Atmospheric emissions of PCDD/Fs in the Baltic Sea region

HELCOM Baltic Sea Environment Fact Sheet (BSEFS), 2023

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Key Message

Annual atmospheric emissions of PCDD/Fs in the HELCOM Contracting Parties have decreased by 27% during the period 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 polychlorinated dibenzo(p)dioxins and dibenzofurans (PCDD/F) 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 PCDD/Fs 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 PCDD/Fs 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 PCDD/Fs 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 PCDD/F emissions to the atmosphere in the HELCOM Contracting Parties show decrease of releases during the period 1990-2021 by 27% (Figure 1). Spatial distributions of PCDD/F anthropogenic emission fluxes in 1990 and 2021 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 PCDD/F emissions of the HELCOM Contracting Parties are shown in Figures 3. The most significant drop of PCDD/F emissions is noted for Germany (86%) followed by Sweden (71%), and Estonia (64%). The lowest decline of national PCDD/F emissions was reported by Poland (15%). No data on temporal changes of PCDD/F emission in Russia was available.

In 2021 total annual PCDD/F emissions of the HELCOM Contracting Parties amounted to 2312 g TEQ. Among the HELCOM countries the largest contribution to total annual PCDD/F emissions of HELCOM countries was made by Russia (77%) followed by Poland (14%) and Germany (5%).

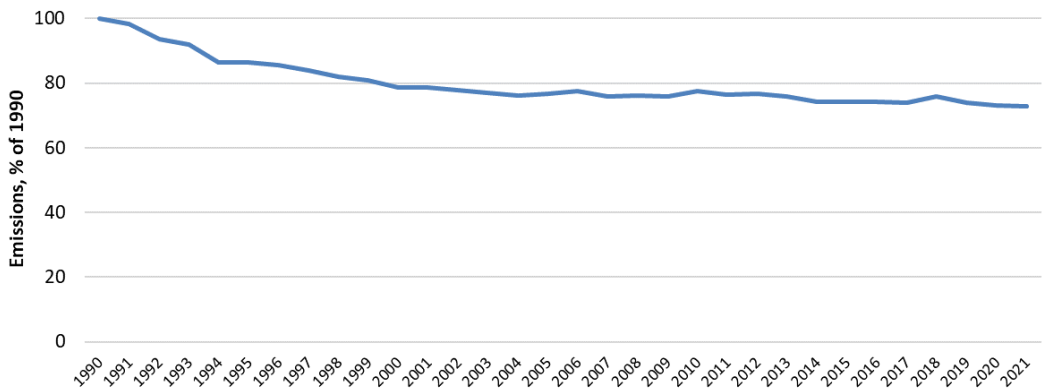

Figure 1. Relative changes of total annual emissions of PCDD/Fs to the atmosphere from the HELCOM Contracting Parties in period 1990-2021 (% of 1990).

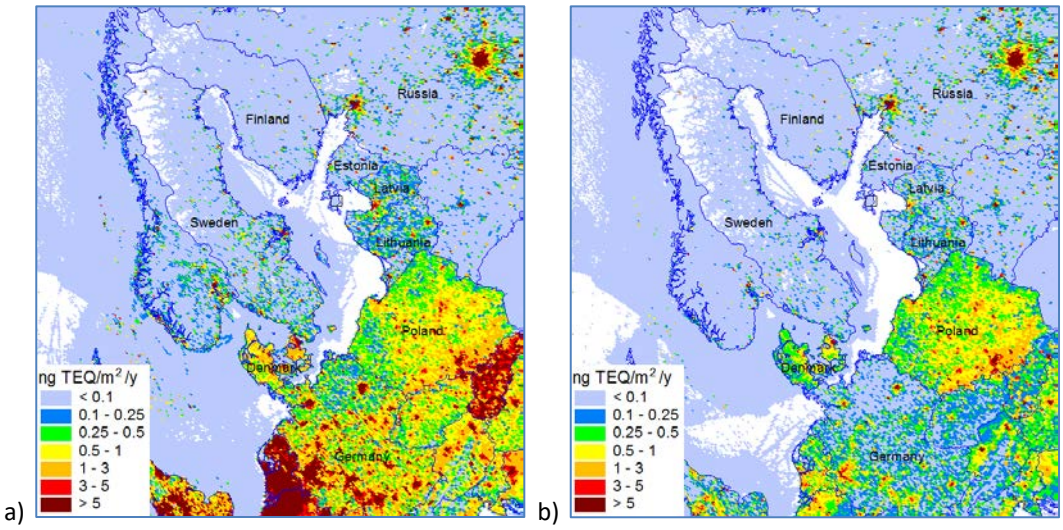

Figure 2. Spatial distribution of annual anthropogenic PCDD/F emissions to the atmosphere in the Baltic Sea region in 1990 (a) and in 2021 (b), in ng TEQ m^{-2} y^{-1}.

