

## Atmospheric emissions of Lead in the Baltic Sea region

HELCOM Baltic Sea Environment Fact Sheet (BSEFS), 2023

Authors: Olga Rozovskaya, Iliia Ilyin, Alexey Gusev, EMEP MSC-E

### Key Message

Annual atmospheric lead emissions of the HELCOM Contracting Parties decreased by 92% from 1990 to 2021.

### Results and Assessment

#### *Relevance of the BSEFS for describing developments in the environment*

This BSEFS shows the levels and trends in lead emissions from anthropogenic sources of the HELCOM Contracting Parties, and other sources in the calculations of the deposition on the Baltic Sea (cf. BSEFS “Atmospheric deposition of lead on the Baltic Sea”).

#### *Policy relevance and policy reference*

The updated Baltic Sea Action Plan states the ecological objectives that concentrations of hazardous substances in the environment are to be close to background values for naturally occurring substances. HELCOM Recommendation 31E/1 identifies the list of regional priority substances for the Baltic Sea.

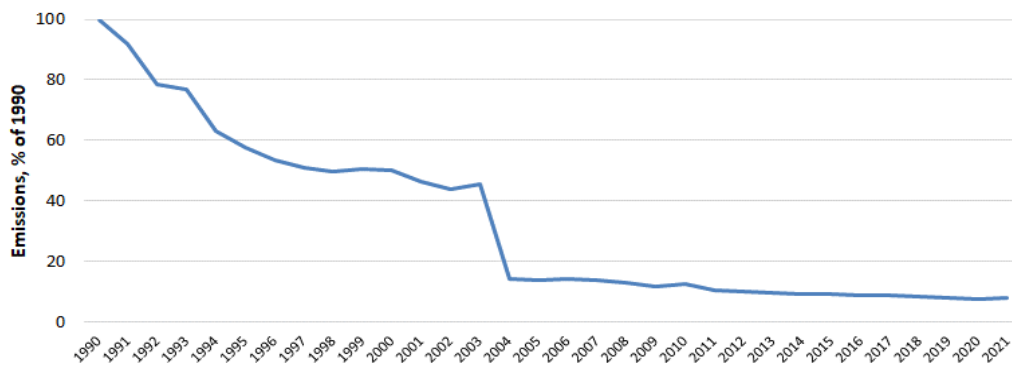
The relevant policy to the control of emissions of heavy metals to the atmosphere on European scale is set in the framework of UN ECE Convention on Long-Range Transboundary Air Pollution (CLRTAP). The CLRTAP Protocol on Heavy Metals (1998) targets three particularly harmful metals: cadmium, lead and mercury. According to one of the basic obligations emissions of these three metals must be reduced below the emission levels in 1990. The Protocol entered into force in 2003 and was signed and/or ratified by 41 countries.

#### *Assessment*

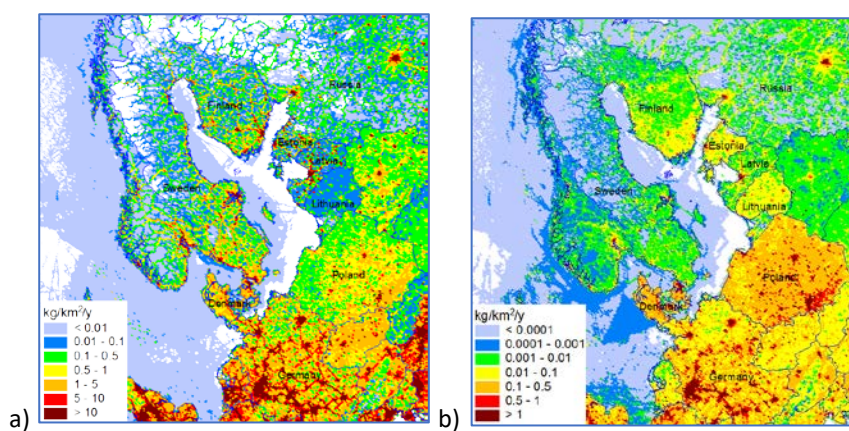
Annual anthropogenic emissions of lead to the atmosphere from the HELCOM Contracting Parties decreased by 92% from 1990 to 2021 (Figure 1). Spatial distributions of lead anthropogenic emission fluxes in 1990 and 2021 are shown in Figure 2. The largest emission fluxes are noted in the areas along the southern and western parts of the Baltic Sea.

Time-series of annual total lead emissions of the HELCOM Contracting Parties are shown in Figures 3. Among the HELCOM countries the largest drop of lead emissions is noted for Estonia, Latvia, Sweden (98% each). The smallest decrease of lead emissions is seen for Poland (49%).

