question related to the export ban of mercury laid down in Regulation 1102/2008; see a summary of Member States' response to the questionnaire in Appendix 3. Two of the 16 Member States that replied reported that market effects had been observed. In one country (CZ) exports of dental mercury beyond the EU (to Turkey) stopped in 2011. Quantitative data were not reported. In another country (Spain) dedicated mercury mining has ceased, with consequential social and economic impacts in the region concerned. Spain also reported economic impacts arising from the prohibition on placing excess mercury from chlor-alkali facilities on the market. Generally such impacts may occur if trade is reduced by import or export restrictions.

It is proposed that imports from outside (and inside) the EU for environmentally sound disposal should remain possible, as disposal facilities are available in the EU and such import could generate extra income here. Costs for the establishment of disposal facilities in countries outside the EU could thus be minimised.

3.3.3.3 Environmental impacts

The MI option may reduce mercury releases in Non-Parties producing mercury, but probably not significantly in the EU. A general import ban (BMC option) should reduce mercury-related environmental impact in the EU but its global impacts are uncertain and possibly negative.

EU imports of mercury will not necessarily be reduced under the MI option, whereas they will fall from 100 t/y to 0 t/y under the BMC option (general import ban). EU supply may thus be reduced under a general import ban, prices increase, and less mercury may be used and be available for release. In the global context, an EU import ban could potentially result in lower production of mercury (leading to smaller releases) or it could in principle reduce mercury prices outside the EU, helping to sustain consumption in regions and activities not subject to environmental management (for example ASGM), potentially giving rise to increased releases. With the relatively modest projected EU mercury imports, the actual effects may be minimal.

As disposal facilities are available in the EU, it is proposed that imports from outside (and inside) the EU for environmentally sound disposal should remain possible. This could reduce costs and adverse effects on environment and health in countries without such facilities.

3.3.4 Conclusions

The MI option may reduce mercury releases in Non-Parties producing mercury, but is not expected to have a significant impact on releases in the EU. A general import ban (BMC option) should reduce mercury-related environmental impact in the EU but its global impacts are uncertain and possibly negative.

Extra costs for importers and competent authorities in administration would arise but these are expected to be low. As the MI option requires a procedure for checking imports from Non-Parties to the MC its administrative burdens (for industry and authorities) would be expected to be higher than that of the BMC option, where only regular import control is required.

Social impacts are difficult to assess in detail but are deemed to be minimal based on the relatively low cost.

Foregone revenues for EU importers are estimated at ~0.39 million EUR for the MI option and ~3.89 million for the BMC option. This may likely be a distributional effect only.

The societal costs of the BMC option are estimated at 0 – 16 million EUR/y. Under the MI option no significant cost impacts are expected.

When the Minamata Convention is implemented, it is expected that the demand for mercury will further decline in the EU and that additional costs for substitution due to import restrictions may not occur.

The general objective of the MC – to reduce mercury supply and use – will be better achieved within the EU by restricting import of mercury from all countries (beyond MC option). In the global context, an EU import ban could result in lower production of mercury, with reduced releases as a consequence. On the other hand, if global production is not reduced, mercury prices outside the EU may decline and potentially result in increased (or sustained) mercury consumption in regions and activities not subject to environmental management (for example ASGM), where supply restrictions are most needed. With the relatively modest projected EU mercury imports, the actual effects may be minimal.

Reducing the supply of mercury to the EU will contribute to a reduction of releases in the life cycle of mercury in the EU. This reduction can be achieved either by restricting mercury imports, or by making less mercury available for recycling within the EU (see Section 3.9). Assuming an equal supply reduction in both cases, reducing imports may have smaller negative economic impacts within the EU than restricting recycling, but may also be less environmentally effective (achieve less reduction of releases) in the global context. Application of both supply reduction measures may be feasible if adequate substitution time is given, but it would be at a higher cost.

It is recommended that imports for environmentally sound disposal of mercury should remain possible in order to use the available capacity to assist other countries with environmentally sound disposal.

3.4 MC Article 4(1): Prohibition of manufacture/import/export of mercury-added products of Annex A, Part I

3.4.1 Problem definition and specific objectives

Article 4(1) MC addresses the prohibition of manufacture, import and export of mercury-added products listed in Annex A, Part I MC. All are to be phased out by 2020.

Mercury-added Products listed in Annex A, Part I, MC
Batteries (with certain exceptions)
Switches and relays (with certain exceptions)
Compact fluorescent lamps (CFLs) (with specifications)
Linear fluorescent lamps (LFLs) for general lighting purposes (with specifications)
High pressure mercury vapour lamps (HPMV) for general lighting purposes
Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for electronic displays (with specifications)
Cosmetics (with specifications)
Pesticides, biocides and topical antiseptics
The following non-electronic measuring devices: (a) barometers; (b) hygrometers; (c) manometers; (d) thermometers;(e) sphygmomanometers (with certain exceptions)

According to the gap analysis, current EU legislation covers placing on the market (sales and import), but not manufacture and export for most of the products. This section explores the impacts of implementing EU legislation restricting the export of these product types (and thereby, in combination with existing EU legislation, in effect also their manufacture).

The options assessed are to restrict the export of:

› Mercury-added products listed in Annex A, Part I MC ("MC standards"), providing conformity with the MC (MI scenario); and

› The same mercury-added products but with export regulated according to the thresholds and standards already in place for placing these products on the market within the EU ("EU standards"), an option going beyond the MC (BMC scenario).

3.4.2 Baseline conditions

Table 3-9 lists:

- the product categories targeted by MC requirements,
- the existing EU legislation relating to the same product categories, and
- the specific product categories affected under the BMC scenario (export restricted to current EU standards), but not under the MI scenario (export restricted to MC standards).

Table 3-9 Mercury-added products targeted i) by the MC, ii) by current EU regulation, and iii) product types that would be affected in the BMC scenario (such for which EU regulation targets broader than the MC).

	MC restrictions	**EU legislation restricting placing on the market**	**Products for which EU marketing restrictions go beyond MC restrictions; affected under BMC scenario only**
1	*Batteries, except for button zinc silver oxide batteries with a mercury content < 2%, and button zinc air batteries with a mercury content < 2%*	EU Batteries Directive 2006/66/EC prohibits placing on the market of all batteries that contain more than 0.0005% by weight of mercury, except button cells with up to 2% by weight. Button cell exception expires in October 2015. The 0.0005% limit is intended to cover all intentional mercury addition (but allow trace concentrations).	Button zinc silver oxide batteries with a mercury content between 0.0005 and 2% Button zinc air batteries with a mercury content between 0.0005 and 2%
2	*Switches and relays, except very high accuracy capacitance and loss measurement bridges and high frequency radio frequency switches and relays in monitoring and control instruments with a maximum mercury content of 20 mg per bridge, switch or relay*	RoHS Directive 2011/65/EU restricts the use of mercury in concentrations over 0.1 % w/w. Annex IV to that does contain the following exemption to the restriction: *Mercury in very high accuracy capacitance and loss measurement bridges and in high frequency RF switches and relays in monitoring and control instruments not exceeding 20 mg of mercury per switch or relay.*	**None**.
3	*Compact fluorescent lamps (CFLs) for general lighting purposes that are ≤ 30 watts with a mercury content exceeding 5 mg per lamp burner*	RoHS Directive 2011/65/EU restricts the marketing of Hg in relevant lamps generally. It introduces in its Annex III, point 1 (a), the following exemptions of the restriction, valid after 31 December 2012: 2.5 mg Hg for general lighting purpose in single capped (compact) fluorescent lamps < 30 W	Compact fluorescent lamps (CFLs) for general lighting purposes that are ≤ 30 watts with a mercury content between 2.5 and 5 mg per lamp burner
4	*Linear fluorescent lamps (LFLs) for general lighting purposes:* *(a) Triband phosphor < 60 watts with a mercury content exceeding 5 mg per lamp;* *(b) Halophosphate phosphor ≤ 40 watts with a mercury content exceeding 10 mg per lamp*	RoHS Directive 2011/65/EU restricts the marketing of Hg in relevant lamps generally and the following specifically as follows (current coverage after specified expiration dates of previous limits/restrictions): 2(a): **Mercury in double-capped linear fluorescent lamps for general lighting purposes not exceeding (per lamp):** 2(a)(1): Tri-band phosphor with normal lifetime and a tube diameter < 9 mm (e.g. T2): 4 mg 2(a)(2): Tri-band phosphor with normal lifetime and a tube diameter ≥ 9 mm and ≤ 17 mm (e.g. T5): 3 mg 2(a)(3): Tri-band phosphor with normal lifetime and a tube diameter > 17 mm and ≤ 28 mm (e.g. T8): 3.5 mg 2(a)(4): Tri-band phosphor with normal lifetime and a tube diameter > 28 mm (e.g. T12): 3.5 mg 2(a)(5): Tri-band phosphor with long lifetime (≥ 25 000 h): 5 mg 2(b)(1): Halophosphate lamps (exemptions for such linear lamps with tube > 28 mm (e.g. T10 and T12) and with Hg content below 10 mg expired on 13 April 2012)	Tri-band phosphor with normal lifetime and a tube diameter < 9 mm (e.g. T2) with a mercury content between 4 mg and 5 mg Tri-band phosphor with normal lifetime and a tube diameter ≥ 9 mm and ≤ 17 mm (e.g. T5) with a mercury content between 3 mg and 5 mg Tri-band phosphor with normal lifetime and a tube diameter > 17 mm and ≤ 28 mm (e.g. T8): with a mercury content between 3.5 mg and 5 mg Tri-band phosphor with normal lifetime and a tube diameter > 28 mm (e.g. T12) with a mercury content between 3.5 mg and 5 mg Halophosphate lamps

	MC restrictions	EU legislation restricting placing on the market	Products for which EU marketing restrictions go beyond MC restrictions; affected under BMC scenario only
5	*High pressure mercury vapour lamps (HPMV) for general lighting purposes*	RoHS Directive 2011/65/EU currently includes an exemption for this product type, but the exemption expires by 13 April 2015; after that date, the general restriction of 0.1 % of Hg w/w (Article 4, Annex II RoHS) applies	High pressure mercury vapour lamps (HPMV) NOT for general lighting purposes.
6	*Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for electronic displays:* *(a) short length (⩽500 mm) with mercury content exceeding 3.5mg per lamp* *(b) medium length (> 500 mm and ⩽1 500 mm) with mercury content exceeding 5 mg per lamp* *(c) long length (> 1 500 mm) with mercury content exceeding 13 mg per lamp*	These lamps are exempted in the RoHS Directive 2011/65/EU but with thresholds for exempted lamps matching exactly the thresholds in of the MC.	**None**.
7	*Cosmetics (with mercury content above 1ppm), including skin lightening soaps and creams, and not including eye area cosmetics where mercury is used as a preservative and no effective and safe substitute preservatives are available*	"Mercury and it compounds" is included in the list of prohibited substances (Annex II, entry 221 in Regulation 1223/2009 on cosmetic products), with the exception of two mercury compounds (Phenyl Mercuric Acetate and Thimerosal) which are allowed to be used in eye cosmetics, with threshold concentrations of 0.007 % w/w (=70 ppm). The MC provision is deemed covered.	Presuming that the further conditions of the MC entry ("*mercury is used as a preservative and no effective and safe substitute preservatives are available*") apply for the EU exemption for eye cosmetics, there are **no products** for which EU marketing restrictions go beyond MC restrictions.
8	*Pesticides, biocides and topical antiseptics*	Mercury and mercury compounds are not approved as active substances for plant protection products or biocides under EU legislation. Topical antiseptics are subject to EU legislation on medicals (Directive 2001/83/EC; Regulation (EC) 2004/726). It cannot be ruled out that authorisations may exist at MS level.	**None**.
9	*The following non-electronic measuring devices except non-electronic measuring devices installed in large-scale equipment or those used for high precision measurement, where no suitable mercury-free alternative is available:* *(a) barometers;* *(b) hygrometers;* *(c) manometers;* *(d) thermometers;* *(e) sphygmomanometers*	Annex XVII of REACH, entry 18a is related to "Mercury (CAS No 7439-97-6)" and restricts the use in fever thermometers and other non-electronic measuring devices. Note that this entry is modified by Regulation (EU) No 847/2012 amending Annex XVII to Regulation (EC) No 1907/2006 with effect of April 2014. The entry reads in full: *5. The following mercury-containing measuring devices intended for industrial and professional uses shall not be placed on the market after 10 April 2014: (a) barometers; (b) hygrometers; (c) manometers; (d) sphygmomanometers; (e) […]; (g) thermometers and other non-electrical thermometric applications.* *The restriction shall also apply to measuring devices under points (a) to (g) which are placed on the market empty if intended to be filled with mercury.* *6. The restriction in paragraph 5 shall not apply to: (a) sphygmomanometers to be used: (i) in epidemiological studies which are ongoing on 10 October 2012; (ii) as*	Wording of EU restriction differs from MC (e.g. it is no precondition in the EU that *no suitable mercury-free alternative is available*). On the other hand, EU restriction contains exemptions (in point 6). Overall, it is assumed in essence there are **no products** for which EU marketing restrictions go beyond MC restrictions.

	MC restrictions	EU legislation restricting placing on the market	Products for which EU marketing restrictions go beyond MC restrictions; affected under BMC scenario only
		reference standards in clinical validation studies of mercury-free sphygmomanometers *(b) thermometers exclusively intended to perform tests according to standards that require the use of mercury thermometers until 10 October 2017;* *(c) mercury triple point cells which are used for the calibration of platinum resistance thermometers.* *[…] 8. The restrictions in paragraphs 5 and 7 shall not apply to: (a) measuring devices more than 50 years old on 3 October 2007; (b) measuring devices which are to be displayed in public exhibitions for cultural and historical purposes.*	

3.4.3 Impact assessment

Table 3-10 summarises the stakeholders affected and the impacts generated by the two options. The types of impacts are the same for the MI and the BMC scenarios, but the scale of impact will be higher under the BMC for the stakeholders involved in production and export of products which are targeted by EU marketing restrictions but not by MC marketing restrictions.

Table 3-10 Stakeholders affected by options in question and impacts in summary.

Options assessed	**Stakeholders affected**	**Impacts**
MI scenario: Restriction of export of MC targeted mercury-added products as per MC requirements ("MC standards"). And: BMC scenario: Restricting export of same mercury-added products but according to Hg thresholds and standards already in place for placing these products on the market within the EU ("EU standards")	Industry and exporters	Costs: Loss of revenues from exports of targeted EU-produced products Social: Loss of jobs with cessation or reduction of production and export of targeted EU-produced products
	Competent authorities	Administrative burdens of enforcement: as control programmes are already conducted for diverse restrictions of manufacture and 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).

3.4.3.1 Impacts

As the data for describing the impacts of these options are generally scarce, economic, social and environmental impacts are dealt with in an integrated manner for each product group.

Under the MI scenario ("MC standards"), export of mercury-added products that do meet the MC standards would not be affected and manufacturing and export could continue. Export of mercury-added products that do not meet the MC standards would be affected; their export would need to be terminated and associated production jobs would be lost. As the EU-based production of these product types has been used to similar or even stricter regulation (for many product types for a number of years), the technology needed for the transition exists and is widely used already.

Under the BMC scenario ("EU standards"), the EU based production would have stricter regulation of their export than the similar production outside the EU (where the MC standards would likely dominate). Therefore any such production now present inside the EU for export may simply be relocated outside the EU, with consequent losses of EU revenues and jobs, but no environmental gain in the global perspective.

If the EU did not implement the Minamata Convention but many other countries did, EU exports of the targeted products would be affected (by MC Article 3's import restriction) unless the production was adjusted according to the MC requirements.

Under the MI scenario ("MC standards"), mercury releases, mercury input and emissions/releases will fall within the EU and globally. Under the BMC ("EU standards"), mercury use and releases inside the EU will be reduced, but if production of the targeted products is relocated out of the EU to countries with lower environment and health standards than in the EU, the global environment and health impacts of mercury emissions/releases may increase.

Switches and relays

For mercury-added switches and relays (a use that has been declining for decades in the EU), the MC requirements are similar to existing EU law, and thus the impacts of the two scenarios would be similar. If the EU did not implement the Minamata Convention but many other countries globally did, any EU exports of the targeted products would be affected (by MC Article 3's import restriction), unless the production was adjusted to meet MC requirements. COWI and Concorde East/West (2008) estimated a total mercury consumption in 2007 for switches, relays and similar products in the EU at 0.3 – 0.8 t/y, and an export of about 0.3 t/y. It is not known whether this export trade still exists and if it will be affected by the MI or the BMC scenario.

Batteries

As regards batteries, the European Portable Battery Association (EPBA) has supported (EPBA, 2014) the BMC option and alignment of a restriction on export and production of mercury containing button cells with the existing deadline in the EU Batteries Directive (BMC scenario). The EBPA was asked for data on exports of EU produced mercury-added batteries that would be affected under the MI and BMC scenario, respectively, but was not in a position to supply such data. However, its support for the BMC option ("EU standards") for production and export indicates that negative impacts on EU battery producers may be small (see also below).

The relevant mercury-added battery types are mercury oxide batteries (marketing banned in the EU since 2006) and silver oxide, air-zinc and alkaline button cells, for which a mercury concentration up to 2% is exempted in the EU Battery Directive until October 2015.

Eurostat data on battery production were checked, but were not sufficiently detailed to show the 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 types (see Appendix 4) 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)[18]. 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 (2015), of these battery types only zinc-air batteries are produced in significant amounts within the EU today. EPBA[19] explained that the same production lines can produce batteries 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, according to the authors' information, has been stable for many years at well below 2% (before mercury-free types were introduced; see also UNEP, 2013). The authors therefore assume that the current EU based production of batteries is in conformity with the MC requirements; the MI option is expected to have no negative impacts for EU based battery production.

Regarding the BMC option, it is possible that some small scale manufacturing or mercury-added zinc-air batteries could continue for customers outside the EU after October 2015, where the exemption for button cell batteries with below 2% mercury ceases, and such production may thus be affected by the BMC option, with possible losses of export revenues of 0 – 50 million EUR/y.

COWI and Concorde East/West (2008) estimated the mercury exported from the EU within battery materials 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 inputs to batteries that are exported is estimated at zero (0) for the MI option and 0-5 t/y for the BMC option. Mercury releases from EU based battery production are not known, but are expected to be minimal in this context.

Lamps

LightingEurope (2014) has advised that, of the lamps listed in Table 3-9, only fluorescent lamps of the halophosphate type would be affected by an "EU standards" export restriction (BMC scenario) but not by an "MC standards" restriction (MI scenario). LightingEurope estimates that around 143 million pieces of halophosphate lamps per year are manufactured in the EU for export (as their marketing is restricted within the EU). Assuming an average consumer price of 5 EUR (within a range of between 2 and 8 EUR) the consumer market value of these lamps is around 715 million EUR/y. The actual export revenue from this production was not reported, but may likely be expected to be around one third to half of this amount, or some 240 – 360 million EUR/y. As these lamps are reported to have a mercury content below 10 mg/piece, the export would not be affected under the MI scenario (export restrictions at "MC standards"), but would be eliminated under the

[18] 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.
[19] 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.

BMC scenario (export restrictions at "EU standards"), meaning loss of export revenues estimated at 240 – 360 million EUR/y. The number of jobs at risk was not reported.

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 in EU production. Assuming that the lamps exported contain an average of 10 mg mercury per lamp, the total mercury in these lamps would be 1.4 tonnes per year. This defines the maximum potential mercury emissions/releases in the life cycle of the lamps under the BMC scenario. While some lamps may be recycled and the mercury therein be reused or deposited as waste, most of this mercury is expected to be lost to the environment. If the production of these lamps is relocated outside the EU, this emission/release potential would be unchanged and incremental emissions/releases from manufacturing cannot be ruled out. Under the MI scenario, no environmental impacts would be expected.

Germany notes, in one of its consultation submissions for this study, that the use of mercury-containing lamps in vehicles with type approval dated before 1st July 2012, and spare parts for these, is still allowed in the EU according to the EoLV Directive. The coverage of such lamps by the Minamata Convention is not explicit, and they are therefore not likely to be targeted. Germany notes that such cars may still be in use after the MC product sunset dates of 2020, and that consequently the production, marketing and export of such lamps may still be needed after that year. No data on the number of lamps are available.

Non-electronic measuring devices

Barometers, hygrometers, manometers, thermometers and sphygmomanometers are targeted in the MC. This group of products is severely restricted in the EU now, and the mercury consumption associated with these products has been declining steadily over the last decades. 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. As indicated in Section 3.3.2, current consumption is expected to be substantially lower today, and probably below 3 t/y. The current export tonnage is not known. Nor is it known whether this export will be affected by the MI or the BMC scenario.

Three thermometer manufacturers, which have experienced impacts from the introduction of EU regulation in this field, made submissions to this study[20]. Two (Ludwig Schneider and Berman) focused on mercury-filled precision thermometers (used for calibration, etc.) and would thus not suffer incremental impacts from the MI scenario, but could potentially be affected under the BMC scenario (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 (with the relevant REACH article that came into force in April 2014). 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).

[20] Stakeholder contribution from Ludwig Schneider, Berman and Russel Scientific (available at http://ec.europa.eu/environment/chemicals/mercury/ratification_en.htm)

According to Ludwig Schneider about 50-60% 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 the MI nor the BMC scenario would affect this production significantly. Ludwig Schneider[21] estimates that the European manufacturers in total use less than 1 tonne of mercury per year. But, as mentioned above, this consumption would not be affected under the MI scenario and any impact under the BMC scenario 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. 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 either the MI or the BMC scenario.

Pesticides, biocides and topical antiseptics

As stated in Table 3-9, 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. Checks on whether Member States have approvals for mercury-added antiseptics were beyond the scope of this study.

[21] Stakeholder contribution from Ludwig Schneider (available at http://ec.europa.eu/environment/chemicals/mercury/ratification_en.htm)

3.4.4 Conclusions

Switches and relays

The total mercury consumption in 2007 for switches, relays and similar products in the EU was estimated at 0.3 – 0.8 t/y, and the mercury exported was about 0.3 t Hg/y. It is not known whether this export still exists and if it will be affected by the MI or the BMC scenario.

Batteries

The EPBA supports the suggested BMC option. No impacts are expected under the MI option. Under the BMC option, lost export revenues are estimated at 0 – 50 million EUR/Y with potential mercury input reductions of 0-5 t/y.

Lamps

Around 143 million halophosphate lamps are manufactured per year in the EU for export. Under the BMC scenario this trade would cease, with resulting loss of export revenues estimated at 240 – 360 million EUR. The number of jobs at risk is not known. The MI option leaves this trade untouched and so no economic impacts arise. The mercury emissions and releases from production of lamps for export are assumed to be minimal in EU production. Under the MI scenario, no environmental impacts would be expected. Under the BMC scenario, the maximum reduction of mercury input to society (in the EU) with the exported lamps is roughly estimated at 1.4 tonnes/y. Relocation of the production of these lamps outside the EU could potentially result in increased emissions/releases from manufacturing due to lower regulatory standards.

Non-electronic measuring devices

For the whole product group, a total mercury consumption around 2007 was estimated at 7-16 t/y, and a mercury export of about 8 t/y. Most likely the consumption is substantially lower today, likely below 3 t/y. The current export tonnage is not known. Nor is it known whether this export will be affected by the MI or the BMC scenario. Minor impacts of the MI as well as the BMC option may be experienced in the manufacture of mercury sphygmomanometers for export. Manufacturers of mercury containing thermometers could be affected by the BMC scenario, but quantification is not possible with the available data.

Other targeted products

No impacts of either the MI option or the BMC option are expected for the other products groups targeted by the MC.

Data gaps

- Current export revenue and mercury export tonnage with switches/relays and non-eletronic measuring devices.
  - Share of any such export that would be affected by the MI or BMC scenarios, and their associated mercury inputs and releases.

