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Innovative Community Engagement for Building Effective Resilience and Arctic Ocean Pollution-control Governance in the Context of Climate Change

Regulations relevant to Persistent Organic Pollutants (POPs) and Heavy Metals in the Arctic

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A policy paper prepared by the ICEBERG project, presenting background information on various elements relevant to pollution governance in the Arctic.

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Global frameworks to control persistent organic pollutants (POPs) and heavy metals

POPs and heavy metals, being among the first major Arctic environmental concerns in the global context, are subject to numerous relatively effective global regulatory frameworks and national/Arctic monitoring initiatives. Locally, food regulations and guidance play a key role in limiting human health impacts. However, new chemicals and challenges related to climate change limit the effectiveness of these instruments.

CURRENT GOVERNANCE - KEY ISSUES

• Compared to other elements of Arctic pollution regulation, the governance of POPs and heavy metals takes place largely at the international level. This is because much of Arctic air pollution originates from outside the region. Key international instruments are the 2001 Stockholm Convention on POPs, the 2013 Minamata Convention on Mercury and the 1979 UNECE Convention on Long-range Transport of Air Pollutants (CLRTAP). The decrease in the amount of regulated pollutants present in the Arctic environment since the 1980s shows that global regulations can be effective.

• Since the 1990s, the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP) has been one of the central actors in aggregating knowledge and understanding the current state of these pollutants in the region, and the Arctic Contaminants Action Programme (ACAP) has been an essential platform for implementing concrete actions and promoting practices and technologies.

• In the EU, the European Chemicals Agency (ECHA) has recently become one of the key actors for EU policymaking and EU inputs into the development of global air pollution conventions.

• The local mitigation of impacts in the Arctic takes place, among others, in the food monitoring and guidance frameworks, which require continuous evaluation of the presence of pollutants in different food groups.

THE MAIN GOVERNANCE GAPS

• Continuous technological development means that, globally, new pollutants continue to enter the environment before they are monitored and banned.

• Locally in the Arctic, insufficient waste and wastewater management potentially contribute to the presence of POPs and heavy metals in the environment.

• A key and often underregulated sources of local toxic pollution in the Arctic regions are decommissioned military and industrial sites, as well as current military operations.

• While long-term monitoring and assessment frameworks exist in the Arctic, they are under constant pressure and uncertainty in terms of resource availability.

• Climate change effects on POPs and heavy metals – deposition, pathways and remobilisation – are acknowledged in the documents produced by the international air pollution instruments, with calls for more research, assessment and strengthening the elimination of existing sources to decrease future burdens. However, the approach to tackling the new challenges is piecemeal, and risk assessment and management are likely insufficient.

EXAMPLES OF GOOD PRACTICE

• Canada's Northern Contaminants Programme (NCP): there is a broad awareness of the programme, community engagement (incl. the ArcticNet programme and involvement of Inuit research advisors), strong interlinkage with other programmes; NCP aims to influence global agreements and local dietary advice, community engagement. The NCP can be seen as a record of over three decades of best practice, still not matched in other Arctic jurisdictions.

• AFFF (Aqueous Film Forming Foam) project of ACAP (Arctic Council): aims to identify fluorinated firefighting foam users and applications, developing cost-effective and appropriate recommendations for the removal of PFAS-based firefighting foams.

FURTHER READING & CONTACT

Read the full policy paper at arctic-iceberg.eu/publications

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ICEBERG project

Climate change and pollution, including plastics, ship emissions and wastewater, pose threats to human health and the ecosystems of the Arctic region.

From 2024-2027, the ICEBERG project, funded by the EU under the Horizon Europe programme, studies pollution and its impacts on the ecosystems and communities in the European Arctic, focusing on three regions: southern Kalaallit Nunaat (Greenland), Northern Iceland and Svalbard.

The ICEBERG project integrates natural and social sciences with Indigenous and local knowledge. Researchers employ an ethical, multi-actor and gender-sensitive approach to assess the impacts, risks and vulnerabilities of local communities. The project applies the One Health approach, which recognises the interconnectedness and interdependence of the health of humans, animals, plants and entire ecosystems.

The aim is to mitigate the impacts of pollutants in the Arctic. The project investigates the sources, types and distribution of pollutants, such as plastics, ship emissions, wastewater and heavy metals, by using simulations, remote sensing and observations. On a practical level, the project develops, for example, automatic marine litter detection tools using drones, AI and citizen science. The toxicological impact of microplastics, nanoplastics and persistent organic pollutants (POPs) on human digestive health is being evaluated. The impact of pollution emissions on the marine food web is assessed.

Researchers work together with the communities and stakeholders to co-develop pollution monitoring, mitigation and adaptation strategies, as well as policy recommendations for multilevel pollution-control governance.

Policy papers

The series of policy papers outlines the main elements of the governance framework relevant to pollution control in the Arctic areas of the North Atlantic, with a focus on the three ICEBERG study sites.

Each paper starts with an introduction on the specific policy area or economic sector relevant for Arctic pollution governance, then proceeds to discuss national regulations in the three ICEBERG study sites, as well as to provide an overview of international law, European Union policies and legislation, Arctic Council actions and corporate governance. Governance gaps and selected best practices are presented.

