European Commission, DG Environment

Study on the potential for reducing mercury pollution from dental amalgam and batteries

Stakeholder Workshop

26 March 2012

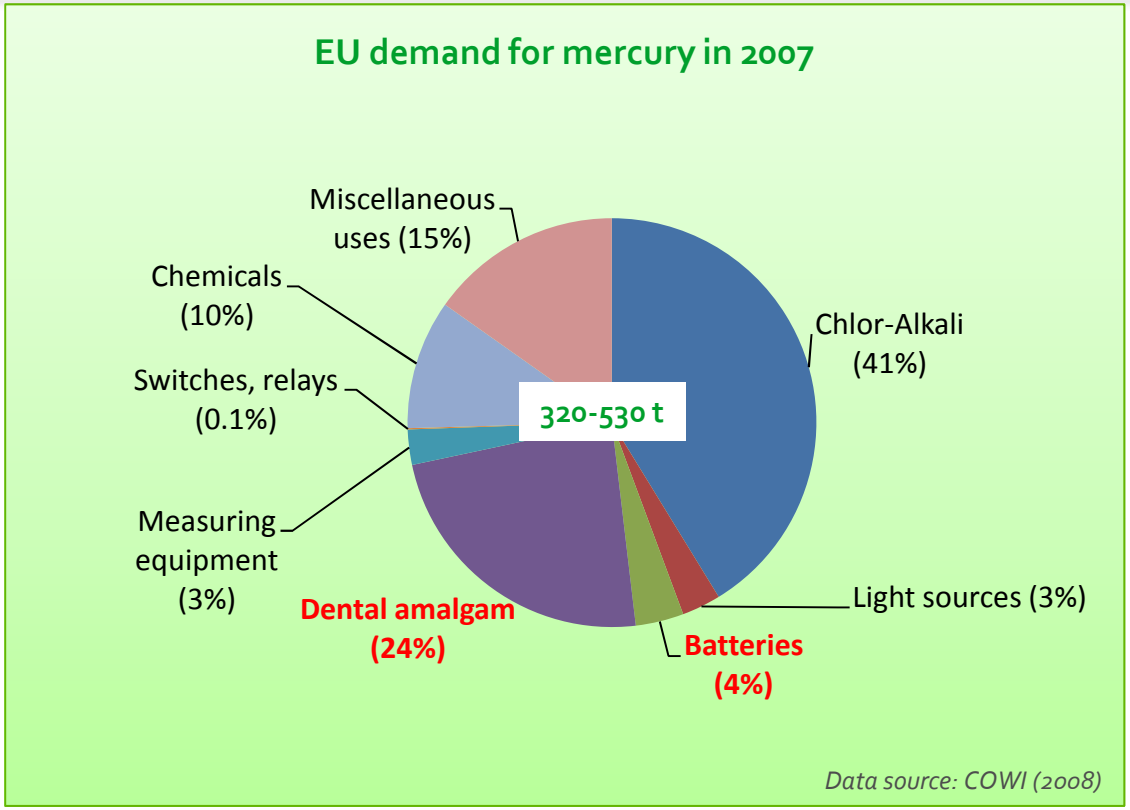
Agenda

9:30 – 9:40	Setting the scene	EC
9:40 – 9:50	Introduction to the study	BIO
PART I: MERCURY IN BATTERIES		
9:50 – 10:20	Presentation of the study results (context, key issues, policy options, environmental and socioeconomic impacts, conclusions)	BIO
10:20 – 10:30	Q&A	
10:30 – 10:45	Discussion and closing remarks	All
10:45 – 11:00	*Coffee break*	
PART II: MERCURY IN DENTAL AMALGAM		
11:00 – 11:45	Presentation on context, key issues, objectives and policy options	BIO
11:45 – 12:00	Q&A	All
12:00 – 12:15	Presentation on environmental impacts of policy options	BIO
12:15 – 12:30	Q&A	All
12:30 – 14:00	*Lunch break*	
14:00 – 14:30	Presentation on socioeconomic impacts of policy options	BIO
14:30 – 14:45	Q&A	All
14:45– 15:00	Presentation on conclusions of the study	BIO
15:00 – 15:15	*Coffee break*	
15:15 – 16:15	Discussion	All
16:15 – 16:30	Summary and closing remarks	EC

Introduction to the Study
&
Objectives of the Workshop

Context

- Increasing evidence of the **adverse environmental and health effects** of mercury (Hg)
- **Emissions from Hg use in products and processes:** significant contributor to EU Hg pollution problem



- **Review of the EU Mercury Strategy in 2010**
  → Highlighted areas for further improvement, among which the **remaining uses of Hg** in several applications where Hg-free alternatives exist and are already used to some extent – in particular **dental amalgam and button cell batteries**.
- Preparation of a **Global Mercury Treaty** (target date for adoption: 2013)

Study objectives

This study aims to provide the Commission with an evidence base in order to inform future EU policy actions

Specific objectives:

- Establish the current situation with regards to the **quantities of Hg used in dental amalgam and batteries** in the EU
- Examine the **environmental impacts** of these products over their life cycle
- Propose and compare relevant **policy options in order to reduce the environmental impact of these products** and **promote the use of Hg-free alternatives**, with the objective to minimise and, where feasible, eliminate mercury use

Approach

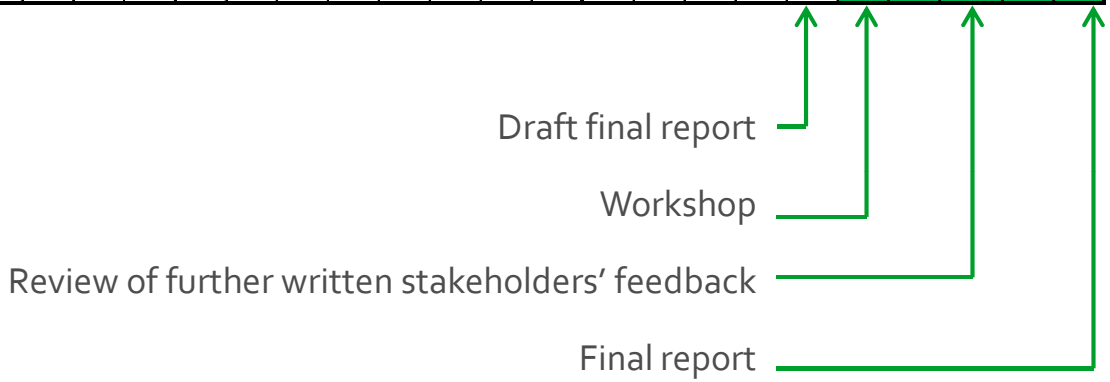
- **Builds upon previous work** conducted on the issue of Hg pollution from dental amalgam and batteries at EU level
- Focus placed on **complementing and updating** results from previous studies, by:
  - Analysing the **most recent data**
  - **Collecting a maximum of information from all MS**

    → Highlight similarities and contrasts between MS
- **Limitations** associated with the availability of data across MS and the reliability of the data provided to BIO

  → Some assumptions and extrapolations required

Study timeframe and objectives of the workshop

Tasks		2011												2012									
		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr		May	
Task 1	Scientific/market review and analysis of environmental impacts																						
Task 2	Assessment of policy options																						
Task 3	Workshop and report finalisation																						



Workshop's objectives:

- Share preliminary findings of the study
- Obtain your feedback
- Validate key assumptions made in the study
- Obtain further data and information to finalise the report

PART I

MERCURY IN BATTERIES

Contents

- Background and policy context
- Methodology
- What is the problem?
- Current situation
- Objectives and selected policy options
- Environmental, economic and social impacts of policy options
- Conclusions
- Discussion

Background

- Small amounts of Hg used in button cells in order to suppress the formation of internal gasses that affect all batteries containing zinc electrodes. Gassing can lead to leakage, possible rupture and/or short shelf life of batteries.

- **Environment Council invited Commission** to "*extend its investigation to mercury-containing button cell batteries that are still allowed on the EU market, and to assess the need for further risk management measures*"

- Next review of Battery Directive (2006/66/EC): 2016

- Present study primarily aims at :

  - ✓ Gathering information on the current market situation
  - ✓ Feed in the future policy and legislative reviews that the Commission will undertake (e.g. international negotiations on a global legally binding instrument on mercury, review of the Battery Directive in 2016)

Policy context

- Use of Hg in batteries already restricted in EU (Directive 2006/66/EC)
  - ✓ All batteries and accumulators containing > 0.0005% Hg by weight
  - ✓ Button cells > 2% Hg by weight
- Hg-containing batteries are classified hazardous waste in EU (Decision 2000/532/EC)
- Internationally, initiatives to further reduce Hg use in button cells
  - ✓ Three US States (Maine, Connecticut and Rhode Island) banned the sale of Hg-containing button cells from mid-2011
  - ✓ US battery manufacturers have voluntarily committed to eliminating Hg in button cell batteries sold in the USA from 2011
  - ✓ China, issued 'Clean Production Guidelines' for the alkaline button cell battery sector in December 2011

Methodology

- Main information sources
  - ✓ Review of publically available market data *(very little)*
  - ✓ Questionnaire to stakeholders *(EPBA, EBRA, several battery manufacturers, battery compliance organisations in MS and battery waste recyclers)*
  - ✓ Follow up telephone interviews
- Limitations
  - ✓ Market share of Hg-free button cells in EU is not available
  - ✓ Volume of button cells imported to EU already incorporated in products cannot be estimated

What is the problem?

