

Figure 2.1 - Contributions of the various source categories to the total mercury emitted from anthropogenic sources in Europe in 1995.

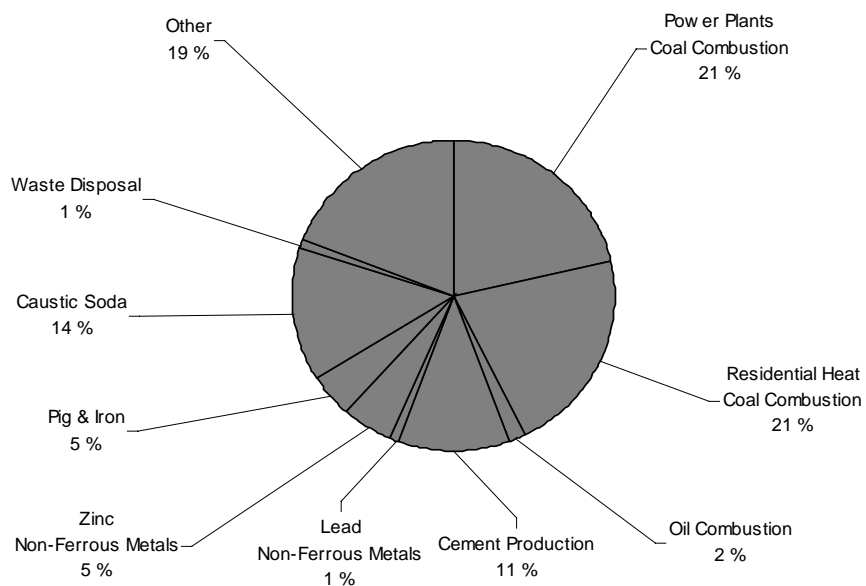


Figure 2.2 - Contributions of the various source categories to the 204.6 tonnes of gaseous elemental mercury emitted by anthropogenic sources in Europe in 1995.

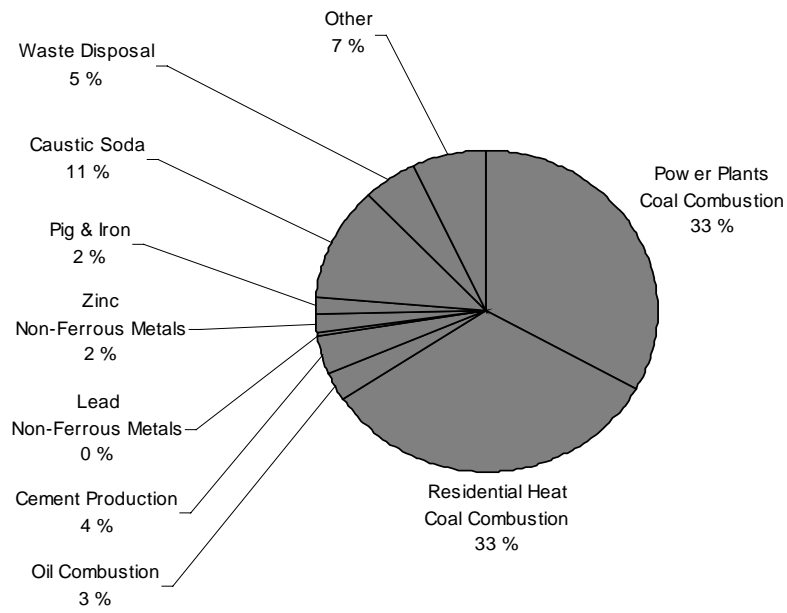


Figure 2.3 - Contributions of the various source categories to the 108 tonnes of gaseous bivalent mercury emitted by anthropogenic sources in Europe in 1995.

