Atmospheric emissions of Benzo(a)pyrene in the Baltic Sea region

HELCOM Baltic Sea Environment Fact Sheet (BSEFS), 2022

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Key Message

Annual atmospheric emissions of benzo(a)pyrene in the HELCOM Contracting Parties have decreased by 23% during the period from 1990 to 2020.

Results and Assessment

Relevance of the BSEFS for describing developments in the environment

This BSEFS shows the levels and trends in benzo(a)pyrene (B(a)P) 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 benzo(a)pyrene 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.

On the European level the relevant policy to the control of emissions of B(a)P to the atmosphere is being taken in the framework of UN ECE Convention on Long-Range Transboundary Air Pollution (CLRTAP). The Executive Body of CLRTAP adopted the Protocol on Persistent Organic Pollutants on 24 June 1998 in Aarhus (Denmark). According to one of the basic obligations, Parties to the Convention shall reduce their emissions of B(a)P below their levels in 1990. The Protocol has been entered into force in 2003 and has been signed and/or ratified by 40 countries.

Assessment

Officially reported inventories of B(a)P emissions to the atmosphere in the HELCOM Contracting Parties show decrease of B(a)P releases during the period 1990-2020 by 23% (Figure 1). Spatial distributions of B(a)P anthropogenic emission fluxes in 1990 and 2020 are shown in Figure 2. The largest emission fluxes are noted for the areas along the southern and western parts of the Baltic Sea.

Time-series of annual B(a)P emissions of the HELCOM Contracting Parties are shown in Figures 3. The most significant drop of B(a)P emissions is noted for Sweden (66%) followed by Estonia (62%), Latvia (62%) and Denmark (61%). At the same time, emissions of Finland in 2020 were higher than emissions in 1990 by 3%.

In 2020 total annual B(a)P emissions of the HELCOM Contracting Parties amounted to 222 t. Among the HELCOM countries the largest contributions to total annual B(a)P emissions of HELCOM countries belong to Russia (50%) and Poland (36%).

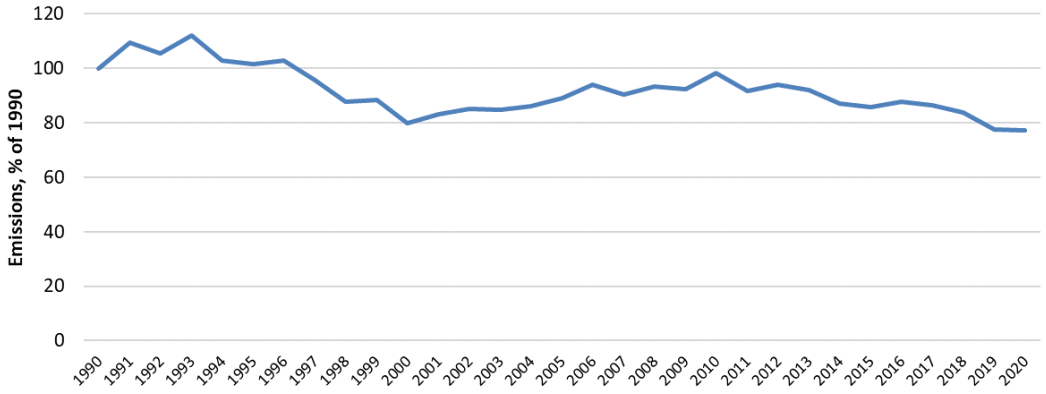

Figure 1. Relative changes of total annual emissions of B(a)P to the atmosphere from the HELCOM Contracting Parties in period 1990-2020 (% of 1990).

