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Tackling Mercury Pollution of EU Waters

Why coal combustion must end by 2027 at the latest

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We are Europe's largest network of environmental citizens' organisations. We bring together over 160 civil society organisations from more than 35 European countries. Together, we work for a better future where people and nature thrive together.

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Contents

Introduction

Mercury pollution remains a significant challenge for Europe's waters. Atmospheric deposition of mercury is the main reason for the failure of good chemical status in over 30% of surface water bodies in the EU.[1] As a consequence, children are suffering brain damage due to mercury exposure, mainly via fish consumption.[2]

EU water regulation sets 2027 as the deadline for Member States to overhaul surface, groundwater and coastal waters and requires the phase out of mercury and other Priority Hazardous Substances by the same year. Water protection authorities have failed to establish adequate measures to address mercury pollution in two cycles of River Basin Management Plans. They will make another attempt in the third cycle (2022-2027).

Coal combustion is the largest source of mercury to the environment in the EU, responsible for around 60% of emissions to air.[3] While it is legally required and technically feasible to reduce the emissions from combustion plants by implementing strict emission limits, authorities responsible for permits have largely failed to seize this opportunity. Instead they have delayed action, opting for the least committing option or even granted derogations.[4]

Without more ambition and closer cooperation between regulatory bodies, EU countries are set to fail the ambition of the Water Framework Directive, letting people and the environment bear the cost.

[1] EEA Drivers of and pressures arising from selected key water management challenges: A European overview

[2] See e.g. Developmental neurotoxicity: Methylmercury and prenatal exposure protection in the context of the Minamata Convention

[3] EEA European Industrial Emissions Portal

[4] EEB Four years of unnecessary pollution: EU governments fail to curb emissions from most toxic plants

Mercury is causing wide-spread pollution of water

Mercury exists in the environment in different chemical forms: elemental mercury, inorganic mercury and organic mercury. The organic form (methylmercury) is particularly toxic due to its biological effects. Once mercury is released into the environment, it can convert from one form to another via natural processes and cycle between the air, water, sediments, soil and living organisms.[5] In the atmosphere, mercury can stay for a long time in the form of particulate matter or mercury vapour, resulting in it spreading over wide distances once it is dispersed into the environment.

Atmospheric deposition of mercury is the main reason why 30% of the EU's water bodies are not in good chemical condition

Atmospheric deposition of mercury is the reason why over 45 000 water bodies in the EU are not in good chemical status and adequate measures to tackle mercury pollution are missing.[6] Once mercury has been released into the environment, remediation is technically difficult and expensive. Therefore, effort and priority should be addressed at all sources we can control, to avoid difficult and costly remediation.

Remediation of mercury is costly and technically difficult. Effort and priority should be addressed to prevent and limit emissions at source.

Remediation of contaminated sediments of a lake and a Baltic Sea bay in Sweden was estimated to cost 16,800 – 21,000 euros per kg mercury in the early 2000s.[7] Due to the vast scale of the problem and the difficulties quantifying the costs related to remediation, there are no large-scale efforts in cleaning up the mercury in our rivers and lakes. Instead, the cost is borne by society and the environment, for example, through IQ loss resulting from mercury exposure or the loss of benefits that healthy ecosystems can provide.

While remediation is highly costly, limiting mercury emissions at the source is much more affordable and all possible measures should be directed to abate emissions at source. In the US, coal operators

[5] European Commission In-depth report: Tackling mercury pollution in the EU and worldwide
[6] EEA 2018 European waters: Assessment of status and pressures 2018
[7] Hylander and Goodsite, 2006, Environmental costs of mercury pollution, Science of the Total Environment 368, 352-370 doi:10.1016/j.scitotenv.2005.11.029

managed to retrofit plants comparable to more than the total EU capacity with mercury abatement techniques in less than two years by 2017.[8]

Mercury is causing severe health effects

Mercury is a well-known toxin, primarily causing neurologic damage, but can also affect the kidneys, liver and lungs.[9] It is particularly dangerous for foetuses, infants and small children as mercury exposure slows down the brain development and negatively affects cognitive thinking, memory, attention and language. Mercury has also been shown to affect the cardiovascular system.[10]

Due to its bioaccumulative properties, mercury ends up in living beings; consuming fish and seafood is a main exposure pathway for humans. Once ingested, mercury can pass from the mother to foetuses via the placenta and to infants via breast milk. This is particularly affecting communities with a high intake of fish and aquatic species. For example, mercury concentration in human hair in Greenland has increased 3-5 times since pre-industrial times to now being 10 µg/g – four times the WHO exposure limit.[11]

Governments and international bodies have derived safety levels of exposure.[12] However, these have repeatedly been revised toward lower levels and it is even questioned if there is any safe level of exposure. The EU regulation of contaminants in foodstuffs (1881/2006/EC) sets maximum levels of mercury for fish that is put on the market for human consumption. The maximum level for mercury in fish is 0.50 µg/g, but some species of predatory fish, such as swordfish, sturgeon and tuna, are allowed to be sold with a higher value of 1.0 µg/g.[13] In the EU, it is up to the Member States to define consumption advice to protect vulnerable groups such as pregnant women, children and the unborn.