The policy papers produced and published on the ICEBERG website are:

- Cruise tourism
- Solid waste & wastewater management
- Microplastics and plastics pollution
- Frameworks for Arctic beach clean-ups
- POPS and heavy metals
- Pollution related to mining activities

The policy paper does not constitute a formal deliverable of the ICEBERG project.

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Key insights:

- Persistent Organic Pollutants (POPs) and heavy metals were in focus for Arctic communities and decision-makers in the 1990s. However, currently these pollutants appear to be outside of the mainstream public attention, including in the three study sites. The impact of long-range pollution on the Arctic region is high compared to local sources.
- Compared to other elements of Arctic pollution regulation, the governance of POPs and heavy metals takes place largely at the international level. Key international instruments are the Stockholm Convention on POPs, the Minamata Convention on Mercury and the UNECE Convention on Long-range Transport of Air Pollutants (CLRTAP).
- There has been a lot of work done on POPs and heavy metals within the Arctic Council. The Arctic Monitoring and Assessment Programme remains the central actor in understanding the current state of these pollutants in the region, and the Arctic Contaminants Action Programme is an essential platform for concrete actions that could be seen as good practices.
- The European Chemicals Agency (ECHA) is currently the key organisation for EU policymaking and EU inputs into the development of global conventions and an important target for insights coming from research projects dealing with pollutants in the Arctic.
- The issues of relevance for ICEBERG scenarios and strategies are: the role of Arctic actors in identifying new POPs, and other pollutant issues and influencing global environmental governance; the public and policymakers' awareness of POPs and heavy metals pollution in the Arctic; understanding and managing local sources of POPS and heavy metals and local mitigation measures.

1. Introduction and background

The paper provides an overview of legislation and policies adopted to control persistent organic pollutants and heavy metals. The paper covers international, regional and local frameworks applicable to Greenland, Iceland (including relevant EU legislation) and Svalbard. However, the primary focus is on international instruments. Pollution related to mining, maritime traffic and waste is covered in separate papers.

POPs and heavy metals in the circumpolar North originate from both local and global sources.

Due to prevailing wind patterns and ocean currents, the Arctic is particularly strongly affected by the long-range transport of these pollutants from major industrialised regions in the Northern Hemisphere. Europe is particularly important as a source region, as it is located relatively closest to the Arctic, although East Asia could be seen as the most important source due to the sheer amount of emissions in that region. 30-40% of POPs and 8% of mercury transported into the Arctic from outside the region come from Europe (Koivurova et al. 2021).

Local sources include various industrial processes. While the emissions in Iceland, Greenland and Svalbard are very small compared to global numbers, these jurisdictions are both subject to European and international frameworks and produce their own regulations covering POPs and heavy metals. Potential local sources include mining activities and industrial processes (e.g. silicon plant in Husavik), as well as compounds used in agriculture (although pesticides are unlikely to use prohibited substances).

The action on the pollutants covered by international and national instruments can be seen as largely successful globally. However, there are a number of challenges. First, the process of including new pollutants into lists of monitored or banned substances is relatively slow, while numerous new substances enter industrial and other processes on an annual basis. Second, while there has been a steady decline in the presence of POPs in the global ocean, the Arctic Ocean appears to be an exception, seeing an increase in POPs in the past decades. Recently, the increased mobilization in the so-called legacy POPs (not produced anymore but continuously present in the environment) has been observed.[1] Third, the latter indicates impacts and interactions of POPs and heavy metals deposition due to environmental changes caused by climate change. These processes are not fully understood (and are among the research questions investigated by ICEBERG). Among general challenges related to the governance of POPs and heavy metals are costs of adjusting industrial processes to the emission requirements, compliance (also in the ICEBERG study sites), monitoring, inclusion in food and water safety procedures, and the training of healthcare staff.

[1] Yuxuan Zhang,Hongce Song, Lei Wei, eiyun Dong, Haifeng Huang, Xiaolong Chu, Kai Zhang, Xiaotong Wang, Effect of cadmium stress on gill tissues of Magallana gigas after adaptation to different light conditions, Marine Pollution Bulletin, 211, (117411), (2025); Zhiyong Xie, Peng Zhang, Zilan Wu, Shuang Zhang, Lijia Wei, Lijie Mi, Anette Kuester, Juergen Gandrass, Ralf Ebinghaus, Ruiqiang Yang, Zhen Wang, Wenying Mi, (2022). Legacy and emerging organic contaminants in the polar regions, Science of The Total Environment, Volume 835, 2022.

The early results of the ICEBERG fieldwork imply that the issue of POPs and heavy metals is not as central to communities and stakeholders as it used to be in the 1990s. The main area of concern with respect to local developments are future mining activities.

2. National and Local Governance

2.1. Greenland

The Greenland Environment Protection Act (No. 9 of 2011) applies to land territory and land-based marine pollution. The Act provides the framework for managing POPs and heavy metals. It regulates activities that may release harmful substances into the environment, ensuring that such activities are conducted in an environmentally sound manner. Heavily polluting activities require an environmental permit from local authorities. In practice, anyone operating a business, an asset or an institution must provide (upon request of the governmental agency) all information relevant to the assessment of a potential pollution hazard as well as specify any preventive or remedial measures planned or taken. This includes requirements for environmental impact assessment for larger industrial developments. Through the Environmental Protection Act, Greenland has implemented measures to control the use and disposal of hazardous chemicals, aligning with broader Danish and EU standards.

