STOCKHOLM CONVENTION

REPORT ON OPTIONS FOR IDENTIFYING PERSISTENT ORGANIC POLLUTANTS IN STOCKPILES, PRODUCTS, AND ARTICLES IN USE, AS WELL AS IN WASTES

POPs in products and articles report

UN environment programme

BASEL / ROTTERDAM / STOCKHOLM CONVENTIONS

STOCKHOLM CONVENTION

REPORT ON OPTIONS FOR IDENTIFYING PERSISTENT ORGANIC POLLUTANTS IN STOCKPILES, PRODUCTS, AND ARTICLES IN USE, AS WELL AS IN WASTES

POPs in products and articles report

SEPTEMBER 2024

PERSISTENT ORGANIC POLLUTANTS REVIEW COMMITTEE
STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS

UN environment programme

BASEL / ROTTERDAM / STOCKHOLM CONVENTIONS

Recommended citation:

UNEP (2024). Report on options for identifying persistent organic pollutants in stockpiles, products, and articles in use, as well as in wastes (POPs in products and articles report). Persistent Organic Pollutants Review Committee, United Nations Environment Programme, Geneva.

Contact information:

Secretariat of the Basel, Rotterdam and Stockholm Conventions
Office address: 11–13, Chemin des Anémones - 1219 Châtelaine, Switzerland
Postal address: Avenue de la Paix 8–14, 1211 Genève 10, Switzerland
Email: brs@un.org

ACKNOWLEDGEMENT

The European Union is gratefully acknowledged for providing the funding that made this publication possible.

The contributions of Parties and observers to the Stockholm Convention on Persistent Organic Pollutants, as well as the work of the Persistent Organic Pollutants Review Committee, are highly appreciated.

TABLE OF CONTENTS

LIST OF ACRONYMS

ABS	Acrylonitrile butadiene styrene
ACAT/IPEN	Alaska Community Action on Toxics and International Pollutants Elimination Network
ACEA	European Automative Manufacturers' Association
APGC	Atmospheric pressure gas chromatography
AVV	Abfallverzeichnis-Verordnung
A2LA	American Association for Laboratory Accreditation
BAT and BEP	Best available techniques and best environmental practices
BDEs	Brominated diphenyl ethers
BFR	Brominated flame retardant
BPOM	Indonesian Food and Drug Authority
chemSHERPA	Chemical Information Sharing and Exchange
CiP	Chemical in products and articles
CLP	Classification Labelling and Packaging
COP	Conference of the Parties
CVMA	Canadian Vehicle Manufacturer's Association
DCM	Dichloromethane
DCPC	Department of Chemicals and Petrochemicals
DDT	Dichlorodiphenyltrichloroethane
DecaBDE	Decabromodiphenyl ether
DPP	Digital Product Passport
eANV	Elektronisches Abfallnachweisverfahren
ECCC	Environment and Climate change Canada
ECHA	European Chemicals Agency
ELISA	Enzyme-linked Immunosorbent Assay
ELV	End of life vehicles
EPRS	European Parliamentary Research Service
EPS	Expanded polystyrene
e-SIR	Electronic System for Waste Information

ESM	Environmentally sound management
ESPR	Ecodesign for Sustainable Products and articles Regulation
EU	European Union
GADSL	Global Automotive Declarable Substance List
GC-ECD	Gas chromatography-electron capture detector
GC-MS	Gas chromatography-mass spectrometry
GEF	Global Environmental Facility
GFC	Global Framework on Chemicals
GHS	Globally Harmonised System of Classification and Labelling of Chemicals
GPSD	General Product Safety Directive
HBB	Hexabromobiphenyl
HBCD	Hexabromocyclododecane
HCB	Hexachlorobenzene
HIPS	High impact polystyrene
HPLC	High-performance liquid chromatography
HSNO Act	Hazardous Substances and New Organisms Act 1996
IEC	International Electrotechnical Commission
IMDS	International Material Data Systems
ISO	International Organization for Standardization
IRAM	Argentine Institute of Standardization and Certification
LAC	Landfill Acceptance Criteria
LLE	Liquid-liquid extraction
LPCL	Low POPs content limits
MCCPs	Medium-chain chlorinated paraffins
MEAs	Multilateral environmental agreements
MMEI	Multi-media emissions inventory
NELAP	National Environmental Laboratory Accreditation Program
NFP	National focal point
NFRs	Nitrogenous-based flame retardants

NIP	National implementation plan
OCPs	Organochlorine pesticides
PBDEs	Polybrominated dphenyl ethers
PBT	Polybutylene terephthalate
PCBs	Polychlorinated biphenyls
PCDDs	Polychlorinated dibenzo-*p*-dioxins
PCDD/Fs	Polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans
PCDFs	Polychlorinated dibenzofurans
PCP	Pentachlorophenol
PCTs	Polychlorinated terphenyls
PFAS	Per- and polyfluoroalkyl substances
PFHxS	Perfluorohexane sulfonate
PFOS	Perfluorooctane sulfonic acid
PFOA	Perfluorooctanoic acid
POPs	Persistent organic pollutants
POPRC	Persistent Organic Pollutants Review Committee
PREAL	Project for the Environmentally Sound Management of POPs in Waste Electronic or Electrical Equipment in Latin American Countries
PRIO	Prioritization of Substances based on Health and Environmental Risks
RAPEX	European Rapid Alert System for Consumer Products and articles
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RIVM	National Institution for Public Health
RoHS	Restriction of Hazardous Substances Directive
SAICM	Strategic Approach to International Chemicals Management
SCCPs	Short-chained chlorinated paraffins
SCIP	Substances of Concern in articles as such or in complex objects (Products and articles)

SDS	Safety data sheet
SMU	Slovak Medical University
SNI	Indonesia National Standard
SOC	Substances of concern
SPE	Solid phase extraction
SPIN	Nordic Substance Register Database
SSS	Sliding Spark Spectroscopy
SVHC	Substances of very high concern
Swedish EPA	Swedish Environmental Protection Agency
SYKE	Finnish Environment Institute
TBBPA	Tetrabromobisphenol A
TOC	Total organic carbon
UNEP	United Nations Environment Programme
US EPA	U.S. Environment Protection Agency
UTCs	Unintentional trace contaminants
WEEE	Waste Electrical and Electronic Equipment
WHO	World Health Organization
WPC	Wood Preservation Canada
XPS	Extruded polystyrene
XRF	X-ray fluorescence

EXECUTIVE SUMMARY

Background

Article 6 of the Stockholm Convention on Persistent Organic Pollutants (POPs) among other things requires Parties to develop strategies for identifying stockpiles, products and articles, and wastes containing chemicals listed in Annex A, B, or C. This identification is essential for ensuring the management of these in ways that protect human health and the environment. There are also requirements on information exchange specified in Article 9 and reporting requirements, from Parties to the Secretariat, specified in Article 15.

A significant challenge for Parties and the Persistent Organic Pollutants Review Committee (POPRC) is identifying chemicals in products and articles due to technical limitations, costs, limited expertise and knowledge, burdens on actors within the value chain and the lack of a globally harmonised system for labelling and other means of identification and labelling of POPs in products, articles, stockpiles and wastes. A definition for these terms can be found in section 1.4 of this report.

Managing wastes containing POPs has revealed difficulties in identifying and appropriately managing such products and articles. Many of these products and articles historically end up in landfills, leading to long-term pollution. Additionally, recycled product streams can become contaminated with POPs, posing risks, especially in items such as consumer products and articles, including toys and food contact materials.

Identifying POPs in products and articles is crucial for their environmentally sound management (ESM) at all stages of the lifecycle including within products, articles, stockpiles and waste. One method is labelling products and articles such as through physical markers to indicate their POP content throughout the value chain, enabling stakeholders to implement appropriate management measures. There are also other means of identification throughout the value chain used by Parties and stakeholders as discussed in this report. Other potential mechanisms include tracer chemicals within materials (e.g. within polymers), digital systems such as databases (supported by tools such as Digital Product Passports (DPP) and blockchain technology) and other certification systems.[1]

---

1 Material Tracking for Circular Economy – A Review (https://www.mdpi.com/2073-4360/15/7/1623/pdf?version=1679647694.

At its eleventh meeting, the Conference of the Parties (COP) to the Stockholm Convention acknowledged these challenges and urged Parties to implement Article 6 effectively. The Conference requested the POPRC to explore options for identifying POPs in products and articles in use and in stockpiles and wastes and to report the findings at its twelfth meeting. The COP decision SC-11/12:

(a) Acknowledged challenges for developing strategies for identifying POPs in stockpiles, products and articles in use and in wastes.

(b) Requested the POPRC to consider options for identifying POPs in stockpiles, products and articles in use and in wastes and report on the outcome to the COP at its twelfth meeting.

(c) Invited Parties and Observers to submit information on experiences with, and challenges encountered in, developing and implementing appropriate strategies for identifying POPs in stockpiles, products and articles in use and in wastes.

(d) Requested the Committee to take into account the information received from Parties and Observers, existing guidance relevant to labelling, export and import.

At the nineteenth POPRC meeting, decision POPRC-19/3 invited Parties and Observers to provide to the Secretariat, information on experiences with and challenges encountered in developing and implementing appropriate strategies for identifying persistent organic pollutants in stockpiles, products and articles in use and in wastes and other relevant information. It also decided to establish an intersessional working group to undertake the activities requested in decision SC-11/12.

Aims of the document

This document aims to support the implementation of the Stockholm Convention by focusing on the identification of POPs in materials, products and articles, and waste. It compiles and synthesises information on current practices used by Parties and observers to identify POPs in products and articles, stockpiles, and wastes. The document highlights best practices, challenges, and barriers. It presents conclusions and recommendations for identifying POPs in stockpiles, products, articles, and wastes including:

(a) Identifying methods, strategies, and approaches for identifying POPs;

(b) Highlighting common barriers and challenges (practical, technical, economic);

(c) Providing case studies of best practices in identification methods;

(d) Offering conclusions and recommendations for the POPRC on addressing challenges, barriers, and data gaps.

The document is based on information from Parties and observers to the Convention, previous reports by the Secretariat and POPRC, and publicly available literature.

Methods, strategies, or approaches for identifying POPs in products and articles

Various methods, strategies, and approaches for identifying POPs in products and articles have been identified, primarily from Party and observer responses. These can be broadly categorised into regulatory measures and practical and technical approaches at global, regional, and national levels to address the challenges of identifying and managing POPs in products and articles.

Regulatory measures

The use of guidance documents such as "Guidance on developing inventories of PFOS, PFOA and PFHxS" (UNEP, 2023)[2] and "Guidance for developing a national implementation plan for the Stockholm Convention on Persistent Organic Pollutants" (UNEP, 2017)[3] have been widely followed by Parties to guide national inventories and the notification processes under the Stockholm Convention for articles in use containing POPs. However, transposition into national legal frameworks varies among Parties.

The European Union (EU) has developed a legal framework for reporting certain POPs which has been adopted by its Member States. Spain for example has a communication protocol for new POP listings under the Stockholm Convention. Notable EU policy measures include the Classification Labelling and Packaging (CLP) Regulation and the Ecodesign for Sustainable Products Regulation (ESPR) (EU, 2024). Whilst these do not require the reporting of all POPs, they require PBT

[2] Available at: https://www.pops.int/tabid/7730.

[3] Available at: https://www.pops.int/tabid/7730.

and vPvB (properties of POPs) reporting. The EU Substances of Concern in Products (SCIP) database, established under the Waste Framework Directive requires companies supplying articles containing Substances of Very High Concern (SVHCs) on the Candidate List, including certain POPs, to submit detailed information on these articles to the European Chemicals Agency (ECHA). Data must be reported to ECHA under the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) regulations where concentrations are 0.1% or above by weight in products and articles and individual components manufactured in the EU, imported into the EU, and to waste that may become secondary raw materials placed on the EU market.

Indonesia mandates compliance with the Indonesia National Standard (SNI) which is used by businesses to assess and test certain products and articles. In Canada, although there are no specific strategies for identifying POPs in products and articles, mechanisms such as mandatory surveys and public consultations under the Canadian Environmental Protection Act are employed.

Practical and technical approaches

Technical approaches to identify POPs encompass stakeholder surveys, labelling, databases and various analytical techniques and monitoring campaigns, particularly focused on electronic and electrical products. However, roll out of these approaches vary considerably between different Parties and observers; For instance, whilst they have experienced challenges, countries including Germany and Sweden have demonstrated relatively robust monitoring and enforcement programs respectively. Conversely, countries with limited capacity, such as Albania and Myanmar, face significant challenges in identifying POPs. There have been some notable examples of good practice for identifying POPs in product streams among Parties to the Convention. For example, the United Kingdom of Great Britain and Northern Ireland (UK) has developed a POPs Waste Tool for comprehensive inventory and waste flow predictions for a limited number of POPs-containing products and articles; this in part makes use of the data held within the UK Annex C emission inventories. In many countries, National databases such as Norway's national Product Register, and Japan's chemSHERPA tool offer a way to track POPs in products, articles and mixtures within certain industries. Many responses noted that International Material Data Systems (IMDS) are widely used, and effective for managing chemical information in automotive components. The EU's Safety Gate system facilitates rapid information transfer about hazardous products and articles placed on the market, potentially including those with POPs.

Methods, strategies, or approaches for identifying POPs in stockpiles

Stockpiles, though not universally defined, generally refer to reserved accumulations of products and articles, or materials intended for future disposal. Their use depends on listing conditions and available exemptions, as well as the status of entry into force and whether the Party has agreed to be bound by the obligations. POPs stockpiles can remain in use due to exemptions but are not meant to stay in use unless specific conditions are met. A definition for stockpiles is provided in section 1.4 of this documents but there are differences in interpretation among responses. The EU POPs Regulation 2019/1021 states that "stockpiles of prohibited substances should be treated as waste, while stockpiles of substances (including manufacturing or use) of which there is still an allowed exemption / acceptable purpose, should be notified to the authorities and properly supervised. In particular, existing stockpiles which consist of or contain banned POPs should be managed as waste as soon as possible. If other substances are banned in the future, their stocks should also be destroyed without delay, and no new stockpiles should be built up."[4]

Regulatory measures

The findings for stockpiles highlight the lack of formal regulatory approaches in several countries, such as Albania, Mauritius, Panama, Paraguay, Sri Lanka, and Yemen, which reported no experience or information on identifying POPs in stockpiles. Most of the information obtained for stockpiles is focused on polychlorinated biphenyls (PCBs); In the EU, regulations require holders of stockpiles containing POPs above certain thresholds to report to national authorities, with specific mandates for equipment containing PCBs. Indonesia also has specific regulations for identifying PCB content through visual, rapid, and laboratory tests. In New Zealand, the storage and disposal of POPs are currently regulated but a new regulation to replace the current Notice will include new provisions for manufactured articles containing POPs other than PCBs, with specific storage and handling requirements and threshold limits, as well as separate provisions for liquid POPs, chemicals, powders, pesticides, and articles containing liquid PCBs. Mozambique has broad regulations for pesticides, industrial chemicals, and hazardous waste management, but faces challenges in regulating POPs.

4 Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1021.

Practical and technical approaches

Practical and technical approaches emphasise gathering information on substances in products, articles, or wastes. In the EU, stakeholders report that they have struggled to identify POP-containing articles despite regulatory obligations to report stockpiles. In the UK, detailed guidance for notifying stockpiles is provided online. Indonesia, along with other Parties to the Convention, have conducted inventories of PCBs in transformers and capacitors as obliged under Paragraph (a), part II Annex A of the Convention. Despite this requirement, some Parties have faced issues in conducting PCB inventories, and at differing levels of granularity, and have therefore provided limited information for this report.

Different approaches have been taken to identify data; Peru relies on manufacturer labels and strategic surveys to identify POPs; whereas Nigeria has used qualitative methods, including questionnaires and focus group interviews, to gather data on POPs. One-off studies, such as a joint study by Moldovan and Czech experts on POPs in chicken eggs, have also been used to identify POP sources from old stockpiles and environmental burdens. Overall, the document underscores the varied and sometimes limited approaches to identifying POPs in stockpiles across different countries and regions.

Methods, strategies, or approaches for identifying POPs in wastes

Regulatory measures

Regulatory measures vary significantly which focus on different waste streams and different POPs; for instance, Argentina focuses on Waste Electrical and Electronic Equipment (WEEE) with specific standards, which, whilst not intended for POPs identification, has aided in identifying POPs, through guidance on methods for identifying and managing PCBs. Finland issues comprehensive guidance documents for stakeholders to manage numerous POPs in construction and demolition wastes, while Portugal enforce strict reporting and handling regulations to ensure proper lifecycle management. EU countries have mandatory notifications and reporting requirements for POPs waste stocks, though stakeholder awareness varies by EU Member State.

Practical and technical approaches

Practical and technical approaches also differ among countries. International conventions such as the Stockholm and Basel Conventions provide frameworks for inventory creation, monitoring, and management of POPs waste. Some EU member states, notably Finland, has national guidelines for managing POPs, particularly in construction and electronic waste. Canada uses monitoring data from waste activities to identify POPs, while the UK employs its Multi-Media Emission Inventory (MMEI) and a POPs Waste Tool, integrating literature reviews, sampling studies, and socioeconomic analysis to inform policy and regulatory action.

Case studies further illustrate specific approaches. In Latin America, regional methods have been developed under the Project "Strengthening National Initiatives and Improving Regional Cooperation for the Environmentally Sound Management of POPs in Waste Electronic or Electrical Equipment in Latin American Countries (PREAL)" to manage WEEE by classifying and testing plastic types for POPs. Indonesia has established best available techniques (BAT) and best environmental practices (BEP) for sorting and handling plastic e-wastes. Germany has implemented simplified analytical methods for detecting POPs including hexabromocyclododecane (HBCD) and PBDEs in plastic wastes.

Requirements for labelling for POPs

The identification requirements for POPs in products, articles, stockpiles, and wastes are governed by various international conventions and national regulations. While the Stockholm Convention requires Parties to develop appropriate strategies for identifying POPs in products and articles in use consisting of, containing or contaminated with, POPs, it does not prescribe specific methods, leaving it to individual Parties to determine how to meet their obligations. However, explicit labelling requirements are mentioned for a selected few POPs listings under the Convention, such as PCBs, HBCD, and PCP and its salts and esters. Parties have implemented labelling schemes in alignment with the international UN Globally Harmonised System for Classification and Labelling (GHS) (United Nations, 2011)[5] although this does not extend to the labelling of articles. However, the implementation of this system still is lacking in many countries despite being adopted by the UN in 2002. The GHS provides criteria for classifying chemicals and mixtures based on their

[5] Available at: https://unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev04/English/ST-SG-AC10-30-Rev4e.pdf.

hazards and sets a common standard for hazard symbols on labels. This system helps protect human health and the environment during the handling, transport, and use of chemicals, while also facilitating international trade.

The feasibility and implementation of labelling depend on factors such as the product itself, the value chain, and end of life pathways, necessitating case-by-case considerations. Challenges related to labelling include the complexity of value chains, limited technical expertise, and practicality issues, especially for small-sized products and complex articles made up of many, often small, components. However, labelling is seen as crucial for hazard communication to consumers in many applications, raising awareness, facilitating proper disposal, ensuring environmentally sound waste management practices, and reuse and recycling. Standardised labelling systems and enhanced information sharing across value chains are largely advocated to streamline labelling efforts globally and improve POPs management as well as saving time and costs for companies that do not have to comply with multiple systems unique to companies or jurisdictions. The absence of rapid and cost-effective screening technologies for identifying POPs in materials poses a significant challenge, leading to reliance on labelling or marking as the most viable approach to enhance information flow on POPs content in many applications. Certain sectors and regions already have labelling requirements in place for various products and articles, with physical labelling being a well-established tool for increasing traceability and transparency. However, physical labelling is at risk of being lost during end-of-life handling. Moreover, low awareness of current POPs legislation and difficulties in identifying POPs-containing products and articles contribute to low notification rates, posing risks to waste management and hindering effective implementation of labelling requirements. Some Parties and observers, including the EU, advocate for a combination of physical labelling and digital information from the labels to prevent information loss.

In the Ecodesign for Sustainable Products Regulation (ESPR), the EU recently passed mandatory requirements for digital passports (EU, 2024). A digital passport is a standardised digital representation of a physical product and is expected to create improved information exchange along value chains, enabling time and cost-efficient verification and management of product sustainability. It combines physical labelling of physical products and articles with data carriers with the digital representation stored in a database. It can save costs from spot checks for chemical analyses. Furthermore, it lowers the risk that information is lost when physical labels may be destroyed in the end-of-life handling of materials and products and articles, which enables recyclers to make informed decision-making.

The requirement to label or mark products and articles containing POPs is considered useful and important, as it raises awareness among consumers, workers, and other stakeholders, including recyclers, facilitates tracking throughout the product lifecycle, and promotes the prevention and reduction of POPs releases into the environment and use within new products and articles made of recycled materials. Some countries advocate for physical labelling (using traditional methods or alternative markers such as luminescent organic/metal-based inks, synthetic DNA codes, barcodes, QR codes, radio-frequency identification chips and watermarks) linked to detailed labelling information, including product formulas, contaminant lists, and links to comprehensive risk sheets. However, challenges such as the lack of global harmonisation, lack of industry disclosure of data and other practical constraints for labelling exist.

Some industry actors may argue against labelling due to minimal POPs use/concentration in products and articles, administrative burdens, and limited impact downstream in recycling processes, however others argue that the burden should not be placed on governments and downstream operators, who do not benefit from profits from sales of these products and articles, to identify POPs in material streams. Stakeholders note that while voluntary initiatives are commendable, legal requirements are seen as necessary to ensure a level playing field and meet the objectives of the Stockholm Convention. Furthermore, some observers note that numerous exemptions adopted under the Stockholm Convention contribute to the use of POPs in products and articles.

Improved implementation of identification means could facilitate information exchange and reduce POPs release, aligning with Article 9 mandates. Despite challenges, the adoption of labelling or marking remains an important tool to aid for POPs tracing and management. One observer noted that numerous exemptions adopted under the Stockholm Convention continue to contribute to the use of POPs in products and articles.