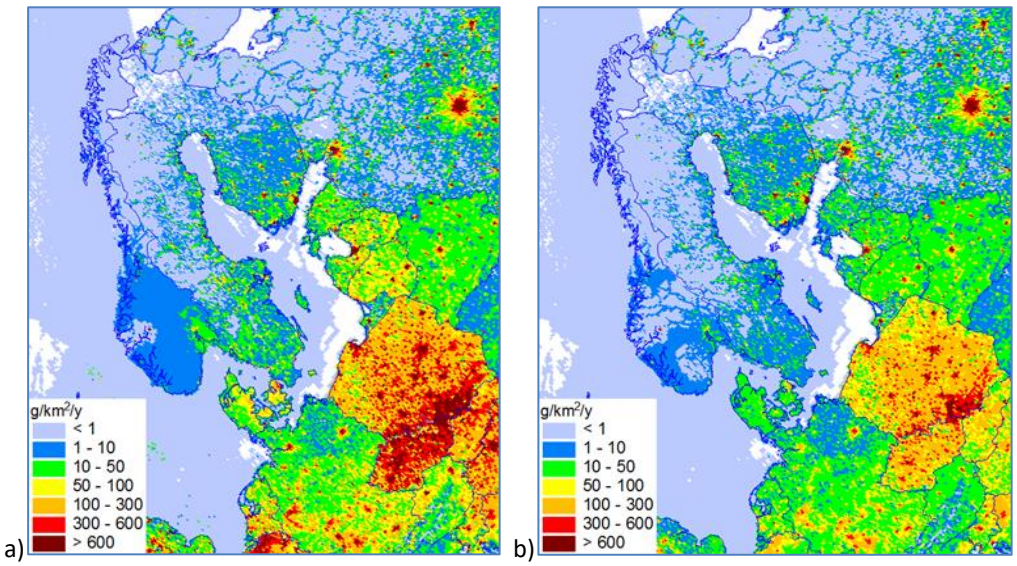

Figure 2. Spatial distribution of annual anthropogenic B(a)P emissions to the atmosphere in the Baltic Sea region in 1990 (a) and in 2020 (b), in g km^{-2} y^{-1}.