- Hg pollution from button cells mainly due to **improper waste management** at their end of life
- Battery Directive sets collection targets: **25% by 2012** and **45% by 2016**
- In 2009 approximately **88% of button cells waste escaped separate waste collection schemes** (representing approx. **5.5 tonnes of Hg**)
- Increasing separate collection of batteries is a challenging task
- The problem can be solved by substituting Hg-containing button cells by **Hg-free alternatives**

Current situation

- Quantities placed on market
  - ✓ Button cells market in EU in 2010 ≈ **1 080 million units**
  - ✓ DE, UK, FR, ES, IT and NL together represent ≈ 80% of button cells market in EU
- Hg-free alternatives
  - ✓ Hg-free alternatives now available **for all applications** (their current market share is not available)
  - ✓ Cost of Hg-free alternatives at present **slightly higher** (approx. 10%) than Hg-containing versions
- **Collection rate of 12%** was calculated for button cell waste in 2009 in EU
- **Similar collection costs** for Hg-containing and Hg-free button cell waste due to lack of sorting

Objectives and policy options

Policy objectives

- General objective: Reduce the environmental impacts from the use of Hg in button cells
- Specific objective: Restrict and, where feasible, eliminate Hg from button cells

- **Option 1: No policy change**
  - ✓ No further constraints concerning the use of Hg in button cells placed on the EU market
  - ✓ Gradual shift to Hg-free button cells in the EU will probably continue in the coming years

- **Option 2: Ban the placing on the market of Hg-containing button cells in the EU**
  - ✓ Deleting the exemption contained in (Article 4 (2)) of the Batteries Directive without any exception
  - ✓ Aiming to accelerate transition to Hg-free alternatives and reduce production costs

Environmental impacts

- **Option 1: No policy change**

  - ✓ Hg contained in button cells placed in EU ≈ **8.4 t** in 2010 (2.3 to 14.4 t)
  - ✓ Waste collection scenario 1 (12% collection rate): ≈ **200 t button cell waste** separately collected. In other words, ≈ **6.4 t Hg** contained in button cell waste escaped separate collection
  - ✓ Waste collection scenario 2 (45% collection rate): ≈ **745 t button cell waste** separately collected. In other words, ≈ **4 t Hg** contained in button cell waste escaped separate collection
  - ✓ Hg potentially released to environment due to button cells ≈ **4 to 6.4 t** in 2010

- **Option 2: Hg ban**

  - ✓ Will avoid Hg introduction in EU economy and subsequent Hg pollution of environment by corresponding quantities listed in Option 1

Economic impacts (1/3)

Option 1: No policy change

- No additional costs over normal business functioning expenditure for the industry
- No additional administrative burden for the Member States authorities

Economic impacts (2/3)

Option 2: Hg ban

- **Button cell manufacturers/trades/importers:**
  - ✓ No significant additional investments in R&D of Hg-free button cells
  - ✓ Small changes are sufficient to convert existing assembly lines for making Hg-free button cells
- **Retailers:** no impact
- **Consumers:**
  - ✓ Hg-free button cells cost **≈ 10% more** than their Hg-containing substitutes
  - ✓ An additional annual cost of around **EUR 143 million** *(≈ **EUR 0.13 per unit of button cell** sold in EU)* for the consumers
  - ✓ **Economies of scale** will lead to decrease in the production cost of Hg-free button cells, resulting in a lower impact on consumers

Economic impacts (3/3)

Option 2: Hg ban

- **Button cell waste management companies**
  - ✓ **No difference in collection costs** for Hg-containing and Hg-free button cells
  - ✓ **Reduced (by 30-40%) waste treatment costs** (in the long-term) for the Hg-free button cell waste will make button cell recycling more attractive to the recycling companies
  - ✓ Unavailability of Hg-containing waste should not have a significant negative impact on the activities of recyclers ***(lowering of their turnover by 5-10%)***
- **Administrative burden**
  - ✓ No additional administrative burden for Member State authorities

Social impacts

- **Option 1: No policy change**

  - ✓ **Employment generation:** No impact

- **Option 2: Hg ban**

  - ✓ **Employment generation:** May slightly affect the employment generation in EU *(primarily related to end-of-life management of button cells)*.

  - ✓ **Public health and safety:** Decrease in Hg releases to the environment would result in avoided damages to public health, as exposure to Hg due to button cells will be eliminated in the long-term.

Conclusions

- Option 2 emerges out as a clear winner in terms of environmental benefits, with very limited adverse economic impacts as compared with the 'no policy change' option

- Option 2 would foster innovation and create further business opportunities for button cell companies in EU on the global market

PART II

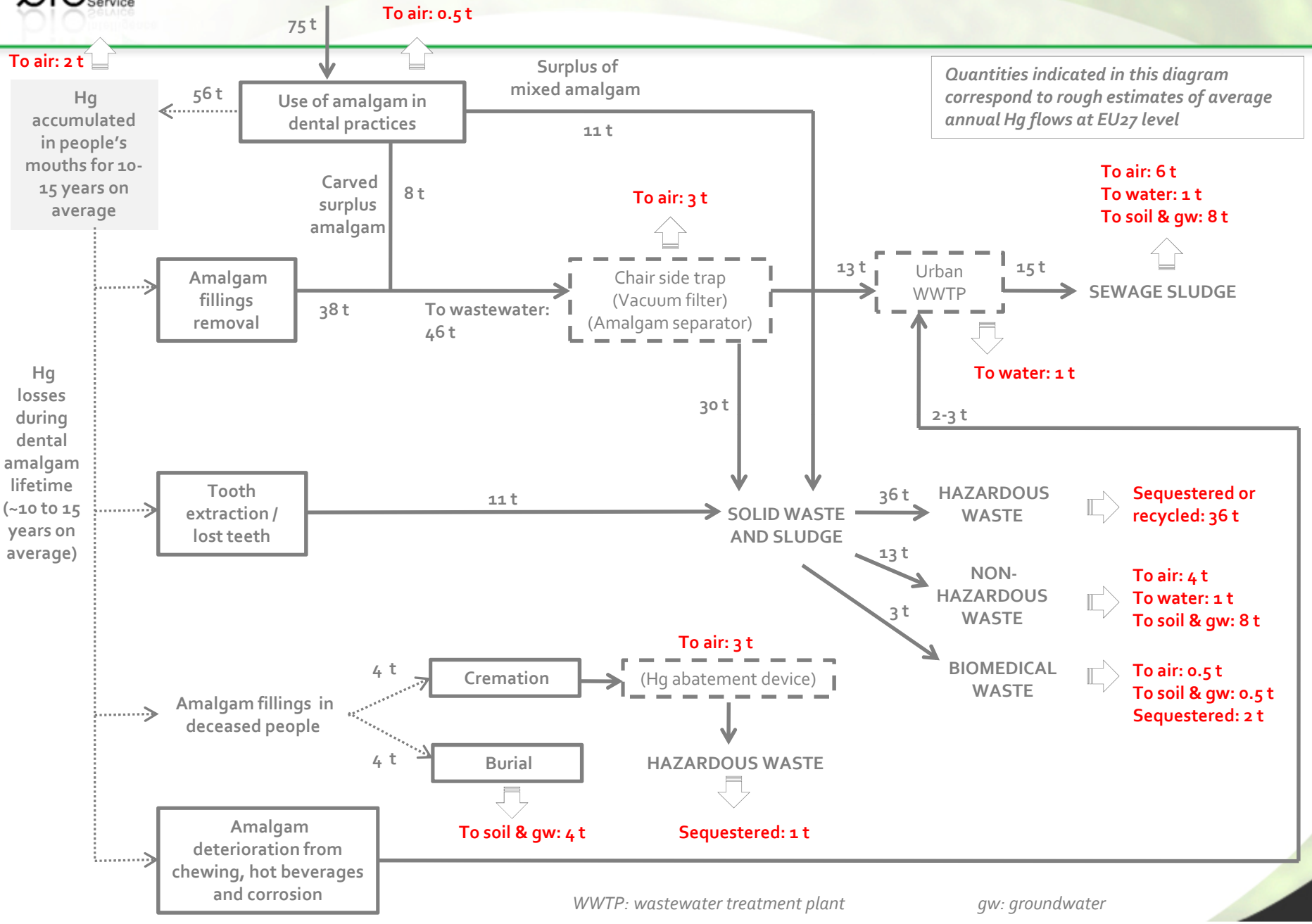
MERCURY IN DENTAL AMALGAM

Context & Key Issues

What is dental amalgam?