Analytical techniques

Various countries employ a range of analytical techniques to identify POPs in products and articles, materials, and waste streams. These methods include requesting data from suppliers, conducting in-house analysis using techniques including gas chromatography-mass spectrometry (GC-MS), high-performance liquid chromatography (HPLC), or enzyme-linked Immunosorbent Assay (ELISA), and outsourcing material analysis to accredited laboratories equipped to detect POPs. Specific methodologies vary by country; for instance, Chile utilises GC-MS for POPs analysis in plastic wastes and electronic devices, while Nigeria has employed methods including Gas Chromatography Electron Capture Device (GC-ECD) and Clor-N-50 test kits for quantitative detection of PCBs. Challenges such as high costs, complexity, and false positives hinder the widespread adoption of advanced rapid screening techniques such as X-ray fluorescence (XRF), although they are effective for initial detection. Visual, rapid screening, and laboratory tests are used for PCB identification in transformers, capacitors, and dielectric oil. Waste management practices, particularly in Oman, involve various extraction methods and GC/GC-MS for detecting POPs in water samples and chemical wastes, with safety data sheets and landfill acceptance criteria guiding waste classification and treatment procedures.

Key challenges and barriers

Identifying POPs in products, articles, stockpiles, and wastes involves significant challenges, including limited information within value chains, regulatory hurdles, financial constraints, and technological limitations. Key issues also include difficulties in capacity building, knowledge sharing, and analytical capabilities. Many responses suggest that improvements in inventory systems, analytical capacities, and global cooperation are crucial. Developing countries face particular challenges due to a lack of technical and human resources, which impacts their ability to manage POPs effectively.

A significant lack of data on POPs complicates management efforts. Enhanced transparency and traceability, through better labelling and information systems, are widely considered necessary. Harmonising regulations and standards globally could reduce financial burdens and improve compliance.

Germany highlights the need for experienced laboratories and consistent analytical methods to address complex mixtures of POPs and develop more frequent testing regimes to better understand waste trends. However, accurate identification of POPs requires sophisticated laboratory equipment and expertise, which are often unavailable, particularly in developing countries, leading to high testing costs. Investment in these technologies is important but expensive both in the short and long term. To tackle these issues, better identification and inventory systems are essential.

Current inventories rely on commissioned studies and testing regimes to understand POPs in material streams, but these efforts often have limited coverage and data gaps. International collaboration and improved information sharing throughout the value chain and for other stakeholders such as regulators are deemed important for effective management and identification of POPs. Digital labelling with globally harmonised standards has been suggested to improve information accessibility. However, this requires developing harmonised infrastructure including databases, to reduce misalignment between countries and reduce financial burdens and there are concerns on the practical feasibility of implementing such a system including agreement of global limits unintentional trace contaminant (UTCs), appropriate use of the system across the value chain and suitable enforcement.

Limited access to detailed information and technical expertise and infrastructure are highlighted as the major challenges for better identifying POPs. Capacity building through training and awareness campaigns is crucial for better understanding and managing POPs both for value chain operators and regulators. Increased knowledge sharing and better labelling could improve public and stakeholder awareness, addressing gaps in information and enhancing management practices.

Conclusions and recommendations

Article 6 of the Convention requires, among other things, Parties to develop strategies for identifying POPs in various contexts, but it lacks practical guidance, leading to diverse measures to be adopted among Parties. Responses reveal varied global approaches to identifying and managing POPs, including guidelines, regulations, and research. Existing methods range from surveys and screening, databases, physical labelling and inventory analysis. Advanced digital tools like product passports are still under consideration. Analytical techniques for identifying POPs vary from simple visual checks to complex laboratory analyses. Countries use methods like XRF and GC-MS, each with specific advantages and limitations.

Countries apply diverse measures based on different POPs or sectors, leading to inconsistent implementation. Most rely on retroactive measures and face challenges like understanding POPs presence and stakeholder coordination. Many Parties face implementation challenges, including compliance, awareness, and cost-effective strategies. Harmonised approaches are needed to improve identification and management of POPs-containing products and articles.

Identifying POPs poses challenges including limited information, regulatory obstacles, and financial constraints. Improved inventory systems, analytical capabilities, and global cooperation are crucial for better management. Many countries, especially importers, lack information on POPs in imported products and articles, complicating management. Harmonising regulations and improving transparency could reduce costs and improve compliance. Accurate POPs identification often requires expensive, sophisticated equipment, which is often unavailable in developing countries. Improved information sharing and harmonised reporting could address these data gaps and management challenges.

Physical labelling may be impractical for small components or complex products and articles. Linking labels to digital databases could enhance identification and traceability. Detailed labelling, including digital product passports, is advocated to provide comprehensive information on POPs. This could simplify international trade and align reporting requirements.

Developing harmonised databases and infrastructure is seen as essential for sharing information and reducing costs. Capacity building through training and international cooperation is also important. A globally harmonised database could ease the burden of multiple national standards. However, existing databases like SCIP face criticism for low usage and high administrative burdens. Whilst a digital database would be valuable, it is contingent on the data quality and completeness which could vary considerably without proper enforcement which will add burden to authorities and regulators.

Clear purpose and user needs should guide the development of labelling and identification systems, whether for consumer information, safe management, or end of life disposal.

Legal requirements, alongside voluntary initiatives, are deemed necessary to ensure effective POPs management and compliance with the Stockholm Convention's objectives. Improved digital identification and information exchange are considered crucial by many contributors.

1. INTRODUCTION

1.1 Background

Article 6 of the Stockholm Convention on Persistent Organic Pollutants (POPs) requires, among other things, that Parties develop strategies to identify stockpiles, products and articles in use and wastes consisting of, containing or contaminated with chemicals listed in Annex A, B or C. It also requires identification, as far as practicable, of stockpiles consisting of, containing or contaminated with, chemicals listed in Annex A or B based on these strategies. These requirements, outlined in sub-paragraphs 1(a) and 1(b) of Article 6, are part of, and a prerequisite to, the wider goal of Article 6 to ensure such that stockpiles, products, articles and wastes containing POPs listed under Annex A, B or C, are managed in a manner protective of human health and the environment.

Article 9 on information exchange requires that each Party "shall facilitate or undertake the exchange of information relevant to: (a) the reduction or elimination of the production, use and release of persistent organic pollutants…" (subparagraph 1(a)) and states that "[f]or the purpose of this Convention, information on health and safety of humans and the environment shall not be regarded as confidential" (subparagraph 5).

Article 15(1) of the Convention requires Parties report to the Secretariat to the Convention on the measures it has taken to implement the provisions of the Convention and on the effectiveness of such measures in meeting the objectives of the Convention. An excerpt of the format for national reporting pursuant to Article 15 regarding this requirement is provided in the appendix to this document.

Identification of chemicals in products and articles has been one of the key challenges for many Parties to the Stockholm Convention. It is also a challenge to the work undertaken by the Persistent Organic Pollutants Review Committee (POPRC), in particular when identifying uses, discussing alternatives and designing safer alternatives. For brominated POPs used as flame-retardants countries typically opt to screen for bromine using X-ray fluorescence (XRF) spectroscopy or use sink-float techniques to separate parts that contain bromine, including polybrominated diphenyl ethers (PBDEs), hexabromobiphenyl (HBB) or hexabromocyclododecane (HBCD) (United Nations Environment Programme (UNEP 2021a).

The experiences related to managing wastes containing POPs have highlighted significant challenges in identifying products and articles that contain POPs and appropriately managing them. A substantial portion of products and articles containing POPs has historically ultimately ended up in landfills (Weber *et al.*, 2011; Babayemi *et al.* 2015, 2018). The disposal of products and articles containing POPs in landfills leads to the long-term release of pollutants and pollution around the disposal sites (Weber *et al.* 2011; Oloruntoba *et al.* 2019; Petrlik *et al.* 2022). POPs in product streams which are recycled (or where POPs are deliberately added to materials, including plastics) can lead to the contamination of new products and articles made of POP contaminated recyclates, often posing high exposure risks, such as toys or food contact materials (Chen *et al.* 2009; Samsonek and Puype 2013; Puype *et al.* 2015; Guzzonato *et al.* 2017; Kuang *et al.* 2018; Kajiwara *et al.* 2022; Kutarna *et al.*, 2023). Environmental release peaks often lag behind production peaks, especially for long-lived products and articles, leading to two distinct peaks in releases: one during production and use, and another during waste disposal resulting in legacy chemicals re-entering circulation long after they may have been restricted (Li *et al.*, 2023). Furthermore, products and articles containing POPs for producer nations are exported resulting in persistent environmental and health concerns in the importing regions (Li *et al.*, 2023).

Identifying products and articles that contain POPs is essential for the environmentally sound management (ESM) of wastes as well as for safe recycling and reuse of materials. One approach to accomplish this is by enabling their identification throughout the lifecycle including marketing, usage, and end of life phases. Combined physical and digital labelling such products and articles offers a method to ensure that information regarding their POP content is clearly indicated and communicated throughout the value chain to stakeholders, who can then implement appropriate management measures. It is important to consider that these stakeholders might be situated in various countries due to the globalised nature of value chains (UNEP 2019a), which stresses the need for globally harmonised standards to remove unnecessary barriers of accessing and interpreting the information.

At its eleventh meeting, the Conference of the Parties (COP) to the Stockholm Convention adopted decision SC11/12 on POPs in stockpiles, products and articles in use and in wastes. In the decision, the COP acknowledged challenges encountered by Parties in developing appropriate strategies for identifying POPs in stockpiles, products and articles in use and in wastes. The COP urged Parties to effectively implement subparagraphs 1(a) and (b) of Article 6 of the Convention.

In order to assist Parties in the implementation of the Convention, in paragraph 2 of decision SC-11/12, the COP requested the POPRC to consider options for identifying POPs in stockpiles, products and articles in use and in wastes and issues related to the production, import and export of products and articles containing POPs, and to report on the outcome of that exercise to the COP at its twelfth meeting.

Furthermore, in paragraph 3 of the same decision, the COP invited Parties and observers to submit to the Secretariat, by the date to be decided on by the Committee, information on experiences with, and challenges encountered in, developing and implementing appropriate strategies for identifying POPs in stockpiles, products and articles in use and in wastes and other relevant information to support the work of the Committee. In paragraphs 4 and 5 of the decision, the COP requested the Committee to take into account the information received from Parties and observers, existing guidance relevant to labelling, export and import, as well as relevant work in other forums when undertaking the work referred to in paragraph 2 of the decision and invited the Committee to involve experts with relevant expertise in that work.

In its decision POPRC-19/4, the POPRC invited Parties and observers to provide to the Secretariat information on experiences with and challenges encountered in developing and implementing appropriate strategies for identifying persistent organic pollutants in stockpiles, products and articles in use and in wastes and other relevant information, using the form set out in annex I to the note by the secretariat on information relating to the work on persistent organic pollutants in stockpiles, products and articles in use and in wastes. The Committee also decided to establish an intersessional working group to undertake the activities requested in decision SC-11/12 on persistent organic pollutants in stockpiles, products and articles in use and in wastes.

1.2 Aims of this document

Identification of the chemical content (and in particular if containing POPs) of a material/product/article is a key priority under the Stockholm Convention. This document aims to compile and synthesize information on the practices currently used by Parties and observers to identify POPs in products, articles, stockpiles, and wastes to highlight best practices as well as challenges and barriers. In line with the mandate outlined in decision SC-11/12, it presents conclusions and recommendations on options for identifying POPs in stockpiles, products and articles in use and in wastes and issues related to the production, import and export of products and articles containing POPs. This document will include (to the extent possible based on the information available):

(a) Identify methods, strategies, and approaches for identifying POPs in products, articles, stockpiles, and wastes;

(b) Highlight common barriers and challenges (such as practical, technical, and economic);

(c) Draw out case studies of best practices in developing and implementing identification methods;

(d) Provide conclusions and recommendations for the consideration of the POPRC on how to address the challenges and barriers and close key data gaps.

1.3 Structure of this document

This document is presented in the following sections:

(a) Methods, strategies, or approaches identifying POPs in products, articles, stockpiles and wastes:

    (i) Separate sections provided to present information on products, articles and stockpiles/wastes;

    (ii) Regulatory measures (national/international level);

    (iii) Practical and technical approaches;

    (iv) Case study examples to highlight good practice or key challenges;

(b) Key challenges and barriers in identifying POPs in product, articles, stockpiles and wastes;

(c) Requirements for labelling for POPs in products, articles, stockpiles and wastes:

    (i) Country experiences;

    (ii) Key challenges and barriers for labelling;

(d) Analytical techniques – available approaches and to identify POPs in products, articles, materials, and wastes streams for use in the absence of labelling;

(e) Conclusions and recommendations.

1.4 Glossary of terms

The following definitions describe common terms used throughout this document. It is important to note that these terms may have different definitions in various regions and contexts. Some terms may also be defined under other multilateral environmental agreements, such as the term "waste" under the Basel Convention. Additionally, some terms lack a universally accepted definition. Therefore, the definitions provided here are specific to the context of this report. However, during the consultation period, definitions for these terms were not available, which may have led to varying interpretations among consultees:

(a) Article – Multiple definitions exist for articles. For the purpose of this report, an article is defined as a manufactured item other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical (as determined under paragraph (d) of US Code of Federal Regulations 29 CFR 1910.1200 Hazard communication),[6] The report drafters recognise that alternative definitions such as the definition under the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) regulation exist but is not aligned with the report context;

(b) Product – There is no universally accepted definition for products. However, in the context of this report, a product is a tangible item produced through a process, typically for sale or consumption or use within another product. A product is generally a broader term than an article as it can include substances or mixtures (including fluids or particles) and, in some definitions, non-material services. In relation to materials, products and articles are often used interchangeably or in conjunction despite

6 https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1910/subpart-Z/section-1910.1200.

slight differences in interpretation. Both products and articles can range in their complexity from a single material to a multicomponent product (e.g. vehicle) within the context of this report. For the avoidance of doubt, "products and articles" are used in conjunction throughout this report;

(c) Wastes – Substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law.[7] These include any materials that are not prime products and articles (i.e., products and articles produced for the market) for which the generator has no further use for purpose of production, transformation, or consumption, and which they discard, or intend, or is required to discard.[8] Once a product or article has entered waste phase, it must be managed according to paragraph 1(d) in Article 6;

(d) Stockpile – There is no universally accepted definition for stockpiles. However, the current understanding is that a stockpile refers to an accumulation of products, articles, or materials held in reserve (or use) that have been designated and intended for future ESM. Whether the use of stockpiled materials is permitted depends on listing conditions and potential exemptions. Once the use is prohibited, stockpiles become waste. Originally, stockpiles listed under the Stockholm Convention referred to listed pesticides which had some permitted uses despite being known to contain POPs. This definition has evolved to include substances mainly used in products and articles. POPs stockpiles can exist as products and articles in use due to exemptions or derogations that allow certain acceptable uses beyond an amendment entering into force. These stockpiles are not intended to remain in use unless specific conditions outlined in paragraph 1(c) of Article 6 (any specific exemption specific in Annex A or any specific exemption or acceptable purpose specified in Annex B) are met. Additionally, certain products and articles can remain in use and not be considered to be listed in the relevant Annex, provided that a Party has notified the Secretariat that a particular type of article remains in use within that Party.[9] These notes are not considered to establish a production and use acceptable purpose or specific exemption.

---

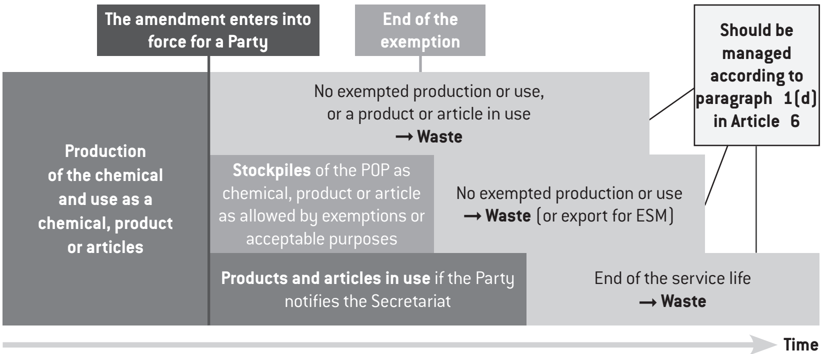
7 Article 2, Basel Convention; http://www.basel.int/portals/4/download.aspx?d=UNEP-CHW-PUB-GUID-GlossaryTerms.English.pdf.

8 https://wesr.unep.org/sites/default/files/2022-02/Waste_Methodologies.pdf.

9 https://www.pops.int/Procedures/Articlesinuseandclosedsystem/tabid/4647/Default.aspx.

It is important to distinguish between Stockpiles and Waste, although they are often conflated. This report acknowledges that differences in interpretation exist regarding this distinction. Figure 1 outlines the distinction between, products and articles in use, stockpiles and waste. Parties may export chemicals listed in Annex A or B for ESM or disposal or as permitted by the Convention.

Figure 1. Distinction between, products and articles in use, stockpiles and waste.



1.5 Sources of information

This document is based on information that has been provided by Parties and observers to the Convention, including information provided in response to the call for evidence, and provided by the following Parties and observers:

(a) Parties: Albania, Argentina, Canada, Chile, European Union (EU), Finland, Germany, Honduras, Hungary, Indonesia, Japan, Mauritius, Monaco, Mozambique, Myanmar, Netherlands, New Zealand, Nigeria, Norway, Oman, Panama, Paraguay, Peru, Portugal, Republic of Moldova, Slovak Republic, Spain, Sri Lanka, Sweden, Tajikistan, United Kingdom of Great Britain and Northern Ireland (UK), Yemen;

(b) Observers: Alaska Community Action on Toxics and International Pollutants Elimination Network (ACAT/IPEN), Canadian Vehicle Manufacturers' Association (CVMA), European Automotive Manufacturers' Association (ACEA), Global Green Network, Health and Environment Justice Support;

(c) Communication with technical experts within UNEP, National Institute for Public Health and the Environment (RIVM), the Finnish Environment Institute (SYKE).

The submissions that often include links to where find more detailed information, are made available at the website of the Convention.

Previous initial information compiled by the Secretariat (UNEP/POPS/POPRC.19/INF/13) relating to the work on POPs in stockpiles, products and articles in use and in wastes, which focussed on the three POPs that have been listed with labelling requirements: HBCD, pentachlorophenol (PCP) and polychlorinated biphenyls (PCBs) has been used to build this document. Initial information on the insights gained from implementing such labelling are summarised in this report. Additional information has been gathered from a search of publicly available literature, including scientific journals, and dossiers prepared for the Basel and Stockholm Conventions.

It should be noted that, whilst stockpiles of pesticides are covered within the scope of this study, limited information was obtained from Parties and observers who contributed to this project and therefore they do not constitute a significant focus of this report. Where relevant information has been identified, it has been included and discussed albeit to a limited degree.

2. METHODS, STRATEGIES, OR APPROACHES IDENTIFYING POPS IN PRODUCTS, ARTICLES, STOCKPILES AND WASTES

2.1 Methods, strategies, or approaches for identifying POPs in products and articles

Approaches to addressing concerns regarding chemicals, including POPs, encompass global, regional, and national initiatives. This section will introduce the methods, strategies or approaches for identifying POPs in products and articles applied in different countries and regions from two perspectives: regulatory measures and practical and technical approaches, aiming to present a comprehensive overview of existing tools for identifying POPs in products and articles. The presented information is based on the submission from Parties and observers. Key challenges and barriers and recommendations drawn from their findings are assessed in section 3 and section 6, respectively.

2.1.1 Regulatory measures

The Convention allows for the notification of POPs in articles in use, i.e. for chemicals occurring as constituents of articles manufactured or already in use before or on the date of entry into force of the obligation with respect to these chemicals. A chemical shall not be considered as listed in the relevant Annex, provided that a Party has notified the Secretariat that a particular type of article remains in use within that Party (i.e., it makes use of an existing exemption under the annexes to the Convention). These notes are not considered as a production and use acceptable purpose or specific exemption. Party notifications of articles in use pursuant to note (ii) of Annex A and note (ii) of Annex B to the Stockholm Convention are listed in a public register on the Convention website.[10]

Based on the received responses, the guidance document "Guidance on preparing inventories of PFOS, PFOA and PFHxS" (UNEP, 2023) and "Guidance for developing and updating National Implementation Plans (NIPs)" (UNEP, 2017) are frequently used to guide national inventories including Albania and Honduras (Albania response, 2024; Honduras response, 2024). Primarily, regulatory measures aimed at in identifying POPs focus on retroactive measures involving testing and inventory studies.

---

[10] https://www.pops.int/tabid/452.

The Rotterdam Convention on the Prior Informed Consent procedure for certain hazardous chemicals and pesticides in international trade facilitates the sharing of information on chemicals listed in Annex III of the Convention to help governments assess the risks connected with the handling and use of chemicals and make more informed decisions about future import and use of chemicals, taking into account local conditions.[11] When a POP is listed in Annex III of the Rotterdam Convention, a decision guidance document, which contains basic information on the chemical, such as its hazard classification, additional sources of information on the chemical and information on possible alternatives, is sent to all parties. Importing parties then decide whether to consent to, refuse, or restrict the import, and this decision is communicated to all parties.[12] The Rotterdam Convention could be used to track certain POPs chemicals imported into a country and inform on their subsequent uses, however, note the Convention does not cover wastes, products and articles within its scope.

In Canada, although there are no specific strategies for identifying POPs in products and articles, several mechanisms are applied to gather information on substances in domestic products and articles and their uses such as, mandatory surveys and public consultations on proposed regulatory initiatives under the Canadian Environmental Protection Act. In 2022, Environment and Climate Change Canada (ECCC) and Health Canada published a Notice of Intent on labelling of toxic substances in certain products and articles (e.g. cosmetics, cleaning products and flame retardants in upholstered furniture) for public comments (Canada response, 2024). In 2025, ECCC and Health Canada plan to publish a Strategy for enhancing the availability of information on chemicals of concern in products and articles (Canada response, 2024; ACAT/IPEN response, 2024).