[8] EEB Quecksilberemissionen aus Kohlekraftwerken in Deutschland
[9] See e.g. Chemicals Observatory for Africa Mercury profile
[10] Nedellec and Rabl, 2016, Costs of Health Damage from Atmospheric Emissions of Toxic Metals: Part 1-Methods and Results, Risk Anal. doi: 10.1111/risa.12599
[11] EEA 2005, Environment and health
[12] E.g. 1.6 µg/kg body weight (bw) per week (WHO), 1.3 µg/kg bw per week (EFSA) and 0.1 µg/kg bw per day (US EPA)
[13] Section 3.3 in the Annex of Commission Regulation (EC) No 1881/2006 setting maximum levels for certain contaminants in foodstuffs

An EU biomonitoring study (DEMOCOPHES) carried out in 17 European counties in late 2011 and early 2012, concluded that more than a third (1.8 million) new-borns in the EU are exposed to a methylmercury concentration above a safe level of 0.58 µg/g.[14] The associated economic loss was estimated to be between 8 and 9 billion euros per year due to loss of IQ. The DEMOCOPHES study showed a geographical variability with the highest concentrations recorded in southern Europe and the lowest values in eastern Europe. A civil society project carried out in 2013 showed that 64% of the individuals (women of childbearing age) tested in Spain had a mercury concentration above the US environmental protection guideline of 1 µg/g.[15]

EU regulation to limit mercury exposure

Good chemical status for surface water bodies under the WFD means that no concentration of the Priority Substances listed in Annex X of the WFD exceeds the standards stated in the Environmental Quality Standards Directive (EQSD, 2008/105/EC, amended by the Priority Substances Directive 2013/39/EU). Member States have to take measures to decrease the discharges, emissions and losses of all Priority Substances, but for those substances such as mercury, that are defined as Priority Hazardous Substances, emissions, discharges and losses have to cease.

Good chemical statuses should have been achieved for all water bodies by 2015. Member States have been able to make use of derogations for another two RBMP cycles, meaning that every effort has to be made to bring Europe's waters into good shape by 2027.

The Environmental Quality Standard (EQS) for mercury in surface water, measured as Maximum Allowable Concentration, is 0.07 µg/L. However, for mercury it is not sufficient to only measure concentrations in water to protect human and environmental health. Therefore, the EQSD also sets an EQS for mercury in biota (20 µg/kg wet weight). For example, in the 3rd Joint Danube Survey no breaches of mercury EQS in water were recorded, but analysis of fish showed values 5 to 18 times higher than

EU water law requires a cessation of emissions of mercury by 2027

EU law regulating industrial emissions requires stricter permit conditions to be set when environmental quality standards are not met

[14] Bellanger M, et al. 2013. Economic benefits of methylmercury exposure control in Europe: Monetary value of neurotoxicity prevention. Environ Health; doi:10.1186/1476-069X-12-3

[15] Zero Mercury Working Group Assessing hair mercury levels of women of childbearing age in 9 countries: A civil society pilot project

the biota EQS.[16] It is up to Member States if they want to analyse biota or set stricter limits for water to ensure the same level of protection.

The timetable of the cessation or phase-out of the Priority Hazardous Substances should not exceed 20 years after the adoption of the Commission's proposal regarding the Priority Substances (Art 16 WFD). This could be interpreted as starting from the adoption of the EQSD in 2008, which would make the deadline 2028. However, while the EQSD does set water quality standards, it is not clear if it includes control for the phasing out of priority hazardous substances. This would mean that Art. 16.8 applies which sets the 20 year timeline to start six years after the adoption of the WFD, which would set the deadline to the of 2026.[17] The OSPAR Commission for the protection of the marine environment of the North-East Atlantic, of which Germany is a signing party,[18] called for a cessation of discharges, emissions and losses already by 2020.[19]