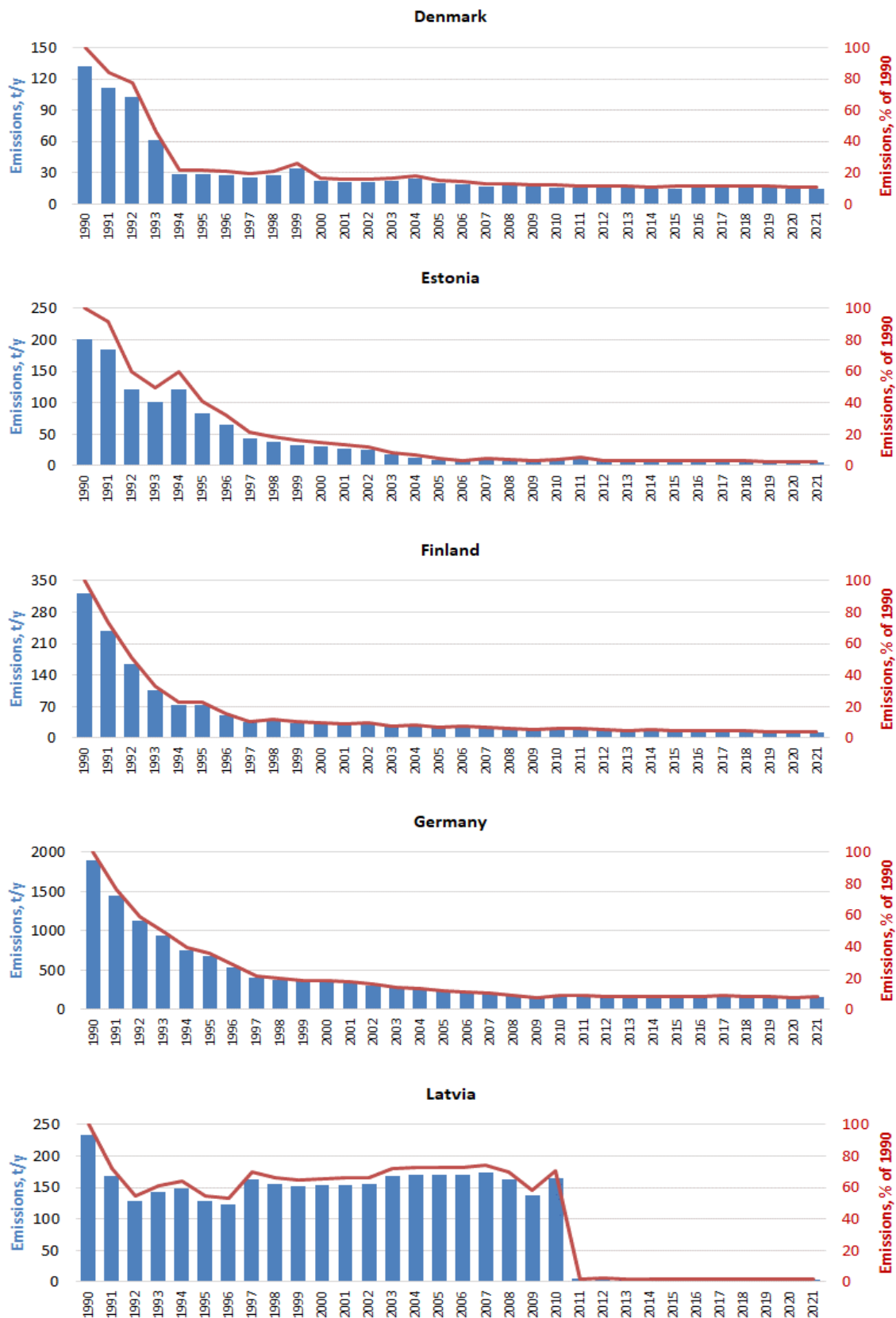
In 2021 total annual lead emissions of the HELCOM Contracting Parties amounted to 717 t. The largest contributions to these emissions were made by Poland (39%), Russia (33%) and Germany (22%).



**Figure 1.** Relative changes of total annual emissions of lead to the atmosphere from the HELCOM Contracting Parties in period 1990-2021 (% of 1990).



**Figure 2.** Spatial distribution of annual anthropogenic Pb emissions to the atmosphere in the Baltic Sea region in 1990 (a) and in 2021 (b), in  $\text{kg km}^{-2} \text{y}^{-1}$ .



**Figure 3.** Lead emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2021 in  $t\ y^{-1}$  (blue bars) and in % of 1990 (red line). The emission data of the CP refer to the total area of the CP except for Russia, where emissions from the territory of Russia within the EMEP domain is used.



**Figure 3 (continued).** Lead emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2021 in  $t\ y^{-1}$  (blue bars) and in % of 1990 (red line). The emission data of the CP refer to the total area of the CPs except for Russia, where emissions from the territory of Russia within the EMEP domain is used.

## Data

Numerical data on anthropogenic lead emissions of the HELCOM Contracting Parties are given in the following table.

**Table 1.** Lead emissions from anthropogenic sources of the HELCOM Contracting Parties from 1990 to 2021.  
Units: t y<sup>-1</sup>.