Responses from EU Member States suggest that the information and guidelines provided by the EU are followed to identify POPs in products and articles in their countries. These include Germany, Portugal, Finland (Germany response, 2024; Portugal response, 2024; Finland response, 2024). Box 1 below shows the regulatory measures provided by EU to identify POPs in products and articles. Note that many of these initiatives are not solely directed at POPs but rather target chemicals of broader human health and environmental concerns. One notable example is the EU Ecodesign for Products Regulation (ESPR) which is introduced below.

11 https://www.pic.int/tabid/1364.

12 https://www.pic.int/tabid/2413.

Box 1: Case studies

EU (EU response, 2024)

Identification of POPs in articles

Substances of Concern in Products (SCIP) is the database for information on Substances of Concern in articles as such or in complex objects (products or articles) established under the Waste Framework Directive. Since 5 January 2021, companies supplying articles containing Substances of Very High Concerns (SVHCs) on the Candidate List, including certain POPs, in a concentration above 0.1% weight by weight (w/w) on the EU market have to submit detailed information on these articles to the European Chemicals Agency (ECHA). This includes trade name data, schematics of the article and specifically which components contain the SVHC or POP. The ultimate aim of SCIP database is to help support the waste sector in the identification and separation of contaminated components from the rest of the article during waste management. The impact assessment undertaken by the European Commission included case studies for different sectors to test and illustrate how the SCIP database may be used in practice.

Identification of POPs in substance or mixtures

POP substances, as such or in mixtures, placed on the EU market may be subject to the registration obligation according to the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) Regulation. If the substance is later to become classified as a POP, information on the substance or mixture (submitted under the REACH process) could be used to identify products and articles containing POPs.

The Classification Labelling and Packaging (CLP) Regulation EC No 1272/2008 (EU, 2008) is the legislation in force in the EU for classification and labelling substances and mixtures. It requires manufacturers, importers or downstream users of substances or mixtures to classify, label and package their hazardous chemicals appropriately before placing them on the market (More detailed information about this regulation will be introduced in section 4). The EU CLP Regulation requires the classification and labelling of substances and mixtures. Where relevant, the information must also be provided in a safety data sheet (SDS), in accordance with the REACH Regulation. POPs are not specifically classified under CLP, but PBT and vPvB (properties of POPs) substances have been incorporated in the EU CLP Regulation since December 2022.

In the ESPR (EU, 2024), which aims to enhance the circularity, energy efficiency, and overall sustainability of various product groups within the EU market, the EU recently passed mandatory requirements for digital passports (EU, 2024). A digital passport is a standardised digital representation of a physical product and is expected to create improved information exchange along value chains, enabling time and cost-efficient verification and management of product sustainability. It combines physical labelling of products and articles with data carriers with the digital representation stored in a database. It can save costs from spot checks for chemical analyses by providing recipe data (or selected data, depending on user permissions). Furthermore, it lowers the risk that information is lost when physical labels may be destroyed in the end-of-life handling of materials, products and articles, which enables recyclers to make informed decision-making. Labelling takes the form of an easily accessible tag on the products and articles that makes sustainability information instantly available to value chain actors, regulators and consumers alike. This supports legal obligations under REACH mandate manufacturers, importers, or distributors to disclose information about articles containing SVHCs on the Candidate List exceeding 0.1% weight by weight and will broaden the scope from SVHCs to Substances of Concern (SOC). However, certain product categories such as food and feed are exempt from this regulation and the exact way in which material passports will be applied is not yet decided.

In Norway, there are approaches that include initiatives and measures at global, regional and national levels (Note that many of these initiatives are not specifically targeting POPs but chemicals of concern more generally). Globally and regionally the country follows guidelines and instructions from UNEP and EU. At national level, it has the Norwegian Product Register to require producers and importers of specified substances and mixtures to register information in the Norwegian Environment Agency's application "Chemical Declaration to the Product Register". The Product Register gives the authorities knowledge about hazardous substance and mixtures on the Norwegian market. It also includes information on POPs. The duty to declare chemicals to the Product Register is set out in the Norwegian declaration regulation. The regulations regarding registration in the Product Register are national regulations that apply in addition to the notification duties in the European regulations CLP and REACH (Norway response, 2024). Product registers containing information on chemical products are also administered in Sweden, Denmark, and Finland. Information on how chemicals are used in the Nordic countries is available in the Nordic Substance Register Database (SPIN). It is a publicly accessible database, which can be used free of charge to find information on the chemicals that are used in the Nordic countries. The information includes quantities, industries in which it is used and the function it is used for. In addition, the Swedish Chemicals Agency's substitution tool, PRIO[13], helps producers and importers fulfil their legal responsibility to understand the chemical content of their products and articles. PRIO allows them to identify both banned substances and those still in use, enabling them to avoid chemicals that may soon be restricted or banned.

In Spain, when a new POP is listed under the Annexes to the Stockholm Convention, the National Focal Point (NFP) initiates communication with relevant national sectors involved in producing, using, or owning products and articles containing these new POPs to gather necessary information. The NFP also requests Autonomous Communities' Competent Authorities to contact relevant sectors within their jurisdictions. Subsequently, if any producer, user, or owner of POP-containing articles or products seeks an exception permitted by the Stockholm Convention, the NFP periodically updates the information received. Although Spain's experience in identifying POPs is generally positive, there is acknowledgment of potential gaps in contacting certain sectors due to reasons such as lack of awareness, inability to establish contact, or unwillingness to collaborate in providing sensitive information (Spain response, 2024).

In Indonesia, several national level regulations directly and indirectly help to identify POPs in products and articles. The national implementation plan (NIP) further includes activities to identify POPs. The Regulation of green industry prioritises efficiency and effectiveness for a sustainable environment (Law No 3 of 2014) (Indonesia response, 2024). Indonesia (2024) requires that all goods manufacturers are obligated to ensure and test their products to comply with Indonesia National Standard (SNI). Not all SNI products and articles have POPs parameters, but several of them do. There are two types of SNI: mandatory and voluntary. In preparing the SNI for a product, the development of a standard takes two different approaches: consensus-based, agreement on a standard design among stakeholders; and scientific evidence-based, agreement on a standard based on scientific evidence (Indonesia response, 2024).

---

13 https://www.kemi.se/prioguiden/english/start.

2.1.2 Practical and technical approaches

The countries that responded to the request for information provided details on identifying POPs, including PBDEs, PFOS, perfluorooctanoic acid (PFOA), HBCD, PCBs, Dechlorane Plus, and other brominated flame retardants through a variety of techniques including analytical monitoring campaigns, stakeholder surveys and communication in the value chain. Most responses highlighted electronic and electrical products and articles as being of particular focus of research and monitoring campaigns and this has seen success in many countries. However, there were differences in the number of POPs investigated within products and articles, and in the level of detail to which they are assessed. This variance often stemmed from the country's role as either a producer of POPs or a manufacturer using them, influencing their approach.

For example, in Argentina, manufacturing with POPs is not reportedly practiced therefore the focus of POPs control is on restricting imported goods containing POPs. Argentina primarily monitors a limited number of POPs, based on the technical documentation of the importers including PCBs and, HBCD in certain products and articles such as electronics. The country has made progress in PCB management, implementing device records, labelling for PCB presence, and training customs agents on the subject. Products and articles such as transformers, fluorescent tube ballasts, pigments, stoves, and paper containing PCBs are monitored. Improved training and analytical capacity development are considered crucial, and the Party highlights that capacity for monitoring imports is complicated by extensive border perimeters. Though it should be noted that most countries experience unique challenges due to differing geography/economic structure etc. While identifying POPs in articles isn't currently common practice in Argentina, proper labelling and information dissemination are deemed necessary to ensure effective management throughout the product's life cycle. Argentina argues that downstream users/importers of these products and articles shouldn't bear the burden of identifying them. Similar responses were received from Honduras (Argentina and Honduras response, 2024).

The level of training and capacity varies significantly among respondents. For instance, Germany, and Sweden have established relatively robust monitoring and enforcement programs supported by training and operational capacity. In the Netherlands, there is a national effort dedicated to chemicals in general under REACH Regulation, but not specifically dedicated to POPs. European actions on enforcement are coordinated under the Forum for Exchange of Information on Enforcement,[14] an EU network of national inspectorates related to REACH Regulation (Communication with RIVM, 2024).

On the other hand, in many other countries including Albania, Honduras, Hungary, Mauritius, Monaco, Myanmar among others, the capacity is severely limited. Albania acknowledges some training provided by the Swedish Chemicals Agency, but its practical application has been limited, and a lack of technical expertise remains a significant barrier. Similarly, Myanmar, despite recognising the Stockholm Convention and banning the importation of POPs, has identified a need for improving funding for technology and resources to identify materials containing POPs.

In Moldova, an inventory of PBDEs has been developed following the UNEP Guidelines under the Stockholm Convention. Products and articles potentially containing flame retardants, such as vehicles, computer casings, cathode ray tube televisions, and flat panel displays, have been assessed at stages of their life cycle: import/production, stocks in use or storage, and products and articles entering the waste stream. This was achieved using XRF for early detection and SDS but no further details on the process were provided. Additionally, an inventory of potential HBCD content in expanded and extruded polystyrene was developed, focusing solely on their import and production stages although no further details on the methodology were provided for this either (Moldova response, 2024).

Whilst many responses identified XRF screening as a possibility for regularly screening POPs in products and articles (see section 5 of this report) this is not widespread practice according to the responses. In Sweden, the Swedish Chemicals Agency conducts enforcement projects aimed at identifying restricted chemicals, including POPs, in both chemical products and articles in use. These projects typically involve chemical testing, facilitated either by the Agency's XRF instrument or accredited external laboratories which is expensive long term, and offers limited information resulting in few data points with which to work. The availability of equipment and lab capacity varies significantly on a global basis. And it was highlighted that the majority of developing countries and countries in transition have no accredited laboratories to conduct such tests. XRF is not officially recognised as a standardised methodology for testing therefore data obtained by XRF is subject for further laboratory testing which is not possible in the majority of countries.

---

14 https://echa.europa.eu/about-us/who-we-are/enforcement-forum.

Enforcement efforts in Sweden prioritise product groups posing potential risks to human health (especially children) and the environment, including toys, childcare articles, clothing, electronics, construction materials, and sports equipment. Selection of product groups for testing considers technical information on intentional addition of specific substances, as well as sectors where non-compliant products and articles have been identified in previous studies. They also regularly check the content of POP substances in the abovementioned product groups. It was reported that the enforcement activities performed between 2012-2023 has found short-chain chlorinated paraffins (SCCPs), medium-chain chlorinated paraffins (MCCPs), polybrominated diphenyl ethers (PBDEs), HBCD, PFOS, PFOA, perfluorohexane sulfonic acid (PFHxS) and hexachlorobenzene (HCB).

In the responses, most countries that have identified POPs in products and articles used estimates and intermittent testing of products and articles placed on the market rather than regular and repeated testing campaigns as it is costly and unsustainable as a primary identification technique. For example, the UK's POPs Multi-media Emissions Inventory (MMEI) serves as a comprehensive inventory of Annex C POPs emissions across various compartments. Initially developed with a focus on specific POPs, the inventory has since been expanded to include nearly all listed substances under the Stockholm Convention and undergoes annual updates and improvements. This includes the development of source-flow approaches (e.g., material/product stockpiles that contain POPs based on national statistics, industry data, and academic research plus emission factor data). In parallel with this inventory, the UK is developing a POPs Waste Tool which aims to improve predictions regarding future waste flows of POPs by considering assumed supplies of in-use goods. Currently, the waste tool encompasses PCBs, decabromodiphenyl ether (DecaBDE), and HBCD, with further development underway for MCCPs. Both the MMEI and the Waste Tool rely on publicly available information (e.g., market data and activity data values to determine market saturation and POP concentrations), data from Risk Management Evaluations and targeted product testing to determine approximate concentrations of POP content in products and articles. Additionally, these tools supplement their information with data on products and articles placed on the market and relevant waste composition data (UK response, 2024).

In the Netherlands, while there is not a specific strategy dedicated to managing POPs in products or articles, investigations occur when substances are added to international conventions. Studies on brominated diphenyl ethers (BDEs) in 2013, HBCD in 2018, and per-and polyfluoroalkyl substances (PFAS) (PFOS, PFOA, PFHxS) in 2021 are conducted based on available knowledge, with ongoing investigations on PCBs in buildings as of 2023. These studies provide insights into POPs presence, particularly in electronics and automotive applications for BDEs, and polystyrene for HBCD, though PFAS work remains complex. The strategy involves individual substance checks for relevance, using existing knowledge, reviewing previous reports, and consulting databases, with relevant substances for 'articles in use' including BDEs, PFOS, HCBD, possibly PCP, SCCPs, PFOA, and PFHxS. Despite reports on BDEs (2013), HBCD (2018), and various PFAS substances (2021), Dutch measurements of articles in use are lacking, rendering the generated information more of a representation of POP-containing product probability rather than quantification (although this can provide a useful resource for future validation and targeted monitoring campaigns). The summarised strategy includes steps such as checking NIPs, reviewing previous reports, consulting relevant websites, and contacting inspectorates if needed (Netherlands response, 2024). However, retroactive research campaigns such as this and the UK Waste Tool are time-consuming, expensive in the long run and rely on limited datapoints which limit accuracy.

Indonesia has identified specific techniques for identifying POPs in certain product categories, detailed in section 5. For PCBs in transformers, capacitors, and dielectric oil, identification can be achieved through visual tests, rapid tests, and/or laboratory tests, provided they meet stipulated provisions as is required under Paragraph (a), part II Annex A of the Convention for all parties. However, for products and articles in use, this analysis is not routinely undertaken and is limited to a targeted campaign (Indonesia response, 2024).

Despite this requirement, some Parties have faced issues in conducting PCB inventories and have conducted the analyses at varying levels of detail. Some have therefore provided limited information for this report. For example, in Kyrgyzstan, all PCB inventory projects focused solely on determining PCB content in transformers and capacitors. Consequently, there is no data on the quantity of PCBs in other equipment and goods, such as hydraulic and cooling equipment, cables, plasticisers, paints, varnishes, glue, and copy paper. No inventory of these goods has been carried out due to a lack of accurate data on the quantities of PCB-containing electrical equipment, transformer oils, and other materials accumulated in the country. Therefore, potentially PCB-containing equipment was identified based on its type, name, and the brand of oils used (Health and Environment Justice Support, 2024).

In Japan, several methods are primarily used for managing information on chemical substances in products and articles. Tools such as Chemical Information Sharing and Exchange (chemSHERPA) and International Material Data Systems (IMDS) are employed for transferring such information, alongside SDS. IMDS is widely used by automotive manufacturers for a variety of reporting obligations, but its use is limited to the automotive sector. Companies also use their own survey sheets and statements on Green Procurement Standards and information on chemical substances is typically transferred with each transaction or regularly, per regulations and downstream company requests. However, in sectors such as electrical and electronic equipment, which involve handling complex articles with varied and customised products and articles, the supply chain is long and spans multiple countries. This complexity makes the flow of information from upstream to downstream companies more intricate and time-consuming, particularly for newly regulated chemical substances (Japan response, 2024). This issue could be mitigated by mandating manufacturers of any material or component to provide its chemical composition, such as through a globally harmonised digital product passport.

Approaches to addressing concerns regarding chemicals, including POPs, encompass global, regional, and national initiatives. Many of these initiatives are not solely directed at POPs but rather target chemicals of broader environmental concern; The Global Green Network outlined the following approach developed by the Stockholm Convention that can be used for identifying POPs. It involves following guidance documents provided by the Convention to aid Parties in establishing inventories, monitoring products and articles containing POPs, and selecting optimal techniques for managing these substances. By employing standardised formats and step-by-step methodologies, inventories of POPs can be established across various stockpiles, products, articles, and wastes. Additionally, screening, sampling, and analytical methods can be used to identify and monitor POPs-containing items. These methods provide best available techniques (BAT) and best environmental practices (BEP) for the production, use, and disposal of POPs as well as promotion of alternatives to POPs (see section 5 of this report).

The Global Framework on Chemicals (GFC)[15] includes Strategic Objective B, which focuses on the availability of data on the properties of chemicals and information about chemicals in value chains and the implementation of the GHS. Specifically, Target B2 of the 2023 GFC aims for reliable information on chemicals in materials and products to be made available throughout the value chain by 2030. The framework's measurability structure is still being developed and will rely on useful indicators for different value chains. Additionally, Target B6 sets the goal for all governments to

15 https://www.chemicalsframework.org/.

have implemented the GHS in all relevant sectors by 2030, as appropriate to their national circumstances.

UNEP's Chemicals in Products (CiP) Programme is an effort initiated in 2009 within the Strategic Approach to International Chemicals Management (SAICM) that focused on enhancing access to information about the chemicals present in everyday products and articles (textiles, toys, electronic equipment and building materials). The Programme defines hazardous chemicals as substances that are persistent, bioaccumulative, and toxic; they may be carcinogens or mutagens or that adversely affect the reproductive, endocrine, immune, or nervous systems. Substances that have one or more of these hazardous properties should be prioritised for disclosure of their presence in products and articles. By increasing the availability and accessibility of such information throughout the products and articles' life cycles, the program and guidance endorsed in 2015 aims to address both policy and practical aspects related to managing chemicals in consumer products and articles and empower actors to effectively manage these products and articles and the chemicals they contain.

At regional levels, there are tools to support the identification of POPs in products and articles. The approach for material passports proposed in the upcoming Ecodesign for Sustainable Products Regulation (ESPR) in the EU, as described in Box 1, is similar to Madaster tool,[16] which is digital platform that supports the circular economy by creating and managing digital passports for building materials. These passports provide detailed information on the properties, origins, and environmental impacts of materials, enabling better resource management and facilitating reuse and recycling in the construction sector. Similarly, the Knowledge and Environmental Education Platform (KEEP)[17] is a digital platform designed to facilitate the sharing of environmental knowledge and best practices. It provides access to a wide range of resources, including data, tools, and case studies, aimed at improving environmental management and promoting sustainability. The platform is intended for use by various stakeholders, including policymakers, businesses, and researchers, to support informed decision-making and foster collaboration on environmental issues.

16 https://madaster.com/.

17 https://keep.eu/.

Within the EU, the SCIP database ensures that the information on articles containing Candidate List substances is available throughout the whole lifecycle of products and materials, including at the waste stage to all operators and users. The SCIP database could supply valuable information on chemicals in articles including POPs that are identified as SVHCs. Although the SCIP facilitates the identification of articles that contain SVHCs, data accuracy varies in its current format as it depends on data provided by the reporter. One observer suggests that if national laws require all manufacturers to maintain digital records of the chemicals used in their materials and products and articles, verifying the contents of these digital passports by third parties becomes much easier. This simplification would reduce the cost burden on regulatory agencies that currently perform expensive chemical analyses.

Some EU Member States have reported significant success in identifying POPs in products and articles through the use of existing information sources under EU legislation. Portugal specifically highlights that EU labelling requirements under CLP and REACH registration requirements have notably enhanced the traceability and identification of POP substances for chemicals. Portugal anticipates that the forthcoming EU ESPR will contribute further to the identification of POPs in products and articles, thus bolstering efforts towards environmental protection and public health.

In the EU, ECHA provides a descriptor list for Article Categories in Chapter R.12 of their 'Guidance on Information Requirements and Chemical Safety Assessment'. This chapter lays out the key elements for describing a use of a substance including factors such as life cycle stage, use name and further description of use, and identification of the markets where the substance is used etc. (ECHA, 2015).

ACAT/IPEN highlights various methods and approaches for identifying POPs in products and articles currently in use. While many existing methods focus on analysing products and articles on the market or wastes, some observers deem this downstream approach to be inefficient, costly, and captures only a fraction of relevant materials, particularly in countries lacking sufficient capacity for such studies. Existing tracking systems within the automotive industry, such as the Global Automotive Declarable Substance List (GADSL, 2016) and the IMDS, provide frameworks for identifying POPs above certain concentrations in motor vehicle parts and facilitate compliance with national and international standards and regulations governing the use of certain substances (ACAT/IPEN response, 2024). However, the data from the GADSL and the IMDS is generally intended for use within the automotive supply chain to facilitate compliance and communication regarding the use of certain substances in automotive products and articles and does not extend to actors beyond this (i.e. consumers and waste handlers).[18,19]

Several larger companies voluntarily provide their clients with declarations on the hazardous substances that their products and articles contain, particularly within the electronics and automotive sectors. These declarations are often dedicated/aligned to the EU REACH Regulation but may contain valuable additional information on POPs (e.g. Dechlorane Plus) (Communication with RIVM, 2024). However, again this data is not routinely shared with consumers and waste handlers.

In addition to regional databases, some countries including Norway and India have developed their own databases or registers specifically for hazardous substances and mixtures. For instance, in Norway, producers and importers of designated substances and mixtures are required to register information through the Norwegian Environment Agency's application called "Chemical Declaration to the Product Register."[20] This register provides authorities with insights into hazardous substances and mixtures present in the Norwegian market, including POPs. However, it is not clear whether the information held within this database is conveyed to consumers and waste handlers.

Other EU member states have adopted product registers (e.g., Cyprus, Norway, Denmark, Finland, and Sweden). However, many of these apply to chemical products rather than their specific use within finished products and articles. Switzerland has maintained a product register since 1972 which contains all chemical products (mixtures) and substances that have legally been placed on the market. To date, this database spans 250,000 products. (Eskoy, 2015). Similarly, the Department of Chemicals and Petrochemicals (DCPC) in the India recently launched the Indian Chemical Inventory via its platform, ChemIndia, aiming to enhance chemical inventory management although, this focusses on chemicals rather than their application within specific products and articles.

In addition to those mentioned above, guidelines have been set for the 'EU rapid information system Safety Gate (formerly The European Rapid Alert System for Consumer Products (RAPEX)' (EU, 2018).[21] The guidance focuses on two sets of

18 https://www.gadsl.org/wp-content/uploads/2022/08/GADSL-Guidance-Document.pdf

19 https://www.aiag.org/corporate-responsibility/chemical-management/international-material-data-system.