Greenland has established guidelines to monitor and control mercury emissions, particularly from industrial activities and waste management practices. The Environmental Agency for Mineral Resource Activities oversees the environmental impact of mining operations, ensuring that mercury levels are within safe limits to protect both the environment and public health. Regular monitoring and reporting are integral components of these regulatory measures.

Food and animal feed safety is covered by the Greenlandic Food Act (No. 24 of 2019).[2] Various regulations (e.g. the Regulation on certain contaminants in food[3]) set maximum safe limits for contaminants. Greenlandic businesses operating in the food sector also need to comply with EU food standards, including limits for POPs and heavy metals, as these apply in Denmark (e.g. EU Regulation (EU) 2023/915, which sets maximum levels for lead, cadmium, mercury, arsenic, PCBs, PFAS, etc.). These norms apply to the food marketed and sold, while traditionally consumed local foods from hunting or fishing activities fall outside of these rules. Compliance and inspections are the responsibility of the Danish Veterinary and Food Authority, and inspections are carry out by food and veterinary inspection units in Greenland.

[2] Inatsisartutlov nr. 24 af 28. november 2019 om fødevarer, see at https://faolex.fao.org/docs/pdf/grl201564.pdf
[3] Bekendtgørelse for Grønland om visse forureninger i fødevarer.

2.2. Iceland[4]

Regulation 954/2013 on persistent organic pollutants (POPs) transposes EU Regulation 2019/1021 on POPs (see below on the EU/2019/1021 Regulation).[5] The EU regulation ensures the EU's compliance with its international commitments and extends to Iceland and Norway as a part of the Single Market regulatory framework (applicable to the European Economic Area).

The Regulation on Pollution Prevention in Industry No. 550/2018 has established strict regulations to control mercury emissions. It sets emission limits for various pollutants, including mercury, for industrial facilities. Industries are required to obtain environmental permits that stipulate conditions for mercury emissions, ensuring they do not exceed thresholds. Continuous monitoring and reporting are required in order to ensure compliance.

Regulation on Environmental Impact Assessment (No. 1123/2005) applies to discharges and emissions (pollution of water, air and soil, noise, vibration, light, heat, radioactivity, etc.) and refers to the type and quantity of waste in larger industrial/construction projects subject to EIA procedure.

Iceland's Act on environmental responsibility (No 55 of 2018) ensures that the (natural or legal) person responsible for the risk of environmental damages or the damages themselves either prevents or pays compensation, in accordance with the polluter pays principle (at least in principle). These provisions intersect with the legislation dealing with marine and coastal pollution (Act no. 33 of 7 May 2004, and Act no. 88 of 12 June 2018 on the organization of ocean and coastal areas), particularly with respect to oil and chemicals, but also ship waste and the disposal overboard of substances or objects into the ocean (in conjunction with MARPOL 73:78).

Iceland is also covered by EU legislation on food safety, which includes regulating, monitoring and ensuring compliance with respect to the content of heavy metals and toxins. Among others, this includes participation in the Rapid Alert System for Food and Feed (RASFF), which allows for the exchange of information on, among others, the presence of contaminants in specific food and feed as well as products used for handling food. EU legislation covering monitoring, laboratory requirements, and reporting applies to Iceland. See the section on EU policies and legislation below for details. Icelandic Food and Veterinary Authority[6] (MAST) has the primary responsibility to promote the quality of food and monitor the performance of the food sector (including contaminants, residues and microorganisms of concern). Inspections in smaller establishments and companies are carried out by the regional responsible authorities. MAST also cooperates with the Icelandic Ministry of Industries and Innovation on developing legislation covering the entire food chain, including the implementation of applicable EU frameworks.

2.3. Svalbard

The CLRTAP, Stockholm and Minamata Conventions (see below) are applicable to Svalbard (the archipelago is in some cases excluded from the international conventions to which Norway is a part

[4] Overview of Icelandic legislation based on FAOLEX database, at https://www.fao.org/faolex

[5] Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants (recast) (Text with EEA relevance.)

[6] See the Icelandic Food and Veterinary Authority's website at https://www.mast.is/en/food-animals/food-safety

and is outside the European Economic Area). These are implemented via national legislation (which needs to comply with applicable EU directives and regulations).

The Svalbard Environmental Protection Act (2001) provides a comprehensive framework for protecting Svalbard's fragile environment. This law aligns with Norway's obligations under pollution conventions. The Act prohibits the use, release, and improper disposal of hazardous chemicals, including POPs and heavy metals, to minimise their impact on the environment. The disposal of POPs-containing waste in Svalbard is regulated under Norwegian waste management laws, which require the destruction or "irreversible transformation" (permanent change into non-toxic compounds) of such substances. Similarly, strict rules govern the disposal of waste containing heavy metals to prevent contamination. For example, batteries and electronic waste must be transported to mainland Norway for proper treatment, which is not possible within the archipelago. The Governor of Svalbard (Sysselmesteren) monitors compliance and enforces environmental regulations. Norwegian institutions regularly monitor POPs and heavy metals in Svalbard's air, water, and biota, including as part of national and international and Arctic research efforts (importantly, most measured substances originate from long-range transport deposition).

Locally, restoration and cleanup projects, under the oversight of the Governor of Svalbard, are underway to mitigate environmental damage from old mining sites in Longyearbyen and Sveagruva (completed in 2023).

