

**Damian Panasiuk, Anna Głodek, Józef M. Pacyna**

*Norwegian Institute for Air Research - Branch Poland*

*[www.nilupolska.eu](http://www.nilupolska.eu)*



***Scenarios of mercury emission  
to air, water and soil  
in Poland to year 2020***

***ECOpole'11 – Zakopane, 12-15 October 2011***



## Results of MERCPOL project

„Cost-benefit analysis of mercury emission reduction in Poland for human health and environment”

2009-2010

financed by Chief Inspectorate of Environmental Protection from sources of National Fund for Environmental Protection and Water Management



Sfinansowano ze środków Narodowego Funduszu Ochrony Środowiska i Gospodarki Wodnej na zamówienie Ministra Środowiska

*Zakopane, 13 October 2011*

## Mercury emission problem

- toxic heavy metal,
  - global pollutant (long atmospheric lifetime, 6-18 months),
  - methylmercury bioaccumulation and biomagnification (marine mammals and fish-eating populations),
  - Minamata disease (muscle weakness, neurological problems, paralysis and death),
  - threat to fetus (IQ losses, autism),
- > *Global mercury (Minamata) convention planned for 2013*

## Inventory of mercury emission in Poland

### **emission to air from:**

- *by-product sources (industrial processes and fuel combustion in residential sector),*
- *the use of mercury-containing products (batteries, light sources, electrical equipment, thermometers),*
- *dental practice (infectious medical wastes),*

### **to water and soil:**

- *discharges of industrial and municipal waste waters,*
- *releases from municipal landfills,*
- *releases from dental amalgam in buried bodies.*

## Industrial processes and fuel combustion

- national inventories for years 2005-2007 (IOŚ)

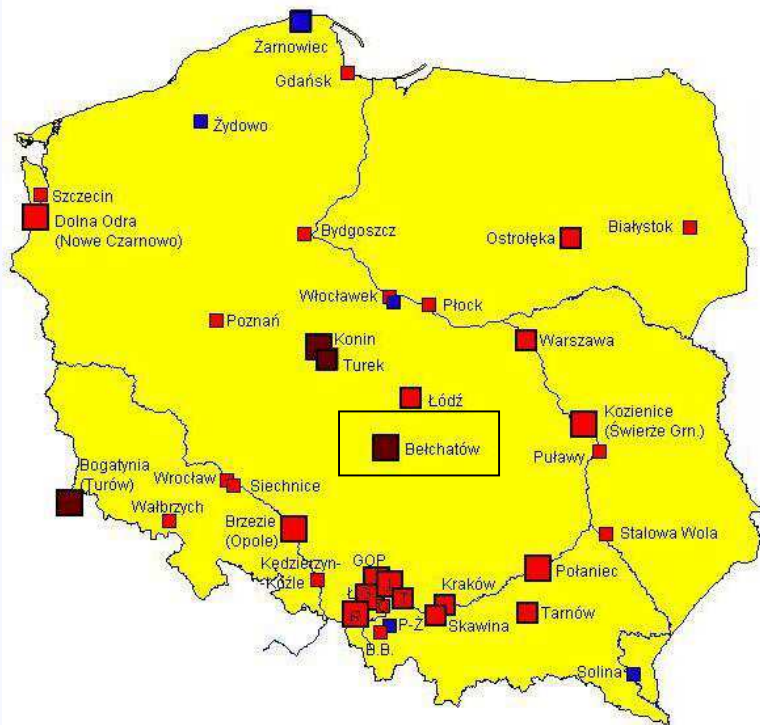
<i>Sector</i>	<i>Emission (Mg Hg/year)</i>
- electricity and heat generation	9.1
- remaining industrial sectors	5.3
- commercial, institutional and residential installations	1.3
<b>TOTAL</b> by-product emission	<b>15.8</b>

## Average mercury concentration in Polish hard coals and lignites

(Bojakowska and Sokołowska, 2001)		(Bojarska, 2006)		(Wojnar and Wisz, 2006)	
Coal fields	ppb	Coal mines	ppb	Power plants	ppb
<b>Hard coal</b>					
<i>Average</i>	<b>85</b>	<i>Average</i>	<b>141</b>	<i>Average</i>	<b>100</b>
górnosławskie	60	Piekary	62	No 1	64 - 100
- Krupiński	13	Wieczorek	104	No 2	97 - 141
- Jas-Mos	37	Staszic	113	No 3	84 - 120
- Silesia	49	Wesoła	113	No 4	53 - 92
- Brzeszcze	73	Murcki	145	No 5	100 - 105
- Jaworzno	106	Mysłowice	151	No 6	93 - 132
- Halemba	113	Wujek	163	No 7	66 - 109
lubelskie	105	Knurów	302	No 8	54 - 124
dolnosławskie	399			No 9	56 - 90
<b>Lignite</b>					
<i>Average</i>	<b>322</b>			<i>Average</i>	<b>250</b>
Lubstów	199			No 10	172 - 283
Kazimierz	202			No 11	117 - 370
Koźmin	216				
Turów	225				
Adamów	401				
Bełchatów	416				