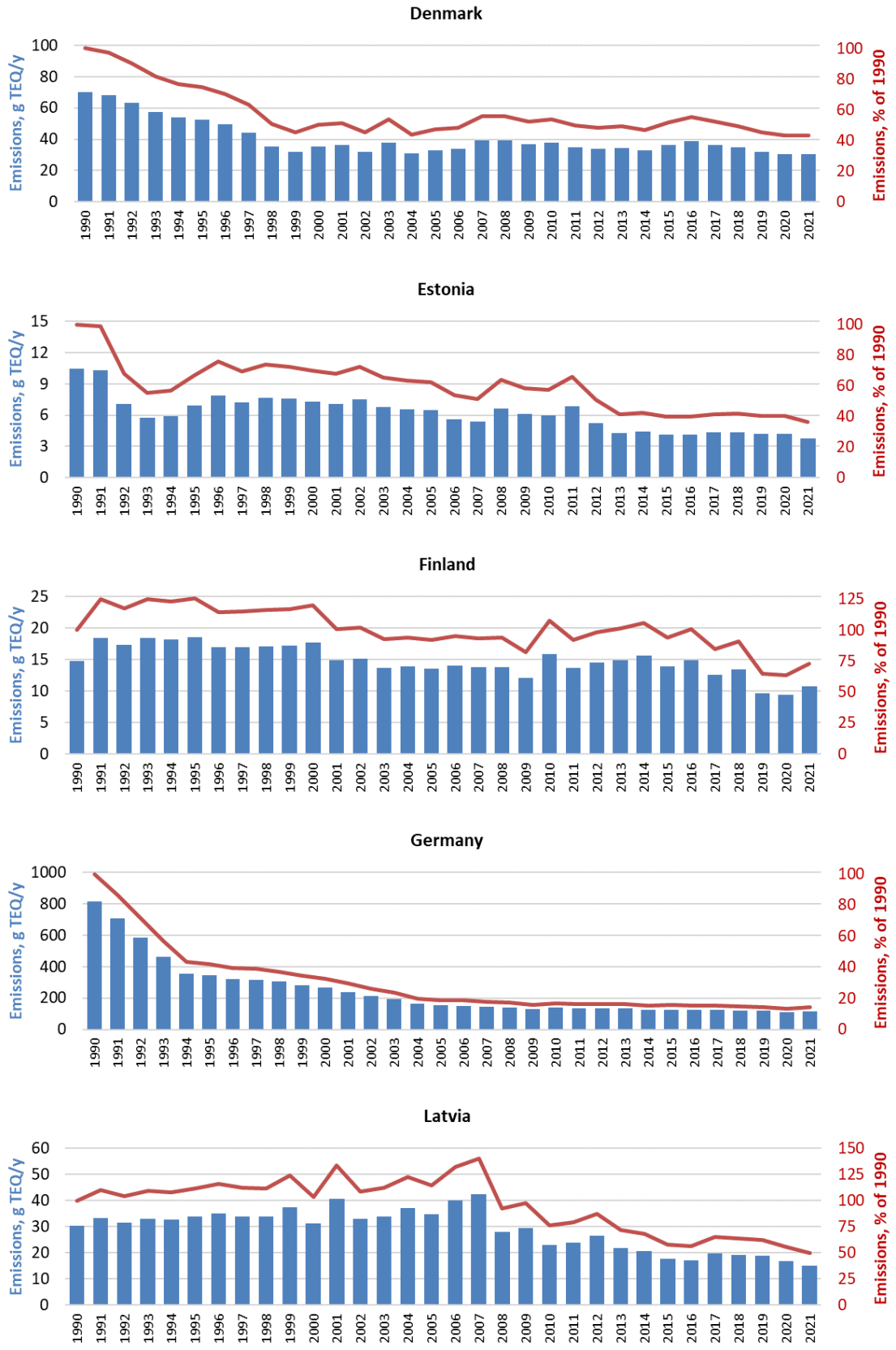

Figure 3. PCDD/F emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2021 in g TEQ y^{-1} (blue bars) and in % of 1990 (red line). The emission data of the CP refer to the total area of the CP.