3.5 MC Articles 4(6) and 5(7): Discouragement of new products and processes with intentional mercury use

3.5.1 Problem definition and specific objectives

Article 4(6) and Article 5(7) MC, respectively, introduce obligations for the Parties to take appropriate measures to discourage mercury-added products or manufacturing processes in which mercury or mercury compounds are intentionally used. The term "discourage" is not defined in the MC, and there is scope for interpretation on how firm implementing measures need to be. The gap analysis showed that there is no current EU legislation covering these requirements.

"Discouragement" could be provided by measures of varying severity, of which two were selected for detailed assessment here:

- Stating that new marketing and commercial use should be discouraged in a communication to Member States or stakeholders (MI scenario);
- Introducing an explicit restriction on all new mercury uses (BMC scenario, under which only the following uses would be allowed (as per MC requirements)):
  - Products demonstrating significant environmental or human health benefits;
  - Manufacturing processes providing significant environmental and health benefits on the condition that there are no technically and economically feasible mercury-free alternatives available providing such benefits (to be demonstrated to the satisfaction of the Conference of the Parties).

R&D activities are exempted from the MC, as well as in existing EU law relevant to mercury, and would thus still be possible.

3.5.2 Baseline conditions

Mercury is, and has been, used in many products and processes. COWI and Concorde East/West (2008) assessed more than 60 mercury applications. A detailed split of EU mercury consumption among 41 product groups taken from that study is shown in Table 3-1 in Section 3.3.

Use of mercury in many of its historic applications has been phased out, or the applications themselves discontinued. Some significant applications remain, e.g. dental amalgam and chlor-alkali production with mercury cells (scheduled for substitution by 2017). Current estimated EU consumption for different applications is shown in Table 3-2.

Table 3-11 shows when mercury-containing products or manufacturing processes were invented. Most inventions date from around 1900, with the last of the listed inventions around the 1950s (mercury switches and relays and finally the use of mercury compounds as catalysts for PU production). Some new variations of former inventions were launched later (such as for example CFLs). To our knowledge, no significant new mercury-added product, or manufacturing process has achieved market scale in the last 50 years with the exception of two new product types containing mercury which have recently occurred at the North-American and Canadian market. Specific information was provided by EEB[22] on anti-vibration wrist bands which contain encapsulated mercury in order to absorb vibrations[23] and on wheel balancing systems using mercury to reduce vibrations[24]. Both examples are non-essential new alternatives to existing non-mercury technology. They thus demonstrate that i) without regulation, such products may be marketed with environmental risks as a consequence, and ii) restricting their marketing would likely have no major socio-economic impacts.

Table 3-11 The year of invention of various mercury applications.

Product/Process	Year of invention	Remarks	Reference
Mercury galvanic cell batteries	1884	1884: Charles L. Clarke, Commercial use since the 1940ies until the 1990ies	US Pat (1884)
Mercury switches	1946	1950s: John Schilling Lorell	US Pat (1951)
Mercury relays	1961/62	Various applications	DE Pat (1965)
Mercury fluorescent lamps	1902	Commercial use since the 1930s	US Pat (1907)
Mercury HPMV lamps	1900	Commercial use since the 1930s	US Pat (1901)
Mercury barometers	17th century	17th century: Evangelista Torricelli	Knowles Middleton (1963)
Mercury thermometers	1714	Early 18th century (1714): Daniel Gabriel Fahrenheit	Achilles (1989)
Mercury Sphygmomanometers	1881	Late 19th century (1881): Samuel Siegfried Karl Ritter von Basch	Booth (1977)
Dental amalgam fillings	1820	Commercial use since the 1820s: inventor unknown	Bates (2006)
Chlor-alkali process (mercury cell)	1890	1890s: Hamilton Castner, Karl Keller	Kiefer (2014)
Mercury for acetaldehyde production	1937	1937: Friedrich Lieseberg	US Pat (1939)
Mercury for VCM production	1913	1913: Fritz Klatte	US Pat (1914)
Mercury for PU production	1965	1965: Joseph T. Willett	US Pat (1968)
Mercury for gold extraction; “ASGM”		Roman age or earlier	

There may be more recent inventions in research and laboratory uses but these are not covered by Article 4(6) or Article 5(7) MC. Except for mercury’s use as a spallation neutron source in particle research and similar, we have no data on new

[22] See stakeholder contribution EEB from 31.07.2014 (available at http://ec.europa.eu/environment/chemicals/mercury/)

[23] see http://www.amazon.com/Tennex-Elbow-Shock-Watch-Black/dp/B002N1OJSI

[24] See http://www.balancemasters.com/flywheels/index.html or http://www.centrabalance.com/centra/about.html

developments of laboratory and research applications of mercury. Mercury use as a spallation neutron source in particle research takes place in a specialised research environment. It is not likely to become part of a product or a manufacturing process and so would thus not be covered by the Minamata Convention obligations.

Evidence indicates that mercury is also being substituted to a large extent in research and laboratory activities, primarily due to digitalisation and environmental concerns.

3.5.3 Impact assessment

Impacts on stakeholders are summarised in the following table. These provisions of the Minamata Convention relate to future products and processes which are unknown today, so a specific impact assessment is not feasible. It is possible only to outline the type of impacts that may occur.

Table 3-12 Stakeholders affected by options in question and impacts in summary.

Options assessed	**Stakeholders affected**	**Impacts**
Stating that new marketing and commercial use should be discouraged in a communication to Member States or stakeholders (MI scenario)	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 gain 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 implementaion may vary quite heavily depending on the implementation mode. Particularly, implementation via REACH may take much effort due to the procedures in place.
	Consumers	Possible cost impacts (positive or negative) due to changed 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.

Options assessed	Stakeholders affected	Impacts
	Environment	Reduced risk of exposure due to avoidance of new mercury uses.
Introducing an explicit restriction on all new mercury uses (BMC scenario)	Researchers and Developers of new products and processes	Generally the same as above for the MI option.
	Industry	Generally the same as above for the MI option. 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	Generally the same as above for the MI option.
	Consumers	Generally the same as above for the MI option.
	Workers	Generally the same as above for the MI option.
	Environment	Generally the same as above for the MI option.

3.5.3.1 Technical considerations on option implementation

It is unlikely that significant new mercury related commercial products and manufacturing processes will be developed. It is expected that non-mercury techniques will be available for possible new products and manufacturing processes where mercury could otherwise be used, as is the case in, for example, chlor-alkali production.

There is a hypothetical risk for industry of not being able to use the solution technically and economicaly most feasible (if that one involves mercury), at the expense of income and jobs. While this cannot be fully ruled out, the risk is considered as minimal. Making and lab-testing inventions involving mercury will still be possible under the MC, but marketing can only take place under certain conditions (stated above).

Since future innovation pathways cannot be determined with certainty *ex ante*, it is not possible to describe specific impacts either qualitatively or quantitatively (possible types of impacts are described in Table 3-12). An assessment of impacts needs to remain at a speculative level and can only be based on examples of past uses of mercury within products or manufacturing processes. A qualitative description of possible impacts is given in Table 3-12.

Generally it can be expected that compared to a general “soft” discouragement (MI), a conditional ban (BMC) is appropriate to avoid new products and processes coming to market.

Should a "soft discouragement" (MI option) be preferred, EEB proposed[25] that Parties would, as a minimum, need to identify new types of products and new processes through an industry reporting obligation. Without such reporting, Parties cannot demonstrate whether in fact the new products and processes have been “discouraged” nor can they comply with reporting and demonstration obligations associated with implementing these provisions.

3.5.3.2 Social impacts

Social impacts cannot be determined.

3.5.3.3 Economic impacts

The economic impacts of both MI and BMC scenarios are uncertain but expected to be small. If a new product/process is brought to the market under the BMC controls outlined above then there would be additional costs for the proponent to obtain authorisation. For example:

- If mercury was made subject to authorisation under REACH Annex XIV then authorisation would be needed for a new product or process according to the existing ECHA procedures. Costs for authorisation under Annex XIV of REACH are usually in a range between 50,000 and 400,000 EUR (mostly for data collection and dossier elaboration). Fees payable to ECHA are in the order of 50,000 EUR.

- The other control options (e.g. inclusion under REACH Article 68(2) or a conditional restriction delivered via Regulation (EC) 1102/2008) are likely to entail similar costs. Such economic impacts will only arise if a new product or process was suggested for authorisation.

3.5.3.4 Environmental impacts

An outright ban (with conditions) on the marketing/use of mercury in new applications would make a clear statement towards industry developers which could eliminate potential novel uses of mercury, unless such uses had clear societal benefits.

The environmental impact of a “soft discouragement” would depend on how it was implemented. The impacts could range between no significant effect and almost full elimination of mercury input to society with novel mercury uses. The choice of implementation mode is therefore important for the effectiveness of the measure.

[25] See stakeholder contribution EEB from 31.07.2014 (available at http://ec.europa.eu/environment/chemicals/mercury/)

3.5.4 Conclusions

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 very low, but the possibility cannot be entirely excluded. A conditional restriction would be an effective means of discouraging such applications. 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 relevant products and processes to market and provide added protection against the health and environmental impacts of mercury use in circumstances where there are not significant social benefits. Such requirements would discourage new uses of mercury and impose no significant direct costs on business if not used (i.e. if there are no requests for authorisation).

If a "soft" discouragement as in the MI option is preferred, it could be considered to establish a reporting obligation on new types of mercury involving products and processes, in order to monitor development and demonstrate conformity.

An explicit ban will have a stronger signal value both internally in the EU and towards other Parties of the Minamata Convention.

3.6 MC Article 5(3): Restricting mercury use in VCM, sodium/potassium methylate/ethylate and polyurethane production

3.6.1 Problem definition and specific objectives

This section considers restricting mercury use in i) vinyl chloride monomer (VCM), ii) sodium/potassium methylate/ethylate and iii) polyurethane production. The EU status of the three targeted processes is as follows:

› VCM: VCM is an illustrative process in the Large Volume Organic Chemicals (LVOC) BREF (adopted in February 2003, currently under revision), and also features in Draft 1 of the revised BREF. Reference is made to historic examples of abandoned mercury processes, whereas mercury-free alternative process routes are well established and in wide use within the EU. Mercury is reported to be used in VCM manufacturing in only one facility (in Slovakia). Due to insignificant scale of the MC's impacts on this process in the EU, the impacts are not investigated further.

› Polyurethane (PUR): REACH Annex XVII (as amended by Regulation (EU) 848/2012) stipulates that the five hitherto most used phenyl-Hg catalysts may not be manufactured, used or placed on the market, if the concentration of mercury in the mixtures is equal to or greater than 0.01% by weight, with effect from October 2017. This restriction does not cover all available mercury catalysts for the purpose. The COWI/Concorde East/West (2008) study indicates that mercury-free alternatives are available for all polyurethane applications. This is supported by the fact that, as of June 2013, no mercury compounds were registered under REACH. This means that, if still used, they are used in quantities of less than 100 tonnes/y[26] in the EU and must be registered by 2018 to be accepted as "existing" chemicals on the market ("existing" chemicals can be marketed with less documentation than new chemicals) (COWI, 2014). The impacts of implementing this MC obligation (a restriction on use) in the EU are expected to be minimal and are not assessed further.

› Sodium/potassium ethylate/methylate[27] process with mercury: The production of sodium/potassium ethylate/methylate is not addressed explicitly in the LVOC BREF, nor in the BREF on chlor-alkali production. The mercury process is reportedly in use only in Germany.

The impact assessment here focuses on production of sodium / potassium ethylate / methylate. The options considered for implementing the requirements of Article 5(3) are:

› An initiative to try to phase out mercury-based alcoholates production as far as possible, and within 10 years of the entry into force of the Convention, including promotion of measures for making available alternative processes for the production of alcoholates or substitutes for those alcoholates in their end-uses (MI Scenario); and

› A ban on production of alcoholates using mercury cells within 10 years (BMC scenario)

The MC states *"Measures to be taken by the Parties shall include …measures to reduce the use of mercury aiming at the phase out of this use as fast as possible and within 10 years of the entry into force of the Convention"*. This can be understood both as "shall phase out" and "shall try to phase out". It has been discussed whether the second option investigated here is within or beyond the strictly minimal implementation of the Convention; that option is here treated as going beyond minimal implementation.

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[28], as do all other known global producers. The mercury process is reported to have about 20% lower

[26] Not to be misunderstood as an environmentally in-significant amount.
[27] Four substances are produced in the same process facilities but with varying feedstock chemicals: sodium methylate, sodium ethylate, potassium methylate and potassium ethylate.
[28] Because according to Evonik (2014), there is no local demand for the co-produced chlorine in these production sites.

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 IE Directive's 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 3-13. The registration bands give an indication of the scale of production of each substance.

Table 3-13 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 (as indicated in registration database)	**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 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.

3.6.2 Impact assessment

Impacts on stakeholders are summarised in the following table.

Table 3-14 Stakeholders affected by options in question and impacts in summary.

Options assessed	Stakeholders affected	Impacts
Initiative to encourage phase-out of mercury alcoholates (MI option)	Industry using mercury process	Costs: Cost of substitution, but with more time and thus no or little lost value from premature scrapping of production facilities.
	Industry using mercury-free process	Benefits (distributional effect only): No or only slow shift of the market to producers currently using mercury-free processes. These include producers within the EU as well as outside.
	Consumers	Price increases to users most likely lower than for an outright ban. For consumers of the resulting biofuels (a major use) minor price differences are expected, due to the minor contribution to overall costs from sodium methylate.
	Global and EU population and environment	Benefits of reduced mercury releases from the lifecycle of mercury for sodium/potassium-methylate/ethylate production, but possibly at a slower rate than with an outright ban.
Introducing an explicit ban of mercury use in alcoholates production (BMC option)	Industry using mercury process	Costs: Cost of substitution. Lost value-added from premature scrapping of production facilities.
	Industry using mercury-free process	Benefits (distributional effect only): If the MC obligation on sodium/potassium methylate/ethylate is effective, more of the market will shift to producers using mercury-free processes. These include producers within the EU as well as outside.
	Consumers	Costs of price increases to users. For consumers of the resulting biofuels (a major use) minor price differences are expected, due to the minor contribution to overall costs from sodium methylate.
	Global and EU population and environment	Benefits of reduced mercury releases from the lifecycle of mercury for sodium/potassium-methylate/ethylate production.

3.6.2.1 Technical considerations

In the mercury process, sodium methylate is produced from a floating mercury amalgam (Na-Hg) similar to chlor-alkali production in mercury cells. By-products are chlorine and hydrogen (BASF/Evonik, 2012; DuPont, 2014).

Alternatives

ICIS (2009), citing Evonik, states that Evonik's sodium methylate production uses an electrolysis (mercury) process at its German facility and reactive distillation at its USA facility. According to (Evonik, 2014; Shao and Wang, 2012), the reactive distillation process for sodium methylate production uses NaOH and methanol as feedstock in a forced distillation process where the chemical reaction takes place.

Sodium methylate is also produced by a direct reaction of metallic sodium with pure methanol (DuPont 2014; Envirocat, 2014), or from sodium hydroxide solutions (including low grade) with the use of sodium-selective ceramic filters (Ceramatec, 2014) in small units which can serve individual bio-diesel plants and produce on demand. According to Ceramatec, the method has potential for production of other alkali alcoholates than sodium methylate (Li, K, Na based).

Evonik (stakeholders consultation input) has advised that an alternative electrolytic process for producing sodium methylate from methanol and caustic soda is in a very early development stage, and it therefore considers it not commercially available. The only pilot plant for this technology is currently operated by Evonik. It expects that this technology will not be commercially feasible "within the foreseeable future".

Potassium methylate and sodium methylate can be produced directly by biodiesel producers from the reaction of the relevant hydroxide with methanol. According to Envirocat (2014), this is seldom done nowadays for sodium methylate, but is common for potassium methylate. Evonik (2014) explains that this is because the self-made sodium methylate contains a certain amount of water, and water induces soap formation in the bio-diesel production, which in turn reduces the yield of biodiesel per tonne of plant oil. The same happens with self-produced potassium methylate, but the soap produced from this substance can better be handled in the biodiesel production process. Neither Evonik nor BASF consider (in their stakeholder consultation inputs[29]) this process suitable for producing marketable potassium methylate. Both companies however have patents (granted or pending) for producing certain alcoholates, including potassium methylate, without the use of mercury (Patent US 7,847,133 B2, 2010 and – according to Envirocat[30]: Patent Application US 2011/0313207, 2011).

GIMS (2011) summarises the three types of alternative catalysts available for biodiesel production as follows:

- "Sulphuric acid catalysts : They are little used (because reaction is slow), just for the esterification of raw materials with a high free fatty acid content (animal fats);
- Enzymes: this technology is currently at the R&D stage;

[29] Stakeholder input available at http://ec.europa.eu/environment/chemicals/mercury/ratification_en.htm

- Methylate basic catalysts: they represent the overwhelming majority of industrial catalysts. Sodium methylate is the most widely used. Potassium methylate, sodium hydroxide, and potassium hydroxide can also be used. Sodium hydroxide and potassium hydroxide have a lower yield (production of soap) and require an additional purification process. Potassium methylate is more expensive than sodium methylate. These catalysts require a raw material containing less than 2% of free fatty acids, which is the case with vegetable oils. Around 15-17 kg of sodium methylate solution is needed to produce 1 ton of biodiesel."

Envirocat (2012, 2014) states that the sodium methylate production price with the direct reaction of sodium and methanol (mercury-free) is about 20% higher than the sodium methylate produced with the mercury process. However, for the key use, biodiesel production, this does not affect the consumer price of the biodiesel significantly, due to the small amounts of catalyst sodium methylate used per tonne of biodiesel, and due to lower transport needs (see below). According to GIMS (2011), the increase in biodiesel costs when using sodium methylate from mercury-free production will be 0.2% compared to biodiesel produced by use of catalysts from the mercury process.

According to Envirocat (2014) the reason why non-mercury process sodium methylate can be competitive in spite of its higher production price, is that it can be produced in relatively small units constructed close to the customers, thereby minimizing transport costs. Envirocat states that transport costs are a substantial part of the downstream user price for the substance.

Envirocat (2014) is currently importing sodium ethylate from Japan, in liquid and powder form, produced with non-mercury technology.

According to Evonik (2014), economically and technically feasible industrial scale production of potassium ethylate without the mercury-process has proven difficult, though it may be possible at lab scale. As pointed out by Envirocat[30], Evonik has a patent for producing alcoholates (also called alcoxides), including potassium methylates and ethylates, with a non-mercury process (US Patent US 7,847,133 B2, 2010).

According to Envirocat (2014), potassium methylate and potassium ethylate are produced with a non-mercury technology by the company Alkalimetals in India. A certificate from Alkalimetals (2014) indicates a production capacity of 30 tonnes per month of each substance. No other sources have been available to confirm this information.

Both producers of alcoholates using the mercury process state that they are dedicated to research for alternative processes (Evonik, 2014; BASF, 2014).

[30] In their stakeholder contribution available at http://ec.europa.eu/environment/chemicals/mercury/ratification_en.htm

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 tonnes of 30% sodium methylate solution (in methanol), of which about 160,000-200,000 tonnes/y are consumed in the EU and 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 tonnes/y of 30% sodium methylate solution (some sodium methylate is sold as powder, which is included in the estimate as converted to the solution basis).

According to BASF (2014), the general market price range for undiluted sodium methylate is between 2,100 and 2,800 EUR/tonne 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/tonne 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/tonne 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/tonne 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).

As shown in Table 3-15, 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 3-15 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[31]. This is a distributional effect and is therefore not dealt with further in this study.

3.6.2.2 Social impacts

A ban on alcoholate production within 10 years (the BMC option) could cost 80 – 200 jobs, though there is uncertainty attached to this estimate. Considering that the MI option could maximally lead to the same effects as the BMC option (see economic impacts below), potential job losses for the MI option is estimated at 0 – 200.

Ten full time personnel are employed per 25,000 t/y of sodium methylate solution production capacity in mercury-free production in the EU, while about 20-35 full time equivalent jobs are engaged in the EU in the full supply chain (including production) of sodium methylate for the same production capacity (Envirocat, 2014 (and stakeholder consultation response; GIMS, 2011). This corresponds to 40 and 80-140 persons, respectively, per 100,000 t/y of sodium methylate solution.

The number of people employed in the mercury-process production of alcoholates in the EU is not known, but is estimated (based on indicative information from Evonik (2014)) at 300-500 persons in the whole supply chain for an estimated

[31] See the stakeholder consultation contribution from BASF (available at http://ec.europa.eu/environment/chemicals/mercury/)

200,000-250,000 t/y production (or some 200 persons per 100,000 tonnes/y of sodium methylate solution).

In the event of a cessation of the mercury-based production this could have substantial effects on the local job situation if alternative processes were not adopted at the same locations. Evonik states (in their stakeholder consultation input) that 500 jobs would be lost, should their German alcoholates production be terminated.

Job data cannot be confirmed from other sources than the involved companies.

3.6.2.3 Economic impacts

BMC scenario

With the regulation of mercury-based sodium methylate production required under the Minamata Convention, 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.

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 tonnes 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[32].

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[33] 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 3-16). Evonik has rejected the above estimate (<60 million EUR) as speculative.

[32] The investment costs have been annualised using a discount rate of 4% over 10 years.

[33] Using 4% as discount rate over 10 years.

Table 3-16 BASF's estimate of investments and variable costs for substitution of their own mercury-based alcoholates production process.

Substitution of mercury on production of	**Investment, Million EUR**	**Min. variable cost (e.g. energy), Million EUR/a**
Sodium methylate[34]	110	14
Sodium ethylate and potassium alcoholates[35]	10 to 20	4-8
Na-dithionate (non-alcoholate[36])	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[37]) 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

[34] BASF's note: Incl. expansion of the existing membrane process for caustic (alkali hydroxides)
[35] BASF's note: Educated guess: process under development, estimation based on projected capacity.
[36] A fifth non-alcoholate chemical produced by BASF with the amalgamation process; not treated further; see text above.
[37] The annualising of the investment costs is done assuming a lifetime of 10 years and a discount rates of 4%.

costs difficult to estimate. According to Evonik[38], 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.

MI scenario

Costs for mercury emissions/releases reduction under the MI scenario are similar to those under the BMC scenario described above. Substitution costs may be lower than in the BMC scenario because there could be more time for substitution such that losses that arise from premature closure of production facilities will be smaller.

In case no technically and economically feasible alternatives were found for potassium ethylate (and potassium methylate), and production was therefore allowed to continue for all four alcoholates, the only costs would be those associated with attempting to develop (but not implement) alternative processes. Research costs cannot be quantified precisely; but it is expected that a reasonable research activity could be run for 2 million EUR/y. If alternatives did become available, the total substitution costs could approach those estimated for the BMC scenario. Ergo, the substitution costs under the MI scenario could range between 2 and 76 million EUR/y.

3.6.2.4 Environmental impacts

It is estimated that if production of alcoholates using mercury cells ceased then mercury emissions to the air in the EU would fall by up to 190 kg/y and mercury input of 0.3 - 1 t/y would be eliminated.

The total mercury emissions to the atmosphere from the two production sites using the mercury process were reported to be 190 kg Hg/y (BASF/Evonik, 2012), of which 84 kg Hg/y was from BASF's alcoholate facility (stakeholder consultation input) and the remaining was from Evonik's facility (covering both alcoholates and chlor-alkali production on this site).

The total mercury input (replenishment) per year for the production is not known, but is assumed to be 0.3-1.0 t Hg/y, taking possible accumulation in the process equipment into account.