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# The largest conventional thermal power plant in Europe



Bełchatów [beu'xatuf]

Lignite consumption  
30 mil. Mg/ year,  
installed electricity  
capacity 4.4 GW



## The use of mercury-containing products

- mercury in products launched to Polish market –  
9.4 Mg Hg/year,
- Kindbom & Munthe model for distribution and emissions,

<i>Mercury in wastes</i>	in first year (Mg)	within 10 years (Mg)
Hg emission to air	0.32	0.46
Hg re-collected and stored safely	2.17	2.89
landfilled wastes (releases to water) + products accumulated in society	6.90	6.04
<b>TOTAL</b>	<b>9.40</b>	<b>9.40</b>

## Dental practice

- mercury in dental amalgam launched to Polish market - 10 Mg Hg/year,
- Maxson (2007) assumptions for mercury flows in dental clinics,

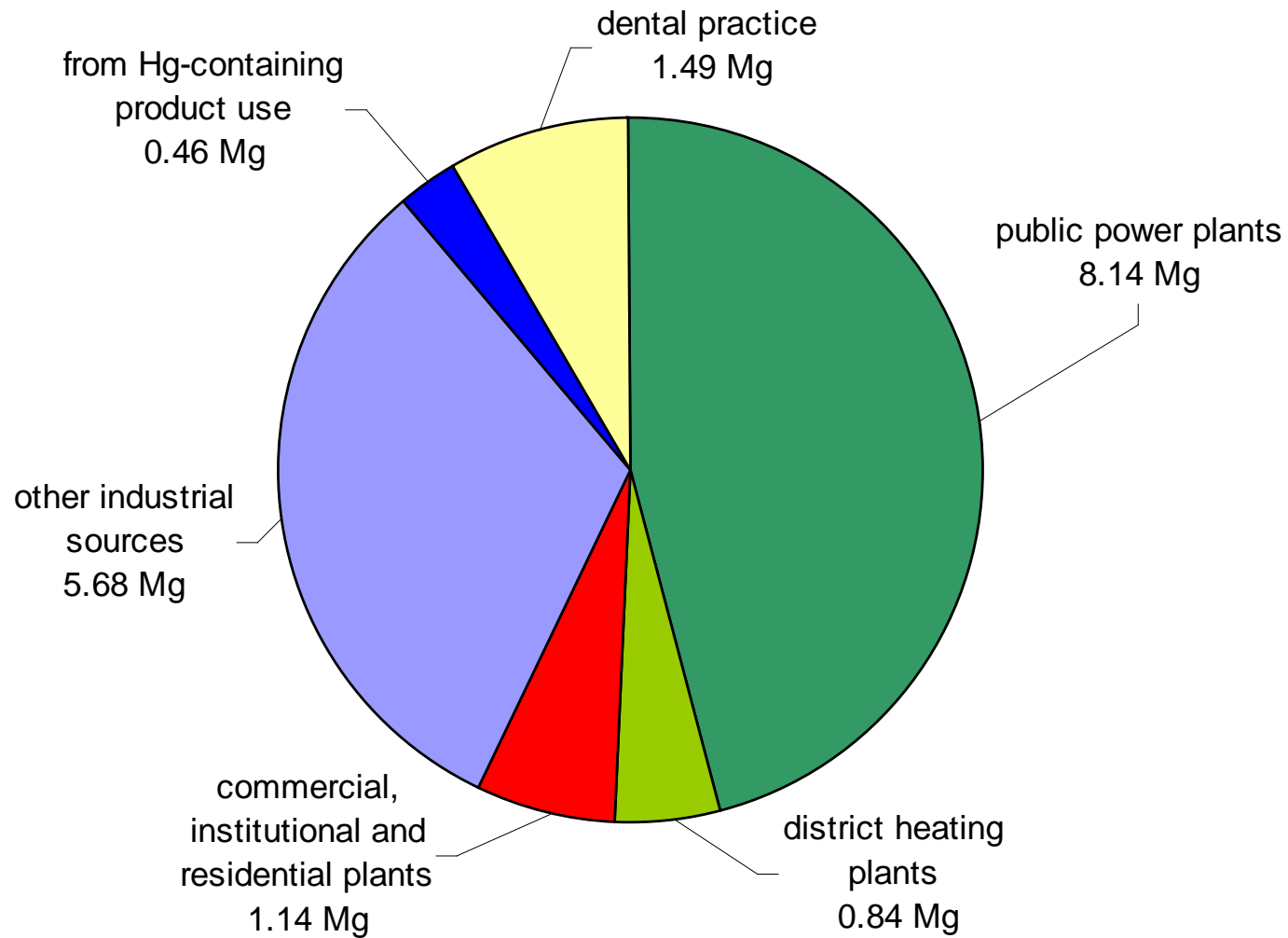
	<i>Mg Hg/year</i>
new dental fillings	2.2
hazardous waste	4.9
infectious medical wastes	2.9
- emission from incineration	1.4