2.4. Corporate governance

POPs and (especially) heavy metals pollution is covered by sectoral industrial guidelines. This includes enclosed material handling to reduce fugitive emissions of heavy metals like lead, cadmium and mercury, advanced tailings management with lined tailing ponds and water treatment to prevent leaching, as well as air filtration systems to capture airborne heavy metals during smelting. Mining companies set up community monitoring and engagement programmes (e.g. in Nunavut and Northern Quebec).

One of the governance tools supporting the environmental performance of companies is ISO certification. For instance, ISO 14001 covers environmental management systems and includes standards for monitoring, environmental governance and decision-making, stakeholder involvement, etc.[7] Companies operating in the EU can also utilise the EU's Eco-Management and Audit Scheme (EMAS).[8]

Companies operating in the Arctic can also utilise international reporting guidelines to enhance their performance and transparency in the Arctic. This includes the Global Reporting Initiative[9] (GRI, including standards on waste, water and effluents, emissions and hazardous waste), Sustainability Accounting Standards Board (SASB)[10] standards on toxic emissions that cover oil and gas and mining sectors, among others, and encourage disclosure of any releases of mercury, lead, etc. Of relevance are also OECD Guidelines for Multinational Enterprises.[11] The EU has adopted the

[7] See International Standardization Organization website at https://www.iso.org/standard/60857.html
[8] See https://green-forum.ec.europa.eu/emas_en
[9] See https://www.globalreporting.org/
[10] See https://sasb.ifrs.org/
[11] See, https://mneguidelines.oecd.org/mneguidelines/

Corporate Sustainability Reporting Directive (EU/2022/2464, relevant for EEA),[12] which requires companies to disclose emissions and outline mitigation/remediation measures for spills and covers several heavy metals, as well as PCBs, dioxins, etc.

3. Supranational Initiatives

3.1. Arctic Council

Pollution constitutes one of the key focus areas of the Arctic Council (AC). While the Arctic Monitoring and Assessment Programme (AMAP) and Arctic Contaminants Action Plan (ACAP) are the key AC working groups in this regard, the pollution work is spread across the AC. AMAP conducts monitoring and assessment of pollutants in the Arctic environment, including persistent organic pollutants (POPs), heavy metals, oil, and other contaminants, as well as produces reports and assessments.[13]

AMAP has been instrumental in assessing the levels, sources, and impacts of persistent organic pollutants (POPs) and heavy metals, especially mercury. AMAP's assessments provided crucial data showing that these pollutants accumulate in Arctic ecosystems, affecting wildlife and human health.[14] The findings have influenced global policy, contributing to frameworks such as the Stockholm POPs Convention and the Minamata Convention on Mercury, both of which aim to reduce the release of these harmful substances into the environment. The Arctic Council has called for global reductions in mercury emissions. The AC work has recently emphasised interactions between pollutants and climate change.[15]

Arctic Council's Arctic Offshore Oil and Gas Guidelines (2009)[16] outline the need for monitoring heavy metals (especially mercury) and POPs released during exploration, extraction and transport of hydrocarbon resources. In the cases where water-based drilling fluids are used, additives containing heavy metals and other substances with negative ecotoxicological properties should be avoided or removed prior to the discharge of such water.

[12] Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting (Text with EEA relevance). There are currently discussions on repealing the diretive.

[13] Note that the activities of the Arctic Council have been disrupted by Russia's invasion of Ukraine in February 2022. While there is currently limited cooperation in working groups, most areas of activity remain limited, which includes projects of ACAP working groups, large part of which were located in Russia.

[14] See, e.g. Arctic Monitoring and Assessment Programme (2021). POPs And Chemicals of Emerging Arctic Concern - Summary for Policymakers. Arctic Council AMAP. URL: https://oaarchive.arctic-council.org/items/748b2cf7-3f0d-46aa-9e96-541a09d8fb88

[15] AMAP (2011). Climate Change and POPs: Predicting the Impacts. Report of the UNEP/AMAP Expert Group. Arctic Monitoring and Assessment Programme working group of the Arctic Council.

[16] Arctic Council (2009, April). Arctic Offshore Oil and Gas Guidelines. Protection of the Arctic Marine Environment working group.

3.2. OSPAR

Oslo-Paris Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)[17] covers fully Icelandic and Svalbard waters as well as the East Greenlandic marine environment. The OSPAR Commission (convention's implementing body) has also been involved in actions related to the management and reduction of POPs and heavy metals in the North-East Atlantic marine environment. OSPAR's objective with respect to hazardous substances has been "to prevent pollution of the OSPAR Maritime Area by continuously reducing discharges, emissions and losses of hazardous substances, with the ultimate aim to achieve concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances".

OSPAR List of Chemicals for Priority Action has consistently identified POPs and heavy metals such as mercury, cadmium, and lead, as priority hazardous substances requiring action by the parties to OSPAR.

Overall, 65 OSPAR Decisions and Recommendations have been adopted targeting point- and diffuse sources of pollution from hazardous substances. Initiatives to reduce mercury emissions from industrial sources, including coal combustion, cement production, and waste incineration, have been supported. OSPAR has also addressed mercury contamination from historical sources, such as abandoned mines and industrial sites. The use of best available techniques (BAT) and best environmental practices (BEP) to minimise heavy metal discharges in industrial and municipal wastewater is promoted, which includes heavy metals released during oil and gas exploration and extraction.