There are also binding cross-references to the WFD's objectives in other EU policies. The Industrial Emissions Directive (IED, 2010/75/EU) aims to reduce harmful industrial emissions at source and covers around 50,000 installations. Compliance with environmental quality standards, such as EQS, is a mandatory and basic permit requirement (Article 14(1) of the IED). Article 18 of the IED requires stricter permit conditions to be set in cases where environmental quality standards are not met. However, the IED also allows Member States to set less strict emission values (derogations). Despite the fact that derogations under the IED can only be applied 'without prejudice to Art. 18' and that they must fulfil additional specific conditions, they have in fact been used extensively.[20]
The Large Combustion Plants Best Available Techniques Reference document (LCP BREF) states a mercury concentration of <1-7 µg/Nm^3 as technically and economically feasible for lignite combustion, and <1-4 for hard coal combustion.[21] The stricter range is achieved by "specific mercury abatement techniques", whilst the upper level is achieved just through co-benefit of existing controls. 1 µg/Nm³ is also considered BAT and judged as economically and technically viable by the Minamata Convention on mercury.[22]

Members States had four years to comply with the LCP BREF standards (by latest 17 August 2021), but most of the time permitting authorities and operators waited until the last minute to cut pollution, or in the case of mercury allowed the status quo by implementing the upper range level. Moreover, most permit writers opted for the less ambitious upper level of the permittable range, resulting in the circumventing of mercury-specific emissions controls leading to emissions of tonnes of harmful pollutants that could have been avoided. This has occurred as a standard approach despite the IED

[16] ICPDR, 2015, Joint Danube Survey 3
[17] Kremer 2013, The Prohibition of Mercury Discharges from Coal-Fired Power Stations under European Law
[18] The other participating governments are Belgium, Denmark, Finland, France, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom
[19] OSPAR Commission 2000 (2004 Update) Background Document on Mercury and Organic Mercury Compounds
[20] EEB Coalympics: A race to the bottom where polluters win
[21] European Commission Best Available Techniques (BAT) Reference Document for Large Combustion Plants,
[22] Minamata Convention Guidance on best available techniques and best environmental practices

requirement (Art 1 IED) to achieve a high protection of the environment. It should exclude a default use of the upper limit of that range and in the case of mercury, for the necessity to comply with the EQS (Art 11 and 18).

There are no EU limits in place for mercury emissions from other large industrial emitters like iron and steel production, and mercury controls are not required for non-ferrous metals and cement plants.[23] EU law does also not set a cap on the total amount of mercury a plant can emit in a year meaning that even when complying with the BAT flue gas concentration range, a plant can emit significant amounts of mercury into the environment.

One of the Ambient Air Quality Directives, 4th daughter directive, 2004/107/EC, requires mercury to be monitored in air but does not set any concentration target values for this pollutant, as it does for other metals like arsenic, cadmium and nickel.

The National Emission Ceilings (NEC) Directive is a critical instrument to reduce air pollution in the European Union (EU). It ensures reductions of emissions of a number of pollutants which are harmful to our health and environment and limits 'exports' and 'imports' of air pollution between different EU countries. Mercury is currently not included among the substances subjected to Emission Reduction Commitments listed in annex II of the directive. However, Article 13(3) requires the European Commission to assess impact on achieving the NEC Directive objectives "and shall consider measures for reducing those emissions and, if appropriate, submit a legislative proposal".

The European Pollutant Release and Transfer Regulation (PRTR, 166/2006/EC) requires emissions of mercury above 10 kg/year to air, 1 kg/year to water and 1 kg/year to soil from the activities in Annex I of the Regulation to be reported to the European Commission on a yearly basis.

[23] EEB contribution to the European Commission's review of EU mercury legislation

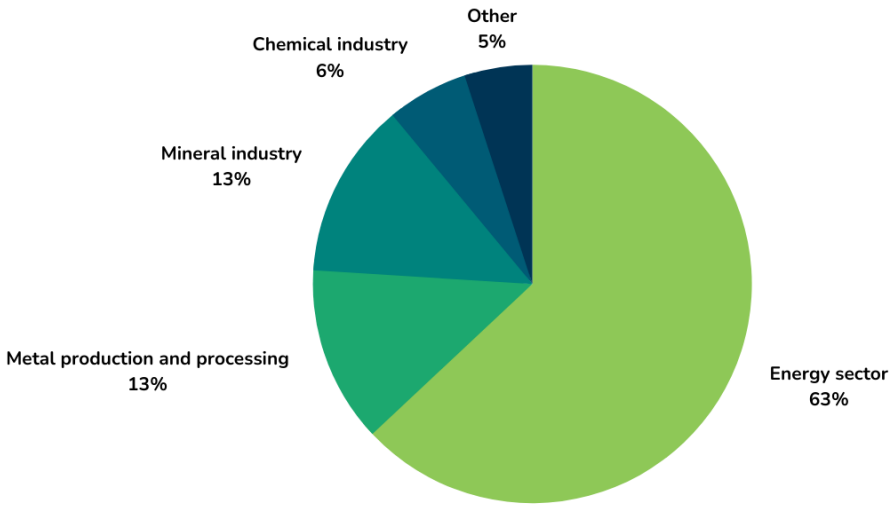
The energy sector is a large contributor to mercury pollution

The vast majority of the anthropogenic mercury emissions in the EU are emissions to air, while emissions to soil and water represent a smaller fraction.