According to BASF/Evonik (2012), the energy consumption (and so carbon footprint) for the production of sodium methylate from the mercury-free processes is higher than for the mercury-process. The mercury process is reported to use 2.3 kWh electricity per 1 kg of sodium methylate produced, while the direct sodium-metal process (direct mixing of sodium metal and methanol; including production of

[38] See the stakeholder consultation contribution from Evonik (available at http://ec.europa.eu/environment/chemicals/mercury/)

the sodium metal) uses 4.4 kWh/kg sodium methylate, and the reactive distillation process requires 2.2 kWh electricity and <3 kWh thermal energy (steam). Envirocat (2014) advises that the energy demand (electricity) for sodium methylate production with the direct sodium metal process is around 30% higher than that of the mercury process, but that the geographical vicinity to the users with these smaller production plants has the potential to reduce this to 10-15% more energy. The company's current sodium metal production in France uses its own hydropower (climate neutral).

For the potassium alcoholates, BASF/Evonik (2012) state that the production of metal potassium (used for the direct potassium and alcohol reaction) requires high temperature distillation and has an energy demand of >5.3 kWh/kg K.

BASF/Evonik (2014) also note that the production of the sodium (Na) metal from NaCl (salt) takes place at high temperatures with the use of graphite electrodes with the potential for formation of perchlorinated carbon substances and dioxins. According to Envirocat, its parent company (Alkaline Group) has produced metal sodium for decades and has not observed any such formation. It also states that the relevant IED BREF (on non-ferrous metal production) does not mention this formation. Therefore, no filters for this have been deemed necessary (Envirocat, 2014).

Metal sodium, and potassium, can oxidise explosively in case of contact with water. Envirocat (2014) states that metal sodium is transported under dangerous goods regulations in the solid state in a protective nitrogen atmosphere.

3.6.3 Conclusions

MC Article 5(3) restricts the use of mercury in the industrial processes of production of VCM, PUR and sodium and potassium methylates and ethylates. Of these processes only the production of sodium and potassium methylates and ethylates, so-called alcoholates, in the EU is expected to be affected to a significant degree by implementation of the Minamata Convention. These substances are used as catalysts in biodiesel production as well as in certain other syntheses of organic chemicals.

Two German companies are the world leaders in production of these substances, of which sodium methylate is by far the economically most important. They use the mercury-based process in their EU production, but a non-mercury alternative process in North and South America. All other global sodium methylate production is based on non-mercury technology. About 10% of the total EU based production of sodium methylate uses non-mercury methods.

Non-mercury technologies for production of potassium methylate and sodium ethylate are also commercially available. Potassium methylate can be produced without mercury, but apparently not in marketable amounts and quality. The production of potassium ethylate with non-mercury technology appears to be possible at lab scale in the EU facilities, but the EU producers using mercury do not consider it technically and economically feasible at 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 possible to confirm from other sources.

For the **BMC scenario** (a ban on the mercury process for alcoholates production), the total costs of substitution for all four alcoholates is estimated at between 60 and 76 million EUR/y[39], of which about half are investments annualised over a 10 years period and the other half are operational costs. The costs of the emission/releases reduction provision of the MC are estimated at 0.6-1 million EUR/y.

Under the **MI scenario** substitution costs could range from research costs only (in case no feasible alternatives were found) up to the same costs for research plus implementation as estimated for the BMC scenario above. Research costs cannot be quantified precisely; but it is expected that a reasonable research activity could be run for 2 million EUR/y. Therefore the substitution costs under the MI scenario could range between 2 and 76 million EUR/y. The costs of the emission/releases reduction provision of the MC for this sector are estimated at 0.6-1 million EUR/y similarly to the BMC scenario.

Social impacts, BMC scenario: While the numbers available are considered uncertain, and not necessarily consistent with the lower production costs for the mercury 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 the **MI scenario**, the transition will come more slowly, or not at all (in case adequate alternatives are not developed for all four alcoholates), and consequently with job loss estimates of 0 – 200.

Environmental benefits from elimination of this process under the **both scenarios** are moderate in the EU context. In the **BMC scenario** 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 the **MI scenario** can also not be quantified more precisely than up to 0.3-1.0 t/y.

The companies using the mercury-based production process consider the production of the four chemicals as economically mutually dependent and state that they may terminate the production of all four substances, should the use of the mercury-based process be prohibited in the EU for those two – three of the substances for which alternative non-mercury processes exist.

The Commission has the option under the MC of asking for exemptions for Annex B listed processes (of which this is one) under the conditions of Article 6 MC for a maximum of five years (plus another five years if accepted by the COP). This might particularly be relevant, if EU industry needs additional time for substitution of the mercury process for the last of the four alcoholates in question.

[39] Based on 10 years and 4% as discount rate.

3.7 MC Article 5(6) on prohibition of using mercury in new Annex B facilities

3.7.1 Problem definition and specific objectives

The processes listed in MC Annex B are:

- Chlor-alkali production with mercury cells
- Acetaldehyde production in which mercury or mercury compounds are used as a catalyst
- Vinyl chloride monomer production (VCM) with mercury catalysts
- Sodium or potassium methylate or ethylate with the mercury process
- Production of polyurethane using mercury-containing catalysts

As described above, mercury cell chlor-alkali facilities are explicitly non-BAT under the IE Directive (new facilities may not be established with mercury cell technology), acetaldehyde production with mercury catalysts is assumed not to take place in the EU (another process is used), there is only minimal VCM production with mercury in one MS, and mercury catalysts in production of polyurethane seem to be substituted (or almost substituted), as described in Section 3.6. This leaves production of sodium or potassium methylate or ethylate with the mercury process as the only process for which restriction on the establishment of new facilities could potentially have major impacts.

3.7.2 Conclusions

The options suggested for implementation of Article 5(6) MC are identical to those proposed to address Article 5(3) MC, provided that all Annex B MC processes are included in the legislative text. Therefore the only substantial incremental impacts of implementation of the Minamata Convention in this field are those for the mercury-based production of sodium or potassium methylate or ethylate. These impacts are described in detail in Section 3.6 and reference is made to that Section (see conclusions in Section 3.6.3).

3.8 MC Articles 8(3+5) and 8(4+5) on (air) emission control measures

3.8.1 Problem definition and additional information

Article 8 (3) MC requires Parties to take measures to control emissions of mercury or mercury compounds from relevant sources, defined in Annex D of the Convention as: coal-fired power plants; coal-fired industrial boilers; smelting and roasting processes used in production of non-ferrous metals (only lead, zinc, copper, and industrial gold); waste incineration; and cement clinker production facilities. Sub-categories or specific sources within an Annex D category can be chosen for emission control as long as 75% of the total emissions of the category in the country are covered (Article 8 (2) lit b.; hereafter the "MC 75% rule").

Article 8 (5) MC provides a list of measures for addressing existing facilities. The Convention requires that at least one measure from this list is implemented as soon as practicable, but no more than 10 years after entry into force of the Convention. The list includes a multi-pollutant control strategy that would deliver co-benefits for control of mercury emissions. Article 8 (4) MC requires that for new sources, Parties shall use best available techniques (BAT), or emission limit values (ELVs) reflecting BAT, and best environmental practices (BEP).

Control and reduction of emissions from the main industrial sources is, at EU level, covered by the IE Directive which operates with BAT and ELVs. Table 3-17 summarises the results of an assessment of these directives' coverage of relevant sources as defined in Annex D to the MC. The originally performed gap analysis highlighted a number of questions as regards the coverage of the current EU legislation of the requirements of the Minamata Convention, which are answered based on later research in Table 3-17. In summary, MC Article 8(3+5) is considered covered by existing (IED) EU legislation, and therefore no incremental impacts of the implementation of the Minamata Convention regarding this aspect would be expected.

As regards Article 8 (4), it is noted that BAT/BEP under the MC is to be defined by the COP. This work is already in preparation (through a dedicated expert group), and the developed BAT/BEP are not expected to go beyond BAT as defined in the EU legislation.

Table 3-17 Coverage of source categories listed in Annex D of MC by IE Directive (IED).

Source	Coverage in existing and planned EU legislation
Coal-fired power plants	IED: Combustion Installations > 50 MW (capacity at site level) and smaller installations that are associated with other activities covered by the IED. According to Eureletric (2014), 100% of the coal fired power plants (= electricity generation) in the EU are covered by the IE Directive.
Coal-fired industrial boilers	IED: Combustion Installations > 50 MW (capacity at site level) and smaller installations that are associated with other activities covered by IED. Energy based calculations indicate that about 95% of the coal consumption in combustion plants excluding power-plant and district heating plant takes place in installations with effect > 50 MW and are thus covered by the IED (2010 data). See Appendix 5 for details. Based on this information, the 75% rule is assessed to be met for coal-fired industrial boilers.
Smelting and roasting	IED: Production of non-ferrous crude metals from ore, concentrates or secondary raw materials by metallurgical, chemical or electrolytic processes. Melting, including the alloyage, of non-ferrous metals, including

Source	Coverage in existing and planned EU legislation
processes	recovered products and operation of non-ferrous metal foundries, with a melting capacity exceeding 4 tonnes per day for lead and cadmium or 20 tonnes per day for all other metals. Eurometaux (2014), the European Association of Metals, which is the industry organisation covering non-ferrous metal smelters, state they do not have precise data on the fraction of EU based Zn, Cu, Pb and Au smelters/extraction plants covered by the IED, but they assume that 100% are covered. Based on this information, the sector is assumed to meet the MC 75% rule.
Waste incineration facilities	IED: All plants are covered by IED Chapter IV. Most plants are also covered by IED Chapter II (waste incineration or co-incineration plants for non-hazardous waste with a capacity exceeding 3 tonnes per hour and for hazardous waste with a capacity exceeding 10 tonnes per day). CEWEP (2014) states that 98% of the facilities incinerating mixed municipal solid waste and similar commercial and industrial waste are covered by the IE Directive requirements, and the sector is thus deemed to meet the MC 75% rule.
Cement clinker production facilities	IED: Production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or in other kilns with a production capacity exceeding 50 tonnes per day. CEMBUREAU (2014) has carried out a survey of its members for this study to obtain an estimate of the maximum percentage of production activity that might be taking place outside the scope of the IED. The survey showed that across the EU, the majority of the existing kilns below the threshold of the IED are covered by the IED as they are part of multiple-kiln installations. There were only seven stand-alone kilns under 500 tonnes/day identified that are not linked to an IED -regulated cement kiln. They are very limited in capacity and would represent less than 1% of the EU28 cement production, according to CEMBUREAU, and the sector is thus deemed to meet the MC 75% rule.

3.9 MC Article 11(3): Mercury waste

3.9.1 Problem definition and specific objectives

Article 11 MC obliges Parties to “take measures” so that mercury waste is managed in an environmentally sound manner according to the Basel Convention guidelines and future guidelines which will be added to the MC. The concept of “waste” follows here the concept of the Basel Convention, the definition of “*mercury waste*” integrates presence of mercury or mercury compounds above thresholds to be determined by the COP under MC itself. Mercury waste may only be recovered, recycled, reclaimed, or directly used for an allowed use under the MC. Parties to the MC that are also Parties to the Basel Convention (which is the case for the EU) are not permitted to transport waste across international boundaries, except for environmentally sound disposal (including recycling).

The gap analysis showed that existing EU legislation covers large parts of these MC requirements, though some parts could not yet be determined as they are subject to future thresholds to be established under the MC. As regards Article 11 (3b), reuse/recovery/recycling of mercury from other mercury wastes than those addressed in Article 2 of Regulation (EC) 1102/2008 are not explicitly covered by EU law.

The following options relating to this article of the Minamata Convention are assessed in detail here:

- Ensuring that reclaimed/recycled mercury is only used for allowed uses under the MC, or for environmentally sound disposal as defined under the MC (MI scenario); and

- Ensuring that waste not currently covered by Reg. 1102/2008 is covered by EU law such that all mercury waste would need to be environmentally soundly deposited (BMC scenario).

The main sources of generation of mercury waste can be allocated to two categories:

(1) Those wastes which are considered as waste according to Article 2 of Regulation 1102/2008:

- metallic mercury that is no longer used in the chlor-alkali industry;
- metallic mercury gained from the cleaning of natural gas;
- metallic mercury gained from non-ferrous mining and smelting operations; and
- metallic mercury extracted from cinnabar ore in the EU.

(2) Other wastes generated from specific applications in the following products and processes (see COWI and Concorde East/West (2008)):

- dental waste;
- mercury waste from other miscellaneous uses such as porosimetry and pycnometry, calibration of mercury monitors, etc.;
- waste from light sources such as fluorescent lamps including CFLs, and specialised discharge lamps;
- waste of older mercury button-cell batteries (until they are out of the society);
- mercury waste from remaining measuring equipment;
- mercury waste from switches and relays; and
- waste from mercury chemicals.

Specific additional information on waste pertaining to category (2) is compiled in Appendix 6.

Metallic mercury from sources covered by Regulation (EC) No 1102/2008 is to be treated as waste and deposited, and cannot be reclaimed and reused within the EU.

The mercury in wastes listed under category (2) is, in principle, available to be reclaimed/recycled for uses allowed under the MC. The MI option would allow this. The recyclable mercury content of such wastes contributes to mercury supply in the EU. The BMC option would, in addition, make the wastes listed under category (2) above unavailable for recycling and re-marketing of the contained mercury. As a consequence, remarketing of recycled mercury from waste would in effect be impossible. The corresponding mercury wastes would have to be disposed of (any mercury-free components of such waste could still be recycled).

3.9.2 Baseline conditions

In the EU, waste fractions containing elevated mercury levels (above 0.1%) are categorized as hazardous waste needing special collection and treatment. Until recently, recycling has been the preferred option for mercury waste, but as the demand for mercury for intentional use has decreased in developed countries, environmentally safe final deposition has become a high priority (COWI, 2014).

The baseline supply of mercury waste is determined by the scale of supply, consumption and trade of mercury (see Section 3.3.2, especially Table 3-1 and Table 3-2).

Mercury-containing waste is also generated by processes that do not involve intentional mercury use since mercury is present at trace level in some materials and can be concentrated by processes and appear in outputs (e.g. solid wastes) at higher levels. Most of the mercury practically extractable from such waste may no longer be recycled (by-product mercury from non-ferrous metal and natural gas extraction) and is therefore not dealt with further in this section.

According to the COWI and Concorde East/West (2008) data, out of a total mercury quantity of about 285 t/y, approximately 67 t/y was recovered in recycling facilities in 2007 (23.4%). The remaining mercury, around 219 t/y, was disposed of by other means. The total mercury supply from recycling waste generated in the EU in 2007 (excluding mercury waste from chlor-alkali production) was about 100 t/y. This is roughly in line with information from “Hazardous Waste Europe” that currently there are 5 facilities in the EU recycling mercury from waste producing in total between 50 and 120 t/y of refined mercury[40]. As no better data on production of mercury from waste is available, a quantity of 100 t/y is used for the assessments in the present study.

As a consequence of the BMC option, waste currently supplying about 100 t/y of mercury would have to be disposed of instead of being recycled.

[40] Personal communication from Hazardous Waste Europe, 5.8.2014

The costs for disposal will increase if specific treatment such as stabilisation / solidification is required and/or specific requirements for disposal are necessary. The quantity to be disposed of depends on the concentration of mercury in waste and any pre-treatment needed prior to disposal since the treatment processes may increase the quantity and volume of the waste to be disposed of.

There are no data from which quantities and volumes of waste containing mercury can be directly estimated (additional information on waste with low to moderate and with high concentration of mercury is contained in Appendix 6.

The current EU supply of mercury is estimated at around 200 t/y. The changes in supply will among other depend on the selection of policies for control of trade in mercury. A general import ban (BMC option) would significantly reduce supply by around 100 t/y.

Analysis performed in this study suggests demand will fall to between 40 and 220 t/y by 2025-2030 for uses allowed under the Convention. If demand exceeds the supply available from EU sources, the deficit will be met by imports from the global market (see Section 3.3.3). Under a business as usual scenario, global mercury availability for supply is expected to exceed demand in the time span from 2010 to 2050 (COWI (2012; citing UNEP 2011a). Unless restricted, sufficient mercury should therefore be available.

3.9.3 Impact assessment

The stakeholders affected and the impact relevance are summarised in the following table.

Table 3-18 Stakeholders affected by options in question and impacts in summary.

Options assessed	Stakeholders affected	Impacts
Ensuring that recycled Hg may only be sold for uses allowed under the MC (MI scenario)	Industry	Waste owners will incur costs for disposal of mercury-containing waste. The costs depend on the selected disposal option. Permanent underground disposal of metallic mercury is considered the most economic environmentally sound disposal option.
	Recyclers in the EU	Costs (distributional effects only) of foregone profits for recyclers. These are however expected to be only moderately affected by this provision as the mercury consumption in the EU will be only moderately reduced due to the MC's "allowed uses" provisions. This is because mercury use is heavily restricted already in the EU and because major mercury sources are already considered as waste according to Article 2 of Regulation (EC) No 1102/2008 including among other metallic mercury from the chlor-alkali industry. Corresponding job losses are possible. Benefits (distributional effect only): Some recyclers are developing services in the stabilisation and final disposal of mercury waste. This activity is expected to grow. Corresponding job gains are possible. Administrative burden for documenting that mercury is only sold for allowed uses. These are expected to be minimal as recyclers are already registering customer names in their accounts. If a permission system for mercury is required this would impose higher administration burdens.
	Importers of mercury	Benefits (distributional only): Depending on how mercury demand changes, any reduction in supply from recycling would need to be compensated for by imports. This would lead to corresponding increases of revenues for importers of mercury. Corresponding job gains are possible.
	Waste disposal companies	Benefits (distributional effects only): Some waste disposal companies are developing business in stabilisation and final disposal of mercury waste and this activity will grow. Corresponding job gains are possible.
	Global and EU population and environment	Benefits of reduced mercury releases from recycling and the life cycle of otherwise re-marketed mercury.

Options assessed	Stakeholders affected	Impacts
	Competent authorities	Administrative input for ensuring that mercury is only sold/bought for allowed uses (normal compliance control activities conducted in MS). Should an actual permission system for mercury be desired, this would impose higher administration costs.
Requiring environmentally sound disposal of all mercury waste (BMC scenario)	Industry	Potential for higher costs if mercury prices rise due to lower supply. though that effect may be neutralised by increases in imports.
		Costs of mercury substitution. Industry may have to bear additional costs of mercury substitution if mercury supply is insufficient.
	Recyclers in the EU	Costs of foregone profits from recycling (distributional effect only). Corresponding job losses are possible. Benefits: Some recyclers are developing business in stabilisation and final disposal of mercury waste and this activity will grow (distributional effect). Corresponding job gains are possible.
	Waste disposal companies	Benefits: Some waste disposal companies are developing business in stabilisation and final disposal of mercury waste and this activity will grow (distributional effect). Corresponding job gains are possible.
	Global and EU population and environment	Benefits of reduced mercury releases from recycling and the whole lifecycle of otherwise re-marketed mercury.

3.9.3.1 Technical considerations

If environmentally sound disposal of all mercury waste was required (BMC option), future demand would have to be met by mercury imports alone. The supply from recycling of mercury from waste from within the EU, amounting to approximately 100 t/y, would have to be disposed of in an environmentally sound manner.

If recycled mercury is only used for uses allowed under the MC, or for environmentally sound disposal as defined under the MC (MI option), future demand can be supplied from EU internal recycling and from imports. This will allow more flexibility to ensure future EU supply.

If imports for allowed uses are banned (import BMC option) and environmentally sound disposal of all mercury waste is required (waste BMC option) there will be no relevant remaining source to provide supply for EU demand, and EU demand would thus have to be substituted for, or otherwise reduced.

The following figure illustrates the flows of waste related mercury, and metal mercury, for the EU concerning the BMC and the MI Scenario.

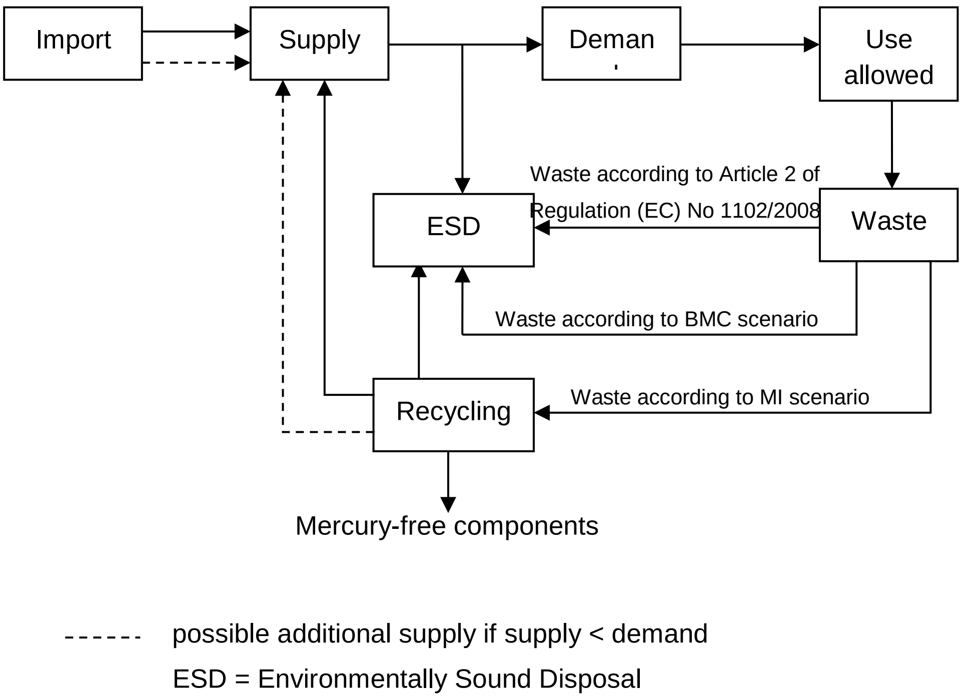

Figure 3-3 Illustration of the flows of waste related mercury, and metal mercury, for the EU concerning the beyond MC and the MI Scenario.

Additional background data on mercury waste, disposal costs and recycling potential are given in Appendix 6.

3.9.3.2 Economic impacts

Provided that the EU recyclers' mercury prices are competitive (or an import ban is imposed), the demand for recycled mercury in the EU is unlikely to be significantly affected by the restriction to uses allowed under the Convention, neither in the period between EU implementation of the Convention and the phase-out dates of allowed uses, nor after these phase-out dates. In the worst case (considering competitiveness), the mercury supply from recyclers could fall by some 60 t/y[41].

Under the assumptions discussed in Section 3.3, the potential loss of revenue from foregone sales of recycled mercury after phase-out dates of the allowed uses would be in the order of 0-5 million EUR/y (for potential reductions of supply from recyclers in the range of 0-60 t Hg/y). Depending on the demand, mercury sufficient to compensate for the supply reduction would need to be imported, resulting in a corresponding increase in revenues at importers of mercury.

[41] If demand is at its expected maximum in 2025/2030 (220 t Hg/y; see Table 3-2), both recycling and import will supply Hg (if not restricted). If demand is at its minimum (40 t Hg/y), and recycling can compete with importers, the supply from recyclers will fall about (100 t – 40 t =) 60 t Hg/y. Some of the projected Hg use is in the form of compounds, and it is assumed that Hg compounds can still be produced in the EU from EU-supplied metal Hg.

The waste associated with 0 to 60 t mercury per year would instead have to be disposed of in an environmentally sound manner. Assuming that most of it would be disposed of as high concentration mercury waste, the costs for 0 – 60 t/y would range from 0 to 0.1 million EUR/y for underground disposal as metallic mercury and from 0 to 0.3 million EUR/y for underground disposal as stabilised mercury waste. These will be costs for waste owners and revenue for waste treatment/disposal facilities (a distributional effect).

There is no information available on quantities of low concentration mercury waste but the following hypothetical example serves as an illustration. If the 0 to 60 tonnes of mercury were disposed of as a low concentration mercury waste (up to 6,000 tonnes) containing 1% of mercury, the disposal costs would range between 0 and 1.6 million EUR/y. For a waste quantity of up to 60,000 tonnes, at a mercury concentration of 0.1% (hazardous waste threshold), these costs would be ten times as high (0-16 million EUR/y).