Most of OSPAR recommendations have been fully implemented, with minor exceptions (mercury from crematorium, while the status for oil facilities, aquaculture, metals in sewage sludge and pesticides remains unknown).

OSPAR conducts regular assessment activities under the decadal North-East Atlantic Environment Strategies. This includes monitoring of heavy metals sources and pathways into the OSPAR marine area,[18] trends for heavy metals and chosen POPs in fish, shellfish and sediment, status and trends of persistent chemicals in marine mammals.[19] Overall, while there had been substantial reductions in the level of POPs and heavy metals in the OSPAR marine environment, the decreasing trends have slowed in recent years, while the concentrations remain well-above the desired background levels for most substances and metals.

[17] The OSPAR Convention was concluded in 1992, combining and up-dating the 1972 Oslo Convention on dumping waste at sea and the 1974 Paris Convention on land-based sources of marine pollution.
[18] https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/inputs-heavy-metals/
[19] https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/heavy-metals-biota-sediment/?promo_name=QSR ; https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/pcb-biota-sediment; https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/pcb-marine-mammals-pilot

3.3. EU policies and initiatives

The EU is an active participant in international environmental policymaking, and its regulatory framework follows from the measures and restrictions adopted internationally. EU environmental legislation is partly applicable to Iceland. However, the biggest impact on the Arctic environment is likely through EU participation in the development of international environmental law and through the EU's internal actions, as pollutants emitted in the EU can be transported into the Arctic via wind patterns and ocean currents.

The EU is a party to the UNECE CLRTAP and to its heavy metals and POPs protocols. The EU takes an active part in the continued Air Convention developments; the EU and its Member States make up more than half of the Convention parties. The EU has been a party to the Stockholm POPs Convention since 2004.

In the negotiations within the pollution conventions, the EU usually wants to be as restrictive as possible and avoid excessive national exemptions to agreed restrictions. In some cases, the EU is negotiating directly with emitters like China, Iran and others, often successfully, for them to drop or limit their exemption demands. The EU is also engaged in discussing the question of long-range pollutants with Arctic countries, especially Norway and Canada, via bilateral dialogue, as these are also key players in the POPs Convention. There is coordination to avoid overlap of work between the EU and these partner states. The EU is also one of the biggest donors to the Stockholm Convention Secretariat, together with the EU Member States (a voluntary trust fund covering the convention's monitoring, reports, guidance and capacity building). It supports the Stockholm, Basel and Rotterdam conventions' secretariats with around EUR 2 million annually. It also provides financial support for the expert work on the review of new chemicals.

With respect to **persistent organic pollutants (POPs)**, EU Regulation 2019/1021 on POPs[20] is the key EU instrument for the implementation and strengthening of the provisions of the Stockholm Convention on Persistent Organic Pollutants (POPs) and the Protocol on POPs under the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP). New POPs are incorporated when they are added to the Stockholm Convention or the POPs Protocol. Importantly, the EU POPs Regulation goes further than the Stockholm Convention, emphasising the goal to eliminate the production and use of internationally recognised POPs (EC 2009). The regulation bans and restricts the production and placing on the Single Market of the POPs listed in its Annexes I and II, with an exception for specific uses, while encouraging efforts to reduce unintentional releases of POPs listed in Annex III (originating from industrial processes and landfills). Waste containing POPs has to be managed to prevent environmental and health impacts so that dangerous compounds are destroyed or transformed (Annex IV covers POPs in waste). The Regulation requires Member States, including Iceland and Norway, to monitor POPs in their territories and report to the database operated by the European Chemicals Agency (ECHA) on emissions, waste management practices, and other compliance measures. Among other measures, EU/EEA Member States must establish effective penalties for market operators violating the regulation. As part of the overarching

[20] Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants (recast) (Text with EEA relevance.)

European Green Deal, the EU has now embarked on further enhancing its air quality legislation to achieve the zero pollution ambition.[21]

Over the years, the EU has emphasised the aim to strengthen the Stockholm POPs Convention. Among all parties to the Convention, the EU has proposed the greatest number of new chemicals for listing, and it continuously screens new candidate POPs for potential listing.[22] Screening chemicals with POPs characteristics is linked to assessments under, e.g., Plant Protection Products regulations (EC 1107/2009; EU 540/2011; EU 546/2011; EU 283/2013; EU 284/2013), Biocides Regulation (528/2012), and REACH Regulation (1907/2006). Most of this work nowadays is carried out within ECHA. However, the long-range transport potential of the POPs under review is not given the same attention as their persistent, bioaccumulative and toxic properties.

Among heavy metals, **mercury** has been an object of particularly strong efforts by the EU. Over the past twenty years, a comprehensive body of legislation has been developed, covering all aspects of the mercury lifecycle, from primary mining to waste disposal. This includes measures on trade, products containing mercury and mercury pollution.