## Dental practice

- cremation of 5% of corpse in Poland,
- OSPAR (2006) assumptions for mercury amalgam concentration in bodies,
- 20% of Hg from buried bodies is reaching groundwaters,

	<i>Mg Hg/year</i>
emission to air from cremation	0.04
releases to water and soil from dental amalgam in buried bodies	0.16

## Total mercury emission to air in Poland for base year 2008



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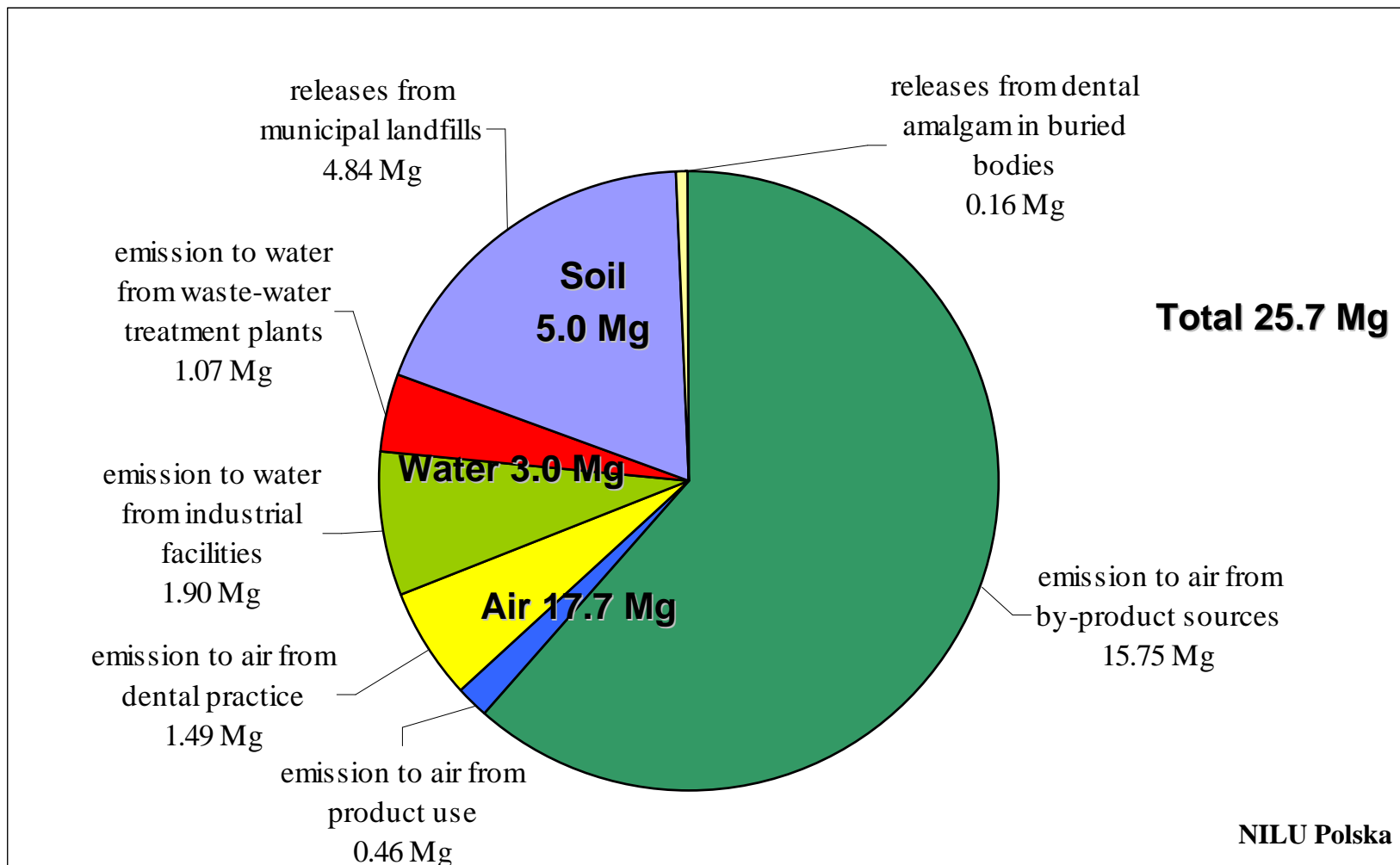
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## Emission to water