20 https://www.environmentagency.no/areas-of-activity/product-register/declaration-of-chemicals/.

21 Eur-lex, Guidelines for the EU rapid information system Safety Gate (formerly RAPEX). Available at: https://eur-lex.europa.eu/EN/legal-content/summary/guidelines-for-the-eu-rapid-information-system-safety-gate-formerly-rapex.html

products and articles, those covered by the General Product Safety Directive (GPSD), and those covered by the Regulation (EC) No 765/2008 on the accreditation and market surveillance of non-food products and articles. The safety gate allows rapid information transfer between the Member States and the Commission, regarding products and articles that pose a serious risk to the health and safety of consumers. This gate is used to restrict the use and supply of dangerous products and articles in Europe, monitor market surveillance and enforcement for effectiveness and consistency, identify and provide a basis for action at an EU level, and to ensure consistency when enforcing these products and articles at an EU level to ensure safety. If a product is found to contain POPs, it could potentially be reported through this system.[22,23]

For pesticides, guidance is available on dealing with obsolete pesticides containing POPs in Latin America and Caribbean countries. This includes steps such as identifying stockpiles, and inventory planning etc. (Martinez, 2004).

Box 2: Case studies

Germany (Germany response, 2024)

German enforcement authorities screen for the certain POPs, e.g.: HBCD, PCBs, DecaBDE, phthalocyanine green, PBDEs, Dechlorane Plus, as well as other brominated flame retardants in targeted market surveillance campaigns. They have applied many techniques for identifying POPs within materials as discussed in section 5 but only some of these techniques are used to analyse products and articles/articles in use. For products and articles in use, they have applied handheld XRF for cables, seals and insulation boards of a potentially contaminated building for bromine-containing and chlorine-containing flame retardants. They have also analysed packaging flakes and insulating material with XRF. They apply laboratory analysis to identify HBCD in polystyrene. In one known example, researchers have taken indoor air measurements in several rooms of a potentially contaminated building to identify a wider range of POPs within indoor-use products and articles.

[22] https://echa.europa.eu/documents/10162/17086/ref-10_project_report_en.pdf/83661988-378d-6268-3f28-182da198e8ac.

[23] https://www.informea.org/sites/default/files/imported-documents/UNEP-POPS-CW.1-NIPS02.En.pdf.

Box 3: Case studies

Finland (Finland response, 2024)

Finland has identified products and articles where POPs are used, primarily based on data gathered during EU risk assessment and management processes under the REACH Regulation and the POPRC evaluation process. POPs are also monitored in products and articles placed on the market by surveillance authorities during targeted campaigns based on use information collected during the EU risk assessment and management processes under REACH Regulation ((EC) No 1907/2006).

Finland has identified POPs-containing articles within construction materials using information on building codes, construction traditions and the national database on buildings. This was possible because of information on building types and sizes being available for the whole country and the use of different insulation materials in construction being relatively well regulated. Construction methods are fairly uniform throughout the country and flame-retardant insulation material grades are used for specific purposes.

POPs identification relies heavily on information from producers/manufacturers rather than analytical data. Initial information on articles in use is largely informed by EU-wide data compiled under the REACH Regulation or global data during the POPRC evaluation.

Targeted market surveillance campaigns, often regional, aim to measure POPs in articles on the market and report findings to the European Safety Gate database. Some of these results have been published in separate research reports.[24] However, no further details on the methodology were provided.

Customs authorities conduct compliance checks on imported goods, but POPs analysis is infrequent due to cost, practical challenges, and lack of guidance. Identifying stakeholders using POPs is challenging, and their awareness varies across industries. Implementing requirements to notify authorities of stockpiles of POPs, as well as products and articles containing them, faces several challenges:

[24] https://www.norden.org/en/publication/analytical-methods-pfas-products and articles-and-environment https://www.miljodirektoratet.no/publikasjoner/2022/mars/nordic-enforcement-project-on-pfos-and-pfoa-in-chemical-products and articles-and-articles/.

- Few notifications are received from users of articles due to unawareness or lack of recognition of POPs-containing items;
- Identifying POPs-containing products and articles, articles, and wastes is difficult, leading to non-compliance risks in waste management;
- Limited awareness of current POPs legislation;
- Lack of rapid screening methods and standard analytical techniques for POPs;
- High costs associated with analytics.

2.2 Methods, strategies, or approaches for identifying POPs in stockpiles

This section introduces the methods, strategies or approaches for identifying POPs in stockpiles applied in different countries and regions from two perspectives: regulatory measures and practical and technical approaches, aiming to present a comprehensive overview of existing tools for identifying POPs for products and articles. It is important to note that the definition of stockpiles may have been interpreted differently therefore some of this section discusses articles in use and wastes, noting the close interlinkages between them. It should also be noted that, whilst stockpiles of pesticides are covered within the scope of this study, limited information was obtained from Parties and observers who contributed to this project and therefore they do not constitute a significant focus of this section. Where relevant information has been identified, it has been included and discussed albeit to a limited degree. The presented information is based on the submission from Parties and observers. Key challenges and barriers and recommendations drawn from their findings are assessed in section 3 and section 6 respectively.

2.2.1 Regulatory measures

Many countries, including Albania, Mauritius, Panama, Paraguay, Sri Lanka, Yemen, have stated there is no experience or information about formal approaches for identifying POPs for stockpiles (Albania, 2024; EU, 2024; Mauritius response, 2024; Panama response, 2024; Paraguay response, 2024; Sri Lanka response, 2024; Yemen response, 2024).

In Canada, according to CVMA (2024), there is no regulatory approach for identifying POPs for stockpiles in the automotive sector due to the high durability and complex character of the products and articles. Information on substances potentially found in wastes can, to a certain extent, be extrapolated from the information collected on substances in commerce domestically and their use (Canada response, 2024).

In the EU, the Article 5 of the EU POPs Regulation (EU) 2019/1021 (EU, 2019)[25] requires that holders of stockpiles greater than 50kg, consisting of or containing POPs, including articles and products and articles for which the use of POPs is permitted shall provide the national authorities with information concerning the nature and size of that stockpile (Finland response, 2024; Netherland response, 2024; Norway response, 2024; Portugal response, 2024).

Most of the response s for stockpiles focused on PCBs; Under COUNCIL DIRECTIVE 96/59/EC, Member States must compile inventories of equipment containing PCB volumes exceeding 5 dm^3 and submit summaries of these inventories to the Commission no later than three years following the adoption of this Directive. For small transformers containing over 0.05% PCBs, the directive mandates reducing the PCB concentration to below 0.05%, and if possible, below 0.005%. Member States were required to dispose of large equipment by the end of 2010. Hungary's 144/2012. (XII. 27.) VM decree extends its scope to include used PCBs and equipment turned into wastes, materials in use containing PCBs, and the equipment itself, as well as their handling. Unlike Directive 96/59/EC, the 144/2012. (XII. 27.) VM decree generalises the obligation of registration and notification, as well as the obligation of disposal, even for equipment filled with less than five dm^3 of PCBs.

In Indonesia, the Ministry of Environment and Forestry issued the regulation No. 29 of 2020 for PCB wastes. The regulation introduced three approaches for the identification process to determine the PCB content, which are a visual test, a rapid test, and a laboratory test (Indonesia response, 2024).

In the UK, holders of stockpiles of POPs are required to notify the appropriate environmental regulator and for equipment containing PCBs, there are separate requirements obligating the registration (and labelling) of equipment containing oils contaminated with PCBs (the PCB register) (UK response, 2024).

25 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1021.

In New Zealand, storage and disposal of POPs are regulated by the Hazardous Substances and New Organisms Act 1996 (HSNO Act) and the Hazardous Substances (Storage and Disposal of Persistent Organic Pollutants) Notice 2004. The New Zealand Environmental Protection Authority is preparing a new regulation ('Notice') to control how POPs are managed and disposed of in New Zealand, to replace the existing Notice. The new Notice will affect people who possess POPs (including items containing POPs), people handling and managing wastes, and people involved in the disposal of POPs. It is proposed the new Notice to include: new provisions for manufactured articles containing POPs other than PCBs, including storage and handling requirements and threshold limits; and separate provisions for liquid POPs, POPs chemicals, powders, pesticides, and manufactured articles containing liquid PCBs (New Zealand response, 2024).

In Mozambique, three regulations have been enacted to manage pesticides, industrial chemicals, and hazardous waste. These regulations cover broad aspects of pesticide handling—from registration to disposal—and aim to protect public, animal, and environmental health. They also address the control of chemical products and articles, including POPs, ensuring hazards are identified and communicated. Additionally, rules for hazardous waste production, collection, and disposal are established to minimise their environmental and health impacts. Currently, Mozambique is updating its operational procedures for handling environmentally sensitive goods in line with international conventions and revising its national waste management strategy to include hazardous waste, which was previously only focused on non-hazardous waste. However, there are still gaps in knowledge and financial resources for identifying POPs in various contexts and managing their production, import, and export effectively (Mozambique response, 2024).

2.2.2 Practical and technical approaches

In many responses, much of the information gathering emphasis lies on substances possibly present in products and articles placed on the market, or wastes. Stockpile data is often extrapolated from the information collected on substances in domestic commerce and their usage patterns. Similarly, to the previous section, there were differences in the number of POPs investigated within articles and products and articles, and in the level of detail to which they are assessed. EU Member States note that EU regulation on stockpile reporting for certain POPs and materials informs the information that is available. Beyond the EU, there are limited examples of stockpile identification activities.

In the EU, the ECHA lacks information regarding stockpiles and wastes containing POPs. Efforts have been made to inform stakeholders about the obligation to report on stockpiles above 50 kg and to gather information on POPs in articles and products and articles in use. However, feedback has been minimal, as most stakeholders struggled to identify POPs-containing articles or products and articles in their records (EU response, 2024).

In the UK, holders of stockpiles of POPs are mandated to notify the appropriate environmental regulator. For instance, in England, detailed information on how to notify a stockpile can be found on the government website. Separate requirements exist for the registration and labelling of equipment containing PCBs, with relevant guidance are also provided on the government website (UK response, 2024).

In Indonesia, individuals responsible for businesses or activities involving the use or production of PCBs and/or PCB wastes were required to identify transformers, capacitors, and/or dielectric oil by December 31, 2022. Consequently, a one-time process was initiated to identify the presence of POPs content in PCBs on these components. An earlier PCB inventory project was conducted between 2015 and 2020, comprising a total of 4,524 samples (Indonesia response, 2024).

In Peru, there is limited information on stockpiles, but it can be inferred through two methods. Firstly, POPs are identified based on information provided by manufacturers on labels. Secondly, although specific physicochemical analysis methods are not widely known, a strategic approach is employed. This involves conducting surveys with institutions involved in POPs identification to leverage their knowledge and resources effectively in identifying products and articles classified as POPs (Peru response, 2024).

In Nigeria, qualitative methods were employed, primarily through the administration of questionnaires with inventory forms, focusing on identifying POPs stockpiles and wastes in various locations. Additionally, focus group interviews have been conducted to gather relevant information (Nigeria response, 2024).

Stockpile identification is largely informed by one-off studies such as a joint study on POPs in chicken eggs conducted by Moldovan and Czech experts in 2022 (Mach et al, 2021). The study identified POPs likely originating from old environmental burdens, such as obsolete pesticide or transformer oil stockpiles.

These experts also cautioned about other known sources of unintentionally produced POPs. Products and articles potentially containing flame retardants, such as vehicles, computer casings, cathode ray tube televisions, and flat panel displays, were assessed across three stages of their lifecycle: import/production, stocks in use or storage, and products and articles entering the waste stream.

2.3 Methods, strategies, or approaches for identifying POPs in wastes

This section will introduce the methods, strategies or approaches for identifying POPs in wastes applied in different countries and regions from two perspectives: regulatory measures and practical and technical approaches, aiming to present an overview of existing tools for identifying POPs for waste. The presented information is based on the submission from Parties and observers. Key challenges and barriers and recommendations drawn from their findings are assessed in section 3 and section 6 respectively.

2.3.1 Regulatory measures

In Argentina, there are a series of regulations and projects which aims to identify POPs in wastes. These measures usually have a specific focus on Waste Electrical and Electronic Equipment (WEEE). Box 4 (below) shows the regulatory measure used to identify POPs in wastes provided by Argentina.

Box 4: Case studies

Argentina (Argentina response, 2024)

Argentine Institute of Standardization and Certification (IRAM) Standard

The standard establishes requirements and recommendations related to the sustainable management of electrical and electronic devices at the end of their useful life in order to promote recovery/recycling/reclamation processes. Whilst it does not explicitly address POPs, it provides tools to establish traceability and includes some references to PCBs and brominated flame retardants (BFRs). It provides methods to manage these as hazardous waste plastics containing or suspected of containing BFRs. This standard was recently published, has national scope and is used on a voluntary basis therefore is not used globally.

PCB Management Law

National Law 25670 requires stocks of PCBs to be identified and stored properly. Given that the country currently lacks the technical capacity to eliminate PCBs with concentrations higher than 5000 ppm, concentrations higher than the aforementioned value must be exported for ESM of the substance.

In Finland, the Ministry of Environment has developed guidance documents for identifying POP containing wastes in order to ensure the appropriate management of POP wastes according to Article 7 of the EU POPs Regulation. The first guidance was issued in 2016. It aims to inform the stakeholders on the presence of POPs especially in construction wastes and to ensure they are informed about the provisions related to management of POPs containing wastes. Due to changes in the limit values for POPs in waste in Annex IV to the EU POPs Regulation and the feedback from stakeholders a new guidance for identification of POPs wastes was issued in 2023. The guidance has also been issued on requirements to screen POPs in renovation and demolition sites, similarly to asbestos and lead. In demolition and dismantling, hazardous substances are required to be evaluated and identified prior to demolition. These include asbestos, lead, PCBs as well as PBDEs, SCCPs and HBCD. This is to ensure construction wastes containing POPs are managed in an environmentally sound manner and to prevent their recycling (Finland response, 2024).

In Portugal, POPs wastes are regulated under the General Waste Management Regime, requiring registration and reporting obligations in the Integrated Electronic Waste Registration System. Producers and operators handling POPs wastes must provide specific information for control and traceability, including quantities, final destination, and treatment methods. If a stockpile contains POPs whose use is prohibited, it must be treated as wastes. Wastes containing POPs must be disposed of or recovered promptly and in compliance with waste legislation to ensure proper management and accountability for POPs wastes throughout its lifecycle (Portugal response, 2024).

In Sweden, the Swedish Environmental Protection Agency (Swedish EPA) has a guidance on its website to assist operators on how to handle wastes in accordance with the EU POPs Regulation and which waste streams may be prioritised to look into for ensuring that POPs wastes are sorted out for separate handling. It is the operators that manage wastes that need to have knowledge of POPs and the limit values set in the EU POPs Regulation (Sweden response, 2024).

2.3.2 Practical and technical approaches

Various methods are available for identifying POPs in wastes. Guidance documents from the Stockholm Convention and the Basel Convention provide frameworks for establishing inventories, identifying, monitoring, and managing POPs, as well as promoting alternatives to these pollutants. These documents cover various aspects such as inventory creation, monitoring techniques, best practices for production, use, and disposal, and the promotion of safer alternatives, offering systematic approaches to POPs management and environmental protection.

However, the practical and technical application of methods for identifying POPs in waste streams differ significantly among countries. In Monaco, Mauritius, Panama, Paraguay, and others, there are no established local methods or strategies for identifying POPs in stocks and wastes, and there is limited technical experience in this regard.

In countries such as Canada, there are no widely used techniques for identifying POPs in waste streams. However, monitoring data from waste activities, such as landfill leachate, can provide valuable information for identifying substances present in wastes. To a certain extent, information on substances potentially found in wastes can be extrapolated from the information collected on substances in commerce domestically and their use (Canada response, 2024).

In contrast, within the EU, according to a response from the Netherlands, stakeholders must notify stocks of POPs in articles and wastes to the Dutch inspectorate since early 2022 as laid down in the EU POP Regulation. The Netherlands report to ECHA on notifications received on a yearly basis (Netherlands response, 2024). The obligation to notify stocks applies in all EU Member States, as well as the reporting to ECHA. Reporting at EU scale is currently very limited, which may have to do with unawareness of this obligation set in the EU POP Regulation by stakeholders in various EU Member States (Communication with RIVM, 2024).

In Spain, producers of hazardous wastes (including POPs wastes) are required to report its type and quantity to the Autonomous Communities. This information is then uploaded to the Electronic System for Waste Information (e-SIR), a centralised system covering the entire national territory. This reporting process occurs annually to ensure regulatory compliance and proper management of hazardous wastes. (Spain response, 2024).

In Sweden, waste management operators are responsible for understanding POPs and the limit values established in the EU POPs regulation. The Swedish EPA offers guidance on waste handling in accordance with this regulation, prioritising certain waste streams for separate handling to ensure POPs wastes is properly managed. Additionally, the Swedish EPA has commissioned a study on controlling severely hazardous chemicals, SVHCs in recycling processes, providing insights into techniques for detecting, quantifying, and removing SVHCs, including POPs. Companies are encouraged to prioritise substituting hazardous substances such as POPs with safer alternatives in their products, articles and processes (Sweden response, 2024).

The Ministry of Environment in Finland has developed guidance documents to help identify wastes containing POPs, including PCBs, PBDEs, SCCPs and HBCD. These guidelines, in accordance with Article 7 of the POPs Regulation, aim to ensure the ESM of wastes containing POPs, particularly in construction wastes. The initial guidance was issued in 2016, followed by a revised version in 2023 due to changes in waste limit values and stakeholder feedback. Additionally, updated guidance is in progress to accommodate new POPs. The ministry has also issued guidance on screening for POPs in renovation and demolition sites, similar to asbestos and lead, to prevent their recycling and ensure proper management (Finland response, 2024).

In Hungary, the National Waste Management Plan 2021–2027 provides guidance on prompt disposal of waste PCBs and polychlorinated terphenyls (PCTs), as well as the equipment containing them (Hungary response, 2024).

There are some notable examples, beyond the EU, of methods developed for specific waste streams particularly for WEEE and PCB-containing wastes. The Project "Strengthening National Initiatives and Improving Regional Cooperation for the Environmentally Sound Management of POPs in Waste Electronic or Electrical Equipment in Latin American Countries (PREAL)", focusing on the ESM of POPs in WEEE in Latin American countries, has developed a regional method, currently in pilot scale. This method involves classifying WEEE equipment by type, brand, and colour, selecting representative quantities for scrapping to separate plastics, and conducting testing on different plastic types in a subsequent phase. The method identifies the types of resins and their potential for containing high levels of BFRs, particularly in High Impact Polystyrene (HIPS) or Acrylonitrile Butadiene Styrene (ABS) resins.

Furthermore, in Argentina, an inventory of pesticide stocks, POPs, and PCBs, along with sites potentially contaminated with POPs, has been established through the "Global

Environment Facility (GEF) Project" to gather information about the presence and existence of POPs and potentially contaminated sites in various jurisdictions. Collaborating with state entities, the project assists in identifying and managing stocks, leading to the export and environmentally sound disposal of substances such as dichlorodiphenyltrichloroethane (DDT) and PCBs. However, Argentina currently lacks the technical capacity to eliminate PCBs with concentrations higher than 5,000 ppm, necessitating their export for ESM. Argentina emphasises that domestic capacities for treatment need strengthening as the costs associated with destruction are prohibitively high, resulting in POPs being stored for extended periods until export becomes feasible.

In Indonesia, national regulations, standards, and guidelines outline various methods, strategies, or approaches for identifying POPs in products and articles in use. The country has established BAT and BEP specifically for sorting and handling plastic e-wastes containing PBDEs by the recycling sector. These guidelines provide direction on identifying and segregating wastes containing PBDEs throughout the handling process, storage, thermal recovery, and disposal. However, accurately measuring PBDE levels in plastic materials poses challenges as outlined in section 5 (Indonesia response, 2024).

Several responses reported one-off investigations into POP presence in waste streams, often when a new POP is added. For example, New Zealand have undertaken a number of studies to help identify POPs in certain waste streams (WEEE and Plastic). In the UK, efforts have been made to manage POPs in wastes. The country developed the POPs MMEI in 2007, continually updating it to include additional POPs including PFOA and its salts was developed. Additionally, the UK is developing a POPs Waste Tool focusing on PCBs, DecaBDE, and HBCD, with MCCPs due to be added. Stakeholder engagement and data collection from various sources, including literature reviews, sampling studies and regulatory information, inform these tools. Further information on the methodology is provided in Box 5. However, challenges remain in accurately estimating POP concentrations and separating POPs wastes from non-contaminated wastes. Desk-based studies help identify potential areas for targeted sampling, but they alone are insufficient for setting Low POPs Content Limits (LPCL). Analytical challenges persist, requiring experienced specialist laboratories, sometimes situated abroad and strategic studies often lack sufficient data to accurately inform socioeconomic impacts. Requiring periodic testing of wastes for POPs could aid in monitoring trends and regulatory decision-making, especially concerning new POPs affecting existing waste streams (UK response, 2024).

In Oman, specific tests for POPs are not included in landfill acceptance standards. However, waste classification and treatment methods are determined based on SDS for chemical wastes. For unidentified wastes or wastes generated from a process, a complete analysis is conducted according to Landfill Acceptance Criteria. Additionally, U.S. Environmental Protection Agency (US EPA) Method 23 is used for measuring Dioxins and Furans emissions, particularly during the incineration of tires and medical/industrial wastes (Oman response, 2024).