The main EU legislation is the Regulation EU/2017/85, as recently amended by the Regulation (EU) 2024/1849. The regulation applies to Iceland (with the formal status of the amendment still in the EEA process). The last major remaining direct uses (and export) of mercury in the EU were dental amalgam and lamps, which have been almost completely banned starting from the start of 2025 (dentistry) and 2026 for lamps. Other direct uses have been banned earlier. The regulation prohibits the export of mercury and mercury compounds, as well as the production, export and import of a broad spectrum of products containing mercury. For instance, mercury compounds have been prohibited from use as catalysts and electrodes in industrial processes. All new uses of mercury are completely prohibited unless significant environmental and health benefits can be demonstrated with no mercury-free alternative available. Mercury waste is to be managed in a way that does not endanger human health or the environment.

Emissions of mercury from large combustion plants, waste incineration, cement production and the manufacture and smelting of metals, which have been additionally regulated under the Industrial Emissions Directive 2010/75/EU[23] (applicable to Iceland), which requires that the best available techniques (BAT) must be used by operators and be the basis for emission limit levels set by permit authorities, covering both emissions to air and to water. Furthermore, SEVESO Directive 2012/18/EU[24] and the revised Industrial and Livestock Rearing Emissions Directive (IED 2.0) 2010/75/EU [25] establish requirements for the environmentally sound storage of metallic mercury and mercury compounds.

[21] See, European Commission (2021). Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'. Communication from the Commission. COM/2021/400 final.
[22] See POPs Convention Secretariat website at http://www.pops.int/
[23] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (recast) (Text with EEA relevance)
[24] Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC Text with EEA relevance
[25] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial and livestock rearing emissions (integrated pollution prevention and control) (Recast) (Text with EEA relevance)

The mercury content, placing on the market and importation into the EU of a wide range of mercury-added products (e.g. batteries, electrical and electronic equipment, and thermometers) are covered in the Battery Directive 2006/66/EC [26] and RoHS (switches, relays and lamps) Directive2011/65/EU, [27] as well as the REACH Regulation and Cosmetic Products Regulation EC/1223/2009.[28]

Mercury emissions from major industrial sources are regulated under the revised Industrial and Livestock Rearing Emissions Directive (IED 2.0). This requires installations to operate based on permits and to apply the best available techniques (BAT), including the production of chloralkali (an industrial process for the electrolysis of sodium chloride solutions), which was the most important remaining manufacturing process using mercury in the early 2010s, and was banned by Commission Implementing Decision 2013/732.

These are regulated by the revised Industrial and Livestock Rearing Emissions Directive (IED 2.0) 2010/75/EU [29] in combination with the Water Framework Directive 2000/60/EC [30] and Environmental Quality Standards Directive 2008/105/EC (EQSD) [31] that establishes maximum concentration levels of mercury in surface water bodies, sediment and biota.

Metallic mercury as waste and waste containing or contaminated with mercury qualify in most cases as 'hazardous waste' under the Waste Framework Directive 2008/98/EC.[32] In parallel, the Landfill Directive 1999/31/EC [33] sets specific requirements for the storage of mercury waste.

CLP Regulation (EC) No 1272/2008,[34] applicable to Iceland, requires classification, labelling, and safety data sheets for chemicals containing **hazardous heavy metals**. Substances and mixtures are classified in specific hazard classes, and labelling requirements are imposed. Measures for safe packaging of the products containing hazardous materials are provided.

In 2017, the EU ratified an amendment to the 2012 Gothenburg Protocol setting emissions reductions from 2020 onwards. Measures towards the control of emissions from Medium Combustion Plants, including for heavy metals, were adopted via the Directive (EU) 2015/2193. There are also pieces of legislation and policy tackling sources of harmful air emissions, such as

[26] Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC (Text with EEA relevance).
[27] Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) Text with EEA relevance
[28] Regulation (EC) No 1223/2009 of the European Parliament and of the Council of 30 November 2009 on cosmetic products (recast) (Text with EEA relevance)
[29] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial and livestock rearing emissions (integrated pollution prevention and control) (Recast) (Text with EEA relevance)
[30] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy
[31] Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy,
[32] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (Text with EEA relevance)
[33] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste
[34] Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (Text with EEA relevance).

from road vehicles, from non-road mobile machinery, from maritime transport, agriculture, energy and industrial sources, and from paints.

In 2006, the Regulation concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH, EC 1907/2006) was also adopted, aiming to improve the protection of human health and the environment through the better and earlier identification of the inherent properties of chemical substances. According to the Regulation, this will be done via registration, evaluation, authorization and restriction of chemicals. REACH not only aims to protect human health and the environment but also to enhance innovation and competitiveness of the EU chemicals industry.

Chemicals and heavy metals are also regulated in the EU through food safety legislation. This covers food production and preservation, food additives, and packaging materials. Among key pieces of legislation is the 1993 EEC Council Regulation laying down Community procedures for contaminants in food[35], as well as the recently revised 2023 Commission Regulation on maximum levels for certain contaminants in food, which also applies to Iceland.[36] This covers heavy metals, dioxins, PCBs, PAHs, and mycotoxins. The legislation establishes risk assessment procedures. In addition, Regulation (EC) No 396/2005 sets maximum residue levels (MRLs) for pesticides in food and feed and provides for monitoring and reporting by EU/EEA states.

