



**Conference of the Parties to the Stockholm
Convention on Persistent Organic Pollutants
Tenth meeting**

Geneva, 26–30 July 2021 and 6–17 June 2022**
Agenda item 5 (d)

**Matters related to the implementation of the
Convention: implementation plans**

**Draft guidance on information collection for industrial
persistent organic pollutants**

Note by the Secretariat

As is mentioned in the note by the Secretariat on the implementation plans (UNEP/POPS/COP.10/10), the annex to the present note sets out a draft guidance on information collection for industrial persistent organic pollutants. The present note, including its annex, has not been formally edited.

* Reissued for technical reasons on 23 February 2022.

** In accordance with decisions BC-15/1, RC-10/2 and SC-10/2 of the conferences of the Parties to the Basel, Rotterdam and Stockholm conventions, the 2021/2022 meetings of the conferences of the Parties are being held in two segments: an online segment held from 26 to 30 July 2021 and a face-to-face segment to be held from 6 to 17 June 2022 in Geneva.

Annex

Draft guidance on information collection for industrial persistent organic pollutants

Guidance for identifying sectors using industrial POPs, collecting information on POPs including those contained in products and on labelling for the chemicals listed in Annexes A and B

February 2022

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1. Introduction

Stockholm Convention lists 30 persistent organic pollutants (POPs), of which 14 are used as industrial chemicals. The sectors and supply chains using industrial POPs are very complex compared to agricultural and forestry sectors using pesticides. Even relatively simple products, such as outdoor clothing, could contain many POPs that have been used at different levels of the production process. Tracing the chemicals used in the supply chain and ensuring compliance with potential regulations, could be challenging.

The need for the functionality provided by a POP in any product could be driven e.g., by regulatory requirements (e.g. building code requiring the use of flame-retardant or self-extinguishing materials), safety (e.g. insurance companies requiring the use of flame-retardant materials), performance (e.g. flexibility, plasticity, corrosion-resistance) or convenience (stain and water repellency; ease of use). It is useful to consider this when beginning to investigate whether certain POPs might be used in the country. Understanding the reasons for these uses is especially important.

Parties to the Stockholm Convention must identify uses of POPs in their countries. Article 6 of the Convention requires parties to develop strategies for identifying stockpiles consisting of or containing chemicals listed in Annexes A and B, in order to ensure their management in an environmentally sound manner. The Convention does not specify whether articles containing POPs should be considered as stockpiles. While Parties could have different interpretations and strategies, e.g. in the European Union holders of articles containing POPs must notify them as stockpiles in line with Article 6 of the Stockholm Convention.

The wastes must be managed according to the provisions laid out in Article 6 of the Convention. This has proven challenging for many new POPs that are still in use. As a consequence, POPs may end up in new products and articles through material recycling (see e.g. Brosché et al. 2021).

It would also be beneficial for a Party to identify uses of chemicals that have been nominated for inclusion in the Stockholm Convention. Better understanding on the national needs and circumstances would benefit the negotiations, when exemptions for production and use could be discussed based on information that accurate and up-to-date. Requests for exemptions that are not needed complicate the decision-making and undermine the work of the POPs Review Committee (POPRC).

The identification production and needs for industrial POPs throughout their life cycle is a challenge when listing new chemicals in the Convention. The purpose of this document is to look at the inventory process from a different, sector-specific angle, to assist country experts and authorities in addressing all relevant POPs anticipated to be of interest for a certain sector at one go, to avoid several processes that follow from addressing POPs substance by substance. It is hoped that this will make the inventory process more comprehensive and save in time and costs in both the administration and the industry.

This document focuses on intentionally used applications for industrial POPs. It does not address presence of POPs in unintentional application due to e.g. use of recycled materials.

Although the objective is to take stock of all present and past known applications, those POPs which are not believed to be in production anymore and hence have no current use, are excluded. Brominated flame-retardants commercial pentabromodiphenyl ether (c-pentaBDE) (listed as tetra- and pentaBDE; production discontinued in ca. 2004), commercial octabromodiphenyl ether (c-octaBDE) (listed as hexa- and heptaBDE; no known production), and hexabromobiphenyl (HBB; production ceased several decades ago) are not included. Furthermore, the industrial chemicals polychlorobiphenyls (PCB), polychlorinated naphthalenes (PCN), pentachlorobenzene (PeCB) are also excluded from this guidance as there are no known production or use. All such POPs, nevertheless, can be and are likely still present in articles in use and in waste.

The remaining 8 industrial POPs, with potential continued use and addressed in this guidance, include historical uses that have been prohibited in the Stockholm Convention listing. The Parties are, therefore, encouraged to refine the scope of their national inventory activities based on their national circumstances, such as existing restrictions e.g. following ratification of the Convention.

The information below is based on the work of POPRC, substance-specific inventory guidance documents developed by the Secretariat, information from the respective industries (including during the listing process), and available open literature and assessments.