- European Pollutant Release and Transfer Register (2009) data for Poland,
- large and medium industrial facilities,
- waste water treatment plants in agglomerations above 100,000 residents,

<i>Sector</i>	<i>Emission (Mg Hg/year)</i>
industry	1.90
municipal WWTPs	1.07

# Total mercury emission to air, water and soil in Poland for base year 2008

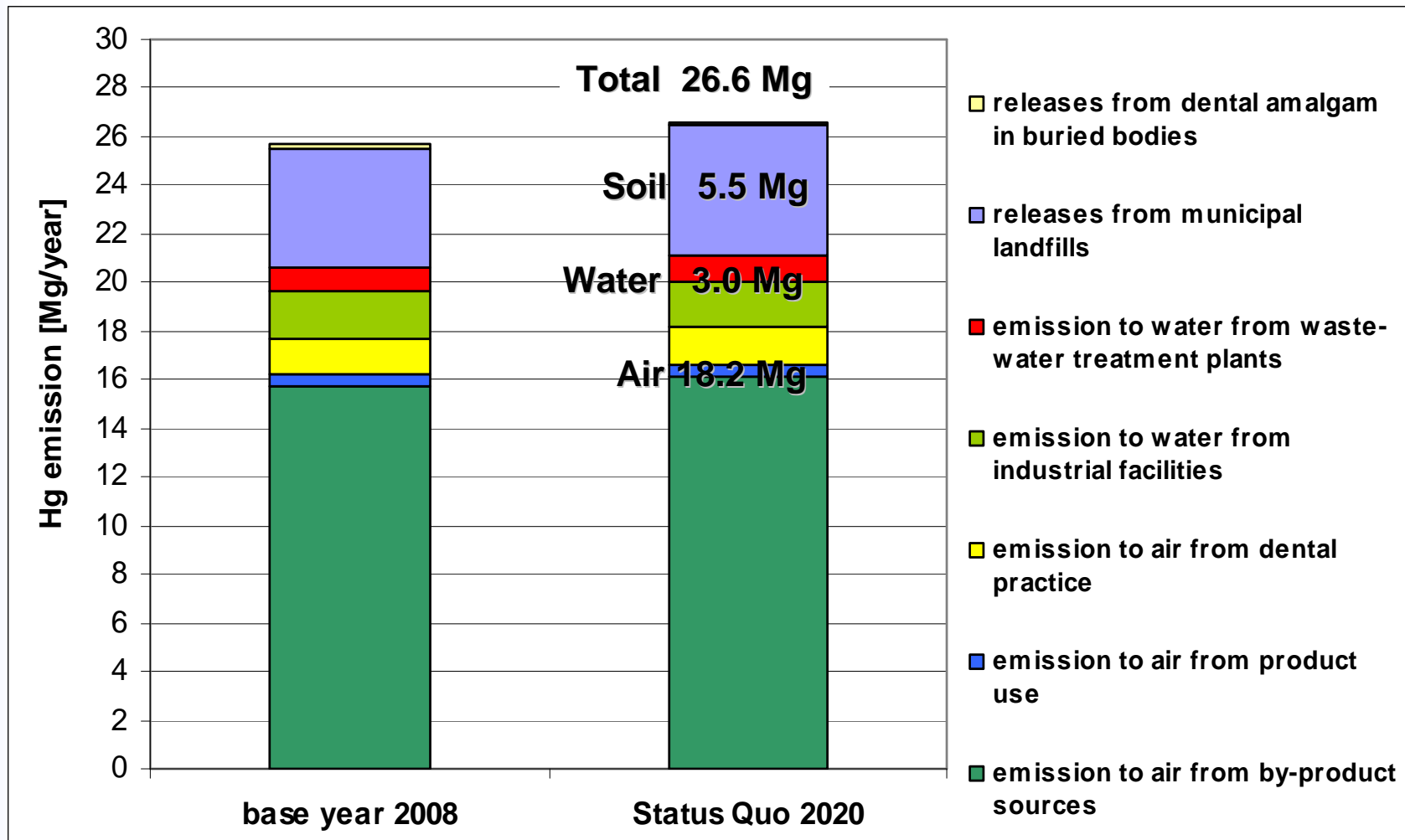


## Status Quo scenario

Current practices and control methods from the base year will be maintained:

- production and consumption growth (increase of coal consumption - assumptions of Energy Policy of Poland, 2007),
  - no changes in product consumption model and waste management (municipal wastes mainly landfilled),
- > **increase of mercury emission**

# Total mercury emission to air, water and soil in Poland for Status Quo scenario



## **EXEC scenario**

### **EXtended Emission Control (EXEC):**

- continuation of economic growth,
- implementation of EU directives and international conventions (Industrial Emission Directive with derogations).

#### *Industrial processes*

- 28% decrease of coal consumption in power plants, 10% decrease in heating plants and other industrial sectors (assumptions of final version of Energy Policy of Poland, 2009),

## **EXEC scenario**

### BAT techniques

- pre-treatment: coal cleaning, fuel switching,
- primary measures: fluidized bed combustion,
- secondary measures: fabric filters or electrostatic precipitators operated with flue gas desulfurisation (FGD) system; Selective Catalytic Reduction, non-catalytic methods, sorbent injection,
- phase-out of mercury cells in chlor-alkali industry.

## **EXEC scenario**

### *Mercury-containing products*

- lower consumption of mercury for production,
- higher level of select collection of product wastes.

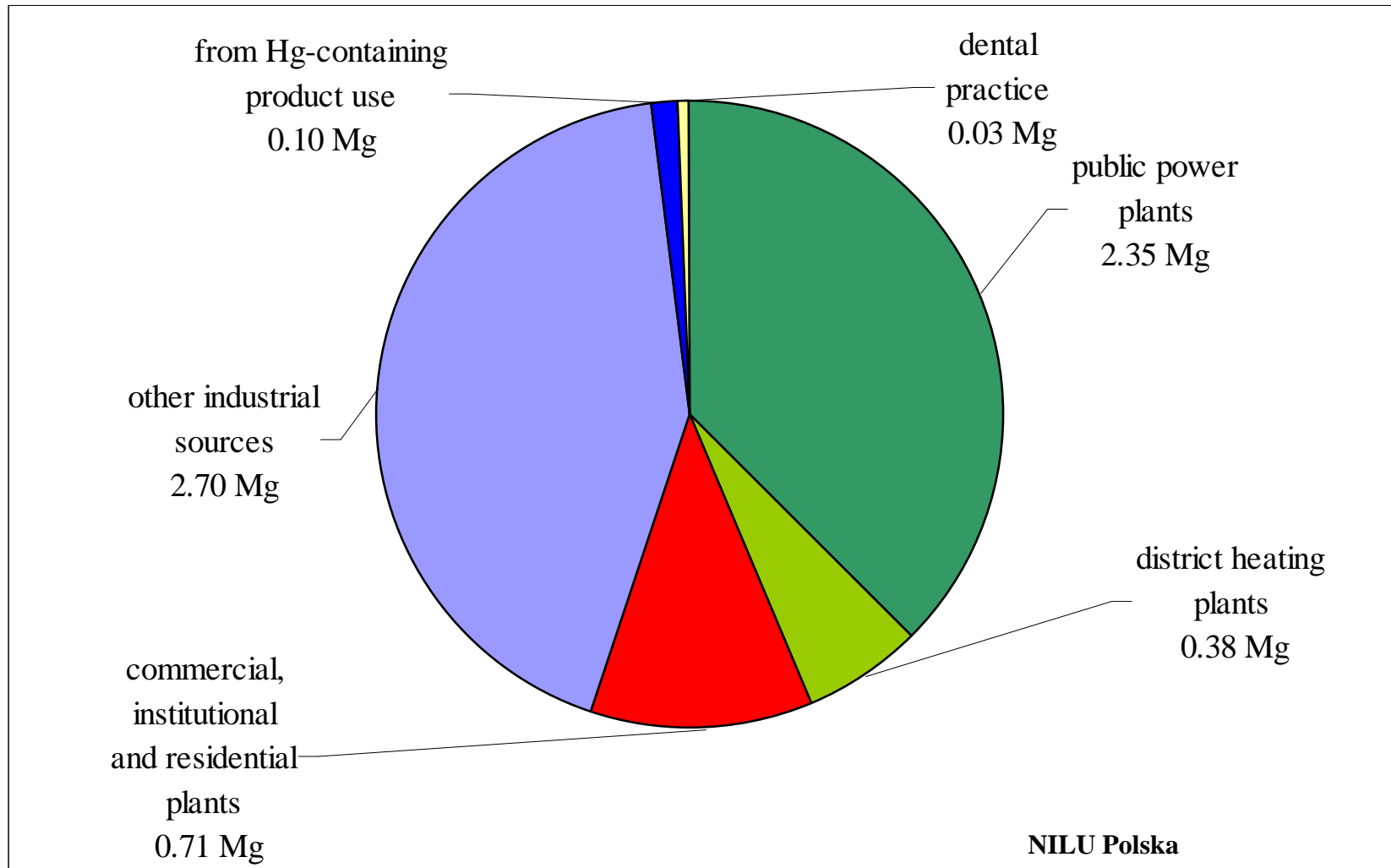
### *Dental practice*

- lower use of dental amalgam,
- infectious wastes incinerated in modern plants.

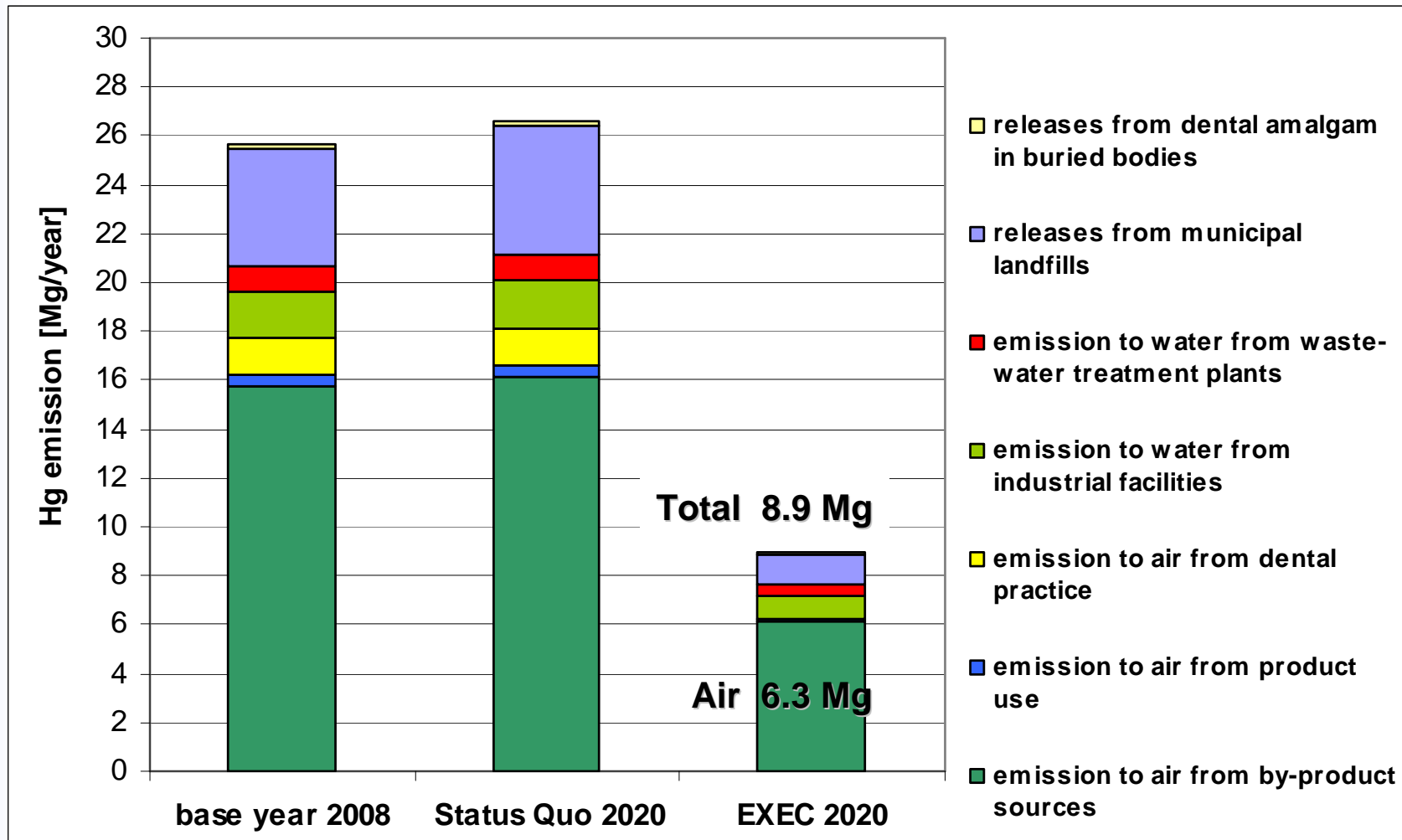
### *Emission to water and soil*

- BAT techniques in industry,
- amalgam separators in dental surgeries.