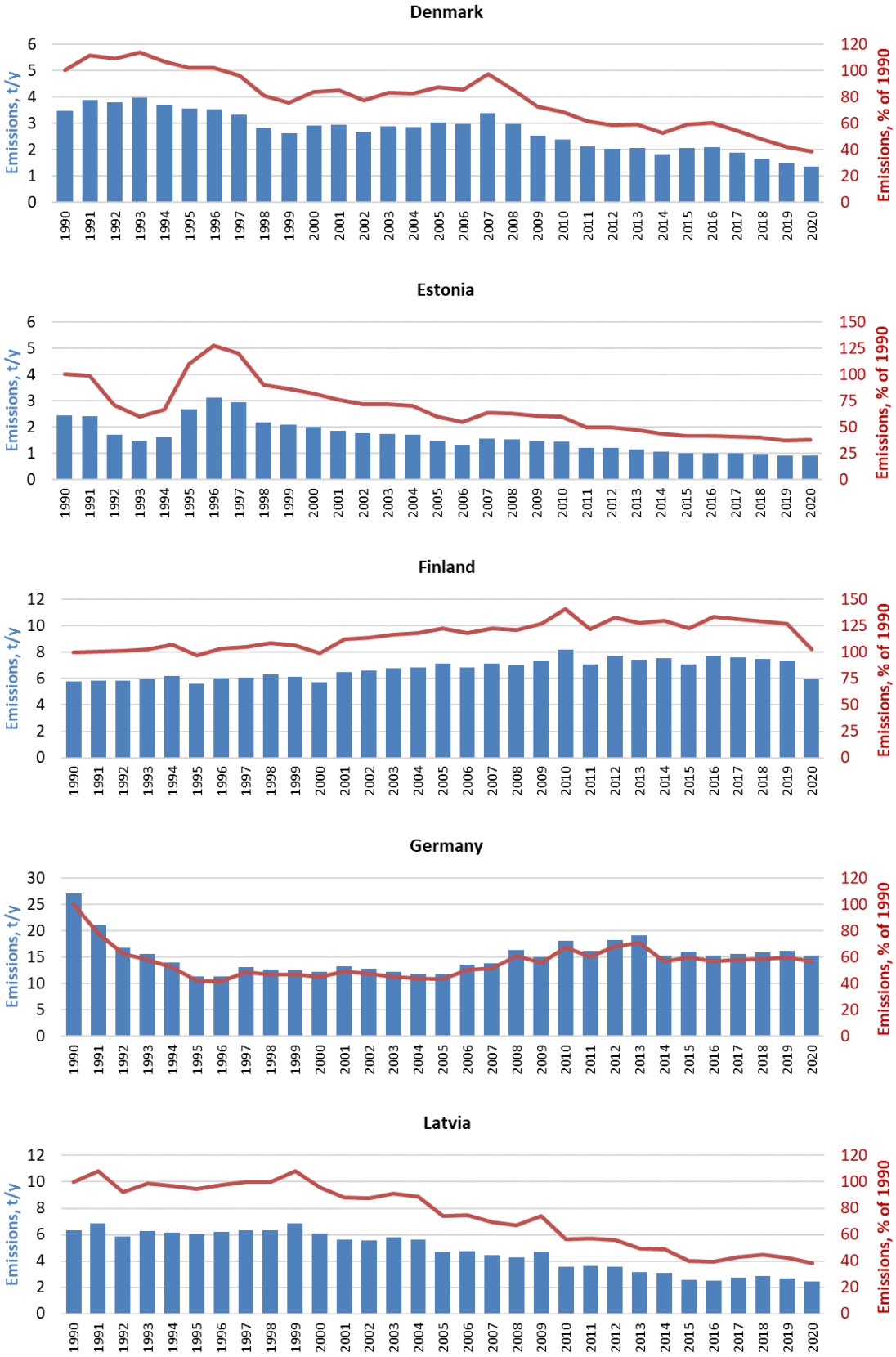

Figure 3. B(a)P emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2020 in t y^{-1} (blue bars) and in % of 1990 (red line). The emission data of the CP refer to the total area of the CP except for Russia, where emissions from the territory of Russia within the EMEP domain is used.