2. Existing guidance for inventories

The Secretariat of the Basel, Rotterdam, and Stockholm Conventions has developed a series of guidance documents to assist countries in making inventories for individual POPs. They comprise a general introduction to the inventory approach to be used in conjunction with detailed substance-specific inventory guidance documents. The detailed guidance documents provide examples on approaches and information sought, including questionnaires.

The following guidance documents for preparing inventories are already available:

- General Guidance on POPs Inventory Development (June 2020) (UNEP 2020);
- Guidance on preparing inventories of perfluorooctane sulfonic acid (PFOS) and related chemicals listed under the Stockholm Convention on Persistent Organic Pollutants (UNEP 2017a);
- Draft guidance on preparing inventories of polybrominated diphenyl ethers (PBDEs) listed under the Stockholm Convention on Persistent Organic Pollutants. (UNEP 2021a);
- Draft guidance on preparing inventories of hexabromocyclododecane (HBCD) (UNEP 2021b);
- Draft Guidance on preparing inventories of short-chain chlorinated paraffins (SCCPs) (UNEP 2021c);
- Draft guidance on sampling, screening and analysis of persistent organic pollutants in products and recycling (UNEP 2021d);
- Draft guidance on preparing inventories pentachlorophenol and its salts and esters (UNEP 2021e).

3. Existing guidance on identifying POPs

In addition to industrial POPs having a variety of uses on different levels of supply chain, there are additional difficulties in identification of their uses. Often information on their presence in the mixtures, materials, products and articles is not conveyed up the chain from the raw material producers or parts manufacturers to the end-user whether it be the industry or the individual consumer. Although there are global agreements on how chemical preparations should be labelled and classified, the concentrations of POPs used are sometimes below the thresholds. Furthermore, once incorporated into materials and end-products and articles, the information on chemicals contained in them is usually not available, making it difficult for the end-user to know. Thus, the information sought by the government expert for inventories, may not simply be known and must be acquired through chemical analyses in the laboratory.

BRS Secretariat has developed guidance documents to address these issues:

- Guidance for the control of the import and export of POPs under the Stockholm Convention (UNEP 2019b);
- Guidance on the labelling of products and articles that contain POPs (UNEP 2019c);
- Draft guidance on sampling, screening and analysis of persistent organic pollutants in products and recycling (UNEP 2021d).

4. Identification of products and articles containing POPs

Labelling products and articles containing a POP is required in the listing decisions of hexabromocyclododecane (HBCD) and pentachlorophenol (PCP) as recommendation to ensure that they can be identified throughout their lifecycles. These provisions are related to only production and use taking place under the specific exemption and is therefore not relevant for non-ratified parties. Labelling is also required for polychlorinated biphenyls (PCB) (Annex A, Part II, para. a (i and ii)).

A specific label in the chemical, mixture, product or articles identifying it contains a POPs would facilitate the control of POPs and the implementation of the Convention through the supply chain and communicate their hazards when they are marketed and traded (UNEP 2019a). That is not typically, however, the case and the identification of POPs is based on information from the manufacturer or chemical analyses (see UNEP 2021d).

The voluntary Globally Harmonized System of Classification and Labelling of Chemicals (GHS) is an international harmonized standard for classification of chemicals and mixtures and hazard communication via labelling and safety data sheets. It is the predominant system for classification and labelling of chemicals as substances and mixtures and can be useful for all POPs chemicals, but it does not cover articles.

The Secretariat has developed a draft guidance to assist countries in sampling, screening and analysis of persistent organic pollutants in products and recycling (UNEP 2021d). National inventories, however, cannot be based on

laboratory analyses and the tiered approach outlined in the General inventory guidance (UNEP 2020) should be followed:

The first phase (**Tier I**) in the inventory is to make an initial assessment on the production and use of the POP in the country based on available information. The outcome could be a literature study complemented with information in the inventory team stakeholders. A full picture of the particular POP may not be achieved based only on available information, but the workplan and scope of the inventory may be further refined by e.g. being able to exclude some applications in the country.

In the second phase (**Tier II**), further information (and likely the main body of the information) is collected through interviews and questionnaires to stakeholders, i.e. producers, users, users of the products/articles consisting of, containing or contaminated with the POP, waste managers etc. Based on information from the producers and users of the POP, the team should have a reasonable understanding on the flows and uses of the chemical in the country as well as the magnitude and concerned sectors of stockpiles and materials containing the chemical.

In the third phase (**Tier III**), in-depth information can be acquired for sectors of special interest and uses of importance to fill-in gaps in the information through chemical analyses and site visits. Analyses are usually expensive and require a lot of technical expertise. Moreover, analytical methods may not be readily available for some POPs.