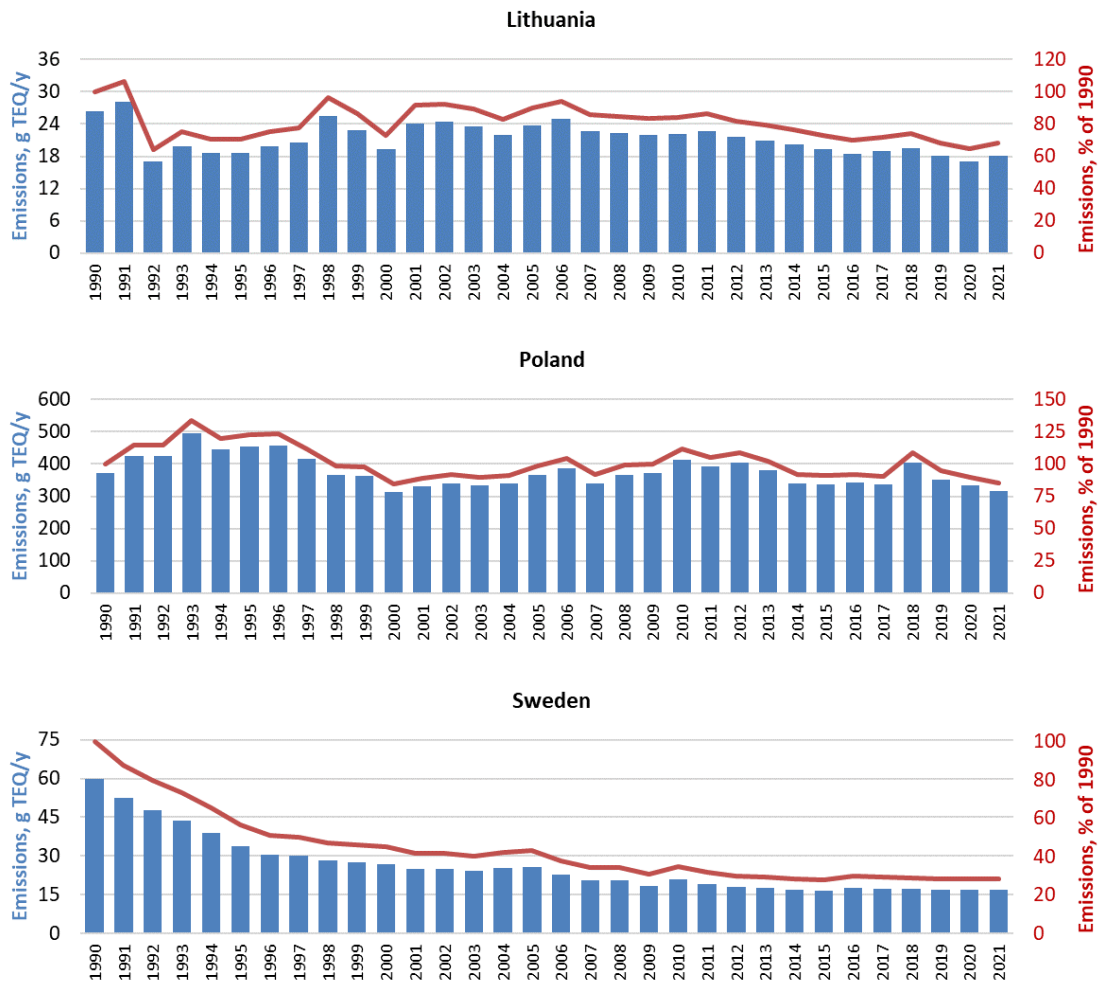

Figure 3 (continued). PCDD/F emissions of the HELCOM Contracting Parties (CP) to the atmosphere for the period 1990-2021 in g TEQ y^{-1} (blue bars) and in % of 1990 (red line). The emission data of the CP refer to the total area of the CP. Changes of PCDD/F emissions of Russia in the considered period are not shown since no data on temporal variations were available.

Data

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

Table 1. PCDD/F emissions from anthropogenic sources of the HELCOM Contracting Parties from 1990 to 2021. Units: g TEQ y^{-1}.