In 2017, mercury emissions to air represented 91% of the mercury emissions reported under the PRTR.[24] Among the sectors emitting mercury to air, the energy sector is responsible for the main share. In 2017, the EU energy sector reported 16.2 tonnes of mercury emitted to air, which represents 63% of all emissions to air. In fact, the energy sector is responsible for more than half of all reported emissions to the environment.

The main source of mercury directly released to water is urban wastewater treatment plants (UWWTP), which reported a little less than 1 tonne of mercury to water in 2017 across EU28.[25] A key source of mercury in wastewater is dental amalgam, currently the largest use of mercury in the EU, a use that should be phased out.[26]

Figure 1: Reported mercury emissions to air by sector in 2017 (source: PRTR)



[24] E-PRTR data 2017 https://industry.eea.europa.eu/#/home
[25] E-PRTR 2017
[26] EEB support a dental amalgam phaseout by 2025, see EEB contribution to the European Commission's review of EU mercury legislation

Who are the main emitters?

Of the 20 plants that reported the highest mercury emissions to air in the EU 2019, all but two are coal combustion plants. The plants are primarily located in the EU's three biggest coal countries, Germany, Poland and the Czech Republic, but Maritsa East 2 in Bulgaria is also high on the list. Maritsa East 2 has been granted a timeless derogation that allows the plant to emit 30 µg/Nm^3, far above the BAT range of <1-7 µg/Nm^3.[27]

The top 10 plants were responsible for 7.6 tonnes of mercury emissions to air, more than twice what France, Greece and Spain emit together. In particular, the Bełchatów plant in Poland stands out, as it alone is emitting more than two tonnes of toxic mercury per year, which is more than most single countries do in a year.

Table 1: The facilities emitting the most mercury to air in 2019 (source: PRTR)

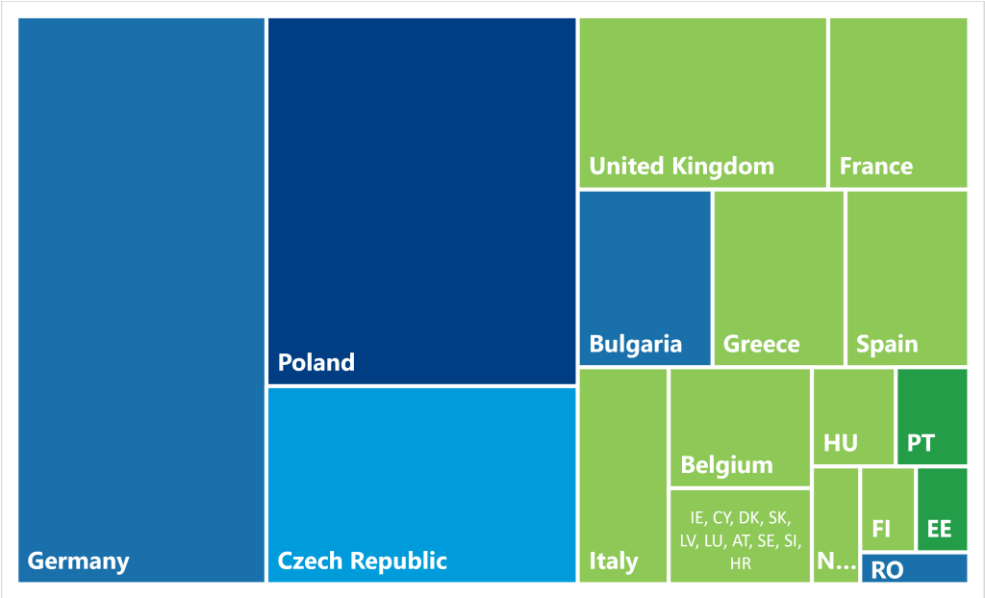
Plant name	Main activity	Parent company	Country	Mercury emissions (kg)
Bełchatów	Lignite power plant	PGE	PL	2600
Maritsa East 2	Lignite power plant	Bulgarian Energy Holding	BG	800
Jänschwalde	Lignite power plant	LEAG	DE	672
Lippendorf	Lignite power plant	LEAG	DE	578
Neurath	Lignite power plant	RWE	DE	568
Chvaletice	Lignite power plant	Sev.en	CZ	537
Boxberg	Lignite power plant	LEAG	DE	536
Niederaußem	Lignite power plant	RWE	DE	483
Egger Hexham	Chipboard production	Egger	GB	481
Počerady	Lignite power plant	Sev.en	CZ	383
Prunéřov	Lignite power plant	ČEZ	CZ	359
Drax Power Station	Hard coal power plant	Drax	GB	344
Schkopau	Lignite power plant	Uniper	DE	340
Aperam Stainless Belgium	Stainless steel production	Aperam	BE	331
Schwarze Pumpe	Lignite power plant	LEAG	DE	256
Kozienice	Hard coal power plant	Enea	PL	250
Tušimice	Lignite power plant	ČEZ	CZ	239
Ledvice	Lignite power plant	ČEZ	CZ	235
Połaniec	Hard coal power plant	Enea	PL	227
Turów	Lignite power plant	PGE	PL	221