	DK	EE	FI	DE	LV	LT	PL	RU	SE	HELCOM	Other
1990	132	202	321	1899	233	10	544	5441	369	9153	30098
1991	111	184	237	1453	169	10	541	5383	325	8414	24358
1992	102	120	165	1127	128	5	548	4689	307	7192	20390
1993	61	100	105	947	142	5	568	4964	144	7037	18699
1994	29	120	74	752	149	4	586	4005	48	5768	17038
1995	29	83	73	679	128	4	579	3676	30	5280	15179
1996	28	64	49	537	124	4	580	3491	25	4901	13339
1997	26	43	34	409	163	4	555	3405	25	4663	11923
1998	28	37	37	378	155	4	480	3427	24	4571	10551
1999	34	33	34	354	151	3	464	3544	22	4639	8893
2000	22	30	31	355	153	3	397	3564	19	4574	6284
2001	22	27	30	334	154	3	271	3386	17	4244	5045
2002	21	24	31	303	155	3	271	3209	14	4032	4207
2003	22	17	25	271	168	3	289	3344	14	4153	3748
2004	24	13	26	253	170	3	303	500	13	1306	3322
2005	20	9	21	230	170	3	281	538	12	1285	2991
2006	19	7	25	213	170	4	304	538	11	1290	2932
2007	17	10	22	196	173	4	313	514	12	1261	2871
2008	17	7	20	172	163	4	308	489	10	1191	2844
2009	16	6	17	146	137	3	274	465	10	1074	2404
2010	16	9	20	168	165	3	306	440	10	1138	2523
2011	16	11	19	166	5	3	303	416	9	949	2318
2012	15	6	16	158	6	4	316	392	9	923	2259
2013	15	7	16	161	4	4	307	367	9	890	2232
2014	15	7	17	157	4	4	309	343	9	863	2126
2015	15	6	15	163	4	4	302	319	8	835	2081
2016	15	6	16	160	4	4	296	294	9	803	2043
2017	15	6	16	165	4	4	310	270	9	800	2068
2018	16	6	15	160	4	4	311	246	8	771	2132
2019	15	6	13	158	4	4	290	221	8	719	2255
2020	14	5	12	143	4	3	270	222	8	682	2143
2021	15	5	13	154	4	4	280	236	7	717	1956

## Meta data

### *Technical information:*

#### 1. Source:

Meteorological Synthesizing Centre East (MSC-E) of EMEP, Centre on Emission Inventories and Projections (CEIP) of EMEP.

#### 2. Description of data:

Annual total emissions of lead were officially reported by the HELCOM Contracting Parties to the UN ECE Secretariat in 2023. These data are available from the EMEP Centre on Emission Inventories and Projections (CEIP) (<http://www.ceip.at/>).

#### 3. Geographical coverage:

EMEP region

#### 4. Temporal coverage:

Data on lead annual emission totals are available for the period 1990 – 2021 for all HELCOM Contracting Parties with the exception of Russia. For Russia, expert estimates of emissions were elaborated on the basis of methodology developed by CEIP [Poupa, 2022].

#### 5. Methodology and frequency of data collection:

National data on lead emissions are annually submitted by countries Parties to LRTAP Convention to the UN ECE Secretariat. The methodology is based on the combination of measurements of releases to the atmosphere and estimation of emission based on activity data and emission factors. Submitted emission data are processed using quality assurance and quality control procedure and stored in the UN ECE/EMEP emission database at EMEP/CEIP Centre.

### *Quality information:*

#### 6. Strength and weakness:

Strength: data on emissions are annually submitted, checked and stored in the database

Weakness: gaps in time series of national emissions, uncertainties in national emissions, lack of gridded emissions, and incompleteness of sectoral distribution.

#### 7. Uncertainty:

Among the HELCOM countries the level of uncertainty of official data on Pb emission was reported by Denmark, Estonia, Finland, Latvia, Poland and Sweden. From other EMEP countries the information on uncertainties of Pb official emissions is available for Austria, Belarus, Belgium, Croatia, Cyprus, France, Monaco, Republic of Moldova, Slovakia, Switzerland and the United

Kingdom. The uncertainty of reported data on Pb emissions expressed as percentage relative to the mean value of emission is as follows:

Denmark:	583%
Estonia:	53%
Finland:	31%
Latvia:	11%
Poland:	19%
Sweden:	27%
Austria:	35%
Belarus:	96%
Belgium:	173%
Croatia:	168%
Cyprus:	3%
France:	107%
Monaco:	26%
Republic of Moldova:	193%
Slovakia:	96%
Switzerland:	50-100%
UK:	69%

#### 8. Further work required:

Further work to refine national inventories of lead emissions is required to reduce their uncertainties, to fill the gaps in sector distribution and improve spatial distribution of emissions. Besides, further studies to evaluate lead releases to the atmosphere from natural and secondary emission sources are of importance for the assessment of lead pollution levels.

## References

Poupa S. [2022] *Methodologies applied to the CEIP GNFR gap-filling 2022. Part II: Heavy Metals (Cd, Hg, Pb) and Persistent Organic Pollutants (Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total polycyclic aromatic hydrocarbons, Dioxin and Furan, Hexachlorobenzene, Polychlorinated biphenyls) of the year 2020. Technical Report CEIP 04/2022* (<https://www.ceip.at/ceip-reports>).