If recycling is restricted to allowed uses, recyclers and authorities will incur some administrative burdens for documenting and controlling that mercury is only sold for allowed uses. These costs are expected to be minimal. Recyclers are already registering customer names in their accounts. An actual permission system for mercury would impose higher administration costs. By way of example, in Denmark a “poison permit” is already required for purchase of mercury for most uses, and this may be the case in other MS as well.

If the BMC option is implemented, 2-7.8 million EUR/y in revenues would be lost from foregone sales of recycled mercury (equivalent to current supply from recycling around 100 t/y), under the assumptions made in Section 3.3.

The fall in mercury supply (reduction from around 200 t/y to around 100 t/y) may result in higher mercury prices for industry although if imports increase to compensate, then price effects would be moderated.

Industry may have to bear additional costs of mercury substitution if mercury supplies become scarce for uses allowed under the MC, if (for instance) insufficient mercury is available from imports. This is considered unlikely given the flexibility of the mercury market. If imports were also restricted, additional cuts in EU mercury demand would be necessary; principally for the two major remaining mercury uses - dental amalgam (where substitutes are available, but at a higher price) and analysis techniques (porosimetry). Porosimetry can technically be substituted for most uses, but development and implementation of new analysis standards would be required, implying additional costs.

If environmentally sound disposal of all mercury waste was required, waste containing 100 t mercury per year would need to be disposed of in an appropriate manner. Assuming that most would be disposed of as high concentration mercury waste, the disposal costs are considered comparatively low. They would range from 0.09 to 0.2 million EUR/y for underground disposal as metallic mercury and from 0.2 to 0.5 million EUR/y for underground disposal as stabilised mercury waste. These will be costs for waste owners but revenue for waste treatment/disposal facilities (distributional effects).

If the 100 tonnes of mercury was disposed of as a low concentration mercury waste containing 1% of mercury, the disposal costs would range between 0.6 and 2.6 million EUR/y. At a mercury concentration of 0.1% (hazardous waste threshold) these costs would be ten times as high (6-26 million EUR/y). As actual concentrations are not known, the overall cost estimate is 1-26 million EUR/y.

3.9.3.3 Social impacts

A decrease in mercury recycling is expected to be partly counterbalanced by increased business in final disposal activities in the same sector. The MI option is therefore not expected to result in major changes in the number of people employed in the waste handling business. The BMC option may result in a moderate loss of jobs in the recycling business due to the lower revenue generated from disposal vs. sale of recycled mercury. Job losses at recyclers may be balanced partly by job gains at importers.

3.9.3.4 Environmental impacts

The MI option, which limits recycling to allowed uses, would potentially result in reduced mercury releases from EU-based mercury recycling, and also in the long run in reduced mercury circulation in society in the EU, if global mercury supply decreases and pushes industry towards substitution of mercury.

In the global context, there is a moderate potential for reduced mercury circulation and thereby for reduced releases in the life-cycle of mercury. These effects are dependent on the developments in the general global supply situation for mercury.

The BMC option would eliminate mercury releases from mercury recycling in the EU and would have a greater potential for reducing the mercury circulation in the global context. It might also have a stronger signal value to other potential Parties to the Minamata Convention and thereby a potential for additional release reductions in the mercury life-cycle. Again however, these effects are dependent on the developments in the general global supply situation for mercury.

Releases

The E-PRTR data base was checked, but no aggregated relevant data for mercury releases from mercury recycling were identified.

Mercury input to society

Mercury input (re-introduction) to society with marketed recycled mercury could be reduced with 0-60 t Hg/y under the MI scenario and 100 t Hg/y under the BMC scenario.

Making all mercury waste subject to final disposal, and thereby severely restricting mercury re-marketing from recycling in the EU would force final environmentally sound disposal of a higher amount of mercury, thus emptying accumulated mercury stocks. Other potential benefits (triggered by higher mercury prices) include:

- Stimulating substitution further in dental amalgam use

- Stimulating development and implementation of mercury alternatives in porosimetry (material analysis technique)

- Making less mercury available on the global mercury market with increasing mercury prices and slightly reduced mercury demand and associated releases in the global context as a result.

A severe restriction (BMC) could have the negative effect of reducing the incentives for separate collection and handling of mercury containing waste in the EU, because the income from selling the recycled mercury would be eliminated.

3.9.4 Conclusions

Both the MI option (which ensures that reclaimed/recycled mercury is only used for allowed uses under the MC or for environmentally sound disposal as defined under the MC) and the BMC option (meaning that environmentally sound disposal of all mercury waste would be required) can contribute to positive environmental and health impacts by reducing mercury releases in the life cycle of mercury. The BMC option would have higher positive environmental impact. However the effects of both options are dependent on the developments in the general global supply situation for mercury, and the additional benefit from the BMC option is difficult to assess.

Recyclers would incur losses of revenue of 0-5 million EUR/y (MI) or 2-7.8 million EUR/y (BMC). Compensating growth in mercury imports would be expected to meet demand, leading to increased revenues at mercury importers, rendering it a distributional effect only.

Additional costs for final environmentally sound disposal of waste with mercury of types which would otherwise be recycled cannot be quantified precisely; rough estimates are 0-16 million EUR/y under the MI scenario, and 1-26 million EUR/y under the BMC scenario). These will be costs for waste owners and revenues for waste treatment/disposal facilities.

In the MI scenario, certain administrative burdens will be incurred by recyclers and authorities for documenting and controlling that mercury is only sold for allowed uses. The corresponding incremental effort at recyclers and competent authorities is expected to be minimal.

As a decrease in mercury recycling is expected to be partly counterbalanced by increased business in final disposal activities, the MI option is not expected to result in major changes in the number of people employed in the waste handling business, while the BMC option may result in a moderate loss of jobs due to the lower revenue generated from disposal vs. sale of recycled mercury. Also, making all mercury waste subject to environmentally sound disposal, thus severely restricting recycling (BMC) could have the negative effect of reducing the incentives for separate collection and handling of mercury containing waste, because the income from selling the recycled mercury would be eliminated.

The impacts of implementing the MI or the BMC option are influenced by the decision taken on a mercury import ban. If imports for allowed uses are banned and environmentally sound disposal of all mercury waste will be required there will be no remaining mercury source to service EU demand. Therefore, it is suggested that if a general import ban is implemented, recycling should likely be restricted as described in the MI option. This would allow future demand to be supplied from EU internal recycling.

On the other hand, severely restricting mercury recycling in the EU would force final environmentally sound disposal of a larger quantity of mercury, thus reducing accumulated mercury stocks, having the added benefits of stimulating substitution, while at the same time drawing mercury from the global market. This could lead to increases in prices and reduced demand and releases outside the EU (though changes may be minor due to the EU's modest projected mercury demand). Requiring environmentally sound disposal of all mercury waste could thus have slightly higher environmental benefits in the global context than a total import ban.

3.10 Final disposal of metallic mercury

This section summarises two recent studies of the impacts of underground disposal of metallic mercury: (i) in elemental liquid mercury form; and (ii) when stabilised prior to disposal, and thus supplements the information given in Section 3.9. For other aspects of the mercury waste issue, see that section.

3.10.1 Technical considerations

BiPRO (2010) evaluated four options for the final disposal of metallic mercury. It concluded that three out of the four options can be recommended for environmentally sound final disposal of metallic mercury:

- Pre-treatment (sulphur stabilisation) of metallic mercury and subsequent permanent disposal in salt mines (highest level of environmental protection, acceptable costs).
- Pre-treatment (sulphur stabilisation) of metallic mercury and subsequent permanent disposal in a hard rock underground formation (high level of environmental protection, acceptable costs).
- Permanent disposal of metallic mercury in salt mines (high level of environmental protection, most cost effective option).

The recommended options are all underground disposal options of stabilised or liquid mercury. Above-ground disposal was not recommended.

The environmental assessment identified uncertainty relating to the underground disposal of liquid mercury in salt rock formations. The storage of liquid mercury in salt rock is generally seen as a safe storage option providing the waste mercury is safely encapsulated. However, it was stated that (1) "... compared to the disposal of stabilised mercury lower safety margins apply in case of an unforeseen severe incident like flooding of the salt mine – due to the significantly higher solubility of metallic mercury in water compared to stabilised mercury." and (2) "...little is known about the long-term behaviour of liquid mercury in the salt rock formation." (BiPRO, 2010).

Disposal options involving stabilisation of metallic mercury prior to final disposal are associated with reduced risks of mercury releases due in particular to the low solubility of the stabilised waste (see BiPRO, 2011). Against this background the question arises of whether metallic mercury should be stabilised prior to final disposal.

Hageman et al. (2014) investigated the risks for operational and long-term safety of underground storages of metallic mercury on behalf of the German EPA. Measures were derived to reduce the risks to an acceptable level. A similar analysis was undertaken for mercury sulphide, which results from most procedures for the stabilisation of metallic mercury. Relevant risks and measures derived are described in the study report (see Hagemann et al., 2014).

The study concluded that, "...neither elemental mercury nor mercury sulphide exhibit properties that threaten the long-term safety of an underground landfill" (see Hagemann et al., 2014).

Considering an unforeseen severe incident, like flooding of the final disposal site in salt rock, Hagemann et al. (2014) concluded, "In the hypothetical event of a failure of the technical barriers, from a geochemical perspective, both elemental mercury and mercury sulphide are suitable for deposition in salt mines. In the hypothetical event of a solution inflow, the low solubility of elemental mercury and mercury sulphide acts as an internal barrier."

BiPRO (2010) did not recommend final disposal of mercury in above ground disposal sites because of possible releases of mercury to the environment. Hagemann et al. (2014) confirmed this assessment. They expect that the surface sealing of above ground facilities will be permeable to air in the long term. Mercury sulphide can then come into contact with atmospheric oxygen and become oxidised to elemental mercury and sulphate. The formation of methylmercury may occur under suitable geochemical conditions. A landfill with mercury sulphide would inevitably become a local source of mercury emissions. Both elemental mercury as well as methylmercury can leave the landfill via off-gassing (landfill gas). Hagemann et al. (2014) conclude that the deposit of mercury sulphide as well as of other high-concentration mercury waste should be prohibited in above-ground landfills. Further technical details can be found in the corresponding studies BiPRO (2010) and Hagemann et al. (2014).

Concerning final above ground disposal, Spain's contributions under the current study should be taken into consideration. In Spain's reply to the questionnaire, a technology for the environmental sound disposal of low concentration wastes is described (stabilization and solidification technology to treat mercury-contaminated soil and waste with sulphur micro-cements). According to the information provided, the technology is applicable and has been already tested in soils and wastes with low mercury contamination levels (Hg ≤ 2% by weight). In its stakeholder contribution, Spain specifies that the leaching behaviour of final products of a stabilisation process of mercury in a polymeric sulphur matrix via mercury sulphide was tested in both monolithic and crushed samples using the EU standard (CEN/TS 14405:2004 and UNE-EN-12457) and the US EPA Toxicity Characteristic Leaching Procedure (TCLP), Method 1311. The leaching values lead to concentrations well below 0.01 mg/kg. Thus, the products meet the EU acceptance criteria for landfills for inert wastes (<0.01 mg/kg, as per Decision 2003/33/EC). Spain has provided specific information on mercury stabilization and solidification technologies and specific information on two technologies used in Spain (sulphur polymer stabilization/solidification (SPSS) and stabilization and solidification with sulphur microcements). Reference is made to López et al. (2010) and López-Delgado et al. (2012).[42]. However, a long term assessment of possible risks of above ground landfilling should be considered, according to Spain.

BiPRO (2010) describes waste acceptance criteria and facility related requirements for the temporary and permanent storage of mercury specifying requirements on:

- Composition of the mercury
- Containments
- Acceptance procedures
- Certificates
- Record keeping
- Facility related requirements
- Monitoring inspection and emergency

Many of these requirements have been taken over in Directive 2011/97/EU amending Directive 1999/31/EC as regards specific criteria for the storage of metallic mercury considered as waste. However, at that time additional assessments of the long-term behaviour of metallic mercury in underground storage were not available for the determination of sound and knowledge-based requirements for permanent storage. The requirements laid down in Directive 2011/97/EU are therefore limited to temporary storage and are considered as appropriate and representing the best available techniques for the safe storage of metallic mercury for a time span of up to 5 years (see recital 10 of Directive 2011/97/EU).

Hagemann et al. (2014) investigated the risks for operational and long-term safety of underground storage that result from the specific properties of metallic mercury and for mercury sulphide, which results from most procedures for the stabilisation of metallic mercury. On this basis, measures were derived, which may help to reduce the risks to an acceptable level. Measures are related to the operation of an underground storage (1) for metallic mercury (such as specific criteria for the mercury to be disposed of, transport and storage containers, storage areas and conditions) as well as (2) for mercury sulphide (compared to metallic mercury, fewer additional measures are required). Hagemann et al. (2014) propose the following requirements:

[42] See stakeholder contribution Spain 31.7.2014 (available at http://ec.europa.eu/environment/chemicals/mercury/ratification_en.htm)

Table 3-19 Recommended additional requirements for the permanent storage of metallic mercury and mercury sulphide (from Hagemann et al., 2014).

Process / Event	**Recommended requirement for the permanent storage of metallic mercury**	**Recommended requirement for the permanent storage of mercury sulphide**
Certification / Labelling	Permanent labelling of inner and outer containers, certificate of producers, amount, and test results similar to Directive 2011/97EU, additional test result of the independent expert.	Permanent labelling of inner and outer containers, certificate of producers, amount, and test results similar to Directive 2011/97EU.
Acceptance control	Advanced acceptance control (purity, identity) by an independent expert and an accredited testing laboratory. No open handling of mercury in the underground storage.	-
Container corrosion	Minimum purity of mercury 99.9% by weight, absence of aqueous, oily, or solid phases. Containers should be corrosion-proof with respect to storage conditions.	-
Underground mechanical impact	Use of containers from which no mercury leaks during mechanical impacts (impact, crash) which cannot technically be excluded. For multi-walled containers: increase in geo-mechanical stability due to pressure-resistant elements, e.g. concrete.	For multi-walled containers: avoidance of cavities to increase geo-mechanical stability.
Thermal impact	Use of containers from which no mercury leaks during mechanical and subsequent thermal impacts (vehicle fire) which cannot technically be excluded. Example: multiple-walled containers with thermal insulation.	Use of containers from which no mercury leaks during mechanical and subsequent thermal impacts which cannot technically be excluded. Example: multiple-walled containers with thermal insulation.
Storage area	Facility separate from storage areas for other types of waste Storage in stages Immediate backfilling and closure Lower floor level.	Facility separate from storage areas for other types of waste Storage in stages Immediate backfilling and closure.
Occupational safety	Multiple daily concentration measurement in open storage sections in which work is being done Visual inspection of open storage sections at least once a month Providing personal protective equipment.	Providing personal protective equipment.
Fire protection	Minimising fire loads and ignition sources in the storage area. Avoiding oncoming traffic and overtaking on transport routes. Setting a maximum speed and avoiding above-ground and underground interim storage Storage area can be separated from the remaining mine operation by ventilation structures.	Minimising fire loads and ignition sources in the storage area. Avoiding oncoming traffic and overtaking on transport routes. Setting a maximum speed. Storage area can be separated from the remaining mine operation by ventilation structures.
Emergency planning	Preparation of plans and measures for the event that a release of mercury has occurred (e.g. leakage or fire).	Preparation of plans and measures for the event that a release of mercury has occurred (e.g. fire).
Emergency planning	Preparation of plans and measures for the event that a release of mercury has occurred (e.g. leakage or fire).	Preparation of plans and measures for the event that a release of mercury has occurred (e.g. fire).

These requirements could be taken into consideration in any supplement to or adjustment of the criteria for the storage of metallic mercury as laid down in Directive 2011/97/EU in order to target permanent disposal of metallic mercury.

A submission received from Hazardous Waste Europe (HWE), a representative body for operators of hazardous waste treatment installations, voiced doubts that the conclusions on above ground landfill of Hagemann et al. 2014 are correct because of the assumptions concerning the engineering and operational conditions of dedicated landfills for stabilised mercury containing waste. HWE deems solidification / stabilisation necessary for any type of disposal (above or underground) in dedicated cells/areas for the storage with specific monitoring requirements[43].

3.10.2 Economic impacts

BiPRO (2010) provides an economic assessment of (among other) final disposal options. A summary of the findings is provided for the following disposal options:

1. Permanent storage of liquid mercury in salt mines
2. Pre-treatment (stabilisation) + permanent storage of stabilised mercury in salt mines
3. Pre-treatment (stabilisation) + permanent storage of stabilised mercury in deep underground hard rock formations
4. Pre-treatment (stabilisation) + permanent storage of stabilised mercury in above ground facilities

The following costs have been estimated and evaluated:

- Permanent storage costs (incl. engineering and construction costs if necessary)
- Costs of a temporary storage of metallic mercury
- Costs for maintaining, monitoring and inspection of the permanent storage site before its final closure (time period depends on the expected closure time of the storage site)
- Transportation costs
- Capital costs for the pre-treatment facility
- Operating and maintenance costs for the pre-treatment process

[43] Stakeholder Contribution Hazardous Waste Europe 28.7.2014 (available at http://ec.europa.eu/environment/chemicals/mercury/)

The assessment is based on information available. For several parameters only estimates are available as no specific quantification is available.

Each option is more cost intensive when it involves pre-treatment, as additional handling, processing and transports is required. Storage costs charged for the disposal in salt mines are 260-900 EUR per tonne. Storage costs at hard rock formations are in general low but highly depend on the necessary engineering and construction measures which have to be implemented for the specific waste and/or location.

Specific containers are only required for the storage of metallic mercury. Costs for these containers are 600-1,100 EUR per tonne of metallic mercury. For stabilised products bags or drums are used which are significantly cheaper (~ 10 EUR/t).

Transport costs are in particular relevant for options including pre-treatment and subsequent permanent storage. Transport costs are estimated to amount to approximately 140 EUR/t metallic mercury.

The number of available storage sites only plays a minor role in case of metallic mercury. The main producers of metallic mercury waste (chlor-alkali plants) are spread around Europe. The existence of several storage options for metallic mercury would not significantly reduce the costs but would require additional costs for the preparation of storage sites for a relatively low volume of waste (due to the high density of mercury).

With pre-treatment (stabilisation) the costs will increase significantly as additional transport (from the pre-treatment site to the final disposal site) is necessary. The pre-treatment results in a product with higher volume and higher total weight than metallic mercury. For the sulphur stabilisation, an elevation of the weight (at least 16%) and volume (up to 500%) has to be considered. As a consequence transport costs significantly increase. Therefore it is advantageous to have short distances from the pre-treatment site to the storage site. As for pre-treated products different types of disposal sites (salt rock, hard rock) are possible, the transport costs might be reduced by selecting the nearest appropriate disposal site.

Specific cost estimates are available for the sulphur stabilisation process. Pre-treatment including transport costs and final disposal is around 2,000 EUR/t metallic mercury. These costs also include the capital costs and the operational costs for the plant. Only one company offered this price (in 2010). The German facility previously owned by DELA was not in operation for a period[44]. The facility has been taken over by another company and is again operational. All other technologies seemed to be more expensive. However, COWI (2012) gave examples of similar price levels for other comparable waste types.

Costs for inspections, monitoring and surveillance are considered comparatively low.

[44] Comment Germany 29.8.2014

Hagemann et al. (2014) do not provide additional relevant information for the economic assessment. Against this background the above listed options are evaluated as follows:

Option (1): Permanent storage of liquid mercury in salt mines

This option is considered to be the most economic disposal solution. Storage costs range between 300 and 900 EUR/t metallic mercury plus the costs for the container with around 600 – 1,100 EUR/t metallic mercury. The transport costs are relatively low as only one transport from the waste generator to the salt mines is required. The total cost thus range between 900 and 2,000 EUR/t metallic mercury.

Option (2): Stabilisation and permanent storage in salt rock

The pre-treatment process is the most cost intensive part of this option. The costs for the stabilisation, the transport to the disposal site and the final disposal costs are at least 2,000 EUR/t metallic mercury. No specific container is required. The stabilized product can be disposed in relatively cheap big bags or drums.

Storage costs increase significantly due to the increased amount of waste which has to be stored. Storage costs are typically charged per tonne of waste. Each stabilisation process results in higher volume as well as increased total weight compared to metallic mercury.

The transport costs are higher compared to option (1) as additional transports are required. The transport costs from the pre-treatment site to the final disposal site depend on the distance and the number of available storage sites.

Option (3): Stabilisation and permanent storage in hard rock

The economics of option (3) are very similar to option (2). The disposal costs of pre-treated mercury in hard rock or salt rock formations are relatively low compared to the other costs. No information was available on the number of sites fulfilling the requirements for the storage of stabilised mercury in hard rock formations.

Ranking

In conclusion, option (1) is considered the most economic option. Options (2) and (3) have similar costs which are higher compared to option (1).

3.10.3 Environmental impacts

BiPRO 2010 also contains an environmental assessment of the four options listed above. The following aspects have been considered in the evaluation:

- Level of protection of the environment in case of permanent storage
  - Protection of the ground water against mercury
  - Protection of the biosphere
- Hg-emissions during storage and handling
- CO_2 emissions resulting from transport
- Energy consumption
- Reversibility (in case of temporary and permanent storage)

- Safety of workers
- Removal of mercury from the biosphere
- Prevention against natural events
- Monitoring possibility
- Possibility of corrective actions with or without incidents
- Safety margins in case of incidents

The level of protection of the environment and human health is the most important criterion of the environmental assessment. Independently of which type of waste is stored - metallic or stabilised - the release of mercury or mercury compounds into the environment should be prevented as far as possible.

Underground storage sites provide generally a higher level of protection of the environment against mercury releases compared to above ground storage sites. Each underground storage facility needs a site specific risk assessment which provides the long term safety of the stored waste in the facility.

Mercury emissions might occur during the transport, handling but also storage of the metallic mercury. It is obvious that the number of handling processes will increase the probability of mercury emissions/releases. Therefore single permanent storage solutions were considered environmentally more favourable concerning possible mercury releases than options including pre-treatment.

Transportation generates CO_2 emissions so options requiring several transport moves are assessed as less environmentally favourable than options with only one. Options for which there are several storage sites distributed around Europe are seen as more beneficial (with respect to transport-related CO_2 emissions) due to the shorter distances involved. The risk of mercury emissions during the transport of stabilised products is considered negligible.

The transportation of metallic mercury is subject to the regulations applying to movement of hazardous wastes. The risk of an incident is considered very low but in case it happens the consequences for the environment are considered significantly higher than those of transport of stabilised mercury.

Little energy is consumed in permanent storage without prior treatment. Energy consumption is a more relevant concern for options with pre-treatment processes. Stabilisation of the metallic mercury requires energy. The sulphur stabilisation process is slightly exothermic so the energy consumption is moderate. However, energy is required elsewhere in the operation, e.g. to provide vacuum conditions or for mixing.

Only storage in hard rock formations and above ground storage would allow the retrieval of the permanently stored waste. Due to the creeping potential of salt rock, the retrieval of permanently stored waste in salt mines is only possible for a certain time period.

Worker safety concerns include possible exposure to mercury and mercury vapour. The probability of an exposure increases with pre-treatment. However, permanent storage in salt mines might also entail risk of exposure to mercury e.g. in case of leaking containment or any other incident.

A permanent storage providing the highest degree of removal of the mercury from the biosphere is environmentally more favourable. Permanent underground storage facilities are constructed and designed in a way to remove the waste from the biosphere.

Permanent above ground storages have the disadvantage that interaction with the environment and emission of the waste to the environment are more likely compared to underground options. Also the consequences of natural catastrophes are considered to have a stronger impact in case of above ground storage compared to underground storage options.