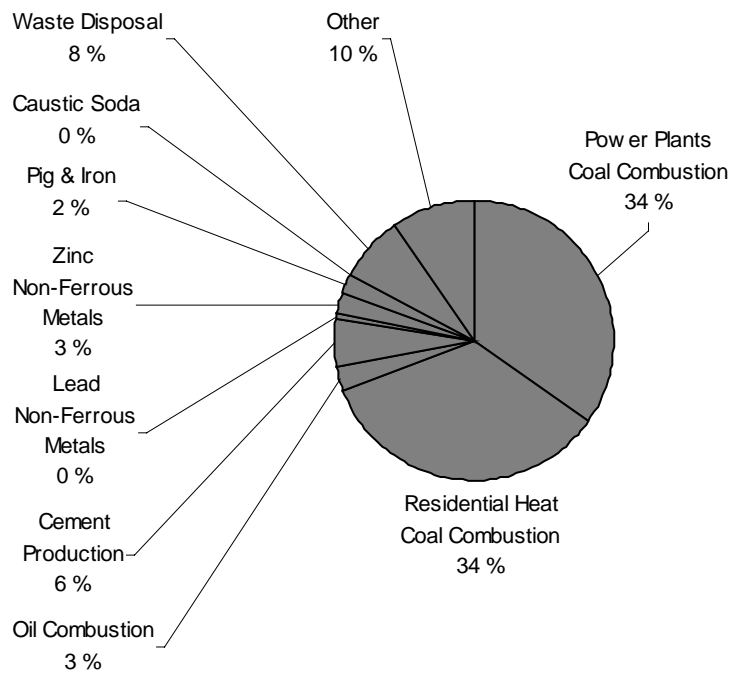


Figure 2.4 - Contributions of the various source categories to the 25 tonnes of particulate mercury emissions emitted by anthropogenic sources in Europe in 1995.