## Total mercury emission to air in Poland in 2020 for EXEC scenario



# Total mercury emission to air, water and soil in Poland in 2020 for EXEC scenario



## **MFTR scenario**

### **Maximum Feasible Technical Reduction of emission (MFTR):**

- additional mercury emission reduction and prevention measures will be applied.

#### *Industrial processes*

- emerging techniques (clean coal technologies, active carbon, sulphure and selenium impregnated sorbents),
- coal cleaning, fuel switching, fluidized bed combustion.

## **MFTR scenario**

### *Mercury-containing products*

- use of mercury only for fluorescent lamp production.

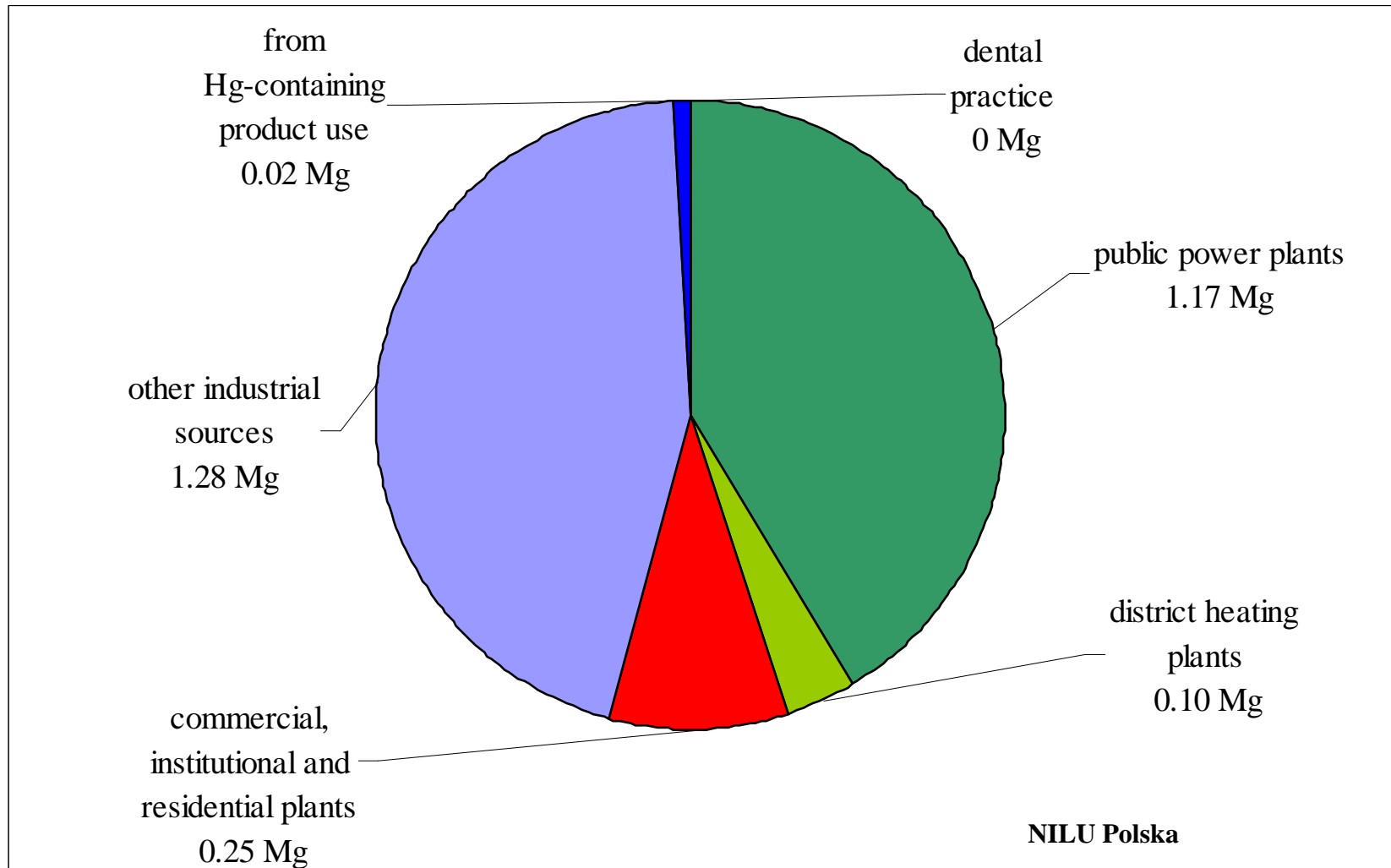
### *Dental practice*

- ban of dental amalgam use.