These disadvantages might be compensated by the easier access to the waste in case of any incidents. The monitoring and the possibility of interventions are easier for above ground facilities.

Against this background and in the light of relevant additional information from Hagemann et al. (2014), the above listed options are assessed as follows:

Option (1): Permanent storage of liquid mercury in salt mines

Storage in salt rock is generally seen as a safe storage option. Under the pre-condition that a safe encapsulation of the waste mercury is ensured, a high level of protection of the biosphere is provided.

This evaluation is supported by the conclusions from Hagemann et al. (2014) (see above):

› concerning an unforeseen severe incident like flooding of the final disposal site in salt rock it is stated that even in the hypothetical event of a failure of the technical barriers both elemental mercury and mercury sulphide are suitable for deposition in salt mines.

› concerning the long term safety in salt rock it is stated that neither elemental mercury nor mercury sulphide exhibit properties that threaten the long-term safety of an underground landfill (in salt rock formations).

After the closure of the salt mine, the possibility of corrective actions with or without an incident is low or not given.

Once the facility is closed the retrieval of the waste is very difficult or even not possible without major risks for the whole storage site.

Option (2): Stabilisation and permanent storage in salt rock

The solid pre-treated product should, in a long term, be encapsulated within the salt rock formation. Even in case the pre-treated product gets in contact with water due to unforeseeable circumstances, the low solubility of the product keeps the environmental pollution limited, and releases are distributed over a very long time period. Due to this, a rapid release of mercury to the environment resulting in acute local contamination can be considered unlikely.

Possible mercury emissions during handling, stabilisation and transport have to be taken into consideration. Further transportation is required to bring the stabilised product to the storage site. From an environmental point of view the increased CO_2 emissions from the transport are negligible compared to the higher protection level of the environment. Mercury emissions during the stabilisation processes are highly dependent on the established emission control measures. Applying state-of-the art equipment significantly reduces mercury emissions during the handling and stabilisation process.

BiPRO (2010) considered option (2) to be the most beneficial solution from an environmental point of view. In the light of the new information provided by Hagemann et al. (2014) option (1) is now considered equally beneficial for the environment or even slightly more beneficial due to possibly lower mercury emissions (less handling), reduced transport costs and less energy demand.

Option (3): Stabilisation and permanent storage in hard rock

Underground hard rock formation storage facilities are seen as a safe storage option by applying adequate multi-barrier systems. A total encapsulation of the waste is not possible as it is the case in salt rock formations and which is an additional environmental safety factor.

Option (3) is comparable to option (2) but in hard rock formations a total encapsulation is not possible and the presence of water cannot be completely excluded. The risk of mercury entering the biosphere via water flows over the long term has been assessed as being slightly higher than for salt mines. Due to these risks the solidification of liquid mercury prior to final disposal in hard rock formations is recommended.

Hard rock formations with stable cavities allow corrective measures over a long time period. For worker safety there are no differences between salt mines and hard rock formations. The stored material can be retrieved, should this be needed.

Option (4) Stabilisation and permanent above ground storage

Permanent above-ground storage of stabilised mercury is considered to be less favourable than the underground storage options. The risk of an interaction with the environment (e.g. penetrating rain water, floods) with a subsequent release of mercury from the storage site is considered to be higher than with underground storage. Although in case of unforeseen incidents potential emissions can be detected and counter measures could be applied, the risk of mercury entering the environment is still very high. Once the protection barrier of the site is destroyed the prospects for stopping mercury from entering the environment are very limited.

This assessment is confirmed by Hagemann et al. (2014) which conclude that the deposit of mercury sulphide and other highly contaminated mercury waste should be prohibited in above-ground landfills because these will become a source of mercury releases in the long term (see above).

The stored material can be retrieved, should this be needed, but the risk of unauthorised retrieval of the stabilised waste is higher compared to underground storage.

Ranking

In conclusion, based on the literature cited, option (1) is considered the environmentally most advantageous option. Options (2) and (3) are slightly less beneficial from an environmental perspective due to the possibility of higher mercury emissions (increased handling required), higher transport efforts and higher energy demand. Option (4) is considered to have significant environmental disadvantages.

3.10.4 Conclusion

Based on the findings of the two authoritative studies reviewed, permanent storage of liquid mercury in salt mines (option (1)) is considered the most favourable option both from an environmental and economic perspective. Stabilisation and permanent storage in salt rock (options (2)) and stabilisation and permanent storage in hard rock (option 3) are considered to be environmentally sound disposal options. Solidification of liquid mercury should be mandatory prior to final disposal in hard rock formations.

3.11 MC Article 13: Financial resources and mechanisms

Article 13 MC commits each Party to allocate resources for implementation of the MC, taking into account national policies, priorities, plans, and programmes. A variety of funding sources are encouraged, including national, multilateral, regional, and bilateral sources. The mechanism shall encourage the provision of resources from other sources, including the private sector, and leverage such resources for the activities it supports. The Convention defines a mechanism for provision of "*adequate, predictable, and timely financial resources"*.

The financial mechanism includes a Global Environment Facility (GEF) trust fund and a "*special international program*" that will provide capacity building and technical assistance. COP guidance to the GEF trust fund includes strategies, policies, priorities, eligibility, and an indicative list of categories of activities that could receive support from the GEF. The international programme will be operated under the guidance of the COP and be accountable to it.

The EU may wish to make contributions to developing country Parties and Parties with economies in transition. As the size of such contributions is subject to political decisions within the EU, they cannot reasonably be estimated in advance.

In this section, we however summarise – for information – an existing assessment of the global need for financial assistance. This aspect was investigated in some detail in a previous study performed by COWI (2012) based on an early draft of the Convention text.

That study considered three different cost elements:

- Financial needs for implementation technical solutions, such as implementation of BAT and substitution of mercury in products and processes.

- National administrative efforts in implementation, including among others: Institutional capacity building, legal framework establishment, monitoring including analytical capacity, awareness raising and training.

- International administration of the Convention: Secretariat, meetings, administration of financial mechanisms, etc.

COWI (2012) assessed – based on limited available data – the global financial needs (excluding North America and the EU) for the key technical solutions at 3-26 billion EUR/y (intermediate estimate: 13 billion EUR/y). For the measures expected to be most costly (those on coal fired power plants, batteries and dental amalgam) this estimate includes options which go beyond what was agreed on in the final Convention text. The actual costs may thus be expected to be in the lower half of the range. The estimate is associated with substantial uncertainty, yet it is deemed the most complete estimate publicly available so far. The Minamata Convention states in (in Article 13.2) that "*the overall effectiveness of implementation of this Convention by developing country Parties will be related to the effective implementation of this article*". While countries may raise national funding for many implementation costs, it must be expected that there will be a significant need for bilateral and international funding of technical solutions related to the implementation of the Convention in developing country Parties and Parties with economy in transition.

For the two other cost elements, COWI (2012) used data from the implementation and administration of the Stockholm Convention. Considering the possible differences (and co-benefits) between the Stockholm Convention and the Minamata Convention, as well as the uncertainties associated with the analysis made, the costs for implementing the Minamata Convention as regards measures relating to institutional capacity building, legal framework establishment, monitoring including analytical capacity, awareness raising and training in developing countries and countries with economies in transition were estimated at around 40-80 million EUR/y. A significant part of this amount is likely to need international funding (that is, primarily from developed country Parties including the EU).

The costs for international administration of the Minamata Convention (the Secretariat, COPs and other meetings, administration of financial mechanisms, etc.) were estimated at 15-30 million EUR/y based on data for the Stockholm Convention.

4 Integrated analysis and comparison of scenarios

In this section the impacts of the minimal implementation (MI) and beyond MC (BMC) scenarios are compared to the business as usual, drawing together the information on the economic, social, environmental and administrative impacts of specific options as described in Section 3. The text focuses on the individual steps in the mercury lifecycle addressed in the Minamata Convention, organised by its articles, and does not go into detail of how the obligations can legally be implemented in EU law. The assessment includes analysis of economic, social and environmental impacts, administrative impacts on competent authorities, and simplification but not transposition or compliance.

The EU may wish to make financial contributions to developing country Parties and Parties with economies in transition for implementation of the Convention. As the size of such contributions is subject to political decisions within the EU, they cannot reasonably be estimated in advance, and they are not included in this section (for indications of the global financial needs, see Section 3.11).

4.1 Legal baseline

The provisions of the Minamata Convention on Mercury are quite similar to the existing EU legislation on mercury, and the overall goals of the Convention are in line with the EU Mercury Strategy. This means that the EU has already realised much of the potential for mercury release reductions that the Convention aims for. Any assessment of the necessary adjustments to EU law to enable EU ratification of the Minamata Convention should be seen in this light.

The performed gap assessment confirmed that most of the Convention provisions are already met or could be met by making minor adjustments to EU law. These adjustments are expected to have minimal impacts. In a few instances, current EU legislation clearly does not meet the obligations of the Minamata Convention. In some instances, there are unresolved questions regarding the degree of coverage of the present EU legislation.

4.2 Impacts of a business as usual scenario

A business as usual scenario would be in conflict with the EU Community Strategy on Mercury and the stated intentions of the EU to ratify the Minamata Convention. It could have the consequence that the mercury exposure within the EU territory would not be reduced, because a significant part of the atmospheric mercury deposition in the EU has origin outside its territories, due to long range atmospheric transport. Additional mercury is transported with ocean currents and rivers to EU waters. The EU is therefore dependent on global cooperation on reducing anthropogenic mercury releases, in order to substantially reduce mercury exposure of humans and the environment in its territories. If the EU did not ratify the Convention it could significantly reduce the chances of the Convention achieving the global mercury release reductions needed, as it may influence others countries' ratification decisions.

4.3 Impacts of a minimal implementation (MI) scenario

4.3.1 Economic impacts

The table below lists the identified economic impacts of a strictly minimal implementation (MI) of the Minamata Convention in the EU, organised by article of the Convention. The table's indications of impacts focus on articles where gaps in the EU legislation were identified in the gap analysis.

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

Total costs of a strictly minimal implementation of the Minamata Convention are estimated at 3-98 million EUR/y. Minor additional costs, not quantified in the assessment, are expected.

In case the EU chooses to provide financial support to the Convention Secretariat or to the financial mechanisms for assistance to developing country Parties and Parties in economic transition, such support should be added to the costs mentioned above. For information on the global financial needs, see Section 3.11.

Table 4-1 Summary of economic impacts of the Minimal Implementation (MI) scenario by (sub) article of the MC (overleaf).

MC article	**Economic impacts by (sub-) article of the MC**
3 Supply and trade	No significant economic impacts (0-0.4 million EUR foregone profits for importers).
4 Products	4 (1): Restriction on export of products: Minor impacts of the MI may be experienced in the manufacture of mercury sphygmomanometers for export. Manufacturers of mercury-filled thermometers in the EU are not expected to suffer significant incremental impacts. 4(3): Dental amalgam: To be considered in separate Commission work. 4(6): Discouragement of new mercury-added products: Impacts are deemed unlikely based on history, especially under a soft interpretation of “discouragement”. Other sub-articles: No significant impacts.
5 Processes	5(3): Existing alcoholates production with a mercury process: Under a soft interpretation (MI scenario), impacts are deemed more moderate than with an outright ban (BMC scenario) as producers would have more time to identify technically and economically feasible alternatives. Under the MI scenario substitution costs could range from research costs only (in case no feasible alternatives were found) up to the same costs for research plus implementation as estimated for the BMC scenario above. Research costs cannot be quantified precisely; but it is expected that a reasonable research activity could be run for 2 million EUR/y. Ergo, the substitution costs under the MI scenario could range between 2 and 76 million EUR/y. The costs of the emission/releases reduction provision of the MC are estimated at 0.6-1.0 million EUR/y similarly to the BMC scenario.
7 ASGM	No significant impacts in the EU perspective.
8 Emissions	8(3+4) and 8(3+5): Based on additional data from the stakeholder consultation process, these provisions are considered already covered by existing EU legislation (IED), and no incremental costs are thus anticipated.
9 Releases	9(4): If the none-action path is chosen, no costs are incurred (but this may send negative signals to other Parties to the MC). Otherwise identification of relevant source categories, and follow up actions for these, could result in significant costs could be needed, but they cannot be assessed at this stage. Other sub-articles: Moderate costs are anticipated.
10 Storage	Moderate costs are anticipated for implementation of interim storage requirements (requirements are not yet defined).
11 Waste	11(3): Procedures that ensure that recycled mercury is only used for purposes allowed under the MC could cause minor loss of revenue for recyclers due to reduced mercury demand (0-5 million EUR) and costs for waste owners (consumers) for final disposal of waste estimated at 0-16 million EUR/y.
	Total quantified costs under a minimal implementation scenario: 3 to 98 million EUR/y.

4.3.2 Social impacts

The table below lists the social impacts of a strictly minimal implementation of the Minamata Convention in the EU. The impact assessment focuses on articles where gaps in the EU legislation were identified.

The assessment of the social impacts focuses here only on the possible employment changes in the affected industries. The employment effects are distribution effects which might be only transitional. The public health effect from reduced exposure to mercury, which is one of the most important benefits of the MC, is described under environmental effects via the indirect indicators of (i) reduced releases of mercury and (ii) reduced input to society of mercury. The latter indicates a risk of releases.

No major social impacts are expected under a minimal implementation scenario.

Table 4-2 Summary of social impacts by (sub-) article of the MC.

MC article	**Social impacts by (sub-) article of the MC**
3 Supply and trade	No significant impacts.
4 Products	4 (1): Restriction on export of products: Minor impacts of the MI may be experienced in the manufacture of mercury sphygmomanometers for export. Manufacturers of mercury-filled thermometers in the EU are not expected to suffer significant incremental impacts under neither the MI nor the BMC scenario. 4(3): Dental amalgam: To be considered in separate Commission work. 4(6): Discouragement of new mercury-added products: Impacts are deemed unlikely based on history, especially under a soft interpretation of "discouragement". Other sub-articles: No significant impacts.
5 Processes	5(3): Existing alcoholates production with a mercury process: Numbers are uncertain but may indicate a minor loss in the order of 0-200 jobs. 5(6): New Annex B MC facilities: No additional social impacts. 5(7): Discouragement of new mercury using processes: Impacts are deemed unlikely based on history, especially under a soft interpretation of "discouragement". Other sub-articles: No significant impacts.
7 ASGM	Potential impacts on ASGM miners in French Guiana: Mercury use is already illegal there, and the implementation of the MC would therefore not result in any incremental impacts compared to the

MC article	Social impacts by (sub-) article of the MC
	present situation.
8 Emissions	8(3+4): No incremental social impacts are expected. 8(3+5): No incremental social impacts are expected.
9 Releases	9(4): If a none-action path is chosen, no social impacts are incurred. If not, moderate social impacts could be a result (cannot be assessed at this stage). Other sub-articles: Moderate impacts are anticipated.
10-11	No significant impacts expected.

4.3.3 Environmental impacts

The implementation of the Minamata Convention is expected to have significant environmental impacts globally, and it will also reduce the inflow of mercury from global sources to the EU territory. As mentioned, the EU has already realised much of the potential for mercury release reductions within its own territory. Reductions of mercury releases outside the EU may thus have relatively significant impacts within the EU territory.

The level of ambition in the implementation of the Convention is also expected to have significant influence on the environmental impacts (expressed as mercury release reduction) within the EU territory. In a minimal implementation scenario, the incremental mercury release reductions are expected to be moderate.

The table below lists the environmental impacts of a strictly minimal implementation (MI) of the Convention in the EU.

Table 4-3 Summary of environmental impacts by (sub-) article of the MC.

MC article	Environmental impacts by (sub-) article of the MC
3 Supply and trade	As dedicated mining is already *de facto* prohibited in the EU, no incremental impacts of EU implementation of this aspect of the MC are expected.
4 Products	4 (1): Restriction on export of products: No major impacts are expected (not possible to estimate closely with available data). 4(3): Dental amalgam: To be considered in separate Commission work. 4(6): Discouragement of new mercury-added products: Impacts are deemed unlikely based on history, especially under a soft interpretation of “discouragement”. Other sub-articles: No significant impacts.
5 Processes	5(3) and 5(6): EU (alcoholates production): Air emission reductions: Up to about 0.2 tonne mercury/y. Reductions of mercury input to society: 0.3-1.0 tonne mercury/y. 5(7): Discouragement of new mercury using processes: Major impacts are deemed unlikely based on history, especially under a soft interpretation of “discouragement”. Other sub-articles: No significant impacts.
7 ASGM	Potential impacts on ASGM miners in French Guiana: Mercury use is already illegal there, and the implementation of the MC would therefore not result in any incremental impacts compared to the present situation.
8 Emissions	8(3+4) and 8(3+5): EU: Incremental reductions of mercury releases are not expected.
9 Releases	9(4): If a none-action path is chosen, no incremental environmental impacts will occur. If action is taken, moderate to significant release reductions may be the result. Cannot be assessed further at this stage.
10 Storage	Interim storage requirements may potentially result in elimination of future mercury spills and associated exposures.
11 Waste	11(3): Minimal environmental impacts are expected under the MI scenario.

4.3.4 Administrative burdens

As described in the table below, moderate incremental administrative burdens to competent authorities are expected from the implementation of the Minamata Convention. In many cases similar or equivalent enforcement and administration procedures are already in place, and administrative processes can likely be coordinated to minimise incremental burdens.

Table 4-4 Summary of administrative burdens by (sub-) article of the MC.

MC article	**Administrative burdens by (sub-) article of the MC**
3 Supply and trade	3(8): Moderate incremental efforts for administration of import restriction procedures.
4 Products	4 (1): Restriction on export of products: Minimal impacts are expected (not possible to estimate closely with available data). 4(3): Dental amalgam: To be considered in separate Commission work. 4(6): Discouragement of new mercury-added products: General control efforts as part of control activities for other products and industry control; the incremental impact is considered minimal.
5 Processes	No major impacts expected.
7 ASGM	No significant incremental impacts.
8 Emissions	No incremental impacts expected (beyond existing IE Directive)
9 Releases	If a non-action path is chosen, no impacts are incurred. Otherwise specific identification of source categories and follow-up actions for which some administrative burden would be expected (studies, action plan development and follow-up activities).
10 Storage	No significant incremental impacts.
11 Waste	No significant incremental impacts.

4.4 Impacts of implementation going beyond the Minamata Convention

Options for implementation that go beyond the perceived strictly minimal implementation of the Convention have been proposed in some areas. This section presents the impacts of such options one by one, as compared to the minimal implementation (MI) scenario. Other measures that go beyond the strictly minimal implementation are possible but have low impacts, or cannot yet be studied due to lack of data, and are not assessed in detail in this study.

4.4.1 Article 3(8) on import restrictions

The table below compares the impacts of the minimal implementation (MI) scenario and the beyond MC (BMC) scenario.

Table 4-5 Overview of impacts from the MI scenario vs. the BMC scenario regarding import restrictions.

MC article	MI	BMC
3(8) on mercury imports	***Option:*** Introduce procedures to ensure that import from Non-Parties comply with MC ***Impacts:*** No significant cost impacts (0-0.4 mio EUR foregone profits for importers). Larger administrative burdens than BMC. Reduced releases from primary Hg mining globally.	***Option:*** Total import ban from countries outside the EU (import of waste for disposal exempted) ***Impacts:*** Possible loss of revenue for Hg importers: 0-4 mio EUR/y, a distributional effect. Potential cost range for industry for raised Hg prices (or substitution) 0-16 mio EUR/y. Environmental benefits, see discussion

Discussion

The expected **economical impacts** under the BMC are 0-20 mio EUR higher than in the MI for this option.

Social impacts are difficult to assess in detail but are expected to be minimal based on the relatively low cost.

As regards **environmental impacts**, a possible import ban should be seen in the context of mercury supply to the EU and should thus involve decisions on mercury recycling. The general objective of the MC – to reduce mercury supply and use – will be better achieved within the EU by banning the import from all countries (BMC). In the global context, an EU import ban could result in lower production of mercury with reduced releases as a consequence. On the other hand, if global production levels were maintained, the import ban could lead to a fall in mercury prices outside the EU and potentially result in increased (or maintained) mercury consumption in regions and activities with less environmental management (for example ASGM), where supply restrictions are most needed. Given the small scale of mercury demand projected for the future in the EU, this effect is expected to be modest.

It is proposed that under an import ban, import of waste for environmentally sound disposal of mercury should remain possible in order to use the available capacity to assist other countries with environmentally sound disposal.

4.4.2 Article 4(1): Prohibition of manufacture/import/export of mercury-added products of Annex A, Part I

Table 4-6 Overview of impacts from the MI scenario vs. the BMC scenario regarding import restrictions.

MC article	MI	BMC
Article 4(1): Prohibition of manufacture, import and export of specified mercury-added products	***Option:*** Restriction on manufacture and export in accordance with the MC requirements: ***Impacts:*** Minor impacts are expected, because targeted products are already restricted for marketing within the EU and for several products the existing export is considered in conformity with MC requirements.	***Option:*** Restriction on manufacture and export in accordance with the EU standards for internally marketed products: ***Impacts:*** Lost export revenues from the lamps industry is estimated at 240 – 360 million EUR/y with possible associated job losses. Possible elimination of an input of an estimated 1.4 t/y of mercury to global society with potential associated environmental releases. Potential impacts on battery industry (lost export revenues of 0-50 million EUR/y). Potential reductions in mercury input to society (0-5 t/y). Potentially minor job losses in the manufacture of mercury-added non-electronic measuring devices.

Discussion

Around 143 million halophosphate type fluorescent lamps per year are manufactured in the EU for export. They comply with MC requirements, but not to EU internal market requirements and estimated lost export revenues would be 240 – 360 million EUR under the **BMC** scenario. 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. Under the **BMC** scenario, the maximum reduction of mercury input to society arising from the export of halophosphate lamps is estimated at 1.4 tonnes per year if the production of these lamps should be terminated. If the production is just moved out of the EU, no reductions are anticipated; on the contrary, increases of emissions/releases from manufacturing may occur. Under the **MI** scenario, no environmental impacts would be expected.

For the non-electronic measuring devices, the current export tonnage is not known. Minor impacts of the MI as well as the BMC option may be experienced in the manufacture of mercury sphygmomanometers for export. Manufacturers of mercury containing thermometers could be affected by the **BMC** Scenario, but quantification is not possible with the available data. The industry association for battery manufacturers (EPBA) supports the BMC option, and the few available data indicate that impacts for batteries may be minor as indicated in the table above.

4.4.3 MC Articles 4(6) and 5(7): Discouragement of new products and processes with intentional mercury use

The table below compares the impacts of the Minimal Implementation (MI) scenario and the Beyond MC (BMC) scenario.

Table 4-7 Overview of impacts from the MI scenario vs. the BMC scenario regarding discouragement of new products and processes.

MC article	MI	BMC
MC Articles 4(6) and 5(7): Discouragement of new products and processes with intentional mercury use	***Option:*** Soft (administrative) discouragement of new Hg uses ***Impacts:*** limited impacts, both cost-wise and environmentally. See discussion.	***Option:*** Conditional ban on new Hg uses: ***Impacts:*** More effective and with higher signal value than MI. New invention of marketable products and processes cannot be ruled out but are not considered likely. See discussion.

Discussion

Economic and social impacts: The discouragement of new 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 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. R&D activities are exempted from the MC, as well as in existing EU law relevant to mercury, and would thus still be possible. Only when considering a general marketing or large scale industrial use, the ban would become effective, unless significant benefits to health and the environment can be proven, as required under the MC.

In the BMC scenario (a conditional restriction) determination of whether the MC conditions for significant environmental or human health benefits are fulfilled would be necessary before a product was placed on market or process deployed. Industry could face additional costs in the 100,000-450,000 EUR range for authorisation costs and fees, or similar procedures where products or processes involving use of mercury were developed. This gives some motivation for only introducing novel mercury uses which have significant benefits.