Note: 2017 data is used for Germany as that is the most recent reporting year

[27] Greenpeace Bulgaria, Za Zemiata appeals against the derogation of TPP Maritza East 2 (in Bulgarian)

The five EU countries + UK responsible for the largest emissions in 2019 were Poland, Germany (2017 data), Czech Republic, United Kingdom and France. In Poland, Germany and Czech Republic, coal-driven electricity generation is responsible for a large share of emissions. While in the UK and France emissions come from power plants as well as chemical industry, iron and steel production, metal processing and cement production.

Figure 2: The countries emitting the most mercury to air in EU+UK 2019 (source: PRTR)



Note: data from 2018 has been used for Italy and the Netherlands, data from 2017 have been used for Germany, Portugal, Slovakia and Latvia. Data from Lithuania missing.

Reported emissions to air are actually increasing in some top-emitting countries due to improvements in monitoring and reporting. The monitoring requirements for large combustions plants until August 2021 only asked for a one-time per year measurement of flue gas emissions, leading to large uncertainties in data. Reported emissions are foreseen to increase in the next reporting period when continuous monitoring becomes mandatory. Sudden increases in reported mercury emissions have already been noted in Poland[28] and Bulgaria[29] since monitoring improved due to the 2017 LCP BREF requirements.

[28] See EEB story Polish coal may be cheating EU limits
[29] See EEB story Off the record: How a Bulgarian coal plant hid its toxic mercury emissions

How are countries complying with regulation?

Even if both the LCP BREF as well as the Minamata Convention guidance on coal combustion[30] have judged an emission concentration of 1 µg/Nm³ as economically and technically viable, permitting authorities have generally aimed to comply with the upper range of the BAT.[31] Many plants do not even comply with the upper range of these standards but are allowed derogations.

Applying the BAT standards for large combustion plants can cut emissions considerably with substantial economic benefits for health and environment. The damage cost of one kilogram of mercury has been estimated to be 22,937 euros.[32] If the coal combustion plants in the Elbe River basin would comply with the upper range BAT, emissions would drop by nearly a tonne per year. If the lower range BAT would be achieved, the number would triple to close to three tonnes per year. This corresponds to avoided health damage costs in the range of millions of euros each year. For the Oder River basin, with just nine coal combustion plants, the emissions savings would be close to two tonnes a year with an upper range BAT compliance and 3.2 tonnes per year with a strict BAT compliance.

River basin authorities are now finalising the 3rd cycle RBMPs outlining the measures to bring Europe's waters to good status by end of 2027. This is an excellent opportunity to take strong measures to address the widespread mercury pollution. Emission controls are among the basic measures listed by the WFD that the Member States should make use of to achieve good water status. Instead, derogations are granted to the biggest polluters. For example, a BAT derogation has been granted to Počerady, the biggest lignite plant in the Czech Republic, allowing the plant to emit up to 28 µg/Nm^3 for four years, which will result in 1250 kg of mercury unnecessarily emitted to the environment.[33]

Judging from the draft RBMPs, Member States often opt to misuse WFD provisions for setting exemptions from reaching the WFD environmental objectives and opt to set less stringent

[30] Minamata Convention on Mercury Guidance on best available techniques and best environmental practices

[31] EEB Coalympics: A race to the bottom where polluters win

[32] From Nedellec and Rabl (2016), 2013 monetary value, taking into account the US EPA no-effect threshold of 0.1 µg/kg/day