Box 5: Case studies

UK (UK response, 2024)

The UK has been strategically addressing the presence of POPs in articles and waste streams via a multi-step process which includes the work done through its as part of the multi-media emissions inventory (MMEI), the inventory covers annual update for Annex C POPs, inventories for the growing list of Annex A POPs, and the POPs Waste Tool for PCBs, DecaBDE, and HBCD. This forms one part of the overall strategic approach the UK has been using to gain a better picture of the presence of POPs in articles and waste streams. The UK has completed a number of one-off studies, but these form part of a larger body of work. The work that is completed by the MMEI contract, literature and additional focussed data collection exercises is used to inform larger sampling campaigns along with literature and focussed data collection exercises, and the information gathered from the larger sampling studies are used in turn to further validate the POPs inventory and waste tool. The approach used for identifying POPs in waste is as follows: **Desk based literature reviews and socioeconomic analysis**.

Consultants were commissioned to carry out desk-based literature reviews and analysis to estimate how much waste is potentially contaminated with POPs at different Low POPs Content Limits (LPCL). The methodology consists of the following:

- Identifying which waste streams are likely to contain POPs through literature searches;
- Through various sampling studies available in the literature, estimating the concentrations of POPs in different products and articles and what the concentration is likely to be at waste. The sampling studies derive a low, high and average concentration for POPs across different waste streams.

It then estimates the proportion or tonnage of a material stream that exceeds the LPCL. This is calculated using the percentage of a product category containing POPs at end of life and using a sigmoid curve normal distribution for the concentration ranges which may exceed the LPCL;

- The tonnage that exceeds the LPCL would need to be redirected to incineration or high temperature incineration depending on where the waste was initially destined for (i.e. landfill). The analysis attempts to determine the socioeconomic impacts of redirecting waste to incineration. This requires information on the size of those waste streams, information on the lifetime of products and articles to determine how long the waste stream will have POPs, and gate fees for disposing of waste;
- POPs waste needs to be separated from other wastes. This requires information on how to distinguish between POPs waste and non-contaminated waste, how waste is collected, treated and sorted, and the capacity for local authorities and businesses to manage waste alongside the costs associated with that.

Site based sampling and analysis including indicative screening assessment (XRF) and quantitative laboratory analysis.

The approach typically involves obtaining a large number of samples from several different waste sites for screening, by XRF and/or qualitative analysis. For example, XRF may be used to identify the presence of bromine if furniture covers. Qualitative or semi quantitative analysis may be used to identify the flame retardant.

A smaller number of positive samples can then be sent for quantitative analysis. Furniture covers can then be sent for analysis to quantify the POP.

Information such as item type, model, brand information is collected where this could be relevant to either data interpretation or operational applications. This applicability of this varies from waste to waste.

It is important to identify what chemicals are there, rather than just look for POPs, as some chemicals may become POPs in future and other chemicals may also be relevant to the management of the waste.

The focus of this work is two-fold – firstly to understand the presence and distribution of POPs in a particular waste stream, and secondly to collect the information needed for waste managers to develop strategies to identify and manage it.

Box 6: Case studies

Germany

Example 1:

As part of an international study on HBCD and PBDEs in plastic-containing wastes, Germany have twice tried a simplified analytical method. The aim of this study was to simplify and shorten the analysis by avoiding expensive cleaning columns and performing only a polymer precipitation of the extract. The new process integrated a short measuring program. Germany determined concentrations of PBDEs and HBCD in a TV casing, a textile sample, extruded polystyrene (XPS), expanded polystyrene (EPS) and a shredder light fraction with GC-MS and achieved good results. The shortened method was compared with the proven laboratory method for determining HBCD and achieved a good match.

Example 2:

The identification of POPs in wastes by specific analytics has been applied on a permanent basis in waste management activities. Polychlorinated dibenzo-l-dioxins and polychlorinated dibenzo furans (PCDD/Fs) is determined in the case of fire wastes, or the determination of further POPs (e.g. PFOS) to assess the possibility of depositing in landfills.

Further information:

POPs related to certain industries can be identified in wastes (mainly in the treatment of contaminated sites). However, experience shows that POPs are not generally routinely considered in some waste disposal practices.

Where POPs are relevant for the classification of wastes according to their hazardousness, a classification is carried out on the basis of analytical findings of the material-specific parameters in accordance with point 2.2.1 of the Appendix to the Waste List Regulation (Abfallverzeichnis-Verordnung (AVV)), which implements an EU decision, in conjunction with Annex III of the Waste Framework Directive (e.g. HBCD in Styrofoam).

For the electronic waste disposal records (Elektronisches Abfallnachweisverfahren (eANV)), the waste holder gives a self-declaration, describing the disposal route of wastes which is declared hazardous or POPs wastes.

The procedure is considered state-of-the-art. In the past two years, neither the authorities nor third Parties have raised issues relating to this procedure.

As far as plastics containing flame retardants are concerned, all fractions (regardless of the POP content) undergo thermal treatment in the same plant, aiming to completely and irreversibly destroy POPs. Therefore, there's no additional need for inspection investigations. However, in rare instances where landfilling is necessary, the disposal company conducts an analytical test following the criteria outlined in the plant license.

2.4 Comparison of methodologies and strategies

Table 1 summarises the advantages and challenges associated with the abovementioned regulatory and practical measures identified by Parties and observers.

Table 1. Summary of advantages and challenges with regulatory and practical measures

Category	Measure type	Measure	Advantages	Challenges
Products and articles	Regulatory Measure	PIC regulation	– Regulations require information sharing between importers and exporters of hazardous chemicals	– Applies only to certain POPs – Wastes, products and articles not within its scope
		EU REACH and CLP	– Regulations enforce registration and labelling of hazardous chemicals	– REACH requires self-reporting so some variation in data quality. Reliance on estimation methods may introduce inaccuracies – Exemptions for certain product categories limit scope
		EU ESPR	– Establishes requirements for sustainable product design – Enhances traceability and accessibility of sustainability information – Facilitates identification and separation of contaminated components – - Simplified compliance via 3rd party verification against recipe database	– Exemptions for certain product categories limit scope – Other implementation challenges related to enforcement and compliance monitoring
		SCIP Database	– Centralises information on substances in articles for waste management – Facilitates identification and separation of contaminated components	– Data accuracy may vary – Implementation challenges related to data management and integration

Category	Measure type	Measure	Advantages	Challenges
		Canada Public Consultations on Proposed Regulatory Initiatives and Mandatory Surveys	– Public consultation on proposed regulatory initiatives and mandatory surveys ensures transparency and stakeholder input	– Level of information provided during public consultations on proposed regulatory initiatives may vary – Efficiency of mandatory surveys varies depending on the types of products or articles. Reporting rates and data quality can vary, particularly for substances imported in manufactured products and articles, due to value chain transparency issues
		Indonesia Regulations	– National regulations and NIP activities help identify POPs in products and articles – SNI ensures product compliance with standards, including POPs parameters	– Varied approaches in SNI development can result in inconsistencies – Resource-intensive testing and compliance requirements for manufacturers
		Argentina Regulations (Argentina comment, 2024)	– Several regulations enforce Stockholm Convention (Management, inventory, registration, labelling)	– Requires self-registration
		National Product's Register (Norway comment, 2024)	– Provides comprehensive information on hazardous substances, including POPs – Facilitates identification of POPs in substances and mixtures imported or exported	– Not all POPs have classifications, for these mixtures the register will only provide information on the POPs in cases where the mixture contains other substances that trigger hazard labelling. – Norway highlights compliance burden on producers and importers for registration

Category	Measure type	Measure	Advantages	Challenges
	Practical/ Technical Measure	Analytical Monitoring Campaigns	– Direct measurement of POPs in products and articles – Targeted identification based on specific substances of concern	– Resource-intensive and costly, especially for countries with limited capacity – Requires specialised equipment and expertise – Often limited to a subset of POPs
		Stakeholder Surveys	– Engages various stakeholders in information gathering – Provides insights into usage patterns and potential sources of POPs	– Relies on voluntary participation, resulting in incomplete data – Requires coordination and communication across multiple sectors
		Communication in the Value Chain	– Facilitates information sharing among stakeholders – Enhances transparency and collaboration in identifying POPs	– Requires cooperation from all levels of the value chain, which can be challenging – Information flow may be limited or distorted due to commercial interests
		XRF Screening	– Rapid and non-destructive identification of potential POPs content – Suitable for screening large quantities of items quickly	– Limited to surface analysis, may not penetrate dense materials or detect low concentrations – Calibration and interpretation require expertise – Only works for limited POPs
		Laboratory Analysis	– Accurate and detailed quantification of POPs – Comprehensive analysis of various substances and matrices	– Time-consuming and expensive, especially for large-scale testing – Requires well-equipped laboratories and skilled personnel

Category	Measure type	Measure	Advantages	Challenges
		National Databases/ Registers	– Centralises information for regulatory oversight – Facilitates monitoring and enforcement efforts – Spain NFP updates information periodically to remain relevant	– Requires ongoing maintenance and updates for accuracy. New cost for each country – Need for alignment with global or regional legislation (E.g. EU) – Reliance on voluntary collaboration or different reporting requirements may result in incomplete data
		Global and Regional Initiatives	– Standardised approaches for identifying and managing POPs – Provides guidance and resources for countries with limited capacity	– Implementation may vary across regions, leading to inconsistencies – Currently relies on voluntary adoption and participation.
		Tools like chemSHERPA and SDS	– Provides information on chemical substances in certain products and articles – Enhances transparency and traceability throughout value chains	– Requires coordination among multiple stakeholders – Effectiveness may vary depending on industry adoption and compliance as well as the lower limit for hazardous substance in SDSs
Stockpiles	Regulatory Measure	EU POPs Regulations	– Mandates reporting of stockpile information, promoting transparency and accountability – Sets specific requirements for disposal and management of POPs wastes including PCB-containing equipment	– Compliance may vary among Member States. – Implementation challenges related to complexity and administrative burden

Category	Measure type	Measure	Advantages	Challenges
		Indonesian Regulation	– Introduces clear approaches for PCB identification process – Enhances clarity and standardisation	– Difficulties in accessing qualified laboratory equipment to accurately identify POPs – Complexities with data sharing
		UK Regulatory Requirements	– Mandates notification to environmental regulators for POP stockpiles – Establishes requirements for registration and labelling of PCB-containing equipment	– Regulatory burden on stakeholders for compliance and reporting – Challenges in enforcement and monitoring
		Targeted Information Gathering by Parties including Finland, Sweden, UK and Netherlands.	– Focuses on substances possibly present in products and articles, articles, or wastes – Uses existing information to extrapolate data/ basis for targeted analytical studies	– Stockpile data often extrapolated from product/ waste data – Variability in the number of POPs investigated by country – Studies often focus on individual sectors and requires prior knowledge or 'tip-off' information – Information campaign often undertaken as a one-off study
	Practical/ Technical Measure	Inventory Project in Argentina	– Establishes inventory of pesticide and PCB stocks – Collaborates with state entities for environmentally sound disposal	– Technical capacity limitations – High costs associated with destruction
		Strategic Approach in Peru	– Uses surveys and leverages institutional knowledge – Employs qualitative methods for data collection	– Limited physicochemical analysis methods – Challenges in ensuring comprehensive coverage

Category	Measure type	Measure	Advantages	Challenges
		Qualitative Methods in Nigeria	– Employs qualitative methods for identification – Uses focus group interviews for data collection	– Subjectivity and bias may be introduced – Challenges in ensuring comprehensive coverage
		EU POPs Regulations	– Regulates POPs wastes under a comprehensive system – Ensures traceability and accountability – Sets specific requirements for disposal and management of POPs wastes including PCB-containing equipment	– Compliance may vary among Member States – Implementation challenges related to complexity and administrative burden – Portugal report compliance challenges
Waste	Regulatory Measure	PCB Management Law in Argentina	– Requires identification and storage of PCB waste stocks – Ensures compliance with national and international standards	– Technical capacity limitations – High costs associated with PCB destruction (exports)
		Argentine Institute of Standardisation and Certification (IRAM) Standard	– Regulates monitoring and management of electrical and electronic devices – Provides methods for identifying POPs in WEEE	– Voluntary basis may limit adoption – Limited global usage and information on implementation
		Guidance documents from the Stockholm and Basel Conventions	– Systematic approaches for managing POPs wastes	– Varying adoption among countries

Category	Measure type	Measure	Advantages	Challenges
	Practical/ Technical Measure	Guidelines by individual country agencies (e.g. Sweden, Finland, Indonesia, UK)	– Provides clear guidance on managing POPs-containing wastes – Assists operators in handling wastes in line with regulations – Enhances compliance and environmental protection	– Challenges in widespread adoption and compliance – Limited resources for monitoring
		Monitoring data from waste activities (e.g., landfill leachate)	– Valuable information for identifying substances in wastes	– Limited availability, reliability accuracy and specificity of monitoring data
		Reporting requirements in Spain under the e-SIR	– Centralised system for waste reporting	– Challenges in data accuracy and completeness
		Specific methods developed for WEEE (under PREAL project) and PCB-containing wastes in Argentina	– Tailored approaches for managing identifying containing POPs waste in WEEE (BFRs)	– Limited scalability – The method is currently used under pilot scale. The project doesn't have conclusive results on its effectiveness yet

Category	Measure type	Measure	Advantages	Challenges
		One-off investigations into POP presence in waste streams	– Provides insights into specific POPs presence	– Limited in scope and frequency
		POPs Waste Tool development in the UK	– Comprehensive tool for managing POPs wastes	– Challenges in estimating POP concentrations due to data limitations – The uncertainty within the model(s) is still high
		Landfill acceptance standards and complete analysis in Oman	– Systematic waste classification and treatment	– Limited specific tests for POPs
		Simplified analytical methods in Germany	– Streamlined POPs analysis approaches	– Challenges in ensuring accuracy and reliability

3. KEY CHALLENGES AND BARRIERS IN IDENTIFYING POPS IN PRODUCTS, ARTICLES, STOCKPILES AND WASTES

Identifying POPs in products, articles, stockpiles, and wastes presents several challenges and barriers, as identified by various Parties and observers. Key issues include: limited information on POPs within value chains; legislative and regulatory challenges; financial and technological constraints; and challenges in capacity building challenges; knowledge sharing and dissemination of information. Additionally, there are challenges with analytical capability and capacity; access to information and technical expertise; and misaligned inventory systems and global standards and regulation. Responses generally highlighted that improvements in inventory systems, analytical capacities, and global cooperation are necessary to address challenges in identifying POPs. Other common themes included enhanced transparency and sharing of information along value chains can improve knowledge and decision-making regarding POPs. Developing countries, in particular, face significant financial and technological limitations. There is a lack of technical and human resources necessary for identifying POPs, which affects the ability to manage their production, import, export and waste effectively. Practical and technical measures such as analytical monitoring campaigns, stakeholder surveys, and communication are deemed to be important for identifying POPs in products and articles, enhancing transparency, collaboration, and understanding within value chains.

Many of the Parties responding to the consultation do not produce the chemicals or the products and articles containing these chemicals. Instead, they are net importers of such products and articles and typically must deal with resulting wastes. These countries are aware that products, articles, and wastes containing or contaminated with POPs are entering their borders. However, they receive no information or transparency about the POPs these imports contain, leaving them with limited means to identify, control or manage them effectively. Compliance can therefore vary across regions, countries and within industries, leading to inconsistencies in data availability and enforcement. Nevertheless, all countries have encountered challenges.

Respondents highlighted a significant lack of data on the presence of POPs in products and articles, which hampers efforts by users, industries, and governments to manage these pollutants effectively. Transparency and traceability throughout the life cycle of POPs are crucial and can be facilitated by better labelling, databases, and information-sharing systems. Diverse regulations and standards across countries complicate the identification and management of POPs, and harmonising these regulations globally could reduce the financial burden and improve compliance. Some observers note that difficulties in obtaining information from upstream suppliers could be avoided if the responsibility to provide the chemical composition is mandatory on the manufacturer of any material or component of a product, such as in the form of a globally accepted digital product passport. This would ensure consistency and result in better quality data with fewer gaps. However, there are some doubts about the feasibility of implementing such a system, particularly when it comes to applying it throughout the value chain. To implement this system, it's crucial to establish when a product is still considered to contain POPs. This requires setting universally agreed-upon thresholds, unintentional trace contaminant (UTC) limits, which is a complex task requiring global consensus. The challenge is similar to what was encountered with the EU's universal PFAS restriction. Defining such limits isn't straightforward.

Accurate identification of POPs requires sophisticated laboratory equipment and expertise, which are often unavailable, and complex mixtures of POPs further complicate analytical processes. Indonesia, among others, has encountered challenges in developing and implementing methods, strategies, and approaches for identifying POPs in products and articles, articles, stockpiles, and wastes primarily due to difficulties in accessing qualified laboratory equipment to accurately identify POPs. Investment in advanced analytical technologies and the establishment of accredited laboratories is widely considered important for the accurate identification of POPs which is currently limited to a small number of countries, resulting in unsustainably high testing costs.

Identifying and analysing POPs pose significant challenges due to their various chemical forms and mixtures. Germany, for instance, has faced challenges in developing, implementing analytical methods for identifying POPs in certain products and articles. Interpreting analytical results and correlating them with regulatory limits can also be difficult, especially when dealing with complex mixtures of POPs. Germany emphasises the importance of using experienced laboratories for analysis and acknowledges that site-based sampling and analysis can be challenging due to the required consistency in sample preparation, chemical extraction, and analysis methods (including XRF) across sites. Whilst Germany highlights the need for experienced laboratories and consistent analytical methods to support more frequent, periodic testing (allowing for identification of trends) and handle complex analytical challenges, others argue that investment in these facilities and ongoing testing costs are an expensive retroactive option that does not provide information at sufficient granularity.

To address these challenges, better identification and inventory systems enable tracking POPs throughout their lifecycle. Countries including the UK and New Zealand have commissioned reports and studies to understand POPs in waste streams and enforce regulations accordingly. However, much of this data relies on targeted studies that require expensive testing regimes and only cover a small proportion of materials on the market, resulting in significant data gaps. To combat this, Germany, amongst others, emphasises the importance of developing harmonised infrastructure such as databases for sharing information to enhance capacity in identifying POPs. Such databases are costly and usually set up by individual countries. Having multiple standards and databases to comply with across different countries can be a considerable financial burden for both states and companies which could be reduced through global harmonisation.

Improved information sharing along value chains, such as by harmonisation of reporting and labelling requirements, can aid in the identification and management of POPs for various stakeholders, including regulators, consumers, and recyclers who currently lack access to this information. Accessing correct information is difficult due to its complexity, further complicating the identification process. Mandatory digital labelling, using globally harmonised standards, has been suggested as a way to convey this complex information to all relevant stakeholders. However, there are concerns over how this data is reported and used. Firstly, greater regulation will be required upstream to ensure producers are reporting correctly for digital passports. Secondly, the information conveyed by the passport will need to be acted on appropriately which may be challenging in certain scenarios. For example, consider a producer of a POPs-containing polymer. This polymer is then used by Downstream User 1 (DU1) to manufacture a membrane. DU1 passes this membrane on to Downstream User 2, who incorporates it into equipment designed for specific filtration purposes. This equipment is then installed in a vehicle by Downstream User 3. Consider the vehicle owner (DU4). It is unlikely that they would check the vehicle to identify the specific equipment and its components. At the end of the vehicle's life, a dismantler is unlikely to be inclined to remove this component before the vehicle is shredded, particularly if it is difficult to access, and takes significant time to dismantle. This highlights the practical difficulties of enforcing such a system across the entire value chain.

Nevertheless, limited access to comprehensive and sufficiently detailed information, as well as technical expertise, hinders the identification of POPs in both value chains and for regulators. Oman highlights several challenges, including the lack of training programs organised by the Stockholm Convention Secretariat and the absence of clear mechanisms for identifying POPs in products and articles. Many Parties, particularly in developing countries, believe that capacity building through training programs and awareness campaigns is vital for better understanding the presence of POPs in products and articles, stockpiles, and waste streams. Hungary also identified a lack of awareness in value chains as a major barrier to managing POPs. And countries including Indonesia and Argentina emphasise the importance of increasing knowledge sharing among stakeholders and the public to enhance awareness and management of POPs.

Finland also notes that few notifications are received to inform targeted studies from users of articles due to a lack of awareness or recognition of POP-containing items. This lack of physical and digital labelling prevents consumers from knowing the content of these items. According to Indonesia, understanding the societal cost implications of POPs is crucial; thus, disseminating information about POPs in products and articles and building capacity among stakeholders and the public is necessary to raise awareness. These efforts may include dissemination through social media platforms and other channels. International cooperation and knowledge sharing can help address these challenges and facilitate the adoption of best practices.

4. REQUIREMENTS FOR LABELLING FOR POPS IN PRODUCTS, ARTICLES, STOCKPILES AND WASTES

4.1 Requirements under the Stockholm Convention and Basel Convention related to labelling

Article 6 of the Convention requires Parties, among other things, to develop appropriate strategies for identifying POPs in stockpiles, products and articles in use and wastes, however, the Convention does not make explicit what this means in practice and approaches are to the interpretation of Parties to the Convention. Physical labelling or marking could be one strategy that Parties could develop for identifying products and articles. However, as noted in UNEP (2019b), the Convention does not specify or suggest any particular labelling or other means of identification (e.g. through sharing of SDS) but leaves it to the Parties to decide on its form.

It is noted that the explicit use of labelling as a means of identifying POPs – either in products and articles, stockpiles or wastes – is not commonly applied across all of the listed substances under the Convention and it only explicitly mentioned for a select few POPs listings. For example:

(a) For PCBs (Part II of Annex A) – specifies Parties shall: "with regard to the elimination of the use of polychlorinated biphenyls in equipment (e.g. transformers, capacitors or other receptacles containing liquid stocks) by 2025 […] make determined efforts to identify, label and remove from use equipment…";

(b) For HBCD (Part VII of Annex A) – specifies: "Each Party that has registered for the exemption pursuant to Article 4 for the production and use of hexabromocyclododecane for expanded polystyrene and extruded polystyrene in buildings shall take necessary measures to ensure that expanded polystyrene and extruded polystyrene containing hexabromocyclododecane can be easily identified by labelling or other means throughout its life cycle";

(c) For PCP and its salts and esters (Part VIII of Annex A) – specifies: "Each Party that has registered for the exemption, pursuant to Article 4 for the production and use of PCP for utility poles and cross-arms shall take the necessary measures to ensure that utility poles and cross-arms containing PCP can be easily identified by labelling or other means throughout their life cycles".