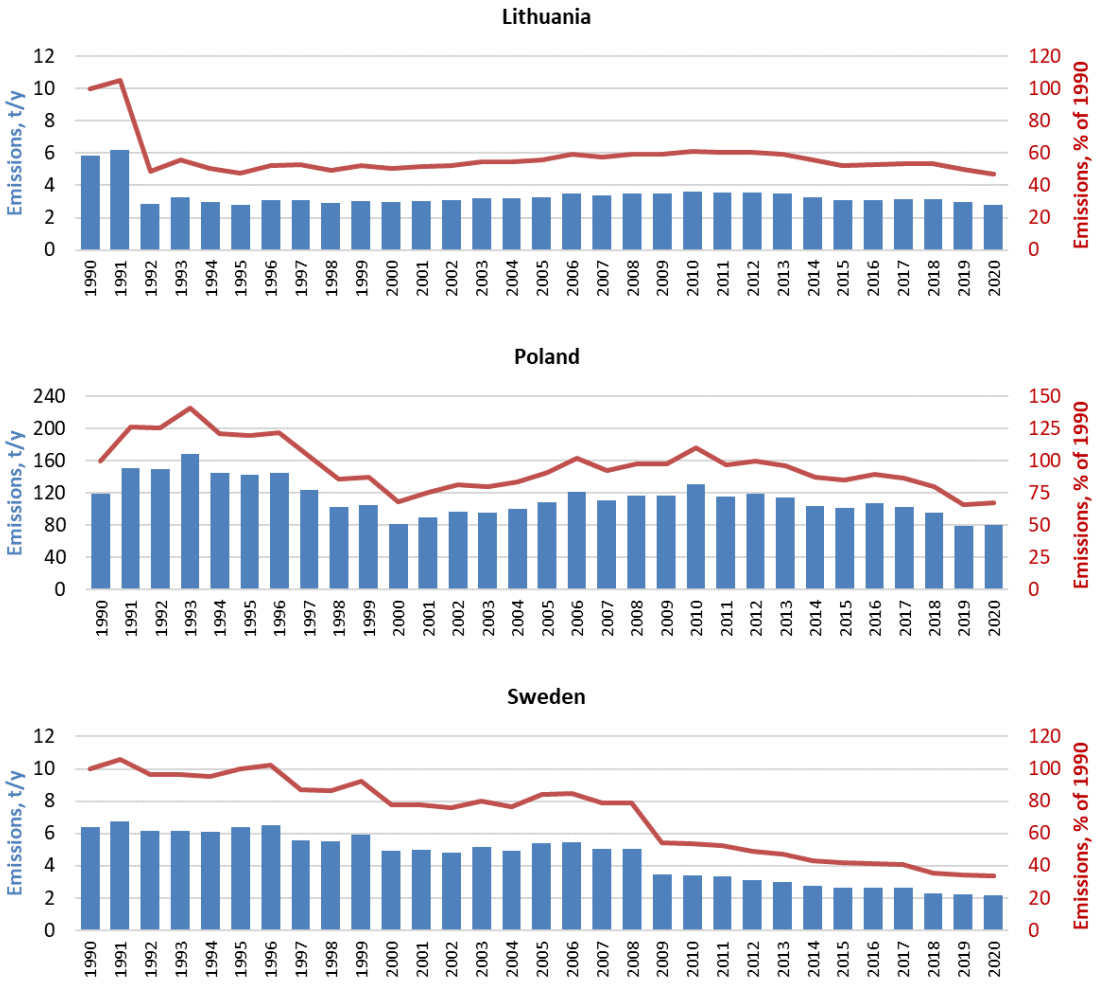

Figure 3 (continued). B(a)P emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2020 in t y^{-1} (blue bars) and in % of 1990 (red line). The emission data of the CP refer to the total area of the CP. No official B(a)P emissions from Russia were reported, therefore expert estimates of B(a)P emissions equal to 110 tonnes y^{-1} were assumed, following the estimates of CEIP.

Data

Numerical data on B(a)P anthropogenic emissions of the HELCOM Contracting Parties are given in the following table.

Table 1. B(a)P emissions from anthropogenic sources of the HELCOM Contracting Parties from 1990 to 2020. Units: t y^{-1}.

	DK	EE	FI	DE	LV	LT	PL	RU	SE	HELCOM	Other
1990	3.47	2.44	5.80	27.0	6.35	5.87	119.5	110	6.38	287	500
1991	3.87	2.40	5.85	21.0	6.86	6.19	151.2	110	6.75	314	482
1992	3.78	1.72	5.87	16.8	5.86	2.88	149.7	110	6.16	303	449
1993	3.95	1.46	5.96	15.6	6.27	3.28	168.7	110	6.16	321	431
1994	3.71	1.62	6.22	14.0	6.15	2.96	144.7	110	6.08	295	406
1995	3.55	2.68	5.63	11.3	6.02	2.80	142.6	110	6.38	291	390
1996	3.54	3.11	6.03	11.3	6.21	3.07	145.3	110	6.53	295	391
1997	3.33	2.93	6.08	13.0	6.35	3.10	123.7	110	5.57	274	377
1998	2.81	2.18	6.31	12.6	6.33	2.90	102.6	110	5.51	251	359
1999	2.62	2.10	6.17	12.6	6.88	3.06	104.6	110	5.90	254	324
2000	2.91	2.00	5.74	12.2	6.08	2.97	82.0	110	4.94	229	314
2001	2.95	1.86	6.52	13.3	5.61	3.04	90.1	110	4.97	238	307
2002	2.68	1.75	6.59	12.7	5.55	3.09	97.1	110	4.83	244	297
2003	2.89	1.74	6.78	12.2	5.78	3.20	95.4	110	5.13	243	304
2004	2.86	1.71	6.88	11.8	5.65	3.20	99.9	110	4.90	247	300
2005	3.04	1.47	7.12	11.7	4.71	3.27	109.1	110	5.39	256	300
2006	2.98	1.34	6.85	13.5	4.76	3.48	121.7	110	5.43	270	298
2007	3.39	1.55	7.13	13.8	4.42	3.40	110.6	110	5.04	259	299
2008	2.97	1.54	7.04	16.4	4.26	3.49	116.6	110	5.05	267	303
2009	2.51	1.48	7.39	15.0	4.71	3.50	116.5	110	3.47	265	299
2010	2.38	1.46	8.19	18.1	3.59	3.61	131.1	110	3.42	282	304
2011	2.13	1.20	7.09	16.2	3.64	3.56	115.8	110	3.34	263	299
2012	2.03	1.21	7.73	18.3	3.57	3.56	119.7	110	3.13	269	309
2013	2.04	1.15	7.41	19.1	3.16	3.49	114.6	110	3.00	264	307
2014	1.83	1.07	7.54	15.3	3.10	3.27	104.5	110	2.75	249	292
2015	2.05	1.00	7.11	16.0	2.54	3.07	101.8	110	2.66	246	297
2016	2.09	1.01	7.75	15.3	2.50	3.10	106.9	110	2.64	251	298
2017	1.89	1.00	7.64	15.6	2.74	3.15	103.3	110	2.60	248	295
2018	1.66	0.97	7.52	15.8	2.85	3.15	95.9	110	2.25	240	290
2019	1.46	0.90	7.38	16.1	2.71	2.95	78.7	110	2.20	222	288
2020	1.34	0.92	5.99	15.2	2.43	2.78	80.9	110	2.14	222	285