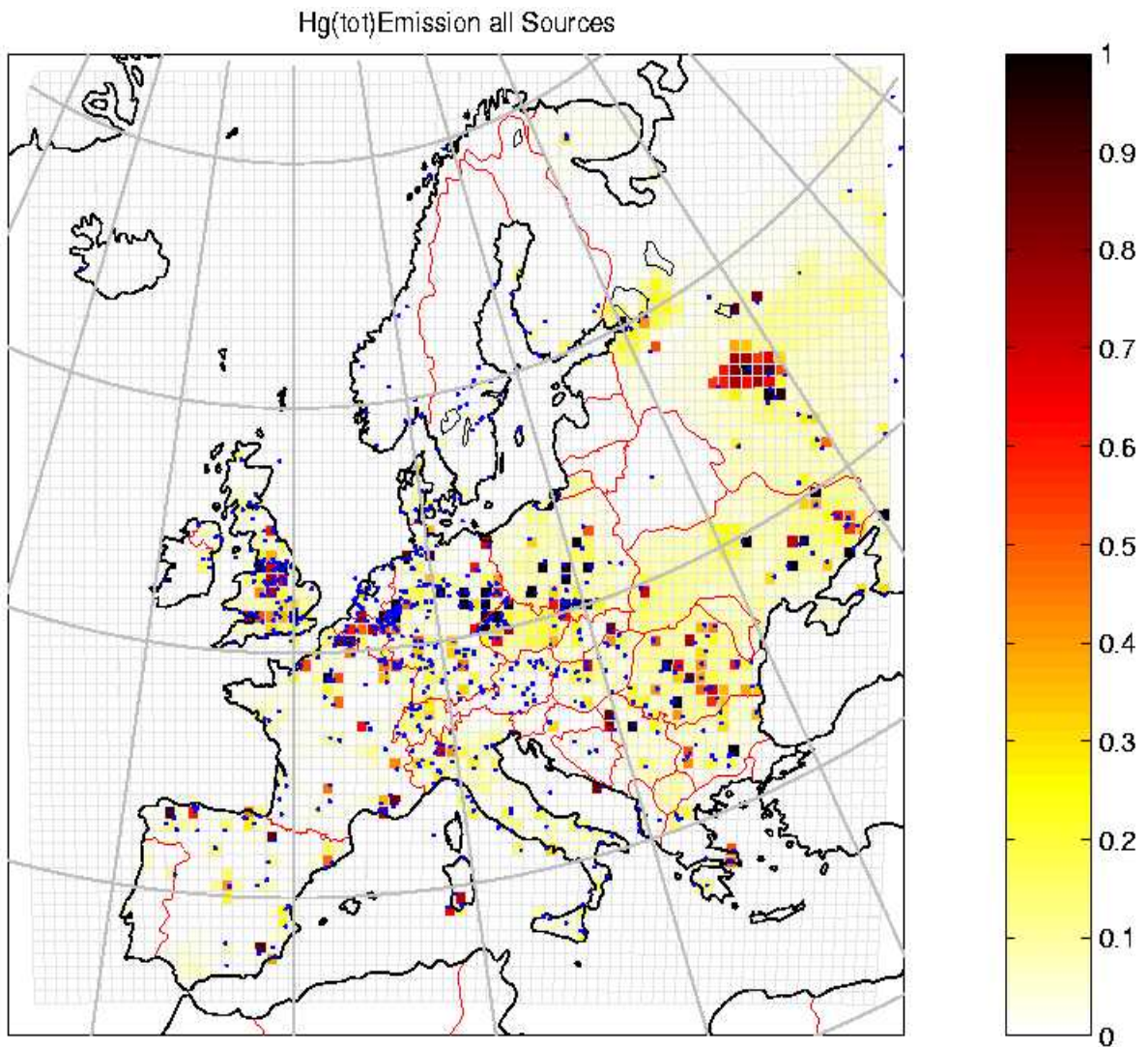


Figure 2.5 - Emissions of total Hg from anthropogenic sources in Europe in 1995 distributed within the EMEP grid system of 50 km x 50 km (Pacyna *et al.* 2001).

Table 2.1 - Emission rates of mercury ($\text{ng m}^{-2}\text{h}^{-1}$) from volcanoes, surface waters and top soils in Europe and in the Mediterranean region (Pirrone *et al.* 2001).

Country	Method	Surface type	Period	Hg Emiss. rate	References	
North-Western Mediterranean	N.A.	Sea surface	N.A.	$1.16 \text{ ng m}^{-2}\text{h}^{-1}$	Cossa <i>et al.</i> , 1996 and reference herein	
Scheldt outer estuary (Belgium)	N.A.	Sea surface	N.A.	$5.8 \text{ ng m}^{-2}\text{h}^{-1}$	Cossa <i>et al.</i> , 1996 and reference herein	
Grand Estuaire de la Loire (France)	N.A.	Sea surface	N.A.	$0.4\text{-}2.5 \text{ ng m}^{-2}\text{h}^{-1}$	Cossa <i>et al.</i> , 1996 and reference herein	
Baie de la Seine (France)	N.A.	Sea surface	N.A.	$1.7\text{-}3.3 \text{ ng m}^{-2}\text{h}^{-1}$	Cossa <i>et al.</i> , 1996 and reference herein	
Northern-Tyrrhenian Sea (Poll. Coastal zone)	FC	Sea surface	Summer	Day	$11.25 \text{ ng m}^{-2}\text{h}^{-1}$	Ferrara <i>et al.</i> , 2000
				Night	$2.4 \text{ ng m}^{-2}\text{h}^{-1}$	
Northern-Tyrrhenian Sea (Off-shore)	FC	Sea surface	Summer	Day	$2.5 \text{ ng m}^{-2}\text{h}^{-1}$	Ferrara <i>et al.</i> , 2000
				Night	$1.16 \text{ ng m}^{-2}\text{h}^{-1}$	
Northern-Tyrrhenian Sea (Unpoll. Coastal zone)	FC	Sea surface	Summer	Day	up to $10.1 \text{ ng m}^{-2}\text{h}^{-1}$	Ferrara <i>et al.</i> , 2000
				Night	$1 \text{ ng m}^{-2}\text{h}^{-1}$	
			Winter	Day	$0.7\text{-}2.0 \text{ ng m}^{-2}\text{h}^{-1}$	
Sweden	FC	Lake surface	N.A.	$2.05\text{-}20.5 \text{ ng m}^{-2}\text{h}^{-1}$	Schoeder <i>et al.</i> 1989, Xiao <i>et al.</i> , 1991	
North Sea	N.A.	Sea surface	N.A.	$1.6\text{-}2.5 \text{ ng m}^{-2}\text{h}^{-1}$	Cossa <i>et al.</i> , 1996 and reference herein	
Etna, Stromboli, Vulcano (Med. Sea)	MN/ Gardis		Fall/Spring	$0.6\text{-}1.3 \text{ t y}^{-1}$	Ferrara <i>et al.</i> , 2000	
Mercury mine in Almaden, Spain (*)	LIDAR	Ambient air	Summer & Winter	2 t y^{-1}	Edner <i>et al.</i> , 1994	
South Europe	FC	Top soil	Summer	Day: $4\text{-}5 \text{ ng m}^{-2} \text{ h}^{-1}$ Night: $1 \text{ ng m}^{-2} \text{ h}^{-1}$	Pirrone <i>et al.</i> 2000	

N.A.= not available; FC = Flux Chamber; LD=LIDAR Technique; MN = Manual Technique.