The background document, preceding this report (UNEP/POPS/POPRC.19/INF/13) provided an overview of labelling requirements and experiences relating to three key application of POPs: i) labelling of HBCD in EPS and XPS; ii) labelling of PCP treated utility poles; and iii) labelling of PCB-containing equipment and materials.

UNEP (2019b) concluded that labelling or marking would increase the flow of information on POPs content in the value chain and ensure the end customer would know to treat the articles appropriately at the end of their service life. However, it is also acknowledged that, value chains and end of life treatment of some of those articles may be more complicated than that of EPS, XPS, utility poles and cross-arms. It is therefore important to consider that labelling and/ or marking should be both feasible, practical and relevant to the article and its subsequent treatment. Physical labelling requirements should therefore be considered (to some extent) on a case-by-case basis although it can be combined or substituted with other means of identification, such as a digital database or material passport.

4.2 Party and observer experiences with labelling

4.2.1 General

In addition to the labelling systems outlined in the "Guidance on the labelling of products and articles that contain POPs" (UNEP, 2019), various global approaches have been implemented.

The openness of interpretation of the requirement for identification by Parties places the responsibility of determining how tracing and labelling is undertaken on the Parties and can result in reduced harmonisation across Parties and producers. The feasibility and implementation of physical labelling is dependent on not only the product itself, but also the value chain and end of life pathway, which may require case-by-case considerations for labelling (Canada response, 2024) although this can be supplemented through digital labelling such as digital passports.

The ACAT/IPEN identified regulatory product certification and labelling schemes already in place for a range of other products and articles in many countries that can be used as models. These include for example the CE marking in the EU, regulations related to labelling in the US and in Australia. There are also existing regulations that apply to a subsection of products and articles containing hazardous substances, such as the Battery regulation in the EU which regulates labelling requirements for heavy metals in batteries (ACAT/IPEN response, 2024).

The Globally Harmonised System of Classification and Labelling of Chemicals (GHS) (UN, 2011) is an international strategy that ensures consistent communication of hazards associated with chemicals. It mandates classification based on intrinsic properties, standardises labelling with pictograms and hazard statements, and establishes packaging requirements to prevent risks to human health and the environment. To make it operational each country or region need to implement the system in their legislation. It is important to note that GHS is applied for chemicals and mixtures not for chemicals in manufactured products and articles. Moreover, GHS hazard classes do not include persistency, endocrine disruption, bioaccumulation, and mobility, which are important hazard classes to consider for POPs. GHS does not support the required level of disclosure to identify POPs in products and articles.[26]

In the EU, the CLP Regulation, implemented since 2015, aligns chemical classification and labelling of chemical products with international standards (the GHS). The CLP Regulation enhances transparency, facilitates trade, and promotes safer handling and management of chemicals within the EU and globally and includes some POPs if they are listed as SVHCs. In addition, legal obligations under REACH mandate manufacturers, importers, or distributors to disclose information about articles containing SVHCs on the Candidate List exceeding 0.1% weight by weight. This information must be provided to consumers upon request within 45 days and is publicly accessible in the SCIP database, aligning with requirements of the Waste Framework Directive (2008/98/EC). There are labelling requirements established in the POPs Regulation, namely for decaBDE (CAS No. 1163-19-5, EC No. 214-604-9) entry in Annex I and HBCD (EC No. 247-148-4 and 221-695-9). For example, HBCD has been identified as a SVHC under REACH. It has a harmonised classification and labelling as toxic to reproduction under the CLP Regulation. In 2023, CLP was amended to introduce classifications based on PBT properties, but these have not yet been included in the harmonised classification. PCP, on the other hand, has not been identified as an SVHC under REACH. Nevertheless, it has a harmonised classification under CLP for several endpoints. In the response from Portugal, their view is that EU legislation already includes a wide range of requirements and mechanisms that

[26] https://www.globalchemicaltransparency.org/#a13lightbox-work-12609.

contribute to the identification of POPs in products and articles, and they report that labelling has notably enhanced the traceability and identification of certain substances including some POPs (Portugal response, 2024).

In the Netherlands, labelling of articles for POP substances has been limited. While there is a requirement for HBCD labelling, it has not been implemented according to responses although specific collection rules for HBCD-containing polystyrene building material are outlined in the Dutch waste guidance (LAP3). Previous labelling efforts have focused on PCBs in transformers and capacitors of which most have been disposed of. However, the effectiveness of labelling depends on the product type and recognition feasibility later on. For numerous small items such as spare parts, labelling may not be practical since dismantlers may not remove labelled parts easily or feasibly. The response also notes that labelling becomes less useful if it doesn't outlast the product's lifespan. Moreover, specific collection points for labelled materials are necessary, making existing infrastructure crucial (Netherland response, 2024).

In Spain, under royal decree 1378/1999 (article 7), all equipment containing PCBs must be appropriately marked and labelled by the owner, indicating various data such as type, volume, weight, among others. Additionally, if the equipment contains more than 5 dm^3 of PCBs, the owner must label the door of the location where the equipment is situated. Spain's current implementation of requirements to identify POPs in products and articles is perceived as a potent tool. It aids in effectively managing these items by furnishing vital information to users and simplifying inventory processes (Spain response, 2024).

Germany received diverse perspectives from its Federal States regarding the introduction of mandatory labelling. Some argued against it, citing limited use of POPs and existing bans on their use, as outlined in Regulation EU 2019/1021. Consequently, mandatory labelling was deemed unnecessary. Conversely, others stressed the importance of labelling to ensure proper disposal of contaminated materials and prevent their entry into recycling cycles. One of the German Federal States suggested labelling methods such as colour coding or embossing for materials such as HIPS. Proponents of labelling assert its significance in increasing awareness among consumers and downstream users, potentially improving recycling rates and reducing pollutants in material cycles. Germany emphasises the need for collaboration with the recycling industry for effective implementation. Hungary also emphasises the importance of labelling POPs in and articles as a crucial task for Parties to consider. However, POPs are commonly used in various products and articles, often in very small quantities. Consequently, identifying all products and articles containing POPs retroactively (as is currently practised) poses a significant challenge. Consistent reporting of materials and labelling saves time and resources from incomplete downstream monitoring exercises. Hungary stresses the significance of achieving an internationally harmonised approach to labelling requirements and encourages all Parties to assess the feasibility of implementing such requirements (Germany and Hungary response, 2024).

Finland notes that given the absence of rapid and cost-effective screening technologies for identifying POPs-containing materials, labelling or marking emerges as the most viable approach to enhance information flow on POPs content throughout the value chain retroactively in Finland. Despite initial resistance from industries, examples exist where labelling of HBCD-containing articles, such as insulation panels, has been achieved, with "HBCD-free" labelling becoming more prevalent. However, challenges may arise in cases where adding new text for labelling is deemed impractical, especially for small parts such as connectors and wires. In these instances, accompaniment with digital labelling might support information transfer. While current recycling processes in electronics and end of life vehicles (ELV) do not necessitate labelling due to reliance on material weight for separation, new techniques would be needed for substances such as UV-328. Some argue against labelling under exemptions due to their historical minimal use, but it could still aid in identifying stockpiles for notification and managing POPs-containing wastes during recycling processes. Labelling or using other identification methods for articles containing POPs would greatly aid stakeholders and authorities in implementing restrictions and ensuring proper management of POPs wastes as per Article 6 of the Stockholm Convention (Finland response, 2024).

Finland in their response advocate for considering labelling and marking earlier in the listing process, possibly at the POPRC level, to facilitate a uniform labelling system globally, as compared to raising the issue later at the COP. Challenges include insufficient capacity to monitor articles entering the market and difficulties in identifying stakeholders using POPs, with varying knowledge levels across industries. In implementing the requirement to notify stockpiles of POPs, as well as products and articles containing them, several issues have emerged (Finland response, 2024):

(a) Few notifications have been received, likely due to stakeholders' unawareness of the obligation or their possession of a POP chemical, product, or article;

(b) Difficulties in identifying products, articles, and wastes containing POPs result in a lack of notifications and pose a risk of non-compliant waste management;

(c) Lack of awareness of current POPs legislation further contributes to the low notification rates;

(d) Rapid screening methods for POPs are lacking, hindering efficient identification;

(e) The cost of analytics and the absence of standard methods for many materials containing POPs add to the challenges faced in compliance and management efforts.

Traceability of POPs throughout their lifecycle and along value chains aid governments and industries in identifying POPs in products, articles, and wastes and will enhance capacity-building efforts. Such information is also needed when tailoring regulations/exemptions and for fulfilling obligations under the Convention, facilitating informed decision-making, expediting the phase-out of POPs, and ensuring toxic-free recycling and environmentally sound waste management practices.

Digital Product Passports (DPP), a blockchain-based tool mandated for various products and articles is planned to be used in the EU as a way of improving transparency and passing information down the value chain (EPRS, 2024). DPP collects and shares product data throughout its lifecycle, highlighting sustainability, recyclability, and environmental impact. Standardised SDS provide essential information on occupational safety and health for substances and products and articles, focusing on hazards and safe handling procedures. While SDSs are not intended for general consumers, they are integral to regulations such as REACH, aligning with CLP and GHS for the classification and labelling and supports appropriate classification and handling of wastes.

In Albania, the Inspectorate of Market Surveillance is the competent authority responsible for inspecting products and articles placed on the market, including those containing POPs. However, to date, they lack experience in this area. Their experts have participated in some training sessions organised by the Swedish Chemicals Agency. These sessions have covered various topics, including product labelling in the market. However, they note that there is limited technical expertise held domestically (Albania response, 2024).

In Argentina, the PREAL[27] project is based on seals/stamps/identifiers on plastic resins criteria to indicate the presence of BFRs. However, these seals do not specify whether the BFRs are associated with POPs. Additionally, there are brands with codes established in the International Organization for standardization (ISO) 11469 standard, where certain codes indicate the presence of dangerous BFRs (POPs) if they contain specific two-digit numbers (e.g., 14, 15, 18-21). These indicators also apply to WEEE plastics when they become wastes. However, these seals are not always visible on the outside of equipment but may be located inside plastic casings. Implementing mandatory labelling requirements would be beneficial, especially for products and articles marketed for specific uses, but it would necessitate prior awareness campaigns. Labelling could promote the consumption of POP-free alternatives and allow a greater quantity of plastics to be recycled. In Argentina's view, the lack of identification may force waste handlers to dispose of materials with unknown compositions as hazardous wastes. Requiring reporting of BFR presence in plastics would simplify classification, enabling more plastics to be recycled in an environmentally sound manner (Argentina response, 2024). Sweden notes that there is a lack of knowledge about the chemical contents of plastic products which hinder recycling, particularly for plastic (Sweden response, 2024).

Some countries, including Chile, have experience in developing labelling for similar products and articles, although not explicitly for POPs. For instance, they have implemented labelling for chemicals such as toluene in toys. In this process, toys imported into the country undergo analysis in certified laboratories. Based on the results, they are either approved or rejected for sale or distribution in the country (Chile response, 2024).

Indonesia has integrated the GHS into its regulations, referencing it in various laws and ministerial regulations. Hazardous substances labelling is specified in Minister of Environment Regulation No. 3 of 2008,[28] which outlines labelling requirements for substances such as transformers, capacitors, and dielectric oil, including PCB concentration values and installation details. Labels are prominently displayed on packaging exteriors. According to the Party response, PBDE labelling in Indonesia follows the EU Restriction of Hazardous Substances Directive (RoHS) related to waste electrical and electronic equipment 2002/96/EC (EU, 2002).[29] Specific regulations for POPs, such as PFOA and PFOS in waterproof textiles, are detailed in

[27] https://residuoselectronicosal.org/.

[28] https://cloud.crpg.info/docs/paramita.pdf.

[29] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32002L0096.

Ministerial Regulation No. 40 of 2022. Food and drug packaging regulations, as per Indonesian Food and Drug Authority (BPOM) Regulation No. 20 of 2019,[30] mandate non-toxic materials to prevent contamination, prohibiting toxic compounds from migrating into products and articles (Indonesian response, 2024).

Identifying POPs with labelling products and articles containing POPs, serves as vital hazard communication to consumers according to Indonesia's response. It aims to protect human health and the environment by raising awareness of the dangers of POPs. Labels help consumers identify whether products and articles are POPs-free, promote eco-friendlier alternatives, and facilitate monitoring of POPs throughout their lifecycle. This labelling initiative aligns with Indonesia's obligations under the Stockholm Convention and other relevant Multilateral Environmental Agreements (MEAs). The requirements are feasible with collaborative efforts between all stakeholders and government entities to regulate and prevent POPs from spreading into the environment (Indonesia response, 2024).

In Canada, efforts are underway to enhance labelling requirements for toxic substances in products and articles under the Canadian Environmental Protection Act. (Canada, 2024)[31] regarding PCP treated utility poles and crossarms, as Canada is an 'opt-in' Party to the Convention, there is no formal regulatory requirement mandating the tagging or labelling of such treated wood. However, the industry has established practices for tagging and identifying affected material. Wood Preservation Canada (WPC) serves as an industry association representing Canadian wood treaters and users of treated wood (Canada response, 2024).

In Japan, strict controls are in place for fire-fighting foams containing PFOS and PFOA, with technical standards and labelling requirements during transfer. Similar regulations mandate labelling for PCB-containing products and articles and wastes to ensure proper handling. However, challenges arise with products and articles containing POPs, where traditional labelling may not be practical. Instead, comprehensive information sharing across the value chain or at disposal, such as through the use of a digital passport or physical identifier linked to digital information, could effectively prevent POPs-related environmental pollution. In sectors such as electrical and electronic equipment, value chains often

---

30 https://leap.unep.org/en/countries/id/national-legislation/regulation-minister-trade-no-40-2022-concerning-amendments.

31 https://laws-lois.justice.gc.ca/eng/acts/c-15.31/.

span multiple countries, complicating information flow and causing delays in ascertaining information on newly regulated chemical substances in final products and articles (Japan response, 2024). Globally harmonised mandatory disclosure, tracking and labelling requirements would simplify information sharing across the value chain.

In Oman, in general, POPs are managed similarly to other chemicals, often using the GHS for labelling or marketing them in products and articles. This standardised approach ensures consistency and clarity in conveying information about these hazardous substances. Oman has identified the use of labelling to identify of utility poles and cross-arms treated with PCP. However, the response notes that better labelling products and articles containing POPs offers several advantages, including better control over import and export activities, improved consumer decision-making by providing informed choices, and the ability to identify POPs-containing items within recycling streams and waste management systems to ensure environmentally sound practices (Oman response, 2024).

In Paraguay, there are currently no national regulations regarding POPs labelling. While the GHS is partially implemented for the agrochemical sector, guidelines or obligations for other sectors have not been established. Similarly, in Peru, certain institutions have not undertaken any actions related to the labelling or marking of POPs such as hexabromocyclododecane and PCP. The absence of specific initiatives suggests a lack of measures implemented to label or mark products and articles containing POPs. However, implementing a requirement for labelling or other identification means for POPs in products and articles is deemed feasible by both nations. This could involve using information provided by importers or collaborating with customs authorities. Importantly, the focus would be on products and articles entering the country, requiring verification to ensure they do not contain POPs (Peru and Paraguay response, 2024).

In addition to government-funded programmes, existing standards at company level also provide good examples of approaches that can be adapted for regulatory purposes. Hewlett Packard, for instance, has established standards for physically labelling plastics and specifying types of phthalates and flame retardants used in plastic pieces weighing over 25 grams. The GADSL and the IMDS, facilitate identification of motor vehicle parts containing POPs as discussed in section 3.

Regulatory measures for specific POPs as outlined in country responses are listed in the following subsections.

4.2.2 POP 1: Hexabromocylododecane (HBCD)

Hexabromocyclododecane (HBCD; CAS No. 25637-99-4; 3194-55-6) is an additive flame retardant that has been used in high volumes since the 1960s with a total use of 703,000 tonnes used until 2021 when the last HBCD productions have been closed in November 2021 in China (UNEP,2023a).

HBCD was listed in Annex A to the Convention in 2013 with specific exemptions for production and use in EPS and XPS in buildings (Decision SC-6/13).

It is noted that the EU has the labelling requirements for HBCD (EC No. 247-148-4 and 221-695-9) which makes sure that the hazards presented by it is clearly communicated to workers and consumers in the EU (EU, 2024). However, the use of HBCD is prohibited in EU 2019/1021 and has not been used since 2017 so this requirement is redundant.

In accordance with Part VII of Annex A, Parties that have registered for the exemption to article 4 for the production and use of HBCD for EPS and XPS in buildings need to take necessary measures to ensure that EPS and XPS containing HBCD in buildings can be easily identified by labelling or other means throughout its life cycle (Decision SC-6/13).

4.2.3 POP 2: Pentachlorophenol (PCP) and its salts and esters

PCP has been produced commercially and used as a wood preservative since the 1930s. PCP has been produced as PCP and as sodium salt of PCP. PCP and its salts and esters include PCP, sodium pentachlorophenolate (CAS No. 131-52-2), as monohydrate (CAS No. 27735-64-4), pentachlorophenyl laurate (CAS No. 3772-94-9) and pentachloroanisole (PCA) (CAS No. 1825-21-4).

The main unintentional contaminants in commercial PCP include other polychlorinated phenols, polychlorinated dibenzo-*p*-dioxins, and polychlorinated dibenzofurans (PCDD/PCDF).

PCP and its salts and esters were listed in Annex A to the Stockholm Convention with specific exemptions for production and use for utility poles and cross arms in accordance with the provisions of Part VIII of Annex A (Decision SC-7/13).

At its tenth meeting in 2022, in its decision SC-10/5, the COP noted, pursuant to paragraph 9 of Article 4 of the Convention, that, as there were no longer any

Parties registered for specific exemptions for the production and use of PCP,[32] no new registrations may be made with respect thereto.

The Stockholm Convention Guidance on preparing inventories of PCP includes a labelling scheme. It requires each Party that has registered for the exemption for the production and use of PCP for utility poles and cross-arms to ensure that utility poles and cross-arms containing PCP can be easily identified by labelling or other means throughout their life cycle (UNEP, 2021).

Canada does not have formal regulatory requirements mandating the tagging or labelling for PCP used for treated unitality poles and crossarms as Canada is an 'opt-in' Party to the Convention. However, industry in Canada has established practices for tagging and identification of POP-treated wood (Canada response, 2024).

4.2.4 POP 3: Decabromodiphenyl ether (DecaBDE)

EU listed DecaBDE (CAS No. 1163-19-5, EC No. 214-694-9) in POPs Regulation to make sure the hazardous properties of the substance are clearly communicated to workers and consumers in the EU (EU, 2024). This further confers the obligations of the Convention to the EU under the POPs Regulation. This includes the identification and control of stockpiles containing decaBDE, and suitable disposal of wastes that contain POPs above the low POP concentration limits.

4.2.5 POP 4: PCBs

PCBs are required to be labelled in Indonesia under the Regulation of Ministry of Environment and Forestry of the Republic of Indonesia No.29 of 2020. The information required to be labelled includes: (a) PCB concentration value; (b) Equipment and serial number; (c) Date of label installation; and 4) Statement that transformers, capacitors and dielectric oil contains PCBs with concentration values: below PCB concentration limit; or equal to or more than the concentration limit PCBs. Symbols and labels are attached to the outside of transformers, capacitors, and dielectric oil packaging when they are easily visible (Indonesia response, 2024).

In Japan, it is stipulated for users to label PCBs when storing, collecting or transporting PCB-containing products and articles and PCB wastes (Japan response, 2024).

[32] Register of specific exemptions: Hexabromocyclododecane. Available at: http://www.pops.int/tabid/5034.

In Nigeria, PCBs are labelled using standard hazard warning pictograms and signal words under the Environmentally Sound Management and Disposal of PCB Project (Nigeria response, 2024)

Republic of Moldova requires PCB information labelled in accordance with the provision of Regulation 81/2009. It requires information including (a) Marking of PCB-contaminated equipment; (b) Marking of rooms for the storage of equipment containing PCBs in concentrations greater than 50ppm and volumes greater than 5 dm^3; (c) Making of equipment in which no PCBs have detected (Republic of Moldova response, 2024).

Spain requires all equipment containing PCBs must be marked and labelled by the owner, identifying various data (type, volume, weigh etc.) in accordance with RD 1378/1999 (article 7) (Spain response, 2024).

Swedish PCB ordinance regulates that any product containing PCBs (as defined in the ordinance and with the exception of joint and anti-slip compounds) need to be visibly labelled as such. The labelling needs to be applied to the products and articles and to any packaging containing the product. Equipment that has been decontaminated from PCBs needs to be labelled as such (Sweden response, 2024).

Argentina requires any equipment containing PCBs above 50 ppm, and any device that has contained PCBs and has been decontaminated to be marked and labelled by the owner in accordance with National Law 25670.

In Moldova, labelling practices adhere to Regulation 81/2009 (EU, 2009)[33] concerning PCBs, as outlined in Annex 3. These labelling requirements particularly apply to electrical transformers and encompass (Moldova response, 2024):

(a) Marking PCB-contaminated equipment is mandated;

(b) PCB-contaminated equipment must also be marked;

(c) Rooms designated for storing equipment containing polychlorinated biphenyls with concentrations exceeding 50 ppm and volumes greater than 5 dm^3 are required to be labelled;

(d) Equipment where no PCBs have been detected must also be marked.

---

33 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0081.

4.2.6 POP 5: Polybromodiphenyl ethers (PBDEs)

Indonesia requires labelling of PBDEs on products and articles based on the EU Restriction of Hazardous Substances (RoHS) related to WEEE2002/96/EC (Indonesia response, 2024).