- Combination of metals containing:
  - ~ 50% Hg in the elemental form
  - Other metals: silver (~ 35%), tin, copper, and other trace metals
- Used for over 150 years for the treatment of dental cavities
- Controversial ever since it was introduced because of its Hg content
- Available in the form of pre-dosed capsules or in bulk form (e.g. 'mercury spills')

Hg flows associated with dental amalgam use



Quantities indicated in this diagram correspond to rough estimates of average annual Hg flows at EU27 level

WWTP: wastewater treatment plant

gw: groundwater

EU policy context

Previous studies identified key data gaps hindering the evaluation and development of further EU policy action, as well as some legislation implementation gaps

- SCENIHR opinion on **direct risks for public health** (2008)
- SCHER opinion on **environmental impacts** and **indirect health risks** (2008)
- Lack of up-to-date data on **Hg emissions from cremation** to assess effectiveness of initiatives in place (OSPAR Recommendation and some national legal requirements)
- Non-compliance of many dental facilities with **EU waste legislation** (2005 EC survey; 2010 review of EU Mercury Strategy)

→ In 2010, Commission expressed its intention to undertake a study to **assess the use of mercury in dental amalgam with due consideration to all aspects of its lifecycle**

→ In 2011, the **Environment Council** invited the Commission and MS to '*consider, where appropriate, the possible need for measures to reduce the environmental impact of mercury in dental amalgam*'

Member States' initiatives

Some MS have put in place legislation that goes beyond EU policy concerning the issue of dental amalgam

For example:

- Recommendations from health authorities to **restrict the use of dental amalgam** (e.g. in vulnerable patients) (DE, FR, IT, NL, and Catalonia in ES) or legal provisions to partially or totally prohibit the use of dental amalgam (DK and SE)
- Mandatory installation of **amalgam separators** in dental facilities (AT, BE, CZ, DE, FR, FI, IT, LV, MT, NL, PT, SE, SI, and the UK)
- ELVs for Hg and/or requirement for Hg abatement devices at **crematoria** (BE, CZ, DE, DK, FR, IT, LU, NL, and the UK)
- More stringent mercury limit values in **sewage sludge used for agricultural purposes** (in many MS)

International policy context

- **Global Mercury Treaty under preparation:** Discussions on possible '**phase-down**' of dental amalgam use at **global level**

- **Existing international agreements concerning the reduction of Hg emissions from crematoria (non-binding):**

  - ✓ OSPAR Recommendation 2003/4 (12 MS) → Use of BAT

  - ✓ HELCOM Recommendation 29/1 (applies to DK, FI, SE) → Hg air emissions < 0.1 mg/Nm^3

- **Initiatives in non-EU countries:** JP, NO and CH have restricted or almost totally banned the use of dental amalgam, among other mercury uses (through legislation and/or voluntary measures)

Key methodological aspects

Thorough **review of recent studies** on environmental and health aspects of dental amalgam use

Identification of **information gaps** and areas requiring **complementary and/or updated** data

Tailored questionnaires addressed to a wide range of stakeholders (approx. 300)

Follow-up telephone discussions with CED, a few national dental associations and researchers

Consultation of stakeholders (workshop)

- Responses received:
  - Environmental and/or health authorities from **19 MS**
  - **5** responses from **national dental associations** (plus some joint responses with national health authorities)
  - **2** responses from **dental fillings suppliers**
  - **4** responses from **cremation organisations**
  - **5** responses from **water treatment organisations**
  - **4** responses from **NGOs and academic experts**
- Some **limitations due to a lack of reliable and up-to-date data** in many MS on dental amalgam use, related Hg emissions, and dental restoration costs

  → Required assumptions and extrapolations

What is the problem? (1/10)

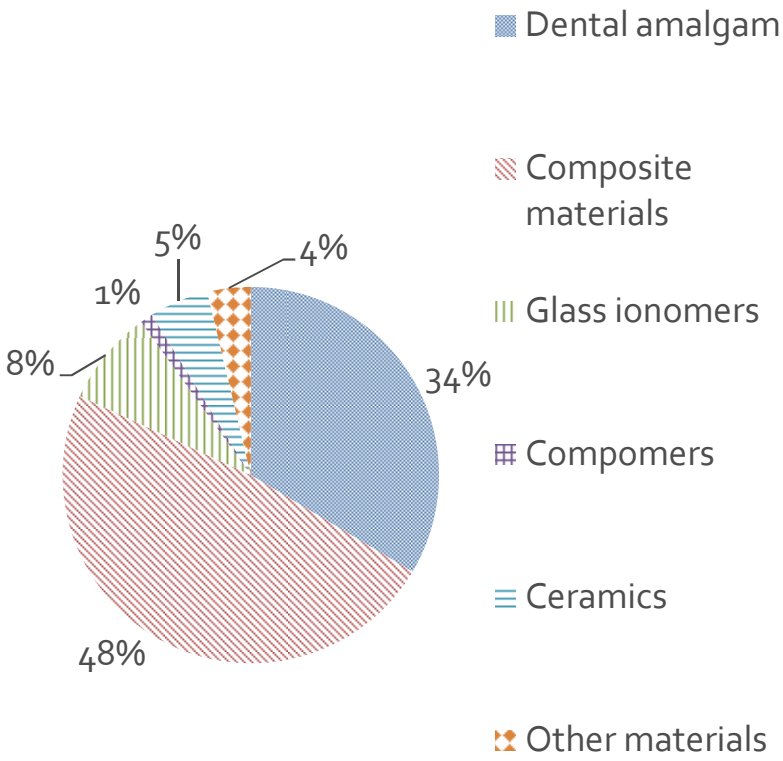
Dental use of Hg seems to have been declining over the last few years

Share of dental amalgam in 2010 (in % restorations)	Expected share of dental amalgam in 2025 (in % restorations)	Dental Hg use in 2010 (t)	Projected dental Hg use in 2025 (baseline scenario) (t)
Group 1 - DK, EE, SE, IT, FI			
0-5%	0%	0.3-0.4	0
Group 2 - BG, BE, CY, DE, HU, IE, LU, NL, PT, ES, LV			
6-35%	5 to 15%	9 – 12	3– 8
Group 3 - AT, CZ, FR, GR, LT, MT, PL, RO, SK, SI, UK			
>35%	20-30%	46 - 78	23-35
	TOTAL EU 27	**55 - 95**	**27 - 43**

- FR and PL account for ~ 50% of EU27 demand
- Decline of dental amalgam use indicated by the CED and responses from 10 MS
- Encapsulated vs. bulk Hg ~70% vs. 30%

What is the problem? (2/10)

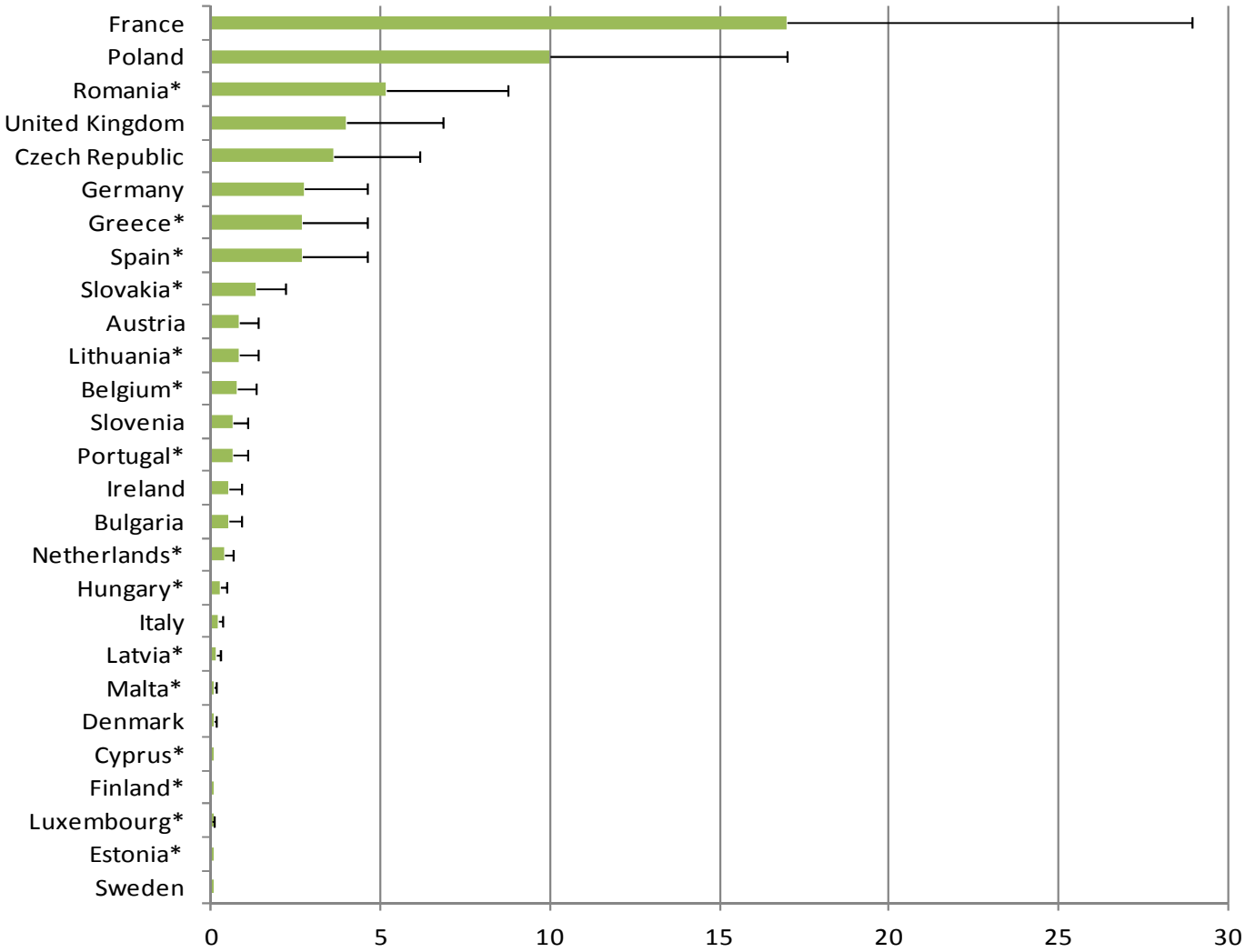
...while a larger proportion of dental restorations have been using Hg-free materials