(*) Almaden mine is active 3 months per year; The Idjia and Mt. Amiata mines are closed since 1994 and 1980, respectively.

Table 2.2 - Concentrations of Hg in various fossil fuels

Fuel	Unit	Concentration
Bituminous coals:	g/tonne	
- Australia		0.03-0.4
- Germany		0.70-1.4
- Japan		0.03-0.1
- New Zealand		0.02-0.6
- Poland		0.01-1.0
- South Africa		0.01-1.0
- United Kingdom		0.20-0.7
- USA		0.01-1.5
- Russia		0.02-0.6
Lignite coals:		
Crude oil	g/tonne	~ 0.01 ⁽¹⁾
Natural gas	mg/m ³	0-5.0 ⁽²⁾

- (1) However, on sporadic occasions the concentrations can be as high as 30.0 g/tonne.
- (2) A reduction of Hg to below 10 µg/m³ has to be obtained before the gas can be used.

Table 2.3 - Total Hg Emissions from Anthropogenic Sources in Europe, 1995 (in tonnes)

Country	Coal Combustion		Oil Combustion	Cement Product.*	Non-Ferrous Metals	Pig & Iron	Caustic Soda	Waste Incineration	Other	Total	Source
Sub-country	Power Plants	Residential Heat									
EU-15 countries:											
Austria	0.40			0.20	0.10	0.10	0.10	0.40	0.90	2.20	(1994) National
Belgium	1.70			0.20	0.50	0.10	0.70	0.10		3.30	EMEP
Denmark	0.70	0.20		0.20				1.00	0.30	2.40	National
Finland	0.10	0.40		0.10	0.30	0.10	0.50		0.10	1.60	EMEP
France	1.50	0.10		2.50	1.80	1.00	7.20	1.90	1.60	17.60	National
Germany	5.70	4.40	1.20	5.60	7.00	1.31	3.00	3.00	0.09	31.30	National
Greece	0.70	0.60		1.20	0.1	0.20		0.20		3.00	Pacyna et al., 2000
Ireland	0.20			0.10	0.1					0.40	Pacyna et al., 2000
Italy	0.50	2.80		3.00	0.80	0.60	4.00	1.00	0.50	13.20	(1994) EMEP
Luxembourg	0.10					0.10				0.20	EMEP
The Netherlands	0.10	0.10		0.30		0.30		0.20		1.00	National
Portugal	0.20			0.70			0.50		0.10	1.50	Pacyna et al., 2000
Spain	2.60	2.10		2.70	0.2	0.50	2.40		1.50	13.20	Pacyna et al., 2000
Sweden	0.10	0.10				0.10	0.10	0.40	0.10	0.90	EMEP
U.K	7.80	1.40		0.60	0.60	0.30	2.20		7.40	20.10	EMEP

* See also Annex-2 from CEMBUREAU.

Table 2.3 – cont'd

Country	Coal Combustion		Oil Combustion	Cement Product.*	Non-Ferrous Metals	Pig & Iron	Caustic Soda	Waste Incinerat.	Other	TOTAL	Source
	Power Plants	Residential Heat									
Countries in accession to the EU:											
Bulgaria	2.70	2.70	0.10	0.10	0.20	0.10	0.80		0.20	6.90	National
Cyprus									0.10	0.10	Pacyna and Pacyna, 2000
Czech Republic	7.00	7.00	0.10	0.20		0.30	0.40			15.00	National
Estonia									0.20	0.20	Pacyna and Pacyna, 2000
Hungary	1.60	0.50	0.10	0.30		0.10	0.90		1.30	4.80	EMEP
Latvia									0.20	0.20	EMEP
Lithuania									0.10	0.10	EMEP
Poland	20.60	11.30		0.10	0.10		0.10	1.40		33.60	National
Romania	7.00	6.00	0.40	1.40	0.40	0.80	7.00			23.00	Pacyna and Pacyna, 2000
Slovakia	0.80	0.80		0.20		0.20			1.20	3.20	National
Slovenia	0.40	0.03	0 0.003						0.30	0.73	Kotniz <i>et al.</i> (2000)

* See also Annex-2 from CEMBUREAU.