The **European Food Safety Agency (EFSA)** has been established[37] to provide scientific advice, and especially to carry out risk assessment towards market authorisation of chemical substances used in the food chain and of contaminants that may be a concern for human and animal health.[38] The contaminants in question may be included in containers or present in the environment during the production of food.[39] EFSA conducts regular monitoring and data aggregation, and produces annual reports assessing exposures and the level of compliance. Part of the EU monitoring framework also applies to Iceland and Norway. For example, the Rapid Alert System for Food and Feed (RASFF)[40] allows for the exchange of information on, among others, the presence of contaminants in specific food and feed, as well as products used for handling food. Coordinated Multiannual Control Plan (EU MACP) - also applicable to the EEA – is annually set up by the European Commission to coordinate states' monitoring processes.

EU legislation, applicable also to Iceland and Norway, establishes accreditation requirements and official methods for laboratories conducting analyses. Sampling must be done according to harmonised EU protocols (e.g., Regulation (EC) No 333/2007 for metals, dioxins, PCBs). Results from non-compliant samples must be reported to EU databases and may trigger EU-wide measures.

[35] Council Regulation (EEC) No 315/93 of 8 February 1993 laying down Community procedures for contaminants in food

[36] Commission Regulation (EU) 2023/915 of 25 April 2023 on maximum levels for certain contaminants in food, and repealing Regulation (EC) No 1881/2006 (Text with EEA relevance).

[37] Established by the Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. This regulation is not EEA-relevant.

[38] European Food Safety Agency website at https://www.efsa.europa.eu/en/topics/topic/chemicals-food

[39] Regulation (EC) No 396/2005 of the European Parliament and of the Council of 23 February 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC Text with EEA relevance.

[40] See European Commission website at https://food.ec.europa.eu/food-safety/rasff_en

Generally, products exceeding legal limits are withdrawn from the market, and the MSs' authorities can impose sanctions on non-compliant operators.

A key actor within the EU institutional system with respect to the control of pollutants is the **European Chemicals Agency (ECHA)**. ECHA plays a central role in supporting the implementation of Regulation 2019/1021 on POPs. ECHA is responsible for facilitating and coordinating the EU's compliance with the Stockholm Convention on POPs and the Protocol on POPs under CLRTAP, with respect to both measures adopted and reporting obligations. It facilitates the flow of data between the EU and international conventions secretariats/organisations.

ECHA maintains an online database of POPs and provides technical and scientific support to the European Commission and Member States. In its work on collecting and disseminating data on POPs, ECHA tracks production, trade, emissions, and waste treatment, as well as compiles periodic reports on compliance and effectiveness of adopted measures. ECHA also assesses proposals to add new substances to the POPs list in the EU and supports the review and update of Annexes I-IV of the regulation.

With respect to heavy metals, ECHA supports the implementation of EU legislation regulating the use and emissions of heavy metals such as mercury, cadmium, and lead under the REACH Regulation, CLP Regulation and Mercury Regulation. It coordinates with Member States to address non-compliance and implement corrective actions.

In addition to regulatory processes and monitoring, ECHA develops guidance for industries, regulators, and stakeholders on compliance with EU laws related to POPs and heavy metals, including collecting best practices for handling, reducing emissions, and managing waste. The Agency promotes awareness of the risks associated with POPs and heavy metals, including their impact on health and the environment. It engages with stakeholders, including industry representatives, NGOs, and the scientific community.

3.4. International Policies and Law

The Convention on Long-Range Transboundary Air Pollution (CLRTAP) - covering the countries of the UN Economic Commission for Europe, including the US, Canada and former Soviet Union countries - is the first international legally binding instrument to address problems of air pollution. It was signed in 1979 and entered into force in 1983. It aims at protecting the human environment against air pollution and to gradually reduce and prevent air pollution, including long-range transboundary air pollution. The Convention established the European Monitoring and Evaluation Programme (EMEP) under UNECE. CLRTAP operates through a series of protocols targeting different pollutants: sulphur (1985, 1998), nitrogen oxide (1988), volatile organic compounds (1991), heavy metals (1998, amended 2012), POPs (1998, known as Aarhus Protocol), and on acidification, eutrophication and ground-level ozone (1999, Gothenburg Protocol). The Convention has been ratified by 51 countries (including Denmark, Iceland and Norway), with varied ratification status for specific protocols. All three countries ratified the 1998 protocol on heavy metals, although Iceland has not yet ratified the 2012 amendment, and Greenland is excluded from the application of the amendment provisions. Similarly, while all three countries ratified the Aarhus protocol on persistent organic pollutants, its 2009 amendment has not been ratified by Iceland and is not applicable to Denmark and Greenland. CLRTAP and its heavy metals and POPs protocols apply to Svalbard.

The Stockholm Convention on Persistent Organic Pollutants (POPs) aims at eliminating or restricting the production and use of persistent organic pollutants. These are chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk to human health and the environment. The convention was signed in 2001 in Stockholm and has been in force since May 2004. Today, 186 countries are parties to the convention. More economically "developed" countries are required to provide financial resources and measures to eliminate globally produced POPs, reduce unintentionally produced POPs, and manage and dispose of POPs wastes in an environmentally sound manner. The convention initially targeted a group of chemicals known as the "dirty dozen," which includes substances like DDT (Dichlorodiphenyltrichloroethane) and PCBs (Polychlorinated Biphenyls). Over time, additional chemicals have been added to the list.