Share of dental filling materials used in EU, 2010 (based on number of restorations)

- ~ 370 million dental restorations/year in EU27 of which:
  - ~ 125 million with dental amalgam
  - ~ 245 million with Hg-free materials
- Dental amalgam is gradually substituted with Hg-free materials

Demand for dental mercury in EU MS, 2010 (t Hg/year)



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

What is the problem? (3/10)

Although dental use of Hg seems to have been declining over the last few years, it remains a significant contributor to the mercury problem in the EU

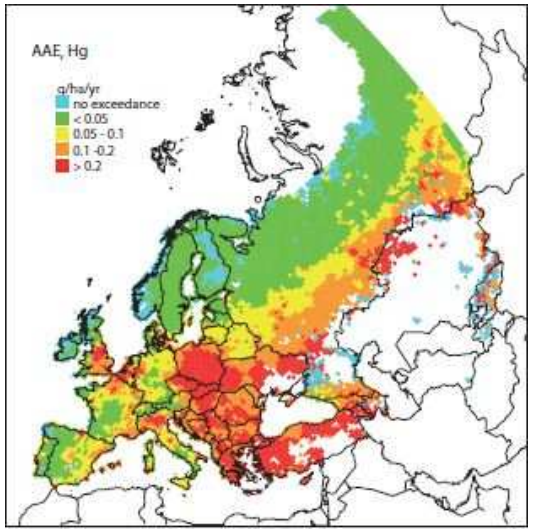
- Current levels of Hg in the environment, in the EU, pose significant **health risks to certain population groups** such as high-level fish consumers, women of childbearing age and children

- There are also **environmental risks**, for example the disturbance of microbiological activity in soils and harm to wildlife populations.

- **Dental amalgam use** remains a significant contributor to overall Hg environmental releases in the EU

  - **~ 45 t Hg/year** from EU dental practices end up in **chairside effluents**, with only a part of which being captured and treated as hazardous waste in compliance with EU legislation

  - Mercury in **dental waste** represents ~ **50 t/year**



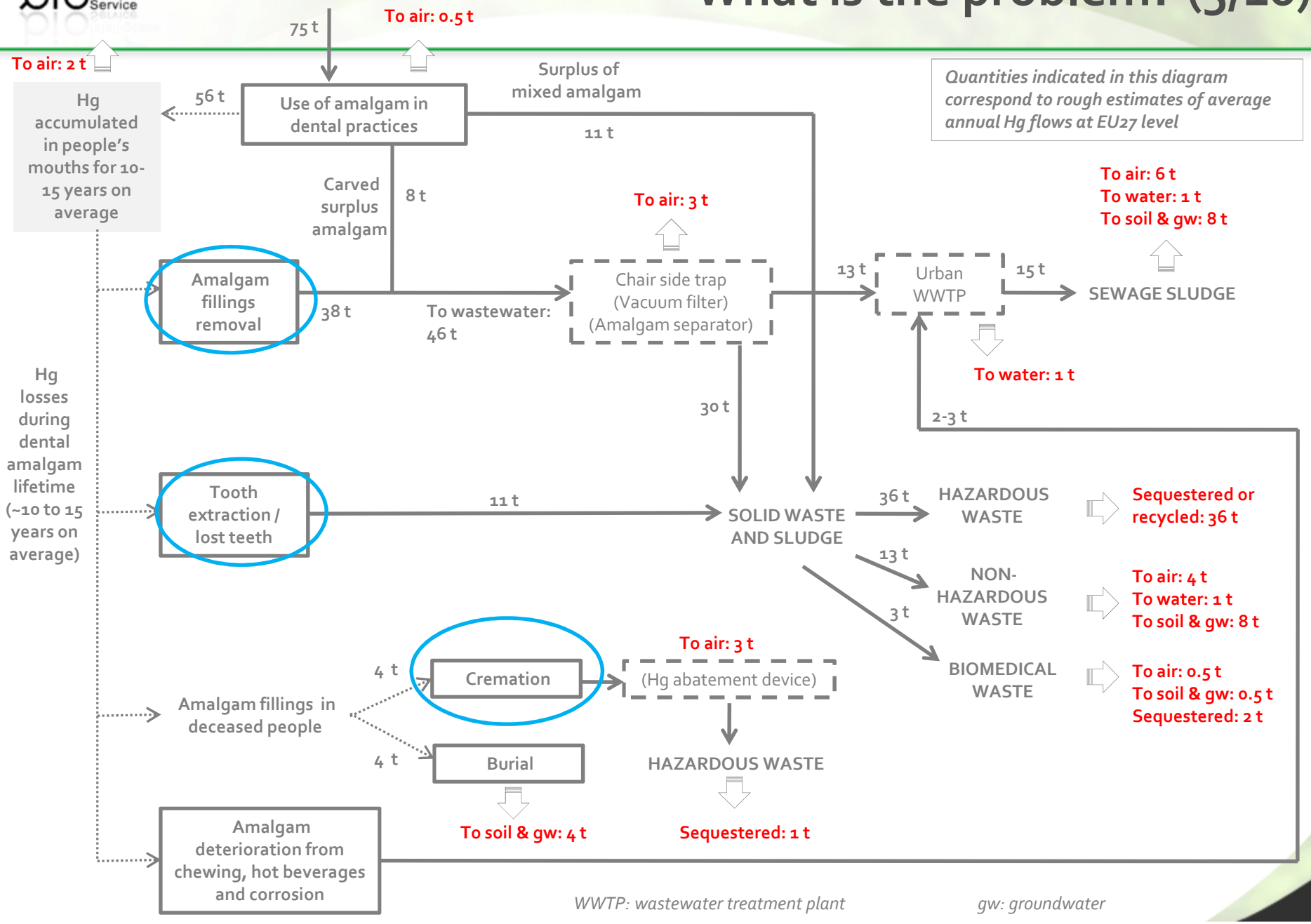
Average accumulated critical load exceedence for Hg (CEE Status Report 2008)

What is the problem? (4/10)

Potentially bioavailable: 34-50 t Hg/y

Fate of mercury from dental amalgam use	Hg quantities associated with dental amalgam use (t /year)	Available data on anthropogenic Hg releases in the EU (t/year)
Released to the **air** (with possible further deposition on soil and vegetation)	16 - 23	EU report under UNECE Convention on LRTAP: **73 t** in 2009
Released to **surface water**	2 - 4	E-PRTR: **6.3 t** in 2009 from industrial facilities (incl. urban WWTPs contributing 2.5 t, i.e. 40%) Sunseth et al.: **27 t** in 2005 (urban WWTPs estimated to contribute 6 t, i.e. 22%)
Released to **soil and groundwater**	16 - 24	N/A
Sequestered for long-term or recycled	31-46	N/A

What is the problem? (5/10)