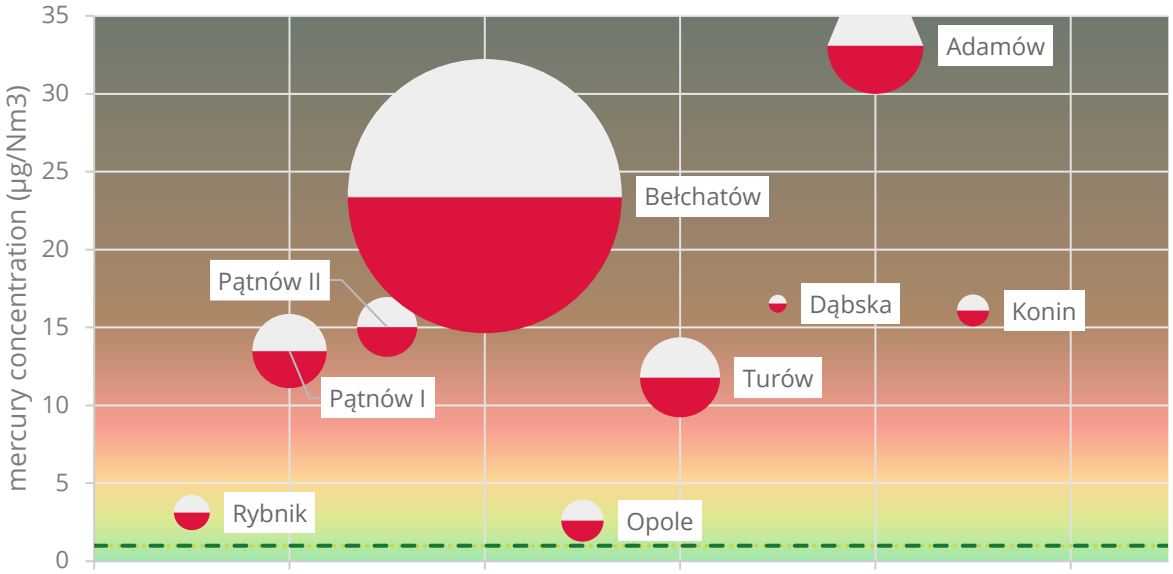
[33] Greenpeace Czech Republic, Environmental organizations are suing the Ministry of the Environment due to an extensive mercury exemption for the Počerady coal-fired power plant (in Czech)

environmental objectives for water bodies, rather than taking action to cut pollution. For example, in the German part of the Elbe, less than 1% of rivers are expected to achieve good chemical status by 2027.[34] The authorities expect most of the surface water bodies to be in good status only by 2033, or even after 2045. This deadline extension is happening without measures being taken to reduce the input through setting stricter emission limits.

In the Oder River basin, 45% of the lakes in the Polish part of Oder, and 71% in the Czech Republic will reach good chemical status only after the 2027 deadline.[35] For Germany, this is the case for all surface water bodies. In Germany, mercury exceedance in biota is listed a main reason. For these surface water bodies, exemptions (Art 4.4) are applied. The justifications incudes technical infeasibility and in Germany the argument that mercury pollution cannot be clearly assigned to a source prevails. At the same time, the Oder international draft RBMP did not include any emission pathway inventory for priority substances, nor concrete measures to abate them.

Figure 3: Emission values for coal plants in the Elbe and Oder River basins compared to the BAT standard (dashed line)

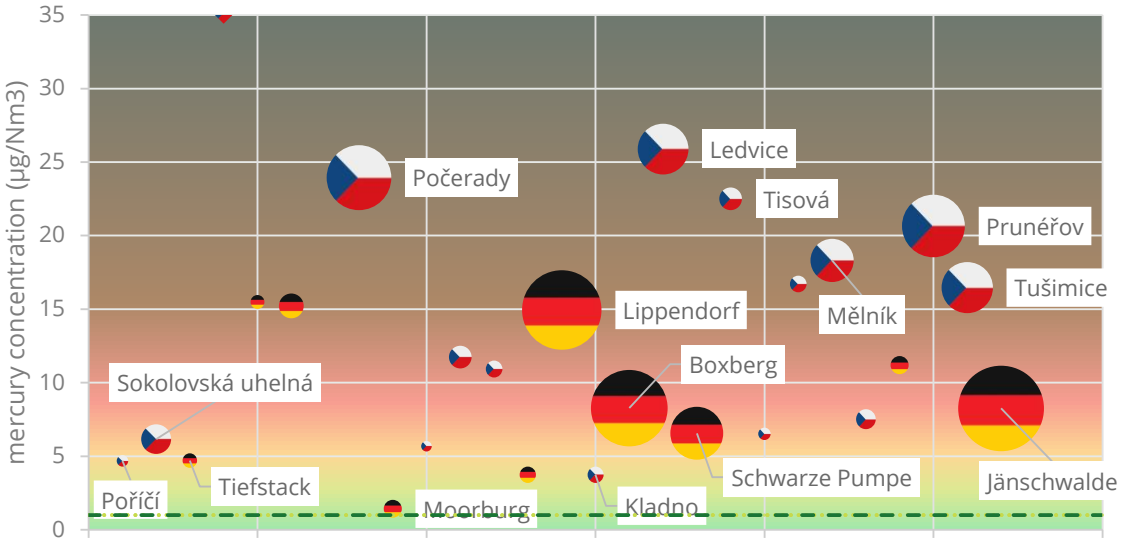
Oder River Basin



[34] See assessment of the DE-Elbe RBMP in the Living River Europe report The Final Sprint for Europe's Rivers