The Minamata Convention is to protect human health and the environment from the adverse effects of mercury. It was adopted in 2013 and has been in force since August 2017. It contains provisions that relate to the entire life cycle of mercury, including controls and reductions across a range of products, processes and industries where mercury is used, released or emitted. The treaty also addresses the direct mining of mercury, its export and import, safe storage and its disposal as waste. The Minamata Convention has been ratified by 128 countries (including Denmark, Iceland and Norway). The Minamata Convention has been subject to criticism, as the countries of the Global South often lack the financial and technical support necessary to implement the Convention's measures. This disparity has led to uneven progress and varied effectiveness across different regions.

The Rotterdam Convention on the prior informed consent procedure for certain hazardous chemicals and pesticides in international trade (adopted 1998, in force from 2004) is an international treaty designed to facilitate decision-making regarding the trade in certain hazardous chemicals and pesticides that pose significant risks to human health and the environment. The Convention operates through a Prior Informed Consent (PIC) procedure, where participating states are provided with information to decide whether to accept or restrict the import of chemicals listed in the Convention, covering both heavy metals and POPs. This is particularly relevant for mitigating pollution caused by heavy metals such as mercury, lead, and cadmium, and persistent organic pollutants (POPs), which are toxic, bioaccumulative, and capable of long-range environmental transport.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal - adopted in 1989 to regulate the movement of hazardous wastes across borders and ensure their environmentally sound management. Its primary objective is to protect human health and the environment from the adverse effects of hazardous and other wastes. The Basel Convention prohibits the export of hazardous waste to countries lacking the capacity for safe disposal and emphasises waste minimisation and recycling in the country of the origin of harmful substances. Heavy metals and persistent organic pollutants (POPs) are often found in industrial waste, e-waste, and other discarded materials. The Convention also addresses illegal trafficking of hazardous wastes and promotes the use of cleaner technologies. The Basel Convention plays a critical role in mitigating pollution, reducing environmental degradation, and ensuring that vulnerable regions are not disproportionately burdened by toxic waste.

The World Health Organization (WHO) develops evidence-based guidelines, conducts risk assessments, and provides technical support to countries for managing exposure to heavy metals and POPs, which are considered important risk factors for human health. Among relevant initiatives

is the International Programme on Chemical Safety (IPCS) - a collaborative programme between WHO, the International Labour Organization and the UN Environmental Programme, which has an aim to enhance scientific bases for a safer use of chemicals and supports national capacities for chemical safety. The chemicals of major public health concern include lead, cadmium, mercury, as well as POPs such as benzene, dioxins, and highly hazardous pesticides.

4. Existing Regulatory and Policy Gaps, and Current Developments

The main challenge for the long-range air pollution regime is the **continuous technological change** within industries, with new chemicals entering industrial processes, often in order to replace those that are found to be harmful and prohibited. The lists of substances (e.g. within the Stockholm POPs Convention) need to be continuously developed, and there is a need for ongoing monitoring and research. As a result, the global policymakers are playing constant catch-up with the industry.

There is increasing attention to the linkages between **contaminants and climate change**. Thawing permafrost and glaciers may release additional pollutants into the Arctic environment.[41] It is a question whether health systems and monitoring frameworks are ready for the occurrence of such chemicals and their effects on humans and the environment.

Locally, w**aste disposal and wastewater management** may be minor sources of both POPs (those not prohibited) and heavy metals. Limited treatment of wastewater and gaps in waste collection pose a challenge, see the paper on solid waste and wastewater management.

Limited attention to POPs and heavy metals creates risks for the continuous monitoring of these pollutants, which requires sustained public funding.

5. Best Practices for POPs & Heavy Metals governance/regulation

Canada's Northern Contaminants Programme (NCP)

Established in 1991, the NCP[42] coordinates actions on northern contaminants, including POPs and mercury, both nationally and internationally. It brings together health aspects, science and communication on contaminants. The main activities include coordinating interdisciplinary scientific research and monitoring, with the primary aim of influencing global agreements. At the

[41] Christensen, Kelley (2024). Thawing Permafrost Releases Industrial Contaminants into Arctic Communities. Environmental Health Perspectives 132(3), https://doi.org/10.1289/EHP13998

[42] Government of Canada. Northern Contaminants Program / Background. URL: https://www.science.gc.ca/site/science/en/northern-contaminants-program/northern-contaminants-program-background

same time, the information is used by health authorities to develop dietary advice, with particular attention to those who consume high amounts of marine mammals and fish. The programme has been cooperating with Indigenous communities (e.g. via the Inuit Health Survey and the ArcticNet community monitoring network) as well as interacting with related programmes, e.g. Health Adaptation for Inuit Communities programme. The Programme also includes five Regional Contaminants Committees – to facilitate links between developments in the regions and NCP leadership - and four Inuit Research Advisors, helping to facilitate participatory research on contaminants, climate change and environmental health and properly engage Inuit communities and advise researchers. Importantly, no comparable programme covering contaminants in the Arctic exists in any other Arctic state.

AFFF (Aqueous Film Forming Foam) and other PFAS-containing Foam Phase Out in The Arctic (a project of the Arctic Council's Arctic Contaminants Action Program)

The project started in 2019 and aims to identify fluorinated firefighting foam users and applications, developing cost-effective and appropriate recommendations for the removal of PFAS-based firefighting foams within the Arctic region and develop replacements that have lower risk levels. Guidance, training and protocols on the transition to effective alternatives will be provided.