4.3 Key challenges and benefits for labelling

The absence of rapid and cost-effective screening technologies for identifying POPs-containing materials poses a significant challenge. This limitation hinders efficient identification and necessitates reliance on physical or digital labelling or marking as the most viable approach to enhance information flow on POPs content (Finland response, 2024). Several countries noted the importance of labelling of POPs as summarised in sections above. However, several barriers and challenges for labelling were reported in the responses which highlight the complexities and considerations involved in implementing labelling requirements for products and articles or articles containing POPs this includes the lack of global harmonisation and the need for improved exchange of expertise and experience.

Practical constraints may also limit the feasibility of labelling, especially for small parts such as connectors and wires, where adding new text may be impractical in some instances. This challenge is highlighted by Finland and responses from vehicles associations. Similarly, in sectors with complex value chains spanning multiple countries, such as the electrical and electronic equipment industry, information flow and identification of newly regulated substances can be challenging which can delay the ascertainment of information on POPs content in final products and articles. Nevertheless, it was commented by multiple Parties and observers that other tools such as linking physical labels to databases (such as a material passport) could facilitate the identification for parts where physical labelling or marking is impractical (ACAT/IPEN and Canada response, 2024). Although a database is suitable for all products and articles regardless of their size.

ACAT/IPEN note that labelling of ingredients in products and articles are not a new concept, and that certain sectors, countries and regions already have labelling and identification requirements in place for the content of a wide range of products and articles. Physical labelling is a well-established tool to increase traceability and transparency throughout the lifecycle of a variety of products and articles and should be considered feasible in many applications. They report that companies prioritising sustainability have found ways to implement the use of labelling and other approaches to identify chemicals used in their products and articles, even on components as small as cables, where marking of properties is already common practice for other purposes (ACAT/IPEN response, 2024).

The Global Green Network consider that a requirement to assist identification of POPs in products and articles in use by labelling or other means is a useful and important measure which can help to:

(a) Raise awareness and inform consumers, workers, and other stakeholders about the presence and risks of POPs in products and articles, and the proper handling and disposal methods;

(b) Facilitate the tracking and monitoring of POPs in products and articles throughout their life cycle, and the implementation of the obligations under the Stockholm Convention and other relevant agreements;

(c) Promote the prevention and reduction of POPs releases into the environment, and the development and adoption of safer alternatives to POPs.

This view is supported by several countries, including Brazil, which considers labelling to be crucial and advocates for detailed information on product labels. They suggest that labels should provide a link to an online platform hosting a comprehensive risk sheet (i.e., a digital product passport) and disclose the product formula, list all contaminants and their maximum expected quantities. This sheet would address concerns such as whether the product is linked to cancer, foetal malformations, diabetes, or acts as a hormone disruptor. They suggest it should also indicate whether the product has undergone testing for POPs which would prevent duplication of resource intensive testing regimes by country for which there is a lack of capacity, particularly in developing nations. Therefore, mandating digital labelling for producers may be more suitable. Implementing a harmonised digital labelling system would avoid fragmented standards, reduce the burden on small companies and resource-poor countries, and simplify international trade by avoiding parallel reporting systems.[34] It should be noted that whilst a digital passport system would be valuable, it is contingent on the data quality and completeness which could vary considerably without proper enforcement which will add burden to authorities.

---

34 https://www.globalchemicaltransparency.org/#a13lightbox-work-12609.

Developing a globally harmonised database is regarded by some Parties and observers as important for identifying chemicals in all products and articles. It would require manufacturers to submit information about the chemicals they use, including chemical identity and hazard properties, to this publicly accessible database in a standard electronic format. This information should be linked to a unique product identifier, allowing for traceability of chemical data within individual materials and products and articles. It may also be possible to limit the information available to certain stakeholders to protect sensitive information.[35] There are various options for data carriers within plastic value chains, as detailed in the review article "Information-Based Plastic Material Tracking for Circular Economy - A Review".[36] Such database may take a long time to develop and be resource demanding to run. National systems of disclosure and tracking of POPs in products and articles results in multiple parallel transparency and traceability standards in different countries, potentially with different priority POPs and disclosure thresholds in different companies and industries. National standards may be incomparable and create challenges for stakeholders in global supply chains, complicating trade as well as border control measures.

According to Hungary, achieving an internationally harmonised approach to labelling requirements is vital. Without consistency in labelling, identifying all products and articles containing POPs and informing consumers about their presence can be challenging and inconsistent across jurisdictions. The cost of analytics and the absence of standard methods for many materials containing POPs add to the challenges faced in compliance and management efforts. Standardising labelling methods and ensuring cost-effectiveness are regarded as essential for widespread adoption (Hungary response, 2024).

The UK's experience while conducting the various waste POPs sampling studies found that with many products and articles the labelling does not survive. When the item is discarded the label is often missing or worn to a state where it is unreadable, making it useless for waste management purposes. This was the case in sampling studies carried out on domestic seating and mattresses where it is a legal requirement to have a fire safety label attached. The experience highlighted that for long-lifetime products and articles, requirements when the item was manufactured (which can be many years prior) are often outdated or ineffective for current legislative controls.

---

35 https://www.globalchemicaltransparency.org/wp-content/uploads/2024/04/INC4-Transparency-Information-paper.pdf.

36 https://www.mdpi.com/2073-4360/15/7/1623/pdf?version=1679647694.

The UK also noted that from a waste management perspective, examination of labels of individual items is labour intensive and time consuming, and inconsistent with more load-based approaches to waste management and treatment. Examining individual labels is a significant burden on the waste industry, although it can be done where items and their labels are large and durable and contain useful chemical information (for example, refrigerants in fridges) (UK response, 2024).

The Health and Environment Justice Support observers, suggests that these challenges can be overcome by combining physical labels with a corresponding digital passport, stored in a central database. The physical label should have data carriers with the product identifiers that link them to the digital labels (i.e. "product passports") preferably in repeated patterns embossed/printed on the surface of the material/product, so that the product identifier can be scanned, e.g., using a dedicated mobile phone app, even from fragmented products and articles.[37]

Industries such as vehicles and construction may argue against labelling in some instances, citing minimal use of POPs or existing bans on their use, and complexities in labelling, administrative burden and their limited impact downstream within recycling processes. However, it was noted that many of the recently listed POPs have been used in high quantities within vehicles and construction; Many of the exemptions for listed POPs are also in these specific sectors and several of the RMEs for listed chemicals indicate that these are sectors that have used high volumes of POPs.

The CVMA/ACEA notes that labelling might offer possibilities to identify POPs, but only under specific circumstances and in specific applications. They argue that physical labelling cannot be seen as a general solution to apply to articles or even more complex objects on the market. The CVMA/ACEA argue that physical labelling of highly complex products and articles such as vehicles that are already on the market is neither feasible nor beneficial for the reasons below:

(a) Components in vehicles containing POPs are often very small and widely dispersed throughout the vehicle (e.g. shrinking tubes on wire harnesses) and labelling may be challenging, although this could be overcome through such means as establishing publicly available databases and digital labelling;

[37] https://www.globalchemicaltransparency.org/wp-content/uploads/2024/04/INC4-Transparency-Information-paper.pdf.

(b) Where vehicles (and their components) are already on the market, labelling would have to be made in the dealerships or other repair workshops, which would be neither realistic nor proportionate. Dismantling a vehicle to apply a label on very specific components would also be challenging but this could also be overcome through the use of publicly available databases and other means. Nevertheless, it is argued that labelling should be provided by the original equipment manufacturer rather than downstream actors and it is unlikely that retrospective labelling of components already in circulation would be feasible;

(c) Even with sophisticated data systems and processes in the automotive sector (e.g., IMDS, GADSL), the knowledge especially about newly added POPs in components on the market is very limited, because at the point of production, there were no reporting requirements for these chemicals by the upstream value chain. Therefore, very often it is not known if the individual legacy components would contain POPs;

(d) There is also no communication duty (e.g., similar to REACH Article 33 which regulate mandatory communication in the value chain after a substance is included in the Candidate List) existing under the Conventions, which makes it even more difficult for manufacturers to collect the required information throughout their global value chain.

It is widely recognised that better controls of POPs in articles and products and articles are required to help industries improve traceability throughout the value chain. However, according to response from CVMA/ACEA, past attempts to label certain components or substances used within complex durable articles has result in an 'over-warning' of customers by applying labels to all components, which may not be read by dismantlers resulting in ineffective labelling (ACEA, 2024; CVMA, 2024). They also claim that the EU End of Life Vehicle Directive ISO labelling requirement since 2005, has shown that labelling only has minor use on the waste operator side. Nevertheless, some Parties including Portugal have found physical labelling to be useful in targeting problematic chemicals in products and articles.

CVMA/ACEA argue that legacy POPs substances (placed on the market before they were identified as a POP) were generally used in small fractional amounts within articles as additives within a broader material matrix. As it becomes clearer that a substance is a POP, its availability from the chemical industry reduces considerably, resulting in a natural decline of its use in vehicles. Therefore, even when used in the production of legacy spare parts, the number of parts containing a POP is generally very small. However, it should be noted that many exemptions for recently listed articles, such as BDE, PFOA, SCCPs, and UV-328, have been for use in vehicles.

For the automotive industry, labels need to last until the of the component's life, which can be up to 30 years. Retrospectively labelling awkwardly shaped or very small components would be very difficult. Labelling or marking subcomponents within an enclosed complex article (such as a window motor regulator or transmission) would also be challenging due to the need to meet extreme performance criteria, including chemical resistance. Some parties suggest supplementing this by coupling the marked component number to a database, such as the EU SCIP database.

Despite this, ACEA contends that the SCIP database is not widely used within industry and places disproportionate administrative burden on manufacturers. They also raise concerns over its accuracy and effectiveness.[38] Conversely, others argue that without better identification or labelling, the burden of identifying and dealing with POPs falls on importers and downstream treatment operators rather than by companies that profit from the sales of these products and articles. Some observers argue that trying to retroactively identify POPs in material streams such as through targeted searches is hugely expensive and unsustainable, particularly in developing nations and do not provide accurate data to make an accurate story and places a huge burden on governments and has a far greater cost to society. They argue that comprehensive harmonised labelling, through digital labelling would reduce the burden on industry by aligning reporting requirements globally, reducing the number of parallel systems.

Observers including ACAT/IPEN and Health and Environment Justice Support conclude that, while voluntary initiatives are commendable and should be encouraged, they suggest that legal requirements are the only way to ensure a level playing field for all companies and meeting the Stockholm Convention objective of protecting human health and the environment. They argue that transparency and traceability considerations are sometimes made based on convenience rather than feasibility. It is therefore important to ensure that requirements are globally harmonised and apply throughout the value chain rather than placing undue burden at any part of it. They also note that improved implementations of means of identification, through digital means would facilitate the information exchange to reduce release of POPs as mandated under Article 9 (ACAT/IPEN response, 2024).

38 https://circabc.europa.eu/ui/group/a0b483a2-4c05-4058-addf-2a4de71b9a98/library/81a3b039-c5d0-4e5a-a476-39cdce562af3/details.

5. ANALYTICAL TECHNIQUES THAT ARE USED IN ABSENCE OF LABELLING

From the responses received, numerous analytical techniques are used to identify POPs in products and articles, materials, and waste streams. The analytical techniques encompass various methods tailored to different contexts and materials: Complexity ranges from information requests from suppliers (i.e. previous analysis) to state-of-the-art laboratory analysis. The key methods include: requesting data from suppliers or manufacturers regarding POPs content in materials, employing analytical techniques in house, outsourcing material analysis to accredited laboratories and following guidance documents developed by the Stockholm Convention. This section also discusses techniques adopted by Parties and challenges or benefits they have experienced.

5.1 General methods

Beyond the guidance documents developed by the Stockholm Convention to assist Parties in establishing inventories mentioned in section 2.1, the Global Green Network outlined analytical approaches that can be used for identifying POPs. These approaches were supported by various country responses. However, their uptake and application under certain scenarios varies as described in this section. The analytical/ identification methods include:

(a) Asking the supplier or manufacturer of the material for information on the presence and concentration of POPs in products and articles. The Global Green Network consider this to be a simple and cost-effective way for users and authorities to obtain information on the POPs content of the material, if the supplier or manufacturer has reliable data and is willing to share it. However, this method may not be feasible or accurate for wastes and some materials, especially if they are imported from countries that do not have strict regulations on POPs or if they are second-hand or recycled products and articles;

(b) Testing the material in-house using analytical methods such as GC-MS, high-performance liquid chromatography (HPLC), or enzyme-linked immunosorbent assay (ELISA) (Lee and Lee, 2016; Dhandapani and Tackett, 2022; Hirobe *et al.*, 2006). This is a more direct and independent way to verify the POPs content of the material, but it requires access to appropriate analytical methods and equipment, as well as knowledge and skills to perform the tests and interpret the results. Some of the common analytical methods for POPs detection[39] are:

(i) GC-MS: This method separates the components of a sample by their volatility and mass, and then identifies them by comparing their mass spectra with a reference database. GC-MS can detect a wide range of POPs, such as PCBs, organochlorine pesticides (OCPs), PBDEs, and PFOS;

(ii) HPLC: This method separates the components of a sample by their polarity and molecular weight, and then detects them by measuring their absorbance, fluorescence, or other properties. HPLC can detect some POPs that are not volatile enough for GC-MS, such as PCDDs/Fs, and HBCD;

(iii) ELISA: This method uses antibodies that bind specifically to the target POPs, and then measures the amount of bound POPs by a colorimetric or fluorescent reaction (Hirobe *et al.*, 2006). ELISA can detect POPs at very low concentrations, but it requires the availability of specific antibodies for each POP, and it may have cross-reactivity with other substances (Global Green Network response, 2024);

(c) Material analysed by an outsourced laboratory that has the expertise and equipment to detect POPs using the above methods. This is a more reliable and accurate way to determine the POPs content of the material, but it may be more expensive and time-consuming than the other methods. It also requires finding a laboratory that has the necessary accreditation, equipment, and expertise to perform the analysis. Some of the criteria for selecting a laboratory are:

(i) The laboratory should be accredited by a recognised body, such as the ISO, the American Association for Laboratory Accreditation (A2LA), or the National Environmental Laboratory Accreditation Program (NELAP);

---

[39] For more specific information on analytical methods for POPs, see the respective Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of, Containing or Contaminated with Persistent Organic Pollutants https://www.basel.int/Implementation/POPsWastes/TechnicalGuidelines/tabid/5052/Default.aspx.

(ii) The laboratory should use validated methods that are consistent with the guidelines and standards of the Stockholm Convention, the World Health Organization (WHO), or other relevant organisations;

(iii) The laboratory should provide a detailed report of the analysis, including the methods, equipment, quality control, results, and uncertainties.

5.2 Party and observer experiences with analytical methods

Chile provided a methodology for conducting chemical analysis on POPs within various materials, including plastic wastes and electronic devices. The process involves a series of steps: Firstly, POPs are extracted from the samples using hexane and an ultrasonic bath, repeated three times for 15 minutes each, followed by concentration under mild nitrogen to 1 ml. Subsequently, the extracted compounds undergo sample cleanup using silica gel and sodium sulphate columns, with elution achieved using a mixture of dichloromethane (DCM)/hexane in a 1:1 ratio. The determination and quantification of these chemicals are then carried out using GC-MS. This method has been effectively applied in monitoring POPs concentrations within plastic wastes found on beaches, resulting in the quantification of several types of POPs including PBDEs, OCPs, PCBs, PFOS, PFOA, PFHxS, and nitrogenous-based flame retardants (NFRs). Furthermore, the methodology is undergoing adaptation for the analysis of e-wastes, which involves a continuous effort over several months, initiated in August 2023 and still ongoing (Chile response, 2024).

In the context of WEEE, efforts are being made in Chile to identify POPs with BFR characteristics. This includes a preliminary check of bromine content using XRF[40] in plastic samples, followed by detailed identification and quantification via GC-MS. However, the Party notes the potential for a high degree of false positives that can be recorded when using XRF, such as where bromine is identified but it is not a POP). A pilot methodology is being applied across three WEEE recovery plants in Colombia to gather precise data, with a particular emphasis on samples listed in “Red and Green Lists” provided by Colombia. The most accurate method identified for this purpose is the use of XRF equipment. The process involves systematic data collection, categorisation of equipment, and the selection of samples for further analysis based

[40] XRF (X-ray fluorescence) is a non-destructive analytical technique used to detect and quantify the presence of halogenated compounds (a potential indicator for POPs) in materials by measuring the characteristic secondary (or fluorescent) X-rays emitted from a sample when it is excited by a primary X-ray source.

on predetermined criteria. Ultimately, the focus of the analysis lies in identifying and quantifying PBDE-type POPs, with the inclusion of tetrabromobisphenol A (TBBPA) within the scope. The overarching objective of this is to design a practical and user-friendly methodology to facilitate the identification and separation of WEEE plastics containing POPs, thereby aiding in the training of recyclers and enhancing the overall management of WEEE (Chile response, 2024).

Various analytical methods are available in Norway and are used to chemically detect and monitor POPs in products and articles, articles and wastes with high confidence and specificity, but are costly and time consuming in comparison to other approaches (Norway, 2024). Such methods typically combine suitable extraction/ cleanup procedures with gas chromatography and mass spectrometry. These tests are often substance-specific and multiple tests may be required to screen for all POPs. Alternatively, screening methods such as XRF are less costly and allow for more rapid screening but can only be used for crude detection and separation. To identify the presence of a POP in material streams, XRF must be combined with more advanced analytical methods that involve mass spectrometry as described above. Furthermore, XRF can only be used to test for certain halogenated compounds at a time (e.g. for Br, Cl and F) (Norway response, 2024; Weber, 2024). However, some POPs such as UV-328 (which do contain a halogen) can therefore not be pre-screened by XRF.

Similarly, in Germany, Different XRF for halogen detection and organic analytics using GC-MS, are used to serve different purposes ranging from consumer inquiries to identifying suspected POP content in products and articles. For products and articles in use, XRF analysis, organic analysis, and indoor air measurements are used. XRF is used to assess samples such as cables, seals, packaging flakes and insulation boards for bromine and chlorine-containing flame retardants. The results reveal consistent levels of HBCD compared to laboratory chemical extraction and GC-MS measurements. Organic analysis quantifies HBCD in polystyrene, while indoor air measurements in potentially contaminated buildings investigate various POPs including HBCD, PBDE, Dechlorane Plus, and other brominated flame retardants (German response, 2024).

XRF requires separate calibration for different material surfaces due to their varying compositions. Calibration standards are employed to ensure analysis accuracy. Organic analysis presents challenges due to the difficulty in homogenising diverse plastics, which requires time and dilution for analysis of high concentrations of POPs. Indoor air measurements offer initial insights into POP presence and require further investigation to pinpoint sources, capable of capturing a range of substances. While XRF offers a rapid semi-quantitative method on-site, all methods demand specialised personnel and costly equipment. To prevent POP-contaminated wastes from entering recycling streams, additional samples from end-of-life vehicles and electrical appliances should undergo POP examination before recycling.

Countries, including Honduras, understand the potential of using XRF to identify certain harmful chemicals on product surfaces. However, widespread adoption of this method has been limited due to its high cost and the complexity involved in using the equipment. Nigeria note that this technique has been used in limited applications particularly in the electronic and electrical sector (Honduras response, 2024).

Another method that has shown promise is the use of the Clor-N-Oil Kit to screen for PCBs in oils. These methods have been mainly implemented within specific projects, such as the Conference of Parties (COP) Project, focused on managing products and articles and wastes containing POPs and addressing associated risks. These initiatives represent unique efforts undertaken within the framework of larger environmental management projects. It should be noted that these methods are used as a screening technique, and their accuracy and compliance with required standards for POPs identification are not certain.

In addition to surveying suppliers and employing the XRF and GC-MS methods already mentioned, Nigeria have used the following quantitative methods. Quantitative method (Nigeria response, 2024):

(a) The use of Gas Chromatography Electron Capture Device (GC-ECD) for POPs detection in different articles;

(b) The use of the Clor-N-50 test kit to detect PCBs above 50ppm;

(c) The L2000DX Chloride Analyser to analyse PCBs for a wide variety of chlorinated organic compounds in various environmental matrices such as soil, oil, and water.

Sri Lanka have used "Sea Marconi" test kits to detect the presence of PCBs in power sector and welding transformers however it does not elaborate on the process. GC was employed to measure the concentration, while grading "tiers" were used to prioritise transformers for testing (Sri Lanka response, 2024).

In Indonesia, three techniques are employed for identifying and separating bromine in plastic. In addition to XRF, these include (Indonesia response, 2024):

(a) Sliding Spark Spectroscopy (SSS): This method involves subjecting the surface of the plastic to tiny sparks, causing some of the material to evaporate.

The steam emitted during this process emits radiation with a specific energy, indicating the presence of bromine. Additionally, SSS can detect chlorine in plastic materials;

(b) Selective Deposition or Sink and Float Technique: This technique relies on the different specific weights of polymer types. Plastics containing bromine-based flame retardants have higher specific gravities than those without or with non-bromine flame retardants, allowing for their separation into specific density groups.

For the identification of PCBs in transformers, capacitors, and dielectric oil, the following provisions are followed:

(a) Visual Test: This involves examining transformers and capacitors, whether in use or not, by checking nameplates, documents such as manuals and technical specifications, maintenance logs, and the presence of drainage channels;

(b) Rapid Test: This test is conducted on dielectric oil from transformers meeting the requirements. Samples are taken, and PCB concentration is determined using potentiometry or other methods such as electrometry or colorimetry;

(c) Laboratory Test: Laboratory analysis of dielectric oil samples is carried out following the International Electrotechnical Commission (IEC) 61619 methodology to determine PCB concentration.

In Oman, various extraction methods including liquid-liquid extraction (LLE), solid phase extraction (SPE), and solid-phase micro-extraction are employed for targeting specific compounds including OCPs and PCBs in water samples. Additional techniques such as Soxhlet extraction, pressurised liquid extraction, and ultrasonic-assisted extraction are used for different matrices and analytes. GC and GC-MS are used for separation and detection for most POPs except PFOS, PFOA and PFHxS. Additionally, atmospheric pressure gas chromatography (APGC) demonstrates good sensitivity and selectivity in dioxin and PCB analysis in food and feed samples (Oman response, 2024).