[35] Draft international RBMP for the Oder River Basin, available in Czech, Polish and German at http://www.mkoo.pl/ For rivers, the numbers are 39% (Poland), 73% (Czech Republic) and 97% (Germany)

Elbe River Basin



However, even with the strictest BAT applied, coal combustion will emit mercury. It is therefore necessary that coal combustion is phased out by the end of 2027 to comply with the phaseout obligation of Priority Hazardous Substances under the WFD. Germany is now aiming for a 2030 coal exit, but this will surpass the WFD deadline by three years and in case the lower range BAT is not adhered to, this will result in several tonnes of mercury emissions that could have been avoided. Romania is aiming for a coal phaseout by 2032, while Bulgaria is only planning to phaseout coal by 2038 or 2040. Elsewhere, the Slovenian and Czech Republic governments have not yet settled on a coal phaseout date. Poland has denounced a phaseout of coal by 2030 and is instead aiming for a phaseout date in the 2040s: the last unit of Bełchatów will be switched off in 2036, which sets the country on a path that unnecessarily puts people and the environment at risk of mercury pollution for years to come.

Notes on data reporting and uncertainties

The data reported to EU-wide portals, like the PRTR, only include mercury emissions to air, above the reporting threshold of 10 kg/year (air) and 1 kg/year (water and soil). Reporting requirements also only cover direct emissions. Smaller emissions sources and diffuse emissions can together have a significant impact.

The PRTR does not specify data quality requirements; Member States can report estimated or calculated values that can be based on a few monitoring events. Even data that is reported based on measurements can be based on a single measurement in a year, leading to high levels of uncertainty.

In the Czech Republic for example, lignite plants were only obliged to carry out a one-time per year measurement of flue gas concentration. The reported value on total emissions was obtained by multiplying the measured concentration with the flue gas volume. It is expected that continuous measurements will give results multiple-times higher than those reported before the BAT conclusions went into force.

Conclusions

Mercury pollution is an urgent environmental and health issue in the EU but is not treated as such by permit writing authorities, as lax emission limits for the biggest emitters are allowed, while people and nature pay the price. Large cuts in mercury emissions are economically and technically feasible but are not fully taken advantage of. Lack of action between water protection authorities and authorities issuing permits have led to reliance on exemptions instead of actual measures to cut emission at source. Source control legislation needs to be strengthened to deliver the required action to achieve the 2027 mercury phase out obligation required by the WFD.

Recommendations

Member States:

1. Stop coal combustion by 2027 to comply with EU water law requiring the full phaseout of mercury
2. Require large combustion plants to comply with the strictest BAT standards on mercury emissions to air (1µg/Nm³) and update permit conditions accordingly
3. Consider allowing for a derogation to point 2 only on the following cumulative conditions:
    a. they are time-limited
    b. the emissions do not exceed 3 µg/Nm³ and the yearly average mercury emission intensity does not exceed 3 kg Hg/TWh output
    c. compliance with the mercury EQS for water and biota in the river basin district and the phase-out goal by 2027 are not jeopardised
    d. the above derogation is approved through an inclusive public participation procedure subject to Article 15.4 derogation under the IED
4. Set strict pollution control limits of maximum 10 µg/Nm³ in permits for other high-emitting industries e.g. iron and steel, cement production and non-ferrous metals
5. Establish a maximum permissible concentration threshold of mercury and compounds in any fuel or waste prior to its combustion set to 25 µg/kg dry weight
6. Establish emission pathway inventories for mercury and other priority substances and include in the RBMPs clear measures to reduce and phase-out emissions of priority hazardous substances by 2027

European Commission:

1. Do not approve state aid to any coal combustion plant with a closure date after 2027
2. Set a binding emission limit value of 1µg/m^3 for coal/lignite combustion to apply as latest from 2025 via IED review, EU mercury regulation review
3. Require compliance with the higher level of BAT-associated energy efficiency levels (BAT-AEELs), to reduce pollution load by useful production outputs via IED review, EU Emissions Trading Directive review[36]
4. Introduce a maximum permissible concentration threshold of mercury and compounds in any fuel or waste prior to its combustion set to 25 µg/kg dry weight via EU mercury regulation, IED review

[36] See EEB position in regards to deletion (minimal expectation) or amendment (preferred option) of Article 26 of the EU ETSD https://eeb.org/library/letter-to-the-european-commission-ensuring-ets-and-ied-consistency-within-upcoming-fit-for-55-package/