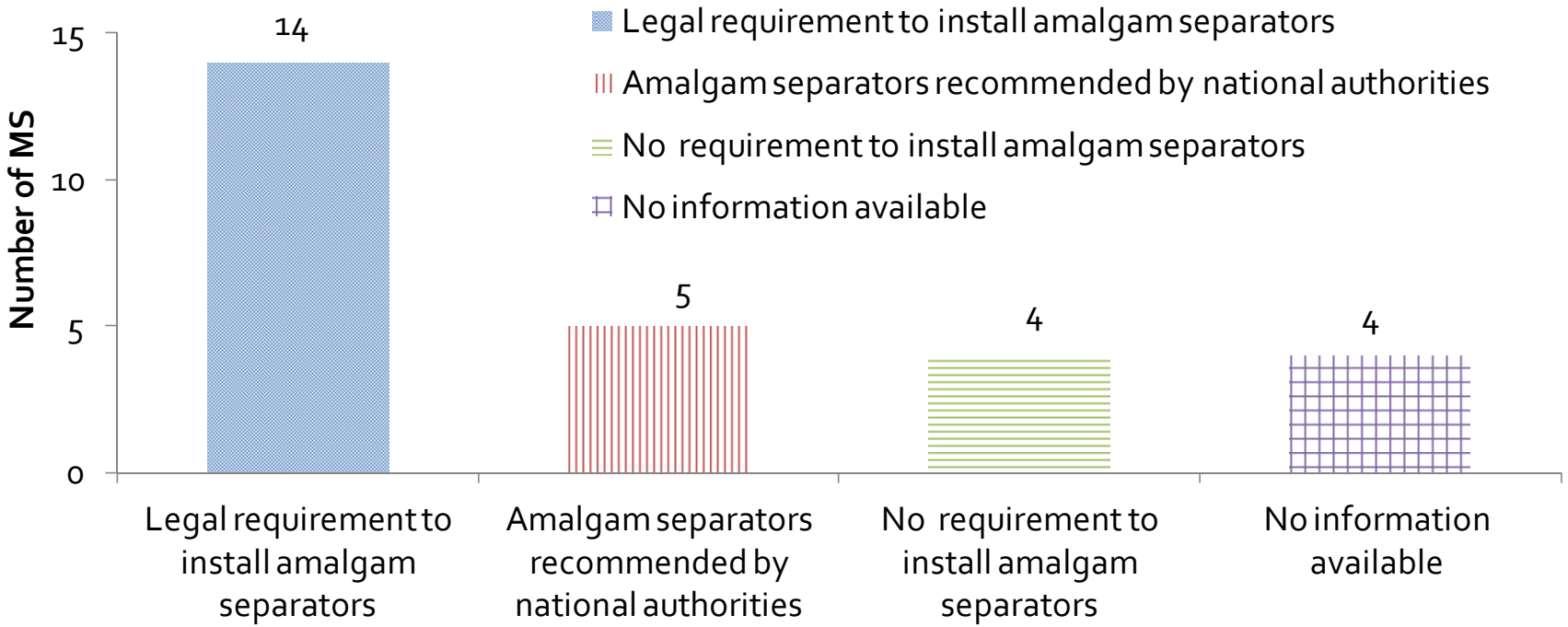
Quantities indicated in this diagram correspond to rough estimates of average annual Hg flows at EU27 level

WWTP: wastewater treatment plant *gw: groundwater*

What is the problem? (6/10)

Pollution due to historical use of dental amalgam mainly results from

- **non-compliance of dental facilities with EU waste legislation**
- **a lack of anticipation with regard to EU legislation on water quality**



What is the problem? (7/10)

- **≈ 25%** of EU dental facilities still not equipped with amalgam separators

% of dental facilities equipped with amalgam separators	Member States
~100%	**10 MS**: AT, CZ, DK, FI, DE, LV, MT, PT, SE, UK
90-100%	**5 MS**: CY, FR, IT, NL, SI
80%	**1 MS**: BE
Unknown	**11 MS**: BG, EE, ES, GR, HU, IE, LT, LU, PL, RO, SK

- A significant % of separators **not adequately maintained** ⇒ Hg capture efficiency **<< 95%**

(→ our assumption: 70% efficiency on average)

What is the problem? (8/10)

Pollution due to historical use of dental amalgam also includes Hg emissions from crematoria

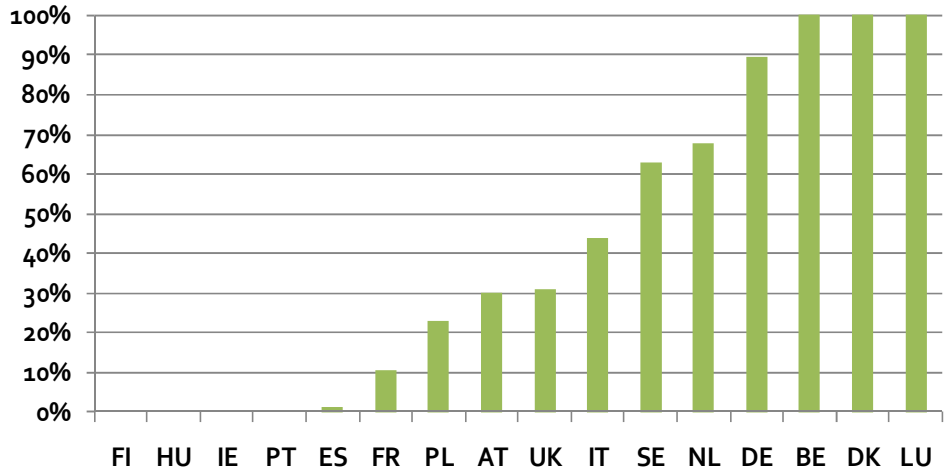
- Previous estimates of Hg air emissions from crematoria in the EU:
  - ExIA of EU Mercury Strategy: **2 to 3.5 t Hg/year in 2002**
  - Concorde/EEB report: **4.5 t Hg/year in 2004**
  - AMAP/UNEP report : **3.5 t Hg in 2005**

- Latest information sources reviewed by BIO:
  - OSPAR Overview Report, 2011
  - Stakeholder data (MS and cremation organisations)
  - Latest cremation statistics

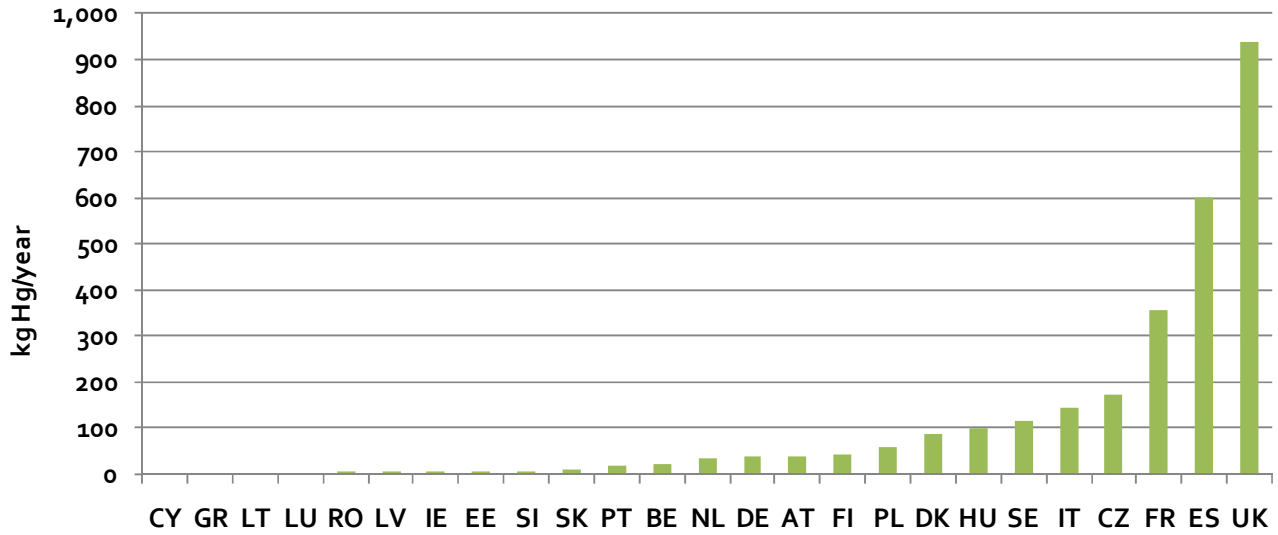
What is the problem? (9/10)

Hg emissions from crematoria seem to have remained stable over the last 5 years

Share of crematoria equipped with Hg abatement devices in 16 MS



- An **increased cremation rate** (51% in 2009 vs. 42% in 2005)
- An increased % of crematoria equipped with **Hg abatement devices** (approx. 40% for a sample of 16 MS)



Estimated annual Hg emissions from crematoria in 25 MS

- Total Hg air emissions **~2.8 t Hg/year for 25 MS** (~4% of total EU Hg air emissions from human activities)

What is the problem? (10/10)

With regard to the current use of dental amalgam, solutions are available to phase out mercury use in most medical conditions

- Although **Hg-free alternatives** to dental amalgam exist and can be used in most medical conditions, they are still not widely used in a number of MS
  - Hg-free dental restorations are **more expensive for patients,** in many MS
  - Not all dentists are properly **trained and skilled** in conducting Hg-free restorations
  - Many dentists are not aware of the **benefits of ART**
  - Some dentists are reluctant to **change their current practices**
  - Questions about l**ongevity** of the different filling materials
  - Some dentists not be fully aware of the **seriousness of the environmental impacts** caused by dental amalgam and of the **societal benefits** of reducing Hg emissions
  - Not all **patients** are fully aware of the pros and cons associated with the different types of filling materials.
  - Some dentists consider that the absence of **long-term environmental and health effects** of these materials has not been fully demonstrated

How would the problem evolve if no action is taken?