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 B(a)P were officially reported by the HELCOM Contracting Parties to the UN ECE Secretariat in 2022. These data are available on the web site of the EMEP Centre on Emission Inventories and Projections (CEIP) (http://www.ceip.at/).

3. Geographical coverage:

EMEP region

4. Temporal coverage:

Data on annual emissions of B(a)P for the period 1990 – 2020 were reported by 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*, 2021].

5. Methodology and frequency of data collection:

National data on B(a)P 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 B(a)P emissions are annually submitted, checked and stored in the database.

Weakness: gaps in time series and uncertainties in B(a)P 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 PAH or B(a)P emission was reported by Denmark, Estonia, Finland, Latvia, Poland and Sweden. From other EMEP countries the information on uncertainties of PAH or/and B(a)P 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 PAH/B(a)P emissions, expressed as percentage relative to the mean value of the emission, is as follows:

Denmark:	B(a)P	747%
Estonia:	B(a)P	154%
Finland:	PAH	184%
Latvia:	PAH	46%
Poland:	PAH	59%
Sweden:	PAH	699%
Austria:	PAH	155%
Belarus:	B(a)P	198%
Belgium:	PAH	271%
	B(a)P	289%
Croatia:	PAH	378%
Cyprus:	PAH	205%
France:	PAH	83%
Monaco:	PAH	45%
Republic of Moldova:	BaP	276%
Slovakia:	PAH	162%
Switzerland:	PAH	>100%
UK:	B(a)P	290%

Evaluation of emission uncertainties is made by the experts of the HELCOM contracting parties on the base of methodology presented in EMEP/EEA guidebook [*EEA*, 2019]. The methodology considers uncertainties of the activity data and the emission factors applied for each emission sector. It is important to note that the uncertainties of emission factors are much higher than those for the activity data. For POPs the default value of emission factor uncertainty suggested by the guidebook exceeds 100%. Besides, the estimates of the uncertainties as a rule do not account for possible lack of completeness of the emission data.

8. Further work required:

Further work to refine national inventories of B(a)P emissions is required to reduce their uncertainties, to fill the gaps in sector distribution and improve spatial distribution of emissions. Besides, studies of natural emissions of B(a)P to the atmosphere are of importance for the assessment of B(a)P pollution levels.

References

EEA [2019]. EMEP/EEA air pollutant emission inventory guidebook 2019. Technical guidance to prepare national emission inventories. EEA Report No 13/2019.

Poupa S. [2021] Methodologies applied to the CEIP GNFR gap-filling 2021. 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). Technical Report CEIP 06/2021 (https://www.ceip.at/ceip-reports).