5. Set a binding emission limit values of 10 µg/m³ for big industrial emitters, such as iron and steel, cement and non-ferrous metals processing plants via IED review, EU mercury regulation review
6. Introduce a cap on total emissions of mercury to air for industrial installations via National Emissions Ceilings Directive, IED review, EU mercury regulation
7. Introduce legally binding air quality standards for mercury with appropriate monitoring and reporting requirements via revision of the Ambient Air Quality Directives
8. Delete thresholds on mercury for reporting obligations, require mandatory continuous emission monitoring on mercury emissions for any combustion activity >50MWth via EU PRTR review, UNECE Kiev PRTR Protocol review

Appendix

Data used for Figure 3

Elbe river basin

Plant	Country	Year	Mercury emissions (kg)	Mercury concentration (µg/Nm^3)
Poříčí	CZ	2019	12,1	4,7
Sokolovská uhelná	CZ	2019	81	6,2
Tiefstack	DE	2017	19,3	4,7
Plzeňská ELÚ III	CZ	2019	38,7	35,1
Wählitz	DE	2017	17,5	15,5
Nord II	DE	2017	55,8	15,2
Chvaletice	CZ	2019	537	42,5
Počerady	CZ	2019	383	23,9
Moorburg	DE	2017	29,8	1,4
energetika	CZ	2019	10	5,7
Mělník I	CZ	2019	47,0	11,7
Plzeňská	CZ	2019	25,91	10,9
Mehrum	DE	2017	24,4	3,7
Lippendorf	DE	2017	578	14,9
Kladno	CZ	2019	23,7	3,7
Boxberg	DE	2017	536	8,3
Ledvice	CZ	2019	235	25,9
Schwarze Pumpe	DE	2017	256	6,6
Tisová	CZ	2019	46,6	22,5
Komořany	CZ	2019	13,8	6,5
Trmice	CZ	2019	25,5	16,7
Mělník	CZ	2019	172	18,3
Opatovice	CZ	2019	35,8	7,5
Deuben	DE	2017	30	11,2
Prunéřov	CZ	2019	359	20,7
Tušimice	CZ	2019	239	16,5
Jänschwalde	DE	2017	672	8,3

Oder river basin

Plant	Country	Year	Mercury emissions (kg)	Mercury concentration (µg/Nm^3)
Rybnik	PL	2019	44	3,1
Pątnów I	PL	2019	190	13,5
Pątnów II	PL	2019	125	15,0
Bełchatów	PL	2019	2600	23,4
Opole	PL	2019	61,8	2,6
Turów	PL	2019	221	11,8
Dąbska	PL	2017	11,1	16,5
Adamów	PL	2017	320	33,1
Konin	PL	2017	35	16,1

The concentrations are calculated by EEB based on the reported mercury emissions to PRTR

Methodology note: The emitted average Hg concentrations were calculated according to the following reasoning.

- The E-PRTR reports emitted loads of both CO_2 and Hg.
- Assumed composition of input and output air of the facility:

Input air	Output air[(1)]
21% O_2	6% O_2
79% other gases	79% other gases
	15% CO_2
	STP (0 °C, 1 atm = 273.15 K, 101.325 kPa)

[(1)] The actual output air likely does not contain 6% of O_2. However, pollutant concentrations have to be normalised to a reference value of 6% of O_2 for reporting (LCP BREF, general considerations). The 15% of CO_2 are produced from 15% of O_2, with the following approximations and assumptions: the combustible fraction of (dry) coal is pure carbon (and hence 1 molecule of O_2 gives 1 molecule of CO_2), the CO_2 content in input air and the moisture content in output air at STP are negligible; all gases are perfect gases.

The concentration of Hg in flue gas is calculated as follows:

$$c_{\mathrm{Hg}} = \frac{m_{\mathrm{Hg}}}{V_{FG}} = \frac{m_{\mathrm{Hg}}}{n_{FG} \times V_m} = \frac{m_{\mathrm{Hg}}}{V_m} \times \frac{r_{\mathrm{CO_2}}}{n_{\mathrm{CO_2}}} = \frac{m_{\mathrm{Hg}}}{m_{\mathrm{CO_2}}} \times \frac{r_{\mathrm{CO_2}} \times M_{\mathrm{CO_2}}}{V_m}$$

Where *c* denotes a concentration, *n* a number of moles, *r* a volume (or molar) fraction, *M* a molar mass and V_m the molar volume at STP, i.e. 22.4 L/mol. *FG* stands for flue gas (output gas).

The fraction in blue corresponds to numbers reported in E-PRTR; the green faction groups constants.

Plant-specific data with the resulting emission scenarios for mercury (pollutant load, concentration, associated costs) can be downloaded from the EEB Industrial Plant Data Viewer (IPDV). We seek to receive further monitoring data as well as permit limits in force, please send information to industrydatabase@eeb.org.

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