Environmental impacts: The choice of implementation strategy is important for the effectiveness of the measure and could result in everything between “no effect” (but conformity with the MC) and virtually full elimination of mercury input to society via novel mercury uses.

4.4.4 MC Article 5(3): Restricting mercury use in sodium/potassium methylate/ethylate production

Table 4-8 Overview of impacts from the MI scenario vs. the BMC scenario regarding discouragement of new products and processes.

MC article	MI	BMC
MC Articles 5(3): Restricting mercury use in sodium/potassium methylate/ethylate production	***Option:*** Reductions in Hg releases plus work to identify alternatives for end uses, possibly culminating in total substitution ***Impacts:*** 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. See discussion.	***Option:*** Ban of Hg use in alcoholates production ***Impacts:*** Significant economic impacts: Annual estimated costs of 61-77 million EUR/y. See discussion.

Discussion

Economic impacts: For the **BMC scenario** (a ban on the mercury process for alcoholates production), the total costs of substitution for all four alcoholates is estimated at between 60 and 76 million EUR/y. The costs of the emission / releases reduction provision of the MC are estimated at 0.6-1 million EUR/y. The companies using the mercury-based production process consider the production of the four chemicals as economically mutually dependent and state that they may terminate the production of all four substances if the use of the mercury-based process be prohibited for the two – three substances for which alternative non-mercury processes exist. A stakeholder has reported that all four substances can be produced without mercury on industrial scale, but this has not been possible to confirm from other sources.

Under the **MI scenario** substitution costs could range from research costs only (in case no feasible alternatives were found) up to the same costs for research plus implementation as estimated for the BMC scenario above. Research costs cannot be quantified precisely; but it is expected that a reasonable research activity could be run for 2 million EUR/y. The substitution costs under the MI scenario could therefore be 2-76 million EUR/y. The costs of the emission/releases reduction provision of the MC are estimated at 0.6-1.0 million EUR/y similarly to the BMC scenario.

Social impacts, BMC scenario: While the numbers available are considered uncertain, and not necessarily consistent with the lower production costs for the mercury process, they could indicate that the mercury-based production technology is more labour-intensive than available alternatives. The loss of 80-200 jobs cannot be ruled out. Under the **MI scenario**, the transition will come more slowly, or not at all (in case adequate alternatives considered technically and economically feasible are not developed for all four alcoholates), and the job loss estimate here is therefore 0 – 200.

There are moderate **environmental benefits** from elimination of this process under the **BMC scenario**. The reduction in emissions of mercury to the air are estimated at about 190 kg/y and reductions of the mercury input at about 0.3-1 t/y. The reductions potentially achieved under the **MI scenario** can also not be quantified more precisely than 190 kg/y of emission reductions and 0.3-1 t/y of mercury input.

4.4.5 MC Article 11(3): Mercury waste (recycling)

The table below compares the impacts of the Minimal Implementation (MI) scenario and the Beyond MC (BMC) scenario.

Table 4-9 Overview of impacts from the MI scenario vs. the BMC scenario regarding recycling of mercury.

MC article	MI	BMC
11(3): Mercury waste (recycling)	***Option:*** Procedures that ensure that recycled mercury is only used for purposes allowed under the MC ***Impacts:*** Possible loss of revenues for recyclers (0-5 million EUR/y). Possible cost (to waste owners/consumers), equalling revenues (benefits) to waste disposal facilities, of an estimated 0-16 million EUR/y. Moderate contributions to positive environmental and health impacts by reducing mercury releases in the life cycle of mercury.	***Option***: Requiring environmentally sound disposal of all mercury waste (and in consequence prevent re-marketing of recovered mercury): ***Impacts***: Possible loss of revenues for recyclers (2-8 million EUR/y). Possible cost (to waste owners/consumers), equalling revenues (benefits) of waste disposal facilities, of an estimated 1-26 million EUR/y. Potentially significant contributions to positive environmental and health impacts by reducing mercury releases in the life cycle of mercury; see discussion.

Discussion

Going beyond the requirements of the Minamata Convention by requiring all mercury waste to be disposed of in an environmentally sound way could have potentially significant **environmental benefits**. The decision on whether to implement the MI or the BMC option must be taken with due consideration to preferences regarding a mercury import ban and the general mercury supply to the EU. If imports for allowed uses are banned and environmentally sound disposal of all mercury waste will be required there will be no remaining source to service EU demand. If a general import ban is implemented, recycling should be regulated as described under the MI option only, if continued use of mercury in the EU is desired.

On the other hand, severely restricting mercury recycling in the EU would force final, environmentally sound disposal of a higher amount of mercury, thus emptying accumulated mercury stocks in society, while having the added benefit (due to potentially higher mercury prices) of (1) stimulating substitution further in the dental amalgam use (a major EU use) and (2) stimulating development and implementation of mercury alternatives in other remaining use sectors, while (3) at the same time drawing from the global mercury market with possible increasing mercury prices, reduced mercury demand and associated reduced releases outside the EU as a result. Requiring environmentally sound disposal of all mercury waste could thus potentially have higher environmental benefits in the global context than a total import ban. With the relative low projected mercury demand of the EU, the effects on the global price development may however be modest. The larger dependence on external sources of mercury should also be kept in mind, in case a further limitation of re-marketing of recycled mercury is considered a prioritised issue.

The possible incremental **economic impacts** of a BMC implementation would be loss of revenues for recyclers (estimated at 2-7.8 million EUR/y; a distributional effect) and costs for waste owners (ultimately consumers) for final disposal (1-26 million EUR/y). Similarly, the possible impacts of a MI implementation would be loss of revenues for recyclers (estimated at 0-5 million EUR/y; a distributional effect) and costs for waste owners (ultimately consumers) for final disposal (0-16 million EUR/y). As companies providing final disposal services are often the same as those recycling mercury, implementing the BMC scenario may be almost cost neutral for the recycling sector, but activities might be centralised on fewer companies.

4.5 Data gaps

Major data gaps include:

- Current export revenue and mercury export tonnage with switches/relays and non-eletronic measuring devices.
  - Share of any such export that would be affected by the MI or BMC scenarios, and their associated mercury inputs and releases.

- Information on available alternatives to potassium methylate and potassium ethylate (in the processes where these substances are used), and the consequences of terminating their production in the EU.

- Updated mercury input and release inventories for various mercury source categories of relevance for this assessment.

- Detailed updated data on mercury supply from recycling in the EU.

4.6 Conclusions

A business as usual scenario (meaning that no change to EU law would be done and consequently, the Minamata Convention could not be ratified) would be in conflict with the EU Mercury Strategy and the stated intent of the EU to ratify the Minamata Convention. It could have the consequence that the mercury exposure within the EU territory would not be reduced. This is because a significant part of the atmospheric mercury deposition in the EU originates outside its territories. Additional mercury is transported with ocean currents and rivers to EU waters. A failure to ratify on the part of the EU could significantly weaken the Convention's momentum and so reduce the prospects of achieving the global mercury release reductions on offer.

Minimal implementation scenario

The minimal implementation scenario investigates the implementation of the Minamata Convention where only changes to the EU legislation that were strictly needed, were implemented. In contrast, the "beyond Minamata Convention" scenario described below investigates some options for implementation that may have added environmental value but go further than the strictly minimal requirements.

The economic, social and administrative burdens of a strictly minimal implementation of the Minamata Convention on Mercury are minimal to moderate when seen in the overall EU context. Total quantified costs of a strictly minimal implementation of the Minamata Convention are estimated at 3 – 98 million EUR/y. Additional costs, not quantified in detail in the assessment, are identified. Based on expert assessment only, they are expected to be comparatively minor.

The single most costly initiative under the minimal implementation (MI) scenario is the phase-out of mercury use in alcoholates production, in which costs for substitution and release reduction are estimated at 3-77 million EUR/y under the MI scenario. In case no technically and economically feasible alternatives were found for the remaining alcoholates, the only costs would be those associated with attempting to develop (but not implement) alternative non-mercury processes. If alternatives did on the other hand become available, the total substitution costs could approach those estimated for the enhanced implementation scenario (BMC).

The overall goals of the Minamata Convention on Mercury are in line with the EU Mercury Strategy and several of its provisions are similar to existing EU legislation on mercury. This means that the EU has already realised much of the potential for mercury release reductions aimed by the Convention thanks to internal EU legislation.

The EU Mercury Strategy identified the need for international action in order to further minimise the impacts to health and environment within the EU territory. The Minamata Convention is the best available, and most cost-effective, means of realising this goal, while at the same time substantially reducing the harmful impacts of mercury globally.

Enhanced implementation

Significant additional benefits to health and environment can be achieved by implementing certain measures which go beyond the minimal implementation scenario described above. These go further in fulfilling the intentions of the EU Mercury Strategy and the Minamata Convention and, in addition to their direct benefits within the EU, they would send a strong signal of the EU's support of the Convention and encourage other countries to become Parties to the Convention. The measures assessed in this study are:

- Restricting mercury supply via restrictions on imports (0-16 million EUR/y costs for increased prices or substitution for industry plus some minor distributional effects).

- Restriction on manufacture and export of mercury-added products by the standards of existing marketing restrictions within the EU, and not only by the slightly less restrictive standards of the Minamata Convention (lost export revenue 240 – 410 million EUR/y; possible associated job losses; mercury input at stake is 1.4 – 6.4 t/y, but emissions/releases could possibly increase if production is moved outside the EU).

- A conditional restriction on new commercial mercury uses; this measure primarily has a signalling effect (costs cannot be known with certainty but are expected to be marginal).

- Eliminating mercury use in alcoholates production (costs estimated at 61-77 million EUR/y, of which a part will also be incurred under MI scenario; 0.3-1.0 t Hg/y could be eliminated from circulation in the EU).

- Requiring environmentally sound disposal of all mercury waste (1-26 million EUR/y, plus some relatively moderate distributional effects).

Other measures going beyond the minimal implementation scenario are possible, but either:

- Cannot be assessed with the evidence currently available (relating to MC Article 9); or
- have been deemed with comparatively moderate impacts,

and are therefore not assessed in detail in this study.

The study found gaps in the data available to inform analysis on some topics. Priority areas for further investigation are:

- Current export revenue and mercury export tonnage with switches/relays and non-eletronic measuring devices.
  - Share of any such export that would be affected by the MI or BMC scenarios, and their associated mercury inputs and releases.

- Information on available alternatives to potassium methylate and potassium ethylate (in the processes where these substances are used), and the consequences of terminating their production in the EU.
- Updated mercury input and release inventories for various mercury source categories of relevance for this assessment.
- Detailed updated data on mercury supply from recycling in the EU.

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Appendix 1 Existing and forthcoming legislation with relevance to the Convention

Overview of current EU legislation with relevance to the Convention

Appendix table 1 below gives an overview of existing EU legislation relevant to the control of mercury and the Minamata Convention as of July 2014.

Appendix table 1 Overview of existing and forthcoming EU legislation concerning mercury.

Thematic issue	EU Legislation	Summary regarding mercury
Export ban and disposal of mercury	Regulation (EC) No 1102/2008 on the banning of exports of metallic mercury and certain mercury compounds and mixtures and the safe storage of metallic mercury	Regulation (EC) No 1102/2008 bans the exports of metallic mercury and certain mercury compounds and mixtures originating from the EU. The ban has applied since March 2011 to exports of: • metallic mercury (Hg, CAS RN 7439-97-6) • cinnabar ore; • mercury (I) chloride (Hg2Cl2, CAS RN 10112-91-1), • mercury (II) oxide (HgO, CAS RN 21908-53-2) • mixtures of metallic mercury with other substances with a mercury concentration of at least 95 % by weight (w/w). Metallic mercury (Article 2 of Regulation (EC) No 1102/2008) from the following sources is considered as waste: • metallic mercury that is no longer used in the chlor-alkali industry; • metallic mercury gained from the cleaning of natural gas; • metallic mercury gained from non-ferrous mining and smelting operations; and • metallic mercury extracted from cinnabar ore in the EU Metallic mercury from these sources is considered waste and can be stored: • temporarily or permanently in an underground salt-mine adapted for the purpose or in deep underground, hard rock formations; or even • temporarily in above-ground facilities specifically dedicated for that purpose prior to its final disposal. This option constitutes a derogation from the provisions of Landfill Directive 1999/31/EC (see entry below), which prohibit the disposal of liquid waste in landfills.

Thematic issue	EU Legislation	Summary regarding mercury
Industrial Emissions	Directive 2010/75/EU (IE Directive / IED) applies to the largest installations operating certain industrial activities (as mentioned in its Annex I); with more detailed EU wide "minimum" requirements set for certain types of activities (large combustion plants, waste incineration, installations and activities using organic solvents, titanium dioxide production). The Directive requires the installations covered to have a permit containing conditions based on the application of Best Available Techniques (BAT), in particular limit values for emissions to air, water and land. The Commission organises an exchange of information between experts from the EU Member States, industry and environmental organisations ("Sevilla process") on BAT, which results in the adoption of "BAT conclusions" (Commission Implementing Decisions) as part of larger BAT Reference Documents (the so-called BREFs), which are published by the Commission. The BAT conclusions have to be used by competent authorities as the reference for setting permit conditions. The emission limits cannot exceed the BAT-associated emission levels in the BAT conclusions unless a derogation can be justified by the competent authorities.	The IE Directive covers several activities for which mercury (use, emissions, releases) is relevant and/or which are addressed by the Minamata Convention (MC). BREFs have been adopted under the former IPPC Directive on, for instance: • Chlor-alkali manufacturing (CAK BREF), • Large Combustion Plants (LCP BREF), • Large Volume Organic Chemical industry (LVOC BREF), • Production of Cement, Lime, and Magnesium Oxide (CLM BREF) • Waste Incineration (WI BREF) • Non-Ferrous Metals production (NFM BREF) Under the IED, new BAT conclusions have been adopted for CAK and CLM, both covering explicitly mercury use and/or emissions. The revision of the BREF under IED is on-going for LCP, LVOC and NFM and will be started soon for WI. The IED includes limits for mercury emissions/releases to air and water from waste incineration and waste co-incineration plants (Annex VI), taken over from Directive 2000/76/EC.
Pollutant Release and Transfer Register	Regulation (EC) No 166/2006 sets up a European Pollutant Release and Transfer Register (E-PRTR) in the form of a publicly accessible electronic database. Reporting obligations are in place for the operators of facilities specified in Annex I to the Regulation, in case the releases of the specified pollutants to air, water and land are above the thresholds set in the Regulation.	Mercury (as the total mass of the element in all chemical forms present in the release) is a pollutant for which reporting obligations apply in case the applicable threshold of 10 kg/y to air, 1 kg/y to water, or 1 kg/y to land is exceeded

Thematic issue	EU Legislation	Summary regarding mercury
Chemicals and certain products	Regulation (EC) No 1907/2006 (REACH) applies to substances as such, in mixtures and in articles. The main instruments of REACH are: (1) Registration of substances which are manufactured or imported in quantities reaching 1 tonne per year per manufacturer/importer; (2) Evaluation of registration dossiers and of substances (3) Authorisation, including as first step the identification of substances as Substances of Very High Concern (SVHC) and their placing on the "Candidate list" for authorisation - this aspect is in detail discussed in the internal background document. (4) Restrictions on specific (groups of) substances (Annex XVII); new restrictions may be added viaa) normal procedure (69(1)) or b) 68(2) for the use of mercury in articles for consumer uses; (5) Obligation for suppliers and users of substances to communicate along the supply chain, and towards consumers	*Registration* Elemental mercury plus 202 mercury compounds were pre-registered by industry under the REACH Regulation. As of October 2013 only elemental mercury itself has been registered, even though a targeted registration deadline of 2010 had been announced for 101 mercury compounds as part of their pre-registration. This indicates that remaining mercury compound uses may be in very small quantities. *Evaluation* Mercury or its compounds have not yet been subject to the evaluation procedure under REACH. Mercury or its compounds are not listed in the current Community Rolling Action Plan (CoRAP) 2014-2016 for substance evaluation, see ECHA proposal to the Member States: Draft Community Rolling Action Plan (CoRAP) update for years 2014-2016[45]. Refer also to the discussion in the internal background document. *Identification as SVHC / Authorisation requirement* Mercury is classified as reprotoxic Cat. 1B in the CLP Regulation (see entry below) and by this meets the criteria for being identified as SVHC. However, no step has been taken to identify mercury (or any of its compounds) as SVHC. *Restrictions* Existing relevant Annex XVII restrictions with respect to mercury are: • Entry 18 which restricts the placing on the market or use of "mercury compounds" (not further specified), as such or in mixtures, for certain specific uses, such as some fouling prevention applications, the preservation of wood or the impregnation of certain textiles and yarn.;

[45] ECHA. Access from ECHA website 30 May 2014. http://echa.europa.eu/documents/10162/13628/corap_2014-2016_en.pdf .

Thematic issue	EU Legislation	Summary regarding mercury
		• Entry 18a is related to "Mercury (CAS No 7439-97-6)" and restricts the placing on the market of mercury in fever thermometers and other measuring devices intended for sale to the general public. This entry has been modified by Regulation (EU) No 847/2012 amending Annex XVII to Regulation (EC) No 1907/2006 which extends the restriction to the placing on the market of a series of mercury-containing devices intended for industrial and professional uses (thermometers, barometers, hygrometers, manometers, sphygmomanometers, strain gauges to be used with plethysmographs, tensiometers and other non-electrical thermometric measuring devices), applicable from 10 April 2014. • Entry 62 introduces general restrictions on the manufacturing, placing on the market or use of five specific phenylmercury compounds as such or in mixtures, as well as on the placing on the market of articles containing these substances, above a certain concentration limit. • Mercury being classified as reprotoxic Cat. 1B in the CLP Regulation (see entry below), mercury (CAS No 7439-97-6) is also subject to the general entry 28 which restricts its placing on the market or use as such, as constituent of other substances or in mixtures, for supply to the general public.
CLP / GHS	The 'CLP' Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures implements the globally harmonized system (UN-GHS) at EU level, setting out internationally accepted definitions and criteria to identify the hazards of chemicals and to communicate those hazards via labels and safety data sheets. Annex VI contains a list of specified hazardous substances for which a harmonized classification has been agreed at EU level.	Annex VI of the CLP Regulation contains an entry on elemental mercury, introducing a harmonized classification: Repr. 1B Acute Tox. 2 * STOT RE 1 Aquatic Acute 1 Aquatic Chronic 1 Mercury compounds are also classified (with similar, but not identical, classification, but very few are also classified as Repr. 1B).
Plant Protection	Regulation (EC) No 1107/2009 generally covers marketing of plant protection products (PPP). It contains rules for the approval of active	Mercury and its compounds are not approved as active substances for PPP in the EU.

Thematic issue	EU Legislation	Summary regarding mercury
Products	substances, safeners and synergists, which PPP contain or consist of, and rules for adjuvants and co-formulants. In particular, a PPP must not be authorised unless the active substance is explicitly approved at EU level; for list of approved active substances see Regulation (EU) No 540/2011.	
Biocides	Regulation (EU) 528/2012 covers biocides. It contains provisions similar to those on PPP, with active substances needing an approval at EU level, and biocidal products needing a further authorization. For list of approved active substances see (currently still) Annex I/IA to Directive 98/8/EC.	Mercury and its compounds are not approved as active substances for biocides in the EU. REACH Annex XVII entry No 18 (which was already contained in former Existing Substance Directive 76/769/EEC) restricts the placing on the market or use of "mercury compounds" (not further specified) for certain biocidal uses (see discussion of REACH above).
Export and import of dangerous chemicals	Regulation (EC) No 689/2008 covers export and import of dangerous chemicals. The Regulation applies an export restriction for certain specified chemicals, and introduces an export notification procedure as well as procedural rules regarding the implementation of the prior informed consent (PIC) procedure of the Rotterdam Convention. The Regulation has been repealed and replaced by Regulation (EU) No 649/2012 with effect from 1 March 2014.	The following relevant chemicals/articles are subject to the export restrictions (Annex V): • Cosmetic soaps containing mercury • Two entries mirroring the export ban imposed by Regulation (EC) 1102/2008: • Metallic mercury and mixtures of metallic mercury with other substances, including alloys of mercury, with a mercury concentration of at least 95 % weight by weight • Mercury compounds, except compounds exported for research and development, medical or analysis purposes, in detail: Cinnabar ore, mercury (I) chloride, mercury (II) oxide In other cases, mercury compounds are subject to export notification procedure (Annex I, Part 1) or the PIC procedure (Annex I, Part 3).
Toys	Directive 2009/48/EC deals with the safety and placing on the market of toys. The Directive contains maximum migration limit values for several chemicals, expressed as mg/kg values.	Mercury is among the pollutants for which migration limit values are set. The values are as follows: In dry, brittle, powder-like or pliable toy material 7.5 mg/kg; in liquid or sticky toy material 1.9 mg/kg; in scraped-off toy material 94 mg/kg.
Cosmetics	Regulation (EC) No 1223/2009 deals with placing on the market of cosmetic products. It contains a list of prohibited substances.	"Mercury and its compounds" is included in the list of prohibited substances (Annex II, entry 221), with the exception of two mercury containing compounds (Phenyl mercuric acetate and Thimerosal) which are allowed to be used in cosmetic products, with threshold concentrations of 0.007 % (of mercury); if mixed with other mercurial compounds authorised by this Regulation, the maximum concentration of Hg remains fixed at 0.007 %

Thematic issue	EU Legislation	Summary regarding mercury
RoHS	Directive 2011/65/EU (RoHS Directive) restricts the use of certain substances present in new electrical and electronic equipment (EEE) put on the market	New electrical and electronic equipment put on the market shall not contain mercury in concentrations over 0.1 % w/w in electrical equipment. Annex III to the Directive contains exemptions from the restriction for mercury, particularly for certain lamps. All exemptions are time-limited and contain a specified maximum limit value above which the exemption is not applicable (and the item is banned from placing on the market, respectively).
WEEE	Directive 2012/19/EU on waste electrical and electronic equipment (WEEE Directive) (recast) promotes collection and separate collection, as well as treatment standards for WEEE.	The Directive contains an obligation for MS to put priority on the separate collection of certain specified EEE, among those fluorescent lamps containing mercury. Further, the Directive contains the obligation to remove from any separately collected WEEE all mercury containing components
Eco Design	Directive 2009/125/EC on ecodesign aims to reduce the environmental impact of products, including their energy consumption, throughout their entire life cycle. In so-called implementing measures, direct provision for mandatory requirements for specific products may be set out. Such a measure is Regulation (EC) No 244/2009 which deals with ecodesign of non-directional household lamps and sets out benchmark and packaging labelling. Note that according to the 7th Environment Action Programme to 2020 (Decision 1386/2013/EU), Eco Design legislation is due for revision before 2015.	Regulation (EC) No 244/2009 contains specific benchmark provisions on the functionality of lamps containing Hg, and packaging/labelling requirements; for instance, the Hg content has to be indicated in mg.
Batteries	Directive 2006/66/EC establishes rules on the placing on the market of batteries and accumulators (in particular, a prohibition on the placing on the market of batteries and accumulators containing certain hazardous substances), and specific rules regarding the management of waste batteries and accumulators	The Directive prohibits placing on the market of all batteries that contain more than 0.0005% by weight of mercury except button cells (exemption valid until 1 October 2015, according to amendment by Directive 2013/56/EU) with 2% by weight. Further, the Directive contains collection rates, and rules on packaging and labelling of batteries containing mercury.
Medicinal products	Directive 2001/83/EC on the Community code relating to medicinal products for human use applies to most medicinal products for	No authorization is in place at EU level regarding mercury-containing topical antiseptics.