	DK	EE	FI	DE	LV	LT	PL	RU	SE	HELCOM	Other
1990	70.2	10.4	14.8	814	30.3	26.4	371	1784	59.7	3181	9543
1991	68.2	10.3	18.4	706	33.5	28.1	426	1784	52.4	3127	9283
1992	63.2	7.1	17.4	585	31.5	17.0	425	1784	47.6	2978	9051
1993	57.2	5.8	18.5	463	33.2	19.8	496	1784	43.8	2921	8535
1994	53.8	5.9	18.2	353	32.7	18.6	446	1784	39.0	2751	8175
1995	52.6	7.0	18.6	343	33.9	18.7	455	1784	33.7	2747	7810
1996	49.4	7.9	16.9	322	35.1	19.8	458	1784	30.5	2724	7196
1997	44.3	7.2	17.0	316	34.0	20.5	415	1784	30.1	2669	6803
1998	35.6	7.7	17.1	304	33.8	25.5	367	1784	28.2	2603	6416
1999	31.9	7.6	17.3	280	37.6	22.8	362	1784	27.6	2571	6109
2000	35.4	7.3	17.7	266	31.3	19.3	314	1784	26.9	2503	6257
2001	36.1	7.0	14.9	240	40.6	24.2	331	1784	24.9	2503	5674
2002	32.0	7.5	15.1	215	33.0	24.4	341	1784	24.9	2477	5599
2003	37.6	6.8	13.7	192	34.0	23.6	334	1784	24.1	2450	5255
2004	30.9	6.6	13.9	163	37.1	22.0	339	1784	25.2	2422	5203
2005	33.1	6.5	13.6	154	34.8	23.7	366	1784	25.8	2443	4878
2006	34.1	5.6	14.0	151	40.1	24.9	386	1784	22.7	2463	4521
2007	39.1	5.4	13.8	144	42.5	22.6	341	1784	20.5	2414	4677
2008	39.2	6.6	13.8	142	27.9	22.3	367	1784	20.4	2424	4789
2009	36.6	6.1	12.1	128	29.5	22.0	372	1784	18.4	2409	3903
2010	37.8	6.0	15.9	138	23.1	22.1	414	1784	20.7	2462	4064
2011	34.9	6.8	13.6	134	24.0	22.7	391	1784	19.0	2431	3993
2012	33.8	5.3	14.5	133	26.5	21.6	404	1784	17.8	2441	4115
2013	34.5	4.3	15.0	133	21.7	21.0	380	1784	17.6	2412	3881
2014	33.0	4.4	15.7	124	20.7	20.2	340	1784	16.8	2360	3763
2015	36.4	4.1	13.9	127	17.6	19.3	338	1784	16.7	2358	3815
2016	38.7	4.2	14.9	125	17.1	18.4	342	1784	17.7	2362	3758
2017	36.6	4.3	12.5	123	19.9	18.9	337	1784	17.4	2354	3784
2018	34.6	4.4	13.4	119	19.3	19.5	404	1784	17.2	2416	3774
2019	31.8	4.2	9.6	118	18.9	18.1	352	1784	16.9	2354	4069
2020	30.5	4.2	9.4	110	17.0	17.1	333	1784	16.8	2322	4128
2021	30.5	3.8	10.8	116	15.1	18.1	316	1784	17.0	2312	6800

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 PCDD/Fs were officially reported by the HELCOM Contracting Parties to the UN ECE Secretariat in 2023. 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 PCDD/Fs for the period 1990 – 2021 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*, 2022].

5. Methodology and frequency of data collection:

National data on PCDD/F 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 PCDD/F emissions are annually submitted, checked and stored in the database.

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

7. Uncertainty:

Among the HELCOM countries the level of uncertainty of official data of PCDD/F emission was reported by Denmark, Estonia, Finland, Latvia, Poland and Sweden. From other EMEP countries the information on uncertainties of PCDD/F 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 PCDD/F emissions, expressed as percentage relative to the mean value of the emission, is as follows:

Denmark:	336%
Estonia:	117%
Finland:	280%
Latvia:	38%
Poland:	50%
Sweden:	167%
Austria:	98%
Belarus:	48%
Belgium:	230%
Croatia:	343%
Cyprus:	75%
France:	36%
Monaco:	9%
Republic of Moldova:	197%
Slovakia:	1267%
Switzerland:	>100%
UK:	+/-50%

8. Further work required:

Further work to refine national inventories of PCDD/F emissions is required to reduce their uncertainties, to fill the gaps in sector distribution and improve spatial distribution of emissions. Besides, the information on congener composition of officially reported PCDD/F emission data is important for modeling.

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).