### *Emission to water and soil*

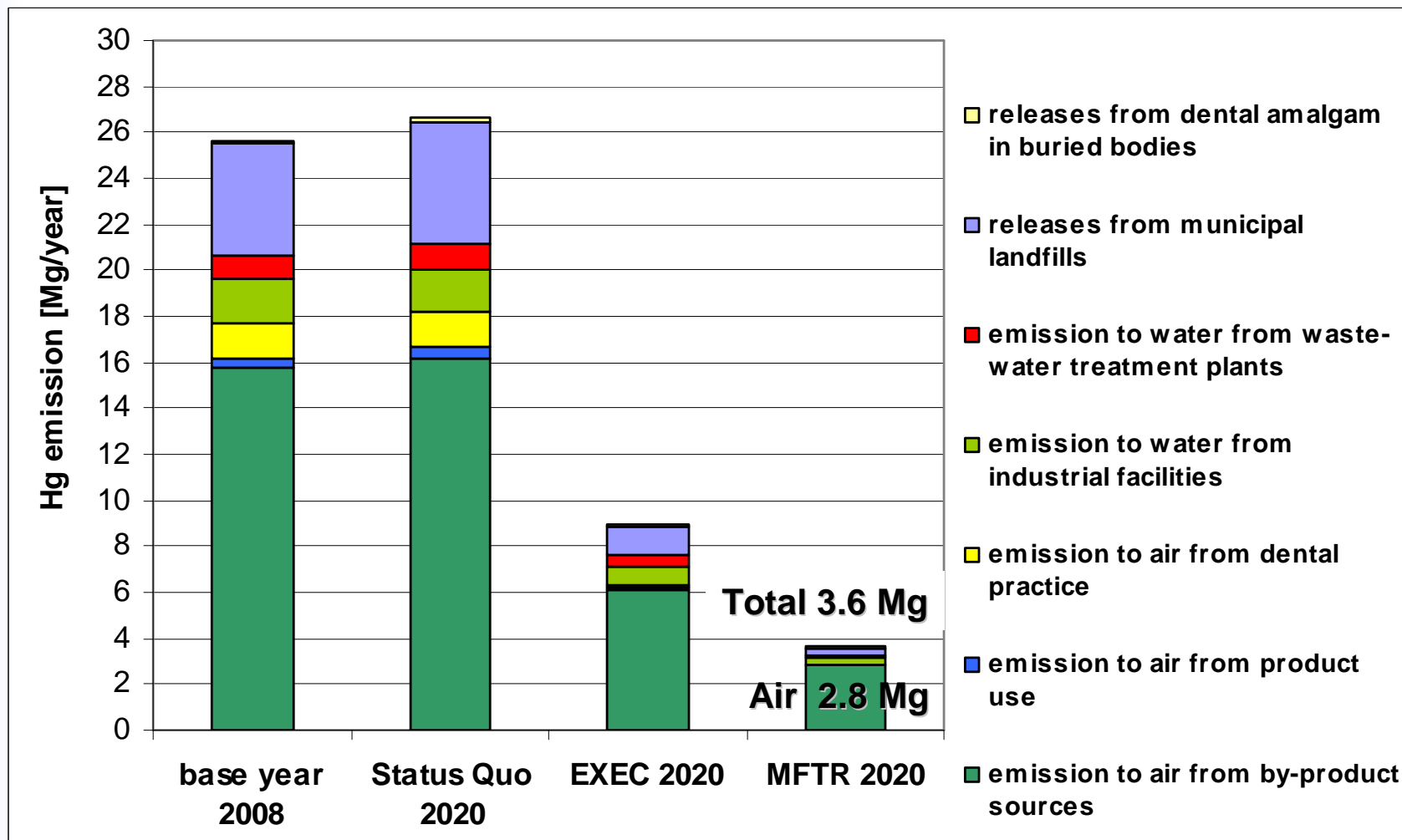
- emerging techniques in industry,
- control of heavy metal discharges to sewerage system.

## Total mercury emission to air in Poland in 2020 for MFTR scenario





## Total mercury emission to air, water and soil in Poland for all scenarios to 2020



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# Conclusions

## EXEC scenario

Mercury emission prevention and control methods should decrease emission to air, water and soil in Poland from **25.7 Mg** in the base year to **8.9 Mg** in 2020.

## MFTR scenario

Additional emission prevention methods (ban of mercury use in products and amalgam use in dental practice) and emerging techniques implementation give possibility to decrease mercury emission to **3.6 Mg** in 2020.

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