In handling chemical wastes, procedures in Oman primarily involve examining safety data sheets to classify waste components and determine appropriate treatment methods. If POPs are identified, the waste is classified accordingly. For unidentified or process-generated wastes, a complete analysis is conducted based on Landfill Acceptance Criteria (LAC), with Total Organic Carbon (TOC) used as a screening test (Oman response, 2024)

6. CONCLUSIONS AND RECOMMENDATIONS

Article 6 of the Convention specifies the obligations of Parties to develop appropriate strategies for identifying POPs in stockpiles, products and articles in use and wastes, however, the Convention does not make explicit what this means in practice and approaches are to the interpretation of Parties to the Convention which has resulted in a range of measures that have been adopted.

The Parties and observers' responses indicate a wide range of policy measures and practical approaches used globally to identify and address POPs in products and articles, stockpiles and wastes. These measures include standardised guidelines, national/regional regulations and research initiatives. Existing practical measures for identifying POPs in products and articles, stockpiles and waste can broadly be categorised into surveys, screening, analytical testing, physical labelling, and databases. Upcoming measures such as digital product passports which link physical labels to a database containing supplementary information are not yet adopted but are considered in many responses as a useful measure as supported in the upcoming EU ESPR, despite some concerns over the feasibility of such a system and how the information is used.

There is significant variation in how countries apply measures to address POPs. For instance, some countries focus on different POPs or target specific sectors and materials, resulting in varying levels of implementation. Most parties rely on retroactive initiatives, such as inventory analysis, which depends on targeted testing regimes and limited publicly available data which result in significant data gaps.

Countries such as Sweden, Finland, Germany, and the UK have established effective practices for developing inventories and guidance, which could serve as models for other parties. For example, the UK has developed a POPs waste tool to identify POPs in waste flows (which draws from the UK's multimedia emission inventories (air, land, water, waste, and product) and the Swedish Chemical Agency's guidance and training have been highlighted positively in multiple responses. However, the majority of Parties, including those with relatively well-developed POPs legislation and strategies and resources, face challenges with implementation including understanding the presence of POPs, improving stakeholder coordination, raising awareness, ensuring compliance, and developing standardised, cost-effective identification and management strategies. Several countries reported difficulties in monitoring POPs or only being able to monitor a limited number, with some arguing that downstream users and importers should not bear the identification burden.

Consequently, some countries have not actively addressed POPs. The information obtained for this study was informed through information from contributors. Review of National Implementation Plans was not included within the scope of this study, but this could provide a better understanding of how POPs in products, articles, stockpiles and waste are managed.

Various analytical techniques are used to identify POPs in products, articles, materials, and waste streams, ranging from visual identification and data requests to sophisticated laboratory analyses. Each method has its advantages and disadvantages, differing in material suitability, data accuracy, availability, reliability, cost, and time requirements. Countries employ specific methodologies tailored to their needs; for instance, Chile uses extraction and analysis processes for POPs in plastic wastes and electronic devices. Other countries use XRF for rapid screening, while GC-MS is often used for detailed analysis. Various other innovative methods such as chlorine test kits and sink-and-float techniques for bromine identification are also used.

The experiences with labelling products and articles containing POPs vary widely across countries, each encountering unique approaches and challenges. Established international systems such as the GHS for classification and labelling of chemical products, the CE marking for products and articles traded with the EU, and the CLP Regulation implementing GHS enhance transparency. However, limitations on their scope, uptake and other practical constraints continue to pose challenges in identifying POPs-containing products and articles. Achieving international harmonisation is seen as crucial by stakeholders to address these issues and ensure consistent information across jurisdictions. Legal requirements are also deemed necessary to meet the objectives of protecting human health and the environment, as voluntary initiatives alone may not be sufficient.

Identifying POPs in products, articles, stockpiles, and wastes presents several significant challenges, as highlighted by various Parties and observers. Key issues include limited information about POPs within value chains, legislative and regulatory obstacles, financial and technological constraints, and difficulties with capacity building and knowledge sharing. Additional challenges involve analytical capability, access to technical expertise, and misaligned inventory systems and global standards. To address these issues, responses emphasise the need for improved inventory and labelling systems, enhanced analytical capacities, and greater global cooperation. Transparency and sharing of information along value chains are deemed critical for better knowledge and decision-making regarding POPs, with developing countries facing particular financial and technological limitations.

Many Parties involved in the consultation are net importers of products and articles containing POPs and often deal with the resulting wastes without adequate information on the POPs these imports contain. This lack of transparency leaves them with limited means to manage and control these substances effectively. Diverse regulations and standards across countries further complicate the identification and management of POPs, and harmonising these regulations globally could reduce financial burdens and improve compliance. Some countries cite capacity restrictions on stockpiling and disposing of wastes containing POPs, noting the high cost of exporting to countries with adequate disposal technologies or developing domestic infrastructure. Improved transparency of POPs content in articles and wastes could decrease these costs for developing countries as it would increase their capacity to prevent import of products, articles and wastes that contain POPs. Mandatory reporting of ingredient contents in products and articles, such as through a globally harmonised digital product passport, could ensure consistency and provide higher-quality data with fewer gaps and provide information to customs authorities at the point of import.

Accurate identification of POPs in material streams often requires sophisticated laboratory equipment and expertise, which are frequently unavailable, especially in developing countries. While some Parties stress the importance of experienced laboratories for analysis, others argue that the investment in such facilities and ongoing testing costs can be prohibitively expensive and may not provide sufficiently detailed information for a comprehensive inventory. Commissioned reports and studies on POPs in waste streams often rely on targeted, costly testing regimes and cover only a small portion of materials on the market, leading to significant data gaps. Improved information sharing along value chains, including harmonised reporting and labelling requirements, could aid in better managing POPs for regulators, consumers, and recyclers who currently lack access to this information.

Some Parties emphasise the importance of developing harmonised infrastructure, such as databases, for sharing information to enhance the capacity to identify POPs. Multiple standards and databases across different countries can create a considerable financial burden for both governments and industry, which could be alleviated through improved collaboration or global harmonisation. Capacity building through training programs and awareness campaigns is also seen as vital for better understanding POPs in products and articles, stockpiles, and waste streams. International cooperation and knowledge sharing can help address these challenges and facilitate the adoption of best practices.

Practical constraints may limit the feasibility of physical labelling, particularly for small components such as connectors and wires. In sectors with complex value chains, such as the electrical and electronic equipment industry, information flow and the identification of newly regulated substances can be challenging, potentially delaying information on POPs content in final products and articles. The CVMA/ACEA argue that labelling certain components or substances within complex durable articles may be ineffective because dismantlers might not be able to read the labels, or access and separate components easily even if they could be identified. Furthermore, the UK's experience with waste POPs sampling studies reveals that labels often do not survive the waste management process, becoming unreadable. However, linking physical labels to databases (e.g., material passports) could help identify parts where physical labelling is impractical. Physical labels could carry product identifiers linked to digital labels, allowing for scanning with a dedicated app (even from fragmented products and articles). Whilst this could aid identification, it would not resolve practical issues regarding access and separation at end of life for certain products and articles.

Several Parties and observers view labelling as crucial and advocate for detailed information on product labels. They suggest that labels should link to an online platform hosting a comprehensive risk sheet (i.e., a digital product passport) that discloses the product formula, contaminants, and their maximum expected quantities, as well as their impacts on human health and the environment and any other relevant information for regulators, waste handlers etc. This information could be updated remotely as regulations and research evolve, reducing the need for resource-intensive testing. Mandating digital labelling could provide a more suitable solution, avoiding fragmented standards and simplifying international trade by aligning reporting requirements globally. However, there remain concerns over the feasibility of identifying specific POPs and their concentration limits which requires global consensus and sensitivity over data sharing.

Developing a globally harmonised database is considered essential by some Parties and observers. This would require manufacturers to submit information about the chemicals used in their products and articles to a publicly accessible database in a standard electronic format. Such a database would link to unique product identifiers, allowing for traceability of chemical data and reducing the burden of multiple national standards. However, existing databases, such as SCIP, are criticised for not being widely used and for placing disproportionate administrative burdens on manufacturers. However, some argue that without better identification or labelling, the burden of managing POPs falls on importers and downstream operators rather than on the companies that profit from these products and articles. Comprehensive, harmonised digital labelling could alleviate this burden by aligning reporting requirements and reducing parallel systems. However, whilst a digital database would be valuable, it is contingent on the data quality and completeness which could vary considerably without proper enforcement which will add burden to authorities and regulators.

Nevertheless, it is important to consider how the information will be conveyed to the handler at each point in the value chain. When developing a labelling system or other means of identification, clarity regarding its purpose is crucial. It should be clearly defined whether the purpose of identification is to: facilitate information to users (e.g., consumers) who may be exposed to it, to support safe management practices within professional/industrial settings, to ensure environmentally sound disposal at its end of life within waste handling/management facilities or a combination of all of these. It is important to consider the intended users and settings for the identification system. For example, labelling or data sheets may be most effective in industry or professional settings where additional guidance and training are available whereas for waste handlers, consideration should be made such that identification is rapid and can be picked up during end-of-life systems (e.g. visual identification).

observers, including ACAT/IPEN and Health and Environment Justice Support, conclude that while voluntary initiatives are valuable, legal requirements are necessary to ensure a level playing field and meet the Stockholm Convention's objectives of protecting human health and the environment. They argue that transparency and traceability must be based on feasibility and globally harmonised to avoid placing undue burdens on states and downstream operators. Improved digital means of identification and information exchange would support the reduction of POPs releases as mandated under Article 9 of the Stockholm Convention.

REFERENCES

Babayemi, J. O., Osibanjo, O., Sindiku, O., & Weber, R. (2018). Inventory and substance flow analysis of polybrominated diphenyl ethers in the Nigerian transport sector – Contribution for end-of-life vehicles policy and management. *Environmental Science and Pollution Research International*, 25, 31793-31928.

Babayemi, J., Sindiku, O., Osibanjo, O., & Weber, R. (2015). Substance flow analysis of polybrominated diphenyl ethers in plastic from EEE/WEEE in Nigeria in the frame of Stockholm Convention as a basis for policy advice. *Environmental Science and Pollution Research International*, 22, 14502-14514.

Chemsafety Pro. (2016). *Introduction to chemical regulations in Indonesia*. Available at: https://www.chemsafetypro.com/Topics/Indonesia/Introduction_to_Chemical_Regulations_in_Indonesia.html.

Chen, S. J., Ma, Y. J., Wang, J., Chen, D., Luo, X. J., & Mai, B. X. (2009). Brominated flame retardants in children's toys: Concentration, composition, and children's exposure and risk assessment. *Environmental Science & Technology*, 43(11), 4200-4206.

Center for Regulation, Policy and Governance. (2017). *Chemical management in Indonesia: Present and future (Analysis on the draft of chemical management law and the draft revision of Government Regulation No. 74/2001 on hazardous and toxic substances and their relations)*. Available at: https://cloud.crpg.info/docs/paramita.pdf.

Dhandapani, R., & Tackett, B. (2022). Top 10 considerations for persistent organic pollutants analysis by gas chromatography. *The Column*, 18(8), 30-35. Available at: https://www.chromatographyonline.com/view/top-10-considerations-for-persistent-organic-pollutants-analysis-by-gas-chromatography.

European Chemicals Agency (ECHA). (2015). *Guidance on information requirements and chemical safety assessment chapter R.12: Use description*. Available at: https://echa.europa.eu/documents/10162/17224/information_requirements_r12_en.pdf.

European Commission. (2002). Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) – Joint declaration of the European Parliament, the Council, and the Commission relating to Article 9. *Official Journal of the European Communities*, L 37/24. Available at: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32002L0096.

European Commission. (2006). *Stockholm Convention on persistent organic pollutants. Official Journal of the European Communities*, L 209/3. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:22006A0731(01).

European Commission. (2008). *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. Official Journal of the European Communities*, L 353/1. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R1272.

European Commission. (2009). Directive 2009/81/EC of the European Parliament and of the Council of 13 July 2009 on the coordination of procedures for the award of certain works contracts, supply contracts and service contracts by contracting authorities or entities in the fields of defense and security, and amending Directives 2004/17/EC and 2004/18/EC. *Official Journal of the European Communities*, L 67/612. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0081.

European Commission. (2011). 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. *Official Journal of the European Communities*, L 174/88. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011L0065.

European Commission. (2018). *Guidelines for the management of the European Union Rapid Information System 'RAPEX' established under Article 12 of Directive 2001/95/EC (the general product safety directive) and its notification system*. Available at: https://eur-lex.europa.eu/EN/legal-content/summary/guidelines-for-the-eu-rapid-information-system-safety-gate-formerly-rapex.html.

European Commission. (2019). *Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants (recast)*. *Official Journal of the European Communities*, L 169/45. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1021.

European Commission. (2022). *Regulation of the European Parliament and of the Council establishing a framework for setting ecodesign requirements for sustainable products and articles and repealing Directive 2009/125/EC*. COM(2022) 142 final. Available at: https://eur-lex.europa.eu/resource.html?uri=cellar:bb8539b7-b1b5-11ec-9d96-01aa75ed71a1.0001.02/DOC_1&format=PDF.

European Commission. (2024). *Regulation (EU) 2024/1781 of the European Parliament and of the Council of 13 June 2024 establishing a framework for the setting of ecodesign requirements for sustainable products*. PE/106/2023/REV/1. Available at: https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-and-articles-labelling-rules-and-requirements/sustainable-products-and-articles/ecodesign-sustainable-products-and-articles-regulation_en#the-new-digital-product-passport.

Eskoy, R. (2015). *Product registers in Europe*. Available at: http://spin2000.net/wp-content/uploads/2015/05/registers_in_europe.pdf.

European Parliamentary Research Service (EPRS). (2024). *Digital product passport in the textile sector*. Available at: https://www.europarl.europa.eu/cmsdata/281452/05.1.a.%20EPRS_STOA_STUD_757808_DPP_textile_DraftPanel.pdf.

Food and Agriculture Organization (FAO). *Pesticide registration toolkit*. Available at: https://www.fao.org/pesticide-registration-toolkit/special-topics/highly-hazardous-pesticides-hhp/identification-of-hhps/hhp-criteria-5/en/.

Global Automotive Stakeholder Group (GASG). (2023). *Global Automotive Declarable Substance List (GADSL)*. GASG. Available at: https://www.gadsl.org/wp-content/uploads/2022/08/GADSL-Guidance-Document.pdf.

Government of Canada. (2024). *Canadian Environmental Protection Act, 1999*. (S.C. 1999, c. 33). Available at: https://laws-lois.justice.gc.ca/eng/acts/c-15.31/.

Hirobe, M., Goda, Y., Okayasu, Y., Tomita, J., Takigami, H., Ike, M., & Tanaka, H. (2006). The use of enzyme-linked immunosorbent assays (ELISA) for the determination of pollutants in environmental and industrial wastes. *Water Science and Technology*, 54(11-12), 1-9. https://doi.org/10.2166/wst.2006.735.

Kutarna, S., et al. (2023). Widespread presence of chlorinated paraffins in consumer products and articles. *Environmental Science: Processes & Impacts*, 25(5), 893–900. https://doi.org/10.1039/d2em00494a.

Lee, J. Y., & Lee, H. K. (2016). Analytical methods for monitoring POPs. In *Monitoring and Governance of Persistent Organic Pollutants in Asia* (pp. 17-24). https://doi.org/10.18356/34628e40-en.

Li, et al. (2023). What do we know about the production and release of persistent organic pollutants in the global environment? *Environmental Science: Advances*, 2, 55-68. https://doi.org/10.1039/D2VA00145D.

Mach, V., et al. (2021). Heavy metals in selected areas in the Dniester River basin. *Environmental Science Processes and Impacts*, 5–41. Available at: https://www.researchgate.net/publication/359524297_Part_I_Heavy_metals_in_selected_areas_in_the_Dniester_River_basin.

Minister of Trade. (2002). Regulation no. 40 of 2022 concerning amendments to Regulation of the Minister of Trade Number 18 of 2021 concerning export of prohibited goods and import of prohibited goods. *Minister of Trade, Indonesia*. Available at: https://leap.unep.org/en/countries/id/national-legislation/regulation-minister-trade-no-40-2022-concerning-amendments.

Oloruntoba, K., Sindiku, O., Osibanjo, O., Balan, S., & Weber, R. (2019). Polybrominated diphenyl ethers (PBDEs) in chicken eggs and cow milk around municipal dumpsites in Abuja, Nigeria. *Ecotoxicology and Environmental Safety*, 179, 282-289. https://doi.org/10.1016/j.ecoenv.2019.04.045.

Petrlik, J., Bell, L., DiGangi, J., Allo'o Allo'o, S. J., Kuepouo, G., Ochola, G. O., Grechko, V., Jelinek, N., Strakova, J., Skalsky, M., Drwiega, Y. I., Hogarh, J., Akortia, E., Teebthaisong, A., Carcamo, M., Beeler, B., Behnisch, P., Baitinger, C., Herold, C., & Weber, R. (2022). Review: Monitoring of dioxins and PCB in eggs as sensitive indicator for environmental pollution and contaminated sites and recommendations for reducing and controlling releases and exposure. *Emerging Contaminants*, 8, 254-279. https://doi.org/10.1016/j.emcon.2022.05.001.

Puype, F., Samsonek, J., Knoop, J., & Egelkraut-Holtus, M. (2015). Evidence of waste electrical and electronic equipment (WEEE) relevant substances in polymeric food-contact articles sold on the European market. *Food Additives & Contaminants Part A: Chemistry, Analysis, Control, Exposure & Risk Assessment*, 32, 410-426.

Samsonek, J., & Puype, F. (2013). Occurrence of brominated flame retardants in black thermo cups and selected kitchen utensils purchased on the European market. *Food Additives & Contaminants Part A: Chemistry, Analysis, Control, Exposure & Risk Assessment*, 30(11), 1976-1986. https://doi.org/10.1080/19440049.2013.829246.

Secretariat of the Basel, Rotterdam and Stockholm Conventions. (2019). *Guidance on the labelling of products and articles that contain POPs*. Available at: https://nips.pops.int/Guidance_docs/Document_2_5_2.pdf.

Sharkey, M., Drage, D., Harrad, S., Stubbings, W., Rosa, A. H., Coggins, M., & Berresheim, H. (2022). POP-BFRs in consumer products and articles: Evolution of the efficacy of XRF screening for legislative compliance over a 5-year interval and future trends. *Science of the Total Environment*, 853, 158614.

United Nations. (2011). *Globally Harmonized System of Classification and Labelling of Chemicals*. United Nations. Available at: https://unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev04/English/ST-SG-AC10-30-Rev4e.pdf.

United Nations Environment Programme (UNEP). (2017). *Guidance on developing and updating National Implementation Plans (NIPs)*. Available at: https://www.pops.int/tabid/7730.

United Nations Environment Programme (UNEP). (2019). *Guidance on the labelling of products and articles that contain POPs.* Available at: https://www.pops.int/tabid/7730.

United Nations Environment Programme (UNEP). (2021). *Guidance on preparing inventories of PCN.* Available at: https://www.pops.int/tabid/7730.

United Nations Environment Programme (UNEP). (2023). *Guidance for the inventories of PFOS, PFOA and PFHxS*. Available at: https://www.pops.int/tabid/7730.

Weber, R., Watson, A., Forter, M., & Oliaei, F. (2011). Persistent organic pollutants and landfills: A review of past experiences and future challenges. *Waste Management & Research*, 29, 107-121.

APPENDIX: EXCERPT OF THE FORMAT FOR NATIONAL REPORTING PURSUANT TO ARTICLE 15

Part B Section V. Article 6: Measures to reduce or eliminate releases from stockpiles and wastes

Note: The references in Section V to the terms "pesticides" and "industrial chemicals" are solely for the purpose of ease of identification of the chemicals in question and are used without prejudice to the provisions of the Convention or the interpretation thereof. The text of the Convention refers to "chemical" or "persistent organic pollutants".

15. Has your country developed strategies for identifying stockpiles consisting of, or containing, chemicals listed in either Annex A or Annex B to the Convention, in accordance with paragraph 1(a)(i) of Article 6 of the Convention? If yes:

> 15.1.a Please select the year(s) in which the strategies were developed for pesticides listed in annexes A or B.
>
> 15.1.b Please select the type of chemicals and the year(s) in which the strategies were developed for industrial chemicals listed in annexes A or B.

16. Has your country identified stockpiles consisting of, or containing, chemicals listed in Annex A or Annex B to the Convention, in accordance with paragraph 1(b) of Article 6 of the Convention? If yes:

> 16.1.a Please select the year(s) in which the stockpiles were identified for pesticides listed in annexes A or B.
>
> 16.1.b Please select the type of chemicals and the year(s) in which the stockpiles were identified for industrial chemicals listed in annexes A or B.

16.2 Has your country quantified the stockpiles consisting of, or containing, chemicals listed in Annex A or Annex B to the Convention? If yes:

> 16.2.a Please select the year(s) in which the measures were taken for pesticides listed in annexes A or B.
>
> 16.2.b Please select the type of chemicals and the year(s) in which the measures were taken for industrial chemicals listed in annexes A or B.

[…]

18. Has your country developed strategies for identifying products and articles in use and wastes consisting of, containing, or contaminated with chemicals listed in Annex A, B or C, in accordance with paragraph 1(a)(ii) of Article 6 of the Convention?

18.1.a Please select the year(s) in which the strategies were developed for pesticides listed in annexes A or B.

18.1.b Please select the type of chemicals and the year(s) in which the strategies were developed for industrial chemicals listed in annexes A or B.

[...]

www.pops.int

Secretariat of the Stockholm Convention

Office address:

United Nations Environment Programme (UNEP)
International Environment House 1
11-13 Chemin des Anémones
CH-1219 Châtelaine GE
Switzerland

Postal address :

Palais des Nations
Avenue de la Paix 8-14
CH-1211 Genève 10
Switzerland

Email: brs@un.org

Layout and Printing at United Nations, Geneva – 2420451 **(E)** – December 2024 – 200 – **UNEP/BRS/2024/3**