Thematic issue	EU Legislation	Summary regarding mercury
	human use, including to the manufacture of medicinal products exclusively intended for export, as well as intermediate products, active substances and excipients. One of its core features is that in principle no medicinal product may be placed on the market of a Member State unless an authorization has been issued by the competent authorities of that Member State or by the European Medicines Agency. The Directive further features inter alia rules on mutual recognition procedures and decentralised procedure as well as on classification, labelling, packaging and advertising. Regulation (EC) 726/2004 contains procedures for the authorisation, supervision and pharmacovigilance of medicinal products for human and veterinary use.	
End of Life Vehicles	Directive 2000/53/EC (EoLV Directive) aims to make vehicle dismantling and recycling more environmentally friendly, sets quantified targets for reuse, recycling and recovery of vehicles and their components, and pushes producers to manufacture new vehicles also with a view to their recyclability. The Directive contains restrictions in materials and components of vehicles, minimum technical requirements and provisions on the removal of components containing mercury	Restriction of mercury presence in vehicles (categories M1 and N1) and their materials and components (maximum concentration value up to 0.1 % by weight and in homogeneous material). Exemption for mercury in discharge lamps for headlight application and fluorescent tubes used in instrument panel displays in vehicles type approved before 1 July 2012 and spare parts for these vehicles Removal of all components containing mercury that are appropriately labelled during treatment of EoLVs
Packaging and packaging waste	Directive 94/62/EC (packaging and packaging waste) contains minimum requirements for packaging material, marking / identification systems, as well as an obligation for Member States for introducing a return/collection system together with recovery targets.	Concentration limit of 100 ppm w/w for sum of concentration levels of lead, cadmium, mercury and hexavalent chromium in plastic packaging and packaging components.
Waste management/ Hazardous	Directive 2008/98/EC (Waste Framework Directive) contains standards for waste management and key concepts. It also contains key definitions, notably for “hazardous waste” (Article 3(2), Annex III),	The List of Wastes assumes for a number of waste types that they exhibit hazardous properties (those marked with an asterisk). In case of so-called mirror entries, i.e. where the classification of the waste as hazardous or not depends on the presence of certain (hazardous substances), the LoW determines which thresholds apply. A number of waste

Thematic issue	EU Legislation	Summary regarding mercury
waste	and specific provisions for the management of this waste. Commission Decision 2000/532/EC (List of Wastes, LoW) contains a source-based inventory of waste streams, identified by a six-digit number. Wastes marked with an asterisk are assumed to be hazardous. The Commission intends to publish a proposal for revision of Annex III and the List of Wastes in the near future.	codes explicitly containing mercury or "heavy metals" (of which mercury is one); these are all considered hazardous waste (entries 05 07 01*, 06 03 13*, 06 03 15*, 06 04 04*, 06 07 03*, 10 11 11*, 10 12 11*, 10 14 01*, 16 01 08*, 16 06 03*, 17 09 01*, 19 08 08*, 20 01 21*). The revised LoW includes the following additional waste codes: 16 03 07* metallic mercury; 19 03 08* partly stabilised mercury
Transboundary shipment of waste	Regulation (EC) No 1013/2006 on shipments of waste (The Waste Shipment Regulation - WSR) applies to shipments of waste: • between Member States, within the EU or with transit through third countries; • imported into the EU from third countries; • exported from the EU to third countries; • in transit through the EU, on the way from and to third countries. It aims to transpose EU obligations stemming from Basel Convention and from OECD level. The Regulation imposes an export restriction for hazardous waste to certain regions as well as a restriction on export for disposal outside the EU/EFTA area. The Regulation recognizes two control procedures: • the procedure of prior written notification and consent which may be seen as the default procedure for shipment, and • the general information requirements of Article 18 of the WSR which is used for the shipments of "green"-listed waste destined for a recovery operation to certain destinations. The approach for classification of waste as hazardous under Basel / OECD is different from that provided for by the EU LoW; nonetheless, the WSR recognizes additionally hazardous properties	All wastes where mercury is mentioned are explicitly listed in Annex V of the WSR – leading to a restriction of exporting such wastes to non-OECD* countries, either through incorporation of lists stemming from Basel Convention, or because they are considered as hazardous under the List of Waste or in national legislation. *: includes OECD countries that have not implemented OECD Council Decision C(2001)107/final

Thematic issue	EU Legislation	Summary regarding mercury
	of waste assessed on the basis of WFD/LoW for the purpose of export control. The notification procedure requires that the competent authorities of the countries concerned by the shipment (country of dispatch, country of transit and country of destination) give their consent prior to any shipment.	
Landfill and storage of waste	Directive 1999/31/EC (landfill of waste) contains rules on the management, permit conditions, closure, and after-care of landfills. Council Decision 2003/33/EC specifies acceptance criteria for waste for the different classes of landfills as recognised by the Landfill Directive.	The Annexes of the Landfill Directive, as amended by Directive 2011/97/EU, contain requirements for the temporary storage of metallic mercury of more than one year.
Mining waste	Mining Waste Directive 2006/21/EC covers the management of waste from land-based extractive industries, arising from the prospecting, extraction, treatment and storage of mineral resources and from the working of quarries	Though the Directive does not address contaminants like mercury specifically, it contributes to the EU acquis for dealing with contaminated sites and hazardous substances. In article 20 it calls upon MS to 'ensure that an *inventory* of closed waste facilities, including abandoned waste facilities, located on their territory which cause serious negative environmental impacts or have the potential of becoming in the medium or short term a serious threat to human health or the environment is drawn up and periodically updated. Such an inventory, to be made available to the public, shall be carried out by 1 May 2012, taking into account the methodologies …'. In the recitals 30/31 it is stated that an inventory of closed, including abandoned, waste facilities is supposed to identify those which cause serious negative environmental impacts or have the potential of becoming in the medium or short term a serious threat to human health or the environment. These inventories should provide a basis for an appropriate programme of measures. The Commission should ensure an appropriate exchange of scientific and technical information on how to carry out an inventory of closed waste facilities at Member State level and on the development of methodologies to assist Member States in complying with this Directive when rehabilitating closed waste facilities.

Thematic issue	EU Legislation	Summary regarding mercury
Industrial hazards	Directive 96/82/EC (Seveso II) relates to industrial hazards involving dangerous substances. Member States must ensure that operators of Seveso establishments: • take all measures necessary to prevent major accidents and to limit their consequences for man and the environment; • prove to the competent authority that all the necessary measures provided for by the Directive have been taken. The Seveso II Directive imposes requirements for notification (Article 6) and the drawing up of a safety report (Article 9) where dangerous substances (as identified by Annex I) are present in the facility in quantities above the relevant thresholds (see Article 3(4) Seveso II Directive). The Seveso II Directive is to be repealed, and Member States have to comply with the provisions of new Seveso III Directive 2012/18/EU, by May 2015. In effect, based on a tiered approach to the level of controls, operators handling dangerous substances above certain thresholds must regularly inform the public likely to be affected by an accident, providing safety reports, a safety management system and an internal emergency plan.	Mercury is not explicitly addressed, but meets the criteria for a “dangerous substance” in Annex I, part 2 (as “very toxic”). The relevant thresholds are 5 tonnes for the purposes of Article 6 Seveso and 20 tonnes for the purpose of Article 9 Seveso.
Discharges to water	Directive 2000/60/EC (Water Framework Directive) as amended by Directive 2008/105/EC (Environmental Quality Standards, EQS, or Priority Substances) and subsequently Directive 2013/39/EU. The Water Framework Directive establishes a framework for the protection of inland surface waters, groundwater, transitional waters, and coastal waters. Its objectives include preventing and reducing pollution, promoting sustainable water usage, environmental	Mercury is identified as a priority hazardous substance. Measures must be aimed at the cessation of emissions, discharges and losses of priority hazardous substances within 20 years of the legislation becoming applicable. The EQS for mercury in surface waters is currently 0.05 µg/l as an annual average and 0.07 µg/l as a maximum allowable concentration to protect against direct toxicity. However, if Member States do not apply the biota EQS of 20µg/kg they must introduce a stricter EQS for water in order to achieve the same level of protection as afforded by the EQS for biota.

Thematic issue	EU Legislation	Summary regarding mercury
	protection, improving aquatic ecosystems and mitigating the effects of floods and droughts. Its ultimate objective is to achieve "good ecological and chemical status" for all Community waters by 2015 (later with respect to some newly introduced pollutants) and to this end Environmental Quality Standards (EQS) are introduced. Discharges of pollutants are to be controlled according to a combined approach aimed at achieving the EQS by establishing or implementing: emission controls based on best available techniques, relevant emission limit values, or controls on diffuse emissions including best environmental practices set out in the legislation listed in Article 10 of the Water Framework Directive 2000/60/EC.	
Groundwater	Directive 2006/118/EC relates to protection of groundwater. *Inter alia*, it outlines criteria for the good chemical status of groundwater, and addresses certain specified pollutants in groundwater.	Member States had to set threshold values for pollutants, including mercury by December 2008.
Drinking water	Directive 98/83/EC is intended to protect human health by laying down drinking water quality requirements. Among other elements, the Directive stipulates minimum requirements (microbiological and chemical parameters and those relating to radioactivity).	Limit value for mercury of 1 µg/l
Marine environment	Directive 2008/56/EC, the Marine Strategy Framework Directive, establishes common principles on the basis of which Member States have to draw up their own strategies, in cooperation with other Member States and third countries, to achieve a Good Environmental Status (GES) based on various criteria, among other contaminants in fish and other seafood for human consumption.	Member States must define objectives and indicators including for heavy metals.
Air quality (EU level)	Directive 2008/50/EC (the 'ambient air quality Directive') lays down measures aimed at:	Directive 2004/107/EC contains measurement obligations for mercury and mercury compounds addressed to Member States, together with reference methods for sampling and

Thematic issue	EU Legislation	Summary regarding mercury
	• defining and establishing objectives for ambient air quality designed to reduce harmful effects on health and the environment; • assessing the ambient air quality in Member States on the basis of common methods and criteria; • collating information on ambient air quality in order to monitor long-term trends, in particular; • ensuring that such information on ambient air quality is made available to the public; • maintaining air quality where it is good and improving it in other cases; • promoting increased cooperation between the Member States in reducing air pollution. The Directive sets, *inter alia*, thresholds for assessment for certain pollutants (sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter (PM_{10} and $PM_{2,5}$), lead, benzene and carbon monoxide), criteria for the assessment method (in particular the siting of sampling points), reference methods for measurement, limit values for the protection of human health and the environment. Directive 2004/107/EC (the fourth daughter directive to former Directive 96/62/EC which was preceding Directive 2008/50/EC) relates to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.	testing. Indirectly, mercury emissions may be affected by Directive 2008/50/EC, as air pollutant filters targeting SO_X, NO_X and PM also retain part of the mercury from the exhaust gas from combustion, etc. (mercury retention efficiency varies depending on fuels used and filter configurations).
Air pollution stemming from heavy metals (UNECE level)	The 1998 Aarhus Protocol on Heavy Metals under the UNECE Convention on long-range transboundary air pollution (CLRTAP) addresses specifically emissions to air from cadmium, lead and mercury. The Protocol that came into force in October 2003 has	In terms of basic obligations under the Heavy Metals Protocol, Parties must: • Reduce total annual emissions of mercury into the atmosphere, compared to the reference year for the Party (1990, or an alternative year between 1985 and 1995 set when becoming a Party), through application of best available techniques

Thematic issue	EU Legislation	Summary regarding mercury
	been approved on behalf of the EU by Council Decision 2001/379/EC. The Protocol has been amended in 2012, mainly to provide flexibility for new Parties joining the Protocol and at the same time making some structural changes in the Annex III with a description of the Best Available techniques for key source categories. Some updates were made on emission limit values for dust and the requirement for new chlor-alkali plants to be operated mercury-free, but no other significant changes were made on provisions related to mercury awaiting the finalisation of the negotiations of the Minamata Convention (January 2013). To ensure coherence between regional and global commitments, the Parties agreed to revisit the issues of mercury-containing products and emission limit values for heavy metals in 2014.	(BAT), product control measures or other emission reduction strategies; • Use best available techniques for stationary sources - for new plants within 2 years, for existing plants within 8 years. The standards for best available techniques are given as examples in Annex III to the Protocol, and include both cleaning technology and substitution of mercury based technology, for example in chlor-alkali plants; • Ensure application of limit values to control emissions from major stationary sources, both new and existing. Parties in the geographical scope of European Monitoring and Evaluation Programme (EMEP), such as the EU, are obliged to submit information on the levels of emissions of mercury using the methodologies specified in guidelines prepared by the Steering Body of EMEP and adopted by the Parties at a session of the Executive Body. Note that the obligations under the (original and 2012 amended) Protocol to the EU level have not been transposed as a single Directive or Regulation, but indirectly as various provisions into other legislation (such as the IED, REACH), as detailed in the Explanatory Memorandum to the Commission proposal for EU ratification (COM (2014)750final).
Emission ceilings (UNECE level and EU NEC Directive)	A "multi-pollutant" protocol exists under CLRTAP (the Gothenburg protocol, agreed in November 1999). The Protocol in the 1999 version contains emission ceilings for certain pollutants responsible for acidification, eutrophication and ground-level ozone pollution (SO_2, NO_x, VOCs, and ammonia), which are mirrored at EU level within the NEC Directive 2001/81/EC. The NEC Directive sets upper limits for each Member State for the total emissions in 2010 of the four pollutants, but leaves it largely to the Member States to decide which measures – in addition to EU legislation for specific source categories - to take in order to comply. The Gothenburg Protocol has been amended in 2012 setting	Indirectly, mercury emissions may be affected by the multi-pollutants policy developed under the Gothenburg Protocol and NEC Directive, as abatement measures targeting SO_X, NO_X and PM will generally also remove part of the mercury from the exhaust gas from combustion, etc. (mercury retention efficiency varies depending on fuels used and filter configurations).

Thematic issue	EU Legislation	Summary regarding mercury
	emission reduction commitments for 2020 and now also covering $PM_{2,5}$. In December 2013, the European Commission published a "Clean Air Policy Package" to, *inter alia,* comply with the amended Gothenburg Protocol; elements of this package include proposals for a revised NEC Directive, and for a Directive on Medium Combustion Plants, both addressing PM emissions, among others. These proposals are discussed in the internal background document.	
Occupational safety	Directive 98/24/EC (protection of health and safety from chemicals at work) lays down minimum requirements for the protection of workers from risks to their safety and health arising, or likely to arise, from the effects of chemical agents that are present at the workplace or as a result of any work activity involving chemical agents. Within the framework set by this Directive, Directive 2009/161/EU establishes indicative occupational exposure limits for certain chemicals.	Minimum requirements and indicative occupational exposure limits(0.02 mg/m^3 8 hrs average) for "mercury and divalent inorganic mercury compounds including mercuric oxide and mercuric chloride (measured as mercury)"
Food safety	Regulation (EC) No 1881/2006 sets out maximum levels (ML) for certain contaminants in foodstuffs.	Mercury is among the heavy metals addressed by the Regulation. ML are introduced for fishery products (at 0.5 mg/kg wet weight with several exemptions of 1 mg/kg wet weight) and for food supplements (0.1 mg/kg).
Contaminated sites / Soils	Directive 2004/35/EC on environmental liability with regard to the prevention and remedying of environmental damage. A strict liability scheme applies to the dangerous or potentially dangerous occupational activities listed in Annex III to the Directive. These are inter alia industrial activities under the IED regime, activities which discharge heavy metals into water or air, installations producing dangerous chemical substances, waste management activities (including landfills and incinerators) and activities concerning genetically modified organisms and micro-organisms. Under this first scheme, the operator may be held responsible even if he is not at	Mercury is only indirectly mentioned as "heavy metals" in Directive 2004/35/EC. Activities involving mercury will be in the scope of Annex III and thus be subject to the strict liability scheme imposed by the Directive.

Thematic issue	EU Legislation	Summary regarding mercury
	fault. A less strict liability scheme applies to all occupational activities other than those listed in Annex III to the Directive, but only where there is damage, or imminent threat of damage, to species or natural habitats protected by Community legislation. In this case, the operator will be held liable only if he is at fault or negligent.	
Contaminated sites / Soils	The Commission has adopted a Soil Thematic Strategy (COM (2006) 231) and a proposal for a Soil Framework Directive (COM(2006) 232). The Commission has indicated (REFIT) that, provided no progress can be achieved on the soil file, it would consider a withdrawal of the proposed legislation	Mercury is not explicitly mentioned, although the proposed Soil Framework Directive would require the identification of contaminated sites, including by mercury, and the prevention of soil contamination.

Forthcoming EU legislation and EU other initiatives

Mercury emissions to air may be indirectly affected by multi-pollutant control strategies as abatement measures targeting pollutants such as SO_X, NO_X and PM will generally also retain part of the mercury from the exhaust gas from combustion, process plants, etc. The mercury retention efficiency varies depending on the process, the fuels or raw materials used and the abatement measures applied.

The following proposals for new EU legislation, while not explicitly targeting mercury, may be relevant in this context.

On 18 December 2013, the Commission adopted a Clean Air Policy Package, containing, *inter alia*, a Communication for a Clean Air Programme for Europe, and legislative proposals for the following:

- A revised NEC Directive containing updated national ceilings (emission reduction commitments) for six key air pollutants (PM, SO_2, NO_x, VOCs, NH_3 and CH_4) for 2020 and 2030, and

- A new Directive for Medium Combustion Plants between 1 and 50 MWth setting emission limits for PM, SO_2 and NO_x.

According to Article 4 and Annex II of the Proposal for a revised NEC Directive Member States must limit their annual emissions of SO2, NOx, NMVOC, NH3, PM2,5 and CH4, to meet specified reduction commitments applicable from 2020 and 2030, subject to some flexibility allowed by Article 5 of the Proposal. Furthermore, Member States must limit in 2025 their annual emissions of those pollutants to the levels defined on the basis of a linear reduction trajectory, unless this would require measures entailing disproportionate costs.

The proposal for a Directive for Medium Combustion Plants (i.e. those with a rated thermal input between 1 and 50 MWth) (COM(2013) 919 final) has the following key features:

- Article 1 defines the aim of the Directive as reducing emissions to air of SO_2, NOx and PM from medium-sized combustion plants between 1 and 50 MWth, and thereby reducing the potential risks to human health and the environment from such emissions;

- Article 4 sets out the obligation of the competent authority to register medium combustion plants, based on notification by the operator. The elements of such notification are listed in Annex I;

- Article 5 defines emission limit values, with the corresponding values for SO_2, NOx, and PM, applicable for existing and new plants (where it is distinguished between *engines and gas turbines* on the one hand and *others* on the other hand) being laid down in Annex II.

Article 5(2) states that the emission limit values apply to existing combustion plants from January 2025 (medium combustion plants with a rated thermal input above 5 MW) and January 2030 respectively (existing medium combustion plants with a rated thermal input of 5 MW or less) to provide them with sufficient time to adapt technically to the requirements of the Directive. New installations have to comply with the requirements one year after the date of transposition.

Exemptions from compliance with these emission limit values for both existing and new sources granted by Member States are possible if the medium combustion plant does not operate for more than 500 hours per year; in that case, for plants firing solid fuels, an emission limit value for particulate matter of 200 mg/Nm^3 shall apply.

Article 5(4) of the Proposal requires Member States to apply more stringent emission limit values to individual plants in zones not complying with air quality limit values. Annex III lays down the benchmark values for that purpose that reflect the performance of the most advanced techniques available.

- Article 9 provides for the obligations of the operator and the competent authority in case of changes to a medium combustion plant.

Appendix 2 Definition of "soft" and "firm" law

Soft law vs. firm law

The term “soft law” (also “soft law measure”, “soft law obligation”) does not have a fixed legal meaning, and there is not a common understanding what soft law is. Usually, in the context of international law and international agreements in particular, “soft law” is distinguished:

› from a “firm law” obligation (or, synonymously used, “hard law” obligation respectively) describing an obligation to act, or to refrain from acting, for which an addressee is legally responsible; and

› from the absence of any obligation which is clearer than “soft law”.

During the negotiation of international agreements, when it comes to describing the obligations of the Parties, it is common practice to use terms having certain meaning in common understanding – either having the impact of imposing firm law obligations for the Parties, or having an impact that enables Parties to lessen, minimize or even avoid obligations or actions entirely. In this sense, for instance the UNEP document “Guide for Negotiators of Multilateral Environmental Agreements”[46] distinguishes the following impacts of some frequently used terms in such international agreements:

*“**May**: under no obligation. ‘May’ is permissive and discretionary on the part of the Party carrying out the action. A clause that says: ‘a country may take into consideration...’ creates no obligation for a country to do so.*

***Must**: is required to. ‘Must’ is almost always binding.*

***Shall**: An action that is required. A clause that uses the verb ‘shall’ is almost always binding, unless the ‘shall’ is used with another word that undermines its strength - e.g., ‘a contracting Party shall strive to do X, Y or Z’ or shall endeavour to. Here, the binding commitment is only to try to do X, Y, or Z, not to actually do it.*

***Should**: an action that is not required, but is advised – e.g., a country ought to try to do X, Y or Z.”*

Following this understanding of the respective terms, and with a specific view on the question of how the current EU acquis covers obligations stemming from the Minamata Convention, the term “soft law” is used to describe obligations below the level at which action (or refraining from action) is mandated (and if applicable, such action would need to be reflected by the Parties legislation).

[46] Accessed from http://www.unep.org/publications/contents/pub_details_search.asp?ID=3925. 30 May 2014.

Examples of firm law and soft law obligations within the Minamata Conventions can, by illustration, be found in Article 8(3) MC:

A Party with relevant sources shall take measures to control emissions and may prepare a national plan setting out the measures to be taken to control emissions and its expected targets, goals and outcomes.

where "*shall take measures*" describes a legal obligation to take action; and "*may prepare*" describes an action that is left to the discretion of each Party.

The use of the term "soft law", as described above, is without prejudice to the fact that a provision imposing a firm law obligation may contain a wording that lessens or minimizes the obligation on other occasions than described above (such as "where feasible"); a factor which is taken into account during the discussion of possible interpretations of the provision.

Appendix 3 Summary of Member State questionnaire replies

As part of this study, a questionnaire was sent to all Members States pertaining to selected issues of the assessment as well as the planned review of Regulation 1002/2008 on the mercury export ban and safe disposal. It also served as a review of Regulation 1102/2008. In the following, a summary is given of the received responses to the questionnaire organised by the questions posed.

2. Which countries have to date responded to the survey?

	Member States
Yes	16 (AT, BE, BG, CZ, DE, DK, ES, FI, HR, HU, IE, LT, PT, RO, SE, UK)

16 Member States have to date responded to this survey, as well as one country confirming that it would not be participating.

3. Member State legislation going beyond the EU law

Has your country implemented or proposed new legislation or other national initiatives since 2010 which go beyond the EU legislation on mercury?

	Member States
Yes	4 (DK, ES, LT, SE)
No	12 (AT, BE, HR, FI, DE, IE, RO, PT, UK, HU, BG, CZ)

The majority of countries that responded (three-quarters) had not implemented or proposed new mercury legislation/initiatives going beyond those already in place under EU law. Only four countries stated that they had. Additional mercury restrictions imposed by these countries, typically pertained to specific sectors and types of mercury compounds e.g. statutory prohibition of import, sale and export of mercury and mercury-containing products with specified exemptions; a phased ban on dental amalgams (SE); limits on mercury emissions from crematoria not covered under EU law (LT); lower occupational exposure limit values for mercury alkyl compounds (LT); stricter mercury migration limits in toys, electrical and electronic equipment (ES); tighter requirements around temporary storage of metallic mercury (ES); environmental quality standards for mercury in water (ES); methods and criteria for evaluation of mercury concentration in air (ES).

These countries also highlighted other non-legislative initiatives, mostly awareness raising campaigns e.g. risk warnings to vulnerable groups associated with consumption of certain sea foods with potentially high mercury content (SE); use and disposal of broken energy saving light bulbs with mercury content (DK), as well as green public sector procurement initiatives which included provisions on mercury (LT).