Table 2.3 – cont'd

Country	Coal Combustion		Oil Combustion	Cement Product.*	Non-Ferrous Metals		Pig & Iron	Caustic Soda	Waste Incinerat.	Other	TOTAL	Source
	Power Plants	Residential Heat			Lead	Zinc						
Other countries:												
Albania	0.20									0.10	0.30	Pacyna and Pacyna
Belarus	0.10										0.10	National
Bosnia-Herzegovina	0.20										0.20	Pacyna and Pacyna, 2000
Croatia				0.20						0.30	0.50	EMEP
Iceland											0.00	
Macedonia										1.50	1.50	Pacyna and Pacyna, 2000
Moldovia										1.50	1.50	Pacyna and Pacyna, 2000
Norway		0.10		0.10			0.10		0.10		0.40	National
Russia	16.00	33.00	5.00	3.80	0.20	1.70	1.80	8.00		18.20	87.70	Pacyna and Pacyna, 2000
Switzerland	0.10	0.10		0.20						2.90	3.30	National
Ukraine	7.00	15.00		2.00			2.00	3.00		7.00	36.00	Pacyna and Pacyna, 2000
Yugoslavia	3.20	0.60	0.10	0.30	0.10	0.20	0.10	0.40		1.60	6.60	Pacyna and Pacyna, 2000
EUROPE	89.20	89.30	7.00	26.30	1.90	13.50	10.21	41.30	9.70	49.29	337.70	

* See also Annex-2 from CEMBUREAU.

Table 2.4 - Changes in total anthropogenic emissions of mercury in Europe since 1980 (in tonnes/year)

Source category	1980	1985	1990	1995
Combustion of fuels	350	296	195	186
Industrial processes	460	388	390	93
Other sources	50	42	42	59
TOTAL	860	726	627	338

Table 2.5 - Emission profiles (fraction of the total) of Hg from Anthropogenic Sources, 1995

Species	Coal Combustion		Oil Combustion	Cement Production	Non-Ferrous Metals	Pig & Iron	Caustic Soda	Waste Incineration	Other	Average of all sources	Information/ Source
	Power Plants	Residential Heat									
Hg⁰ (gas)	0.5	0.5	0.5	0.8	1.6	0.8	0.7	0.2	0.8	0.64	Pacyna et al., 2000
Hg(II)	0.4	0.4	0.4	0.15	0.3	0.15	0.3	0.6	0.15	0.285	Modified by Pacyna, 1998
Hg (partic.)	0.1	0.1	0.1	0.05	0.1	0.05	0	0.2	0.05	0.075	

Table 2.6 - Top ten point sources of anthropogenic mercury emissions in Europe in 1995 (in tonnes)

Source name	Country	Source category	Emission
Belchatow	Poland	Coal combustion	2.14
Turow	Poland	Coal combustion	2.05
St. Petersburg	Russia	Coal combustion	1.90
Woloszilograd	Russia	Coal combustion	1.80
Starobeszewskaya	Ukraine	Coal combustion	1.50
Novoczerkassk	Russia	Coal combustion	1.40
Perm	Russia	Coal combustion	1.40
Siekierk – Warsaw	Poland	Coal combustion	1.32
Jaworzno II	Poland	Coal combustion	1.32
Marita	Bulgaria	Coal combustion	1.30

Table 2.7 – Global Emissions of Total Mercury from Major Anthropogenic Sources in 1995 (Tonnes/ year)

Continent	Stationary combustion	Non-ferrous metal production	Pig iron and steel production	Cement production	Waste disposal	Total
Europe	185.5	15.4	10.2	26.2	12.4	249.7
Africa	197.0	7.9	0.5	5.2		210.6
Asia	860.4	87.4	12.1	81.8	32.6	1 074.3
North America	104.8	25.1	4.6	12.9	66.1	213.5
South America	26.9	25.4	1.4	5.5		59.2
Australia&Oceania	99.9	4.4	0.3	0.8	0.1	105.5
TOTAL 1995	1 474.5	165.6	29.1	132.4	111.2	1 912.8
TOTAL 1990⁽¹⁾	1 295.1	394.4	28.4	114.5	139.0	2 143.1⁽²⁾

(1) Estimates of maximum values, which are regarded as close to the best estimate value.

(2) The total emission estimate for 1990 includes also 171.7 tonnes of Hg emission from chlor-alkali production and other less significant sources.