- Hg releases to the environment due to the **historical use** of dental amalgam would continue to occur during the **whole lifetime of amalgam fillings** → 10-15 years on average, with a broad distribution

- Hg releases from dental practices may decrease progressively along with the modernisation of dental practices, however it is **highly unlikely that 100% of dental practices become compliant with the EU waste legislation in the short term** without any further policy action

- A stabilisation of **Hg emissions from cremation** seems to have occurred since 2005, but **future trends are difficult to predict**

- Environmental impacts due to **current and future use of dental amalgam** depend upon future trends in dental amalgam use in the EU as well as possible improvements in Hg emission control strategies

Direct health aspects of dental amalgam (1/2)

There is a common viewpoint that adverse environmental effects of dental amalgam use may lead to ***indirect* health effects** and need to be addressed

However, possible ***direct* human health impacts of dental amalgam** are still a subject of scientific controversy

- Only areas of **consensus**:
  - **Allergies** due to dental amalgam
  - **Oral galvanism**
- Other aspects subject to **controversy**:
  - **Exposure levels**
  - Types of **associated pathologies** and their **probability** to occur
- **Varying sensitivity** between individuals

- **Further research needs**
  - Gender differences
  - In utero effects of Hg exposure on foetal brain development
  - Associations, if any, between amalgam load and degenerative retinal diseases
  - Associations , if any, between thyroid disease and amalgam fillings
  - Co-ordinated clinical studies of people who undergo amalgam removal on suspicion of side-effects from Hg (focus immune system, thyroid and nervous system, muscle pain)
  - Mechanisms whereby Hg vapour affects the central nervous system

Objectives & Policy Options

Policy objectives

General objectives

- Reduce environmental impacts from Hg use in dentistry
- Reduce contribution of dental amalgam to the overall mercury problem

  → Contributing to achieving reduced Hg levels in the environment, at EU and global level, in the long term

Specific objectives

- Minimise Hg emissions from current and historical use of Hg in dentistry
- Minimise and, where feasible, eliminate the source of pollution, i.e. phase out dental amalgam use

Policy options (1/2)

'No policy change' option (baseline scenario)

OPTION 1: Improve enforcement of EU waste legislation regarding dental amalgam

- MS asked to:
  - ✓ Report on measures taken to **manage dental amalgam waste** in compliance with EU waste legislation
  - ✓ Provide evidence of the **effectiveness of the measures in place**

Policy options (2/2)

OPTION 2: Encourage MS to take national measures to reduce the use of dental amalgam while promoting the use of Hg-free filling materials

- Improve **dentists' awareness** of the environmental impacts of Hg and the need to reduce its use
- Review **dental teaching practices** so that Hg-free restorations techniques are given preference over dental amalgam techniques
- Improve dentists' awareness and skills with regard to the **Atraumatic Restorative Treatment (ART)**
- Improve **public dental health** to reduce the occurrence of cavities

OPTION 3: Ban the use of Hg in dentistry

- Adding the use of mercury in dentistry to Annex XVII of the **REACH Regulation**
- **Possible limited exemptions** to take into account specific medical conditions where dental amalgam cannot be substituted at present
- Assumed here that such a legal requirement would be **adopted in 2016** and would become applicable 2 years later, i.e. **in 2018**

The Atraumatic Restorative Treatment (ART) (1/2)

Remove dentine caries with hand instruments
Fill the cavity with e.g. glass ionomer cement (GIC)
Less pain and atraumatic to tooth and patient

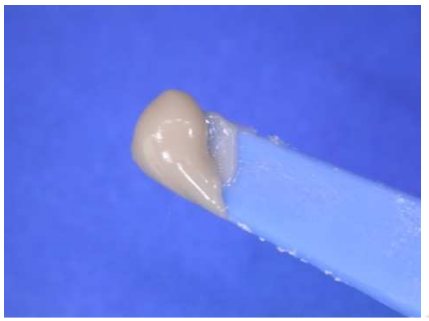
1. Remove the zone of bacterial invasion and destruction of carious dentine with spoon excavator

2. Make circular scooping movement from the dentino-enamel junction downwards

3. Protect the pulp at the floor of deep cavities

4. Mix the GIC to correct consistency with a glossy look

5. Finger press the GIC into the cavity and spread the overflow GIC over the adjacent pits & fissures



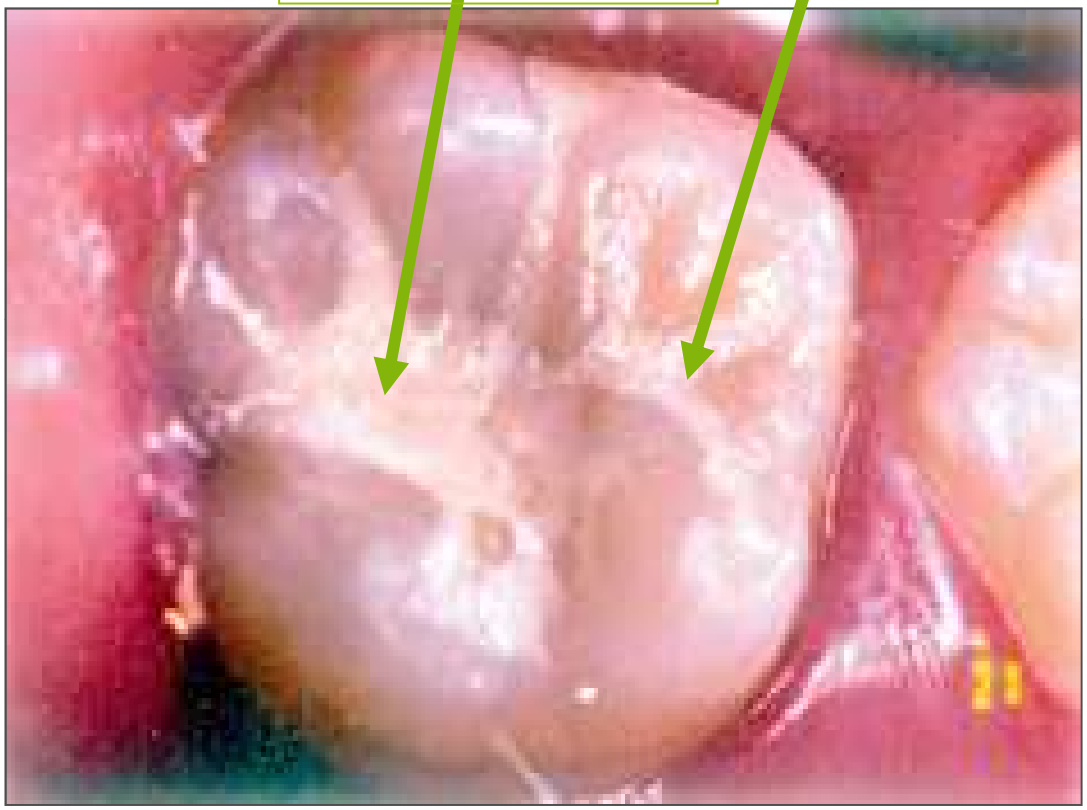
Acknowledgement:

Yupin Songpaisan, Thailand.

Frencken J.E. 2010. The ART approach using glass-ionomers in relation to global oral health care. Dent Mater 26 (2010):1–6.

Phantumvanit P, Songpaisan Y, et al. J Public Health Dent 56 (1996):141–5

The Atraumatic Restorative Treatment (ART) (2/2)