4. Sectors affected by the Minamata Convention provisions in your country

To your knowledge, do any of the sectors/activities targeted by the Minamata Convention listed below exist in your country?

	No. Member States
Yes	15 (AT, BE, DK, FI, DE, IE, LT, RO, ES, SE, PT, UK, HU, BG[47], CZ)
No	1 (HR)

Sector	No. Member States
Button cell batteries	
Switches and relays	2 (FI, UK)
Fluorescent lamps/ high pressure vapour lamps (HPMV)	2 (UK, HU)
Barometers	3 (BE[48], DK[49], UK)
Hygrometers	3 (BE[50], DK[51], UK)
Manometers	1 (DK[52])
Thermometers	3 (BE[53], DK[54], UK[55])

[47] Further details of domestic sectors targeted by the Minamata Convention were not provided by Bulgaria.
[48] Belgium's response indicates that one company was identified in barometer, hygrometer and thermometer sectors, though it is not known whether mercury is used in production.
[49] Denmark's response indicates that there may be production of barometers, hygrometers and manometers taking place in Denmark, although these in any case will be alternatives to traditional instruments and so will not contain mercury.
[50] See 2
[51] See 3
[52] See 3
[53] See 2
[54] See 3
[55] One company producing thermometers was identified in the UK, although mercury is unlikely to be used in production (Eds.: As stated elsewhere in this report, the company in question has produced mercury-added thermometers; their current state of substitution has not been investigated here).

Sphygmomanometers	1 (UK)
Dental amalgams/ filling materials	5 (AT, DK, ES, SE,CZ)
Acetaldehyde with Hg catalyst	
Vinyl chloride monomer (VCM) with Hg catalyst	3 (BE, RO[56], HU)
Sodium or potassium methylate/ ethylate with Hg catalyst/feedstock	2 (DE -production, UK -end-use)
Polyurethane using mercury containing catalysts	
Artisanal and small-scale gold mining	
Primary production of lead, zinc, copper or industrial gold with smelting and roasting processes	5 (BE, FI, ES, SE, HU)[57]
Waste incineration	10 (AT, BE, FI, IE, LT, ES, SE, PT, CZ, HU)
Cement clinker	9 (AT, DK, FI, IE, LT, ES, SE, PT, CZ)
Large scale commercial Hg stocks (above 50 tonnes stored)	1 (DE)
Recycling of mercury	5 (BE, IE, CZ, UK, HU)
Commercial disposal of hazardous Hg waste	1 (HU)

All but one of the Member States which responded had domestic sectors targeted by the Minamata Convention. Cement clinker production and waste incineration were the most prevalent sectors stated by countries (around three-fifths of respondents), and to a less extent the production of dental amalgams and filling materials (a third of respondents). This is not surprising given that these sectors were relatively mainstream in comparison to more specialised uses of mercury. The use of mercury in the manufacture of scientific instruments, electrical components and industrial components was restricted in each case to a few countries with specialised operations. Almost all countries responding were also

[56] There are no VCM installations currently in operation in Romania, although there are some quantities of mercury still present from a facility that is no longer in operation.
[57] Zinc and lead concentrates are produced at two major mines in Ireland although these operations do not involve smelting or roasting of ores.

able to provide examples of companies operating within these sectors. A few countries also specified domestic studies used to assess sectoral impacts (UK, SE, DK). The UK referred widely to a domestics study – 'An Assessment of the Future Levels of Demand for Mercury in the UK' (2009). Denmark highlighted a study looking at alternatives to mercury-containing measuring devices. Sweden drew on 4 domestic studies on the effects of amalgam use on different population cohorts, which formed the basis of its national ban.

5. Review of the Mercury Export Ban Regulation

5.1. Article 5 (1): "Member States shall submit to the Commission a copy of any permit issued for a facility designated to store metallic mercury temporarily or permanently (disposal operations D 15 or D 12 respectively, as defined in Annex II A of Directive 2006/ 12/EC), accompanied by the respective safety assessment pursuant to Article 4(1) of this Regulation."

Has your country issued any such permits?

	No. Member States
Yes	2 (HU, HR)
No	12 (AT, DK, FI, DE, IE, LT, ES, SE, PT, UK, BG, CZ)
Not answered / No information available at present	2 (BE, RO)

The overwhelming majority of countries had not issued permits for mercury storage facilities. Only two countries – Hungary and Croatia – stated having issued permits. Both of these were able to provide a list of permit issued. A total of 7 permits were issued in Hungary, and 63 permits issued across 44 different companies in Croatia.

5.2. Article 5 (2): "By 1 July 2012, Member States shall inform the Commission on the application and market effects of this Regulation in their respective territories."

Has this Regulation found any application in your country?

	No. Member States
Yes	4 (IE, ES, SE, HU)
No	11 (AT, HR, DK, FI, DE, LT, RO, PT, UK, BG, CZ)
Not answered	1 (BE)

The majority of respondents did not find that the Article 5(2) regulation had any application in their countries. Only four countries – Hungary, Ireland, Spain and

Sweden – noted any concrete application of the laws, mostly in the storage, disposal and waste export sectors.

Has any market effects of the Regulation been observed in your country?

	No. Member States
Yes	2 (ES, CZ)
No	11 (AT, HR, DK, FI, DE, IE, LT, RO, SE, PT, BG)
Not answered	3 (BE, UK, HU)

Two Member States – Spain and Czech Republic – stated having observed market effects in their countries as a result of the regulation, though this was largely confined to sub-regions and sectors. Some negative economic impacts had been felt regionally in Spain since 2001, with the closure of mercury mining operations. Nevertheless, the affected region has since been able to shift its focus to culture and tourism with the opening of a regional mining park and to the research of environmentally sound management solutions of mercury through The National Technological Centre for Mercury Decontamination. Impacts on the chlor-alkali sector were also noted in Spain. Czech Republic highlighted some adverse trade impacts resulting from the cessation of exports of dental mercury outside the EU (this related specifically to trade with Turkey – a key partner for a major Czech mercury production and waste recollection firm - BOME).

5.3. Article 5(3): "By 1 July 2012, importers, exporters and operators of activities referred to in Article 2, as appropriate, shall send to the Commission and to the competent authorities the following data:

(a) volumes, prices, originating country and destination country as well as the intended use of metallic mercury entering the Community;
(b) volumes, originating country and destination country of metallic mercury considered as waste that is traded cross-border within the Community."

Has your country received submissions of the following types of data from importers, exporters and operators of activities referred to in Article 2 of Reg. 1002/2008: (a) volumes, prices, originating country and destination country as well as the intended use of metallic mercury entering the Community?

	No. Member States
Yes	1 (UK)
No	14 (AT, HR, DK, FI, DE, IE, LT, RO, ES, SE, PT, HU, BG, CZ)
No information available at present	1 (BE)

Almost no respondents had received data submissions from relevant operators. The UK was the only country stating that it had received submissions of this kind. This comprised a submission from one company on the volumes and destinations of metallic mercury extracted from the cleaning of natural gas. This was transported for treatment in Switzerland and long-term storage and disposal in Germany.

Has your country received submissions of the following types of data from importers, exporters and operators of activities referred to in Article 2 of Reg. 1002/2008: (b) Volumes, originating country and destination country of metallic mercury considered as waste that is traded cross-border within the Community?

	No. Member States
Yes	1 (BG)
No	12 (AT, HR, DK, FI, DE, IE, RO, SE, PT, HU, CZ, UK)
Not answered	3 (BE, ES, LT)

Does your country find that there is a need for each of the following additions to EU legislation?

	No. Member States			
	Yes	No	Undecided	Not answered
(a) extending the export ban to other mercury compounds, mixtures with a lower mercury content and products containing mercury, in particular thermometers, barometers and sphygmomanometers	5 (AT, DK, DE, , SE, HU)	4 (CZ, HR, FI, BG)	4 (BE, IE,LT, UK)	3 (RO, ES, PT)
(b) an import ban of metallic mercury, mercury compounds and products containing mercury	5 (AT, DK, SE, HU, BG)	4 (CZ, HR, DE, FI)	4 (BE, LT, IE, UK)	3 (RO, ES, PT)
(c) extending the storage obligation to metallic mercury from other sources	5 (BE, DK, LT, SE, HU)	4 (CZ, HR, FI, BG)	2 (IE, UK)	5 (DE, RO, ES, PT, AT)
(d) time limits concerning temporary storage of metallic mercury	2 (DK, SE)	7 (CZ, HR, DE, FI, LT,HU, BG)	3 (BE, IE, UK)	4 (RO, ES, PT, AT)

Almost none of the respondents received data submissions from relevant operators. Bulgaria was the only country stating it had received submissions of this kind. This pertained to waste from mercury containing lamps.

Support for additional legislation varied across the Member States. There were marginally more countries in favour of the proposed additions than were opposed, though most countries were opposed to time limits to temporary storage of metallic mercury. Where specified, objection was raised on the basis that there were insufficient assessments undertaken as yet to provide a clear case for stricter regulation, rather than any fundamental opposition (LT). Bulgaria suggested that storage regulations should only be extended on the basis of a comprehensive impact assessment so as not to jeopardise the competitiveness of EU industry. Both Germany and Sweden concurred in principle on the need to set clear limits on temporary storage. Sweden was open as to the precise length of the limitations. Germany highlighted a specific need for additional assessments on the long-term behaviour of metallic mercury in underground storage to determine sound, knowledge-based requirements for permanent storage, though felt that present regulations were appropriate in the context of temporary storage (up to 5 years) and represented the best available techniques. In the remainder of cases, countries responding did not state the reasons for their position.

Concerning the extension of export bans to products and compounds with lower mercury content, countries in favour had either already put in place further restrictions or were broadly supportive of stricter regulations given the environmental risks involved (SE, DK). Specific concern was raised around the shipment of mercury wastes from scientific instruments to developing countries where it is an important source for small-scale and artisanal gold mining (DE). Lack of data and research also, in some cases, made it difficult for countries to form clear positions. Germany was opposed to an import ban. Its view was that such a ban would unduly restrict countries from exporting waste mercury to safe underground storage and disposal facilities that were presently only available in some Member States.'

5.4. Article 8(2)

Does your country have new research (since 2008) regarding the safe disposal of mercury waste?

	No. Member States
Yes	2 (ES, DE)
No	12 (AT, BE, HR, DK, FI, IE, LT, UK, BG, HU, CZ, RO)
Not answered	2 (SE, PT)

Two countries – Germany and Spain – mentioned new research they had undertaken regarding the safe disposal of mercury waste. A German study (the results of which have been provided to the EC), examined the risks of permanent disposal of metallic mercury and mercury sulphide in underground landfills in salt rock, drawing up a basis for establishing criteria and requirements to determine the feasibility of these options. Spain highlighted two studies looking at stabilisation and solidification processes/technologies to treat mercury-contaminated soil and waste with sulphur micro-cements.

Appendix 4 Import and export of mercury-added batteries

Import and export of mercury-added batteries, World/EU28					
Value in EUR		**2011**	**2012**	**2013**	**Average 2011-2013**
IMPORT	MERCURIC OXIDE CELLS AND BATTERIES (EXCL. SPENT)	746.455	1.269.497	2.376.935	1.464.296
EXPORT	MERCURIC OXIDE CELLS AND BATTERIES (EXCL. SPENT)	503.321	257.334	880.988	547.214
Net export		**-243.134**	**-1.012.163**	**-1.495.947**	**-917.081**
IMPORT	SILVER OXIDE CELLS AND BATTERIES (EXCL. SPENT)	26.650.826	30.681.733	26.257.492	27.863.350
EXPORT	SILVER OXIDE CELLS AND BATTERIES (EXCL. SPENT)	12.593.158	18.836.160	59.401.994	30.277.104
Net export		**-14.057.668**	**-11.845.573**	**33.144.502**	**2.413.754**
IMPORT	AIR-ZINC CELLS AND BATTERIES (EXCL. SPENT)	14.486.514	16.440.038	12.643.265	14.523.272
EXPORT	AIR-ZINC CELLS AND BATTERIES (EXCL. SPENT)	42.318.166	50.566.199	56.390.890	49.758.418
Net export		**27.831.652**	**34.126.161**	**43.747.625**	**35.235.146**
Tonnage		**2011**	**2012**	**2013**	**Average 2011-2013**
IMPORT	MERCURIC OXIDE CELLS AND BATTERIES (EXCL. SPENT)	261	270	272	268
EXPORT	MERCURIC OXIDE CELLS AND BATTERIES (EXCL. SPENT)	31	12	16	20
Net export		**-230**	**-258**	**-255**	**-248**
IMPORT	SILVER OXIDE CELLS AND BATTERIES (EXCL. SPENT)	277	350	193	273
EXPORT	SILVER OXIDE CELLS AND BATTERIES (EXCL. SPENT)	154	171	166	164
Net export		**-122**	**-180**	**-27**	**-110**
IMPORT	AIR-ZINC CELLS AND BATTERIES (EXCL. SPENT)	2.472	2.492	1.735	2.233
EXPORT	AIR-ZINC CELLS AND BATTERIES (EXCL. SPENT)	770	997	954	907
Net export		**-1.702**	**-1.495**	**-782**	**-1.326**

Appendix 5 IED coverage of coal-fired industrial boilers

Assessment of IED coverage of coal fired industrial combustion plants (boilers)	2010, TJ/y
Total energy input for all LCPs combusting "other solid fuels" *1 *2	**8,427,774**
Of this:	
CHP (Combined Heat and Power Plant)	2,523,478
ESI (Electricity Supply Industry)	2,504,403
District heating *4	21,352
Sub-sum, electricity and heat	**5,049,233**
Sub-sum for non-power, non-district-heating LCPs (difference) *4	**3,378,541**
MCP (1-50W), "other solid fuels" (estimate *3)	**169,000**
Share of IED-covered coal fired industrial combustion plants of total reported consumption of "other solid fuels"	**95%**

Notes:

*1: Data from http://www.eea.europa.eu/data-and-maps/data/plant-by-plant-emissions-of-so2-nox-and-dust-and-energy-input-of-large-combustion-plants-covered-by-directive-2001-80-ec-2, accessed 25 Feb 2015
The energy input is considered an adequate proxy for the coal consumption in this context.
*2: "Other solid fuels" are primarily coal of different types (AMEC, 2012).
*3: Data from http://ec.europa.eu/environment/archives/air/pdf/Impact_assessment_en.pdf, accessed 25 Feb 2015
*4: It is here assumed that district heating is not covered by "industrial boilers". Due to the small quantity it would not influence the percentage stated even if the district heating was included in the industrial boilers.

Appendix 6 Background information relating to mercury waste and recycling

In section 3.9.1 two categories of mercury waste are identified:

Category (1) wastes which are considered as waste according to Article 2 of Regulation 1102/2008

Category (2) other wastes generated from specific mercury applications in certain products and processes (see section 3.9.1):

Available information on the wastes listed under category (2) is summarised in the COWI and Concorde East/West (2008) study. The following table gives an overview of the quantities of mercury in the wastes listed under category (2) ending up in waste, being recycled, disposed of in MSW and otherwise disposed of. It shows that substantial amounts of mercury have accumulated in society and will be removed gradually and become available for mercury recycling in the EU.

Appendix table 2 Quantity of mercury in different waste types listed under category 2 in the EU in tonnes; (reference year 2007; based on COWI and Concorde East/West, 2008).

Origin of waste	Total quantity (t/y)	Recovery (t/y)	MSW disposal (t/y)	Other disposal (t/y)	Accumulated in society (t)
Light sources	14.2	1.6	11	1.6	65
Batteries	30	4	20	6	99
Dental amalgams	95	30	22	43	1,000
Measuring equipment	21.4	4.5	13.5	3.4	70
Switches and relays	14	7	5.6	1.4	125
Chemicals	40.5	6.5	22	12	300
Miscellaneous	70	13	0	57	125
Total	285.1	66.6	94.1	124.4	1,784
Percentage (in %)	100	23.4	33.0	43.6	n.a.

According to the COWI and Concorde East/West (2008) data, out of a total mercury quantity of about 285 t/y approximately 67 t/y is recovered (23.4%). The remaining mercury, around 219 t/y, is disposed of. The total mercury supply from recycling in 2007 (excluding mercury waste from chlor-alkali production) in the EU was about 100 t/y. The current annual supply from recycling of waste is assumed to amount to approximately 100 tonnes (year 2014; still excluding waste from chlor-alkali production). This is roughly in line with information obtained for this study from "Hazardous Waste Europe", i.e. currently there are five facilities in the EU for the treatment of mercury containing waste. These produce between 50 and 120 t/y of mercury[58] in total. In its submission to the study Hazardous Waste Europe explains that the real production is below 100 t/y and that only one plant is equipped with triple distillation to produce very high quality mercury.[59]

There are no data from which volumes of waste containing mercury can be directly estimated. Table 26 of COWI (2014) reports typical mercury concentrations in relevant mercury-containing products but these data cannot be used to estimate volumes of waste that contain the 100 t/y mercury.

In Germany in 2005 there were 32,600t of waste containing mercury. Information on mercury content is available for some waste (see COWI and Concorde East/West, 2008). If the generation of mercury-containing waste throughout the EU matched that of Germany (on a *per capita* basis), then about 200,000 tonnes of mercury-containing waste was generated in 2005 in EU 27 (including waste from chlor-alkali production). But Germany is not considered a representative country with respect to mercury waste generation and several sources of mercury-containing waste are not relevant in the context of the options discussed or have significantly changed since 2005. It can be assumed that annual quantities of mercury-containing waste have decreased since 2005 and are currently below 200,000 t/y.

Prices for treatment of waste per kg of mercury depend on the mercury concentration and the character of the waste. COWI (2012) differentiates between (1) waste with low to moderate concentrations of mercury and (2) waste with high concentrations of mercury. Cost estimates for environmental sound disposal of waste with low to moderate concentrations of mercury have not been calculated in that report.

Waste with low to moderate concentrations of mercury – considerations related to quantities and cost impacts

With existing data it is not possible to assess the impacts of requiring wastes containing moderate concentrations of mercury to be disposed of. The quantities of relevant waste would also be heavily dependent on the thresholds set for mercury-containing waste by the Conference of the Parties to the MC.

However, approximate costs can be estimated from existing information. Waste with even quite low concentrations of mercury (above 0.1%) is considered hazardous according to the EU waste regulation. Costs for disposal of mercury waste with low to moderate mercury content are similar to disposal costs for other hazardous waste. Costs for wastes containing persistent organic pollutants (POPs) range from 80 to 250 EUR/t, depending on treatment:

- 80 EUR/t for disposal;
- 250 EUR/t for disposal with stabilisation;
- 250 EUR/t for underground disposal;

[58] Personal communication from Hazardous Waste Europe, 5.8.2014
[59] Stakeholder contribution Hazardous Waste Europe 28.7.2014 (available at http://ec.europa.eu/environment/chemicals/mercury/)

100 EUR/t for incineration (100 EUR/t);

The best estimate average cost is ~ 170 EUR/t).

Recycling costs are around 40 EUR/t (see BiPRO, 2011). With these cost factors, and assuming around 100,000 t/y of mercury-containing waste with low to moderate mercury content and that 23.4 % (otherwise recovered) will have to be disposed of instead of being recycled, then the incremental costs are around 3 million EUR/y. Waste quantities may be significantly higher or lower and costs for treatment of mercury waste may be significantly higher. Prices (gate fees) for treatment of mercury-containing waste in Denmark range from 100 to 2,700 EUR/kg Hg for specific waste types and may even be higher. Prices range from 12,000 to 15,000 EUR/kg Hg for specific waste types such as thermometers, manometers etc. with fluid metal mercury which require labour intensive segregation of mercury and mercury refining abroad (see COWI, 2012).

Other additional costs are associated with the segregation and collection of such waste, as well as for the transport and packaging of the waste prior to the final waste treatment. Transport costs for regional (lorry) transport are generally considered low compared to the costs for safe treatment/deposition (COWI, 2012).

Waste with high concentrations of mercury – considerations related to quantities and cost impacts

A large volume of mercury stemming from wastes listed under category (1) will have to be disposed of in an environmentally sound manner. The disposal of excess mercury from decommissioned chlor-alkali plants is a key issue, albeit one that arises from Regulation (EC) 1102/2008 and is thus not an impact of the MC.

In total, around 11,000 tonnes of metallic mercury will need to be disposed of as waste in the EU over the next 40 years. The majority, approximately 8,400 tonnes, will accrue between 2011 and 2020 (an average of 840 t/y in that period, see Hagemann et al. (2014)).

The relevant excess EU supply (i.e. that not coming from waste listed under category (1)) is expected to be in the range of 0 - 160 t/y. 160 tonnes excess supply would be available if supply was 200 t/y while demand stood at 40 tonnes. This is not a realistic scenario, as actual supply is expected to mirror demand, at least in the short term. With supply in the around 200 t/y and demand in the 40 - 220 tonnes range (130 t/y) it is estimated that 60 t/y of excess mercury would be generated. This additional excess mercury would have to be disposed of as waste in addition to that disposed of due to the Regulation (EC) 1102/2008 obligation.

Some category (2) mercury waste is separately collected and treated as hazardous waste (about 23%; see Appendix table 2), while a substantial share is disposed of, e.g. with municipal waste, and is thus often either incinerated or landfilled and contributes to mercury emissions. This should be avoided by increasing the share of mercury which is disposed on in an environmentally sound manner.

Additional information on environmentally sound disposal of mercury waste

Technologies for the environmentally sound disposal of mercury wastes containing low or and high mercury wastes are available (see e.g. UNEP (2011): Basel Convention technical guidelines for the environmentally sound management of wastes consisting of elemental mercury and wastes containing or contaminated with mercury).

Appendix 7 Stakeholder consultation

A preliminary version of this report was presented at a stakeholder consultation workshop held 7 July 2014 in Brussels, and stakeholders were invited to submit written feedback to the study report generally and for a number of specific issues for which data were needed.

All written contributions submitted by stakeholders is presented at the European Commission's mercury website at http://ec.europa.eu/environment/chemicals/mercury/ratification_en.htm, where the full contributions can be studied.

The stakeholder feedback received is dealt with in the following ways:

- Stakeholder contributions exclusively pertaining to dental amalgam will be considered by the Commission as part of their work with implementing the Minamata Convention on Mercury (separately from this study).
- All other contributions were reviewed and considered for implementation in this study report.
  - Of these, contributions exclusively consisting of positions will be considered by the Commission as part of their work with implementing the Minamata Convention on Mercury (separately from this study).
  - All other contributions, namely those listed below, were reviewed carefully, and aspects supplementing the preliminary report's description, or pointing out errors, were implemented in the report as appropriate and feasible, with explicit references. Some contributions suggesting substantial additional study could not be implemented within the framework of this study contract.
    - Albemarle, 4 Aug 14
    - BASF, 4 Aug 14
    - BERMAN Termómetros e Instrumentación, 4 July 14
    - Bulgaria, 7 Aug 14
    - CEMBUREAU, 4 Aug 14
    - CEWEP, 24 July 14
    - EnviroCat; 25 July 2014
    - EURELECTRIC, 4 Aug 14
    - Euromines, 4 Aug 14
    - European Environmental Bureau (EEB), 31 July 14
    - Evonik, 4 Aug 14
    - FEAD, 18 July 14
    - Germany, 14 July 14, 4 Aug 14 and 28 Aug 14
    - Hazardous Waste Europe, 31 July 14
    - Institute for environmental Security, 4 Aug 14
    - Lighting Europe; 1 Aug 14

- Ludwig Schneider, 3 July 2014
- Peter Maxson, Concorde East/West; 31 July 14
- Russel Scientific, 7 July 2014
- Spain, 4 Aug 14
- Sweden, 4 Aug 14

Later follow-up communication has taken place with some stakeholders (also some not listed above), and resulting data have been incorporated in the report, as appropriate, with explicit references.

*