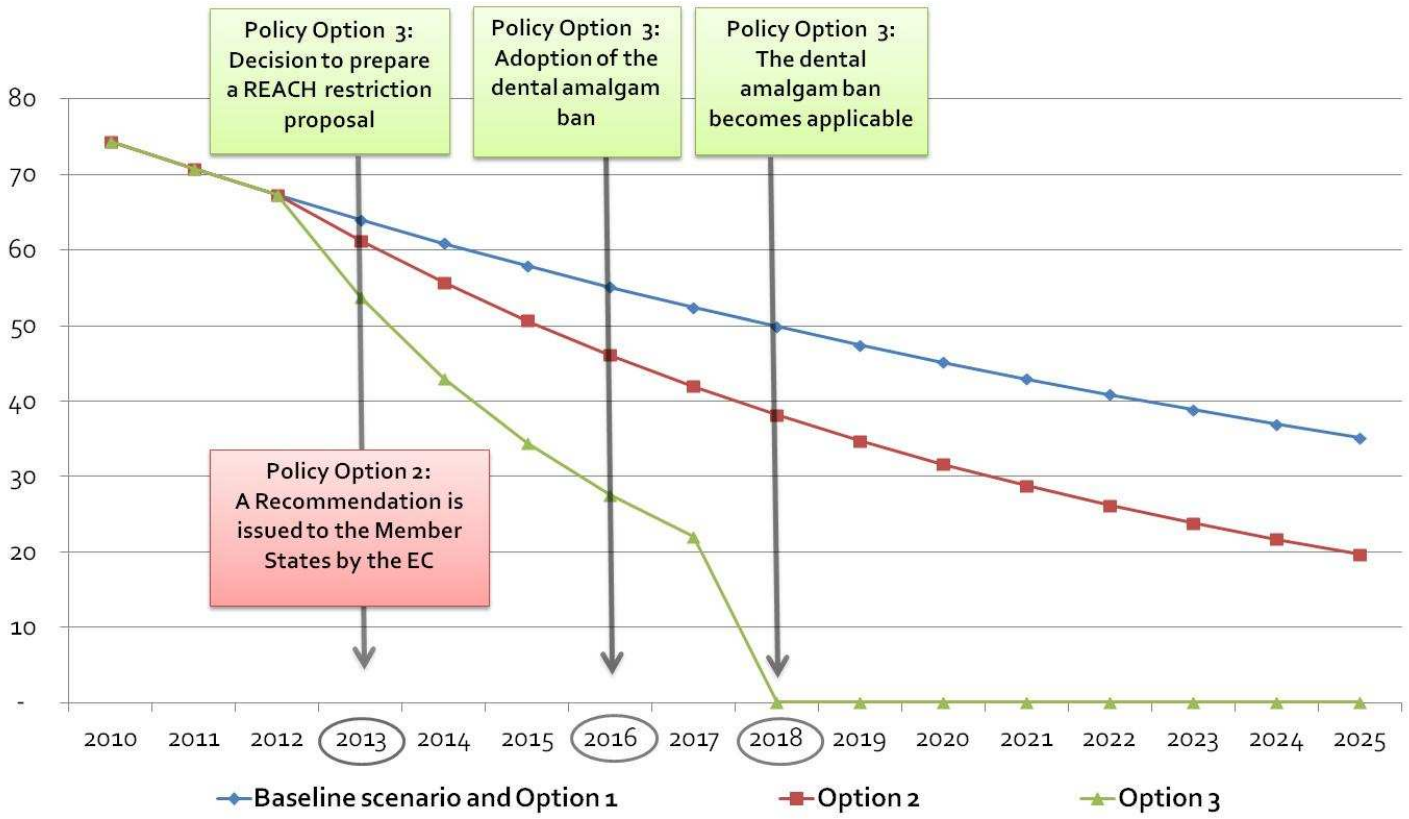
Acknowledgement: Yupin Songpaisan, Pathumthani, Thailand

Environmental Impacts of Policy Options

Trends in dental amalgam use

- **Baseline scenario** assumes a gradual decrease in dental amalgam demand over the next 15 years (approx. **–5% demand per year**)
- **Option 3:** Sharp decrease (**approx. 20% annually**) of dental amalgam demand from 2013
- **Option 2:** More rapid decline in dental amalgam demand than in the baseline scenario but lower than in Option 3 (**approx. 9% per year)**

Projected annual demand for dental mercury in the EU (t Hg)



Effects on mercury emissions

Key impact indicators	'No policy change' (baseline scenario)	Option 1 Improve enforcement of EU waste legislation in dental practices	Option 2 Encourage MS to take national measures to reduce dental amalgam use	Option 3 Ban the use of Hg in dentistry
EU demand for dental amalgam	↘	↘	↘↘	↘↘↘ (reaching zero in 2018) Avoided Hg use in 2025: approx. 50 t/year
Environmental impact indicators				
Quantities of dental amalgam waste produced	↘	↘	↘↘	↘↘↘
% of dental amalgam waste treated as hazardous waste	≈	↗↗↗	≈	≈
Dental Hg emissions to the environment (air / surface water / soil and groundwater)	↘	↘↘ Approx. –7 t Hg/year discharged to urban WWTPs (30% reduction in 2015)	↘ (approx. – 3% within 15 years) to ↘↘ (within several decades)	↘↘ (approx. -15% in 2025) to ↘↘↘ (within several decades)
Dental Hg accumulated in fish (in the form of methylmercury)	↘ (within several decades)	↘↘ (within several decades)	↘↘ (within several decades)	↘↘↘ (within several decades)

NB: Trends are presented over a 15-year horizon (2010-2025), unless otherwise specified

Socio-Economic Impacts of Policy Options

Overview of key socio-economic impacts

Key actors affected	Key economic impact indicators	Key social impact indicators
Dental fillings industry (manufacturers and suppliers)	Revenues Competitiveness Innovation	Employment
Dental patients	Dental restoration costs	Possible *direct* health risks
Dental clinics & dental staff	Hazardous waste management costs	Occupational health risks
Waste management industry	Revenues from dental waste management	
Crematoria	Hg abatement costs	
EU citizens	Tax contribution to municipal costs for managing Hg present in urban WWTPs, sewage sludge and municipal waste incinerators	*Indirect* health risks (through dental Hg emitted to the environment)
Public authorities	Administrative burden	

Impacts on the dental industry

- **61 main dental filling manufacturing companies** identified in EU27
- Only **3 companies produce solely mercury** for applications in dental restorations (and no Hg-free filling materials), 2 of which produce solely bulk mercury

Policy Option	Likely evolution 2010 -2025	Reasoning
Baseline scenario	**Increase in revenues** ≈ EUR 2.3 billion	**Substitution of dental amalgam** with Hg-free restorations + higher sale prices of Hg-free filling materials
Option 1	Same as baseline scenario	Same as baseline scenario
Option 2	**Increase in revenues** ≈ EUR 2.5 to 3.3 billion (+ 7% to 42% compared to the baseline)	**Substitution of dental amalgam** with Hg-free restorations + **reduction in the sale price difference** between dental amalgam and Hg-free materials due to innovation and increased competition
Option 3	**Increase in revenues** ≈ EUR 2.6 to 5.3 billion (+ 14% to 128 % compared to the baseline)	**Higher substitution of dental amalgam** with Hg-free restorations + higher **reduction in the sale price difference** due to innovation and increased competition

Impacts on dental patients (1/2)

Baseline scenario

Average dental restoration costs borne by patients (based on information from 19 MS – taking into account possible amounts reimbursed by national health insurance schemes):

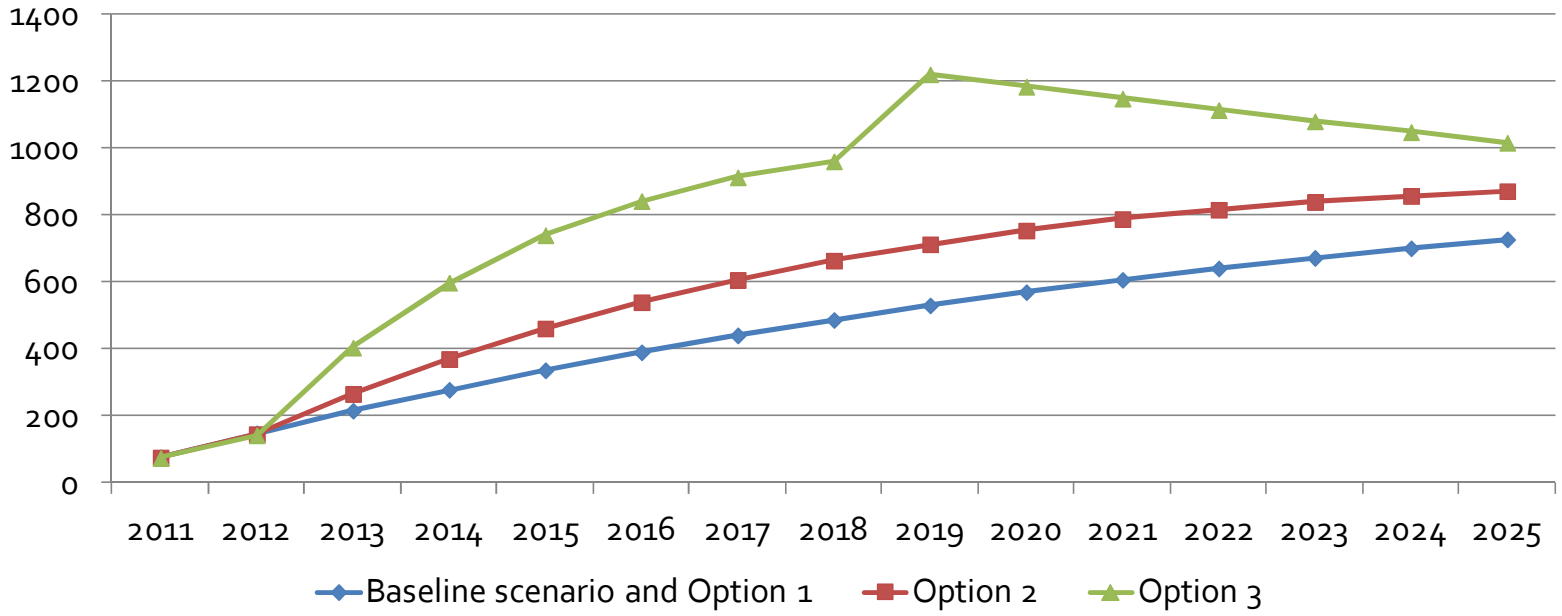
	Average dental amalgam restoration cost (EUR)	Average Hg-free restoration cost (EUR)
EU27	32.2	47.0
EU15	49.7	67.8
EU12	14.7	24.0

Four main cost factors:

- Cost of **filling material** (small influence)
- **Labour cost**
  - Currently, on average, dental amalgam restorations need less time compared to Hg-free restorations
  - **Time difference decreases as dentists gain more experience in the use of Hg-free materials**
- Possible amount reimbursed to the patient by the **national health insurance scheme**
- **Longevity** of the filling (indirect cost factor)
  - Recent studies show that the **longevity** of dental amalgam and composite fillings **tends to become similar**

Impacts on dental patients (2/2)

Annual costs borne by EU dental patients due to the substitution of dental amalgam (million EUR)



Policy Option	Average cost for 2010-2025 (EUR)	Assumption on price difference amalgam vs. Hg-free restorations
Baseline scenario and Option 1	6.8 - 7.5 billion (14 to 15 per capita)	–1%/year
Option 2	8.8 – 10.7 billion (18 to 22 per capita) ⇒ + 2 – 3.2 billion compared to baseline	– 2%/year
Option 3	13.5 – 16.8 billion (25 to 34 per capita) ⇒ + 5.7 - 9.3 billion compared to baseline	–3%/year

Impacts on dental clinics

Hazardous waste management costs

Cost of amalgam separators (incl. purchase, installation, maintenance and replacement of canisters)	Collection and treatment costs
150 -750 EUR per year per clinic	100-600 EUR per year per clinic

Baseline scenario

- ≈ 75% of dental offices equipped with amalgam separators
- **Highly unlikely that 100% of dental practices become compliant** → No significant change in costs expected

Option 1

- **100% of dental clinics will be equipped with amalgam separators** in the short-term → Total cost ≈ EUR 5.1 to 25.6 million per year
- Assumingly, **50% of dental clinics currently equipped with amalgam separators** will need to significantly **improve the maintenance of separators** and **management of dental amalgam sludge** → Total cost ≈ EUR 5.3 to 32 million per year

Option 2 & Option 3: No significant impacts expected

Impacts on health of dental staff

Baseline scenario

- Occupational health risks at dental practices are mainly due to **inhalation of Hg vapours from the handling of amalgam** (approx. 0.5 t Hg/year) or from **effluent treatment devices** (approx. 3 t Hg/year), if protection measures are not used or are not efficient
- However, increasing use of **pre-dosed capsules** contributes to reducing Hg emissions occurring during amalgam storage and preparation

Option 1: No significant impacts expected

Option 2

- **Positive impact:** Decrease in dental amalgam use → Less Hg vapours emitted → Reduced exposure of staff → Lower occupational health risks
- However, as long as Hg is present in old fillings, dental personnel will continue to be exposed to Hg vapours from dental effluents and from solid Hg-containing waste (if no adequate protection measures)

Option 3

- **Very positive impact:** Will eliminate exposure of dental staff in the long-term

Impacts on waste management industry

Waste management revenues

- **Additional revenues for companies** that manufacture, install and maintain amalgam separators as well as for companies that collect and treat dental mercury-containing waste **are directly linked to the cost estimates for dentists**

Option 1

- Positive economic impact: **Additional revenues for waste management companies** involved in the maintenance of amalgam separators and/or in the collection and treatment of dental amalgam waste

Option 2 & Option 3: No significant impacts expected

Impacts on crematoria

Baseline scenario

- ≈ **2,700 crematoria** and **2.5 million cremations** per year in EU
- More stringent recent national **legislations adopted in some MS** + Effect of the **OSPAR Recommendation** ⇒ % of crematoria equipped with Hg abatement devices expected to **continue to increase in future years**

Costs for crematoria	2010	2025	'Best' situation
% crematoria equipped with Hg abatement equipment	40%	80% (assumed)	100%
Cost of investment for Hg abatement equipment	EUR 540 to 755 million	Additional cost of EUR 540 to 755 million	Additional cost of EUR 810 to 1,135 million
Cost for waste management	EUR 2.9 million per year	Additional cost of EUR 2.9 million per year	Additional cost of EUR 4.4 million per year

Option 1, Option 2 & Option 3: No significant impacts expected by 2025

Impacts on EU citizens

How are EU citizens economically affected?

- **WWTPs:** Residual Hg quantities in dental effluents entering urban WWTPs
  → Possible need to install Hg abatement devices in **sewage sludge incinerators**
  → **Lower potential for agricultural use** of sewage sludge
- **Municipal waste incineration:** Hg abatement devices required
- **National insurance schemes:** Possible increase in tax contribution to the schemes (but no significant changes expected)

Baseline

- From a sustainability perspective, Hg content of sewage sludge must decrease, although, in most MS, it is presently **not a legally limiting factor for the use of sludge in agriculture**.

Option 1

- Positive impact (cost savings):
  → **Lower Hg content of dental** effluents entering WWTPs
  → May increase possibilities of using **sewage sludge for agricultural purposes**

Option 2 & Option 3

- Some limited positive impacts in the mid-term

Impacts on EU citizens' health (1/2)

Baseline scenario

- ***Indirect*** **health impacts of dental amalgam use**
  - As a significant contributor to overall mercury pollution, dental amalgam use affects the **entire EU population**
  - Some groups are particularly vulnerable and/or exposed: **high-level fish consumers, children** and **women in childbearing age**
  - **High health damage costs from Hg pollution**: EUR 5,000 to 20,000 per kg Hg emitted to air for IQ losses but can be much higher (e.g. EUR 250,000 per kg) if the less certain cardiovascular effects are included
- ***Direct*** **health impacts of dental amalgam**
  - Consensus on metal allergies, otherwise subject to scientific controversy
- ***Direct*** **health impacts of Hg-free restoration methods**
  - **Eliminate the need for Hg** in dentistry
  - **Less invasive** techniques
  - Considered to be **safe for patients and health professionals,** according to EU health authorities and dental associations
  - Some resin-based filling materials contain **bisphenol A** (endocrine disruptor), however many manufacturers offer **BPA-free composite resins**

Impacts on EU citizens' health (2/2)

Option 1

- ***Indirect*** **health impacts of dental amalgam use**
  - Will significantly reduce Hg releases to urban WWTPs → Avoided Hg releases to the different environmental media, mainly depending on the fate of Hg in sewage sludge
  - Tentative monetisation of avoided health damages (only IQ losses associated with Hg air emissions): EUR 35-140 million/year in 2015

Option 2 & Option 3

- ***Indirect*** **health impacts of dental amalgam use**
  - Positive impact through avoided Hg releases
  - Tentative monetisation of avoided health damages (only IQ losses associated with Hg air emissions): EUR 2-8 million/year in 2025 (Option 2); EUR 15-60 million/year in 2018 (Option 3)
- ***Direct*** **health impacts of dental amalgam**
  - Subject to scientific controversy for aspects other than metal allergies
- ***Direct*** **health impacts of Hg-free restoration methods**
  - Positive impact with regard to the decrease or elimination of Hg use and the less invasive nature of Hg-free techniques (more original tooth material left after restoration)
  - Most likely, less and less resins containing BPA to be placed on the market

Impacts on public authorities

Baseline scenario

- **Administrative burden** for MS authorities: Enforcement of legislation concerning Hg emissions and waste, in particular at **dental clinics, urban WWTPs** and **crematoria**
- No significant change expected by 2025

Option 1

- Additional administrative costs for a **more effective enforcement of EU waste legislation** in **dental clinics** ≈ 1 million EUR/year

Option 2

- Additional administrative costs for **awareness raising activities:** Difficult to estimate due to the different actors and possible actions involved but could be relatively high
  - E.g. cost of sending information letters to all dentists ≈ EUR 100,000 to 300,000

Option 3

- **Additional administrative costs** for enforcing an **additional restriction contained in REACH Regulation**
- However, all MS already have dedicated staff in charge of REACH enforcement
  → Not a significant increase in administrative burden

Conclusions of the Study

Conclusions (1/2)

'No policy change' option

- **Cannot meet the policy objective** (i.e. eliminate environmental impacts of dental amalgam use)
- Complete phase-out of dental amalgam use is **very unlikely to happen** (see the Swedish example)

Option 2

- **Leaves some flexibility to MS** to implement national measures aimed at reducing dental amalgam use
- But the **effectiveness** of this option is subject to **high uncertainty**
- In order for this option to be effective, the **administrative costs** incurred by public authorities may be relatively high

Conclusions (2/2)

Preferred combination of options = Option 1 + Option 3

- Would achieve the highest **effectiveness**
- **Associated costs are considered to be reasonable** for the various stakeholders and outweighed by the associated **environmental and health benefits**
- Cost efficiency of Option 3 improves with:
  - The active promotion of **cheaper Hg-free restoration techniques** such as ART
  - The improvement of **dentists' skills** in Hg-free restoration techniques
  - A **gradual decrease in the price of Hg-free filling materials** thanks to continuous innovation and increased competitiveness within this industry sector
- Success of Option 3 would require to take measures to **avoid the presence of BPA and other known endocrine disruptors** in composite resins
- Logical follow-up of **Actions 4 and 8 of the Mercury Strategy**
- Necessary to achieve Hg-related requirements of **EU legislation on water quality**

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