Basel Convention has developed a set of guidelines assisting parties in identifying waste consisting, containing, or contaminated with POPs. These guidelines contain information available of uses of POPs in the manufacture of products and articles as well as loads used for different applications and can be helpful in identifying the relevant types of industry:

- General technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants (General POPs) (UNEP 2019d);
- Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with hexabromodiphenyl ether and heptabromodiphenyl ether, or tetrabromodiphenyl ether and pentabromodiphenyl ether (POP-PBDEs) (UNEP 2015a);
- Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with hexachlorobutadiene (HCBd) (UNEP 2017b);
- Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with pentachlorophenol and its salts and esters (PCP) (UNEP 2017c);
- Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with hexabromocyclododecane (HBCD) (UNEP 2015b);
- Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOSF) (UNEP 2015c).

5. Identifying relevant stakeholders

General guidance on POPs inventory (UNEP 2020) and detailed inventory guidance documents contain lists of suggested stakeholders, which are dependent on the chemical in question and its uses. They need to be identified and contacted during the process.

For industrial POPs, the stakeholders could include the producers and/or importers, environmental authorities, chemicals registration authorities (as appropriate), chemicals trade and associations and relevant industry associations, manufacturers and users' organizations and larger enterprises using the POP, relevant research and educational institutions, and consumer and environmental NGOs. All areas with continued use should be included.

Especially with industrial POPs used in the production of materials, equipment, products/articles, or those sold for household use, the information on uses and amounts may only be available from the relevant industry and trade. Therefore, special effort should be put to list all relevant stakeholders in the country who might have information on the POP. Identifying stakeholders that produce, import and use the chemical can be used in the future for direct outreach when regulations change etc.

Tracking the use of POPs in different stages of the supply chain is difficult because of the large number actors in different stages of the life-cycle of the chemical and the often a large variety of applications in many sectors. The

information on chemicals used contained in the materials is seldom conveyed to downstream in the supply chain by means of labelling, material safety data sheets or other material. RPA (2014) provides an example of the supply chain for decaBDE (Figure 1), containing many stages which are relevant for making an inventory of POPs as well.

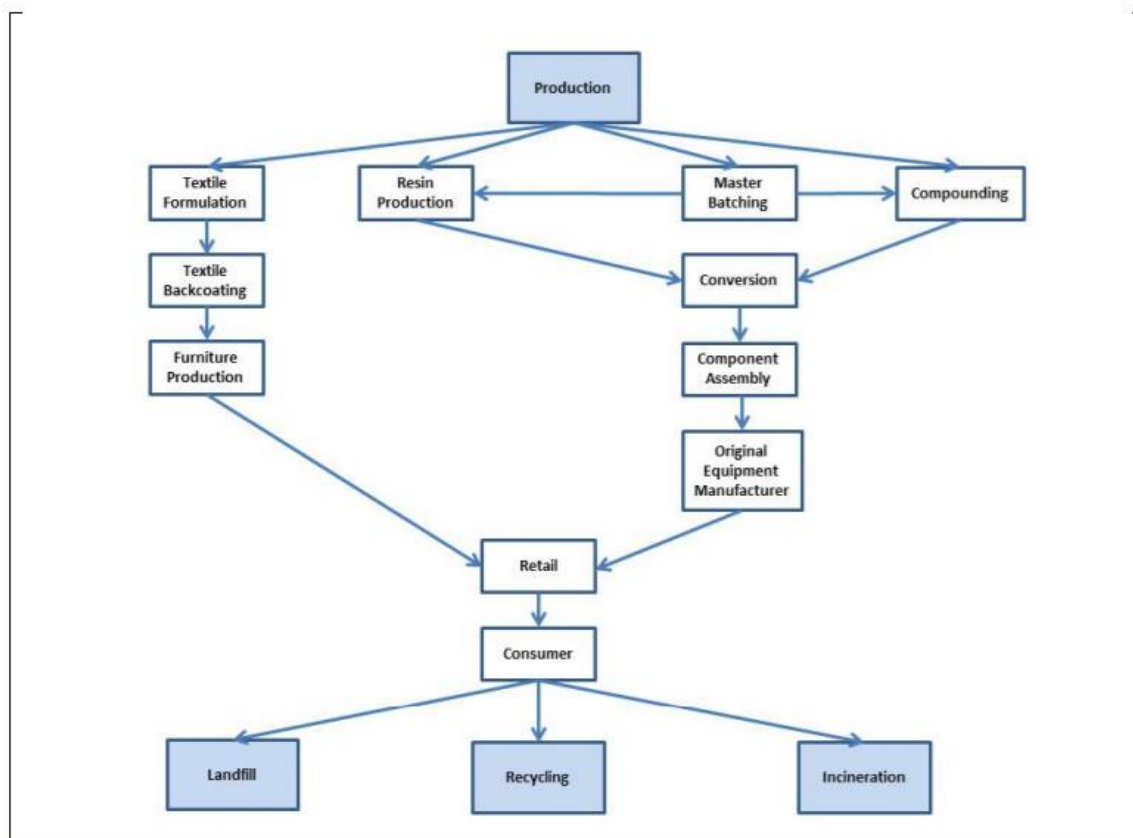


Figure 1. Schematic representation of decaBDE supply chain (RPA 2014). DecaBDE example is applicable to most industrial POPs that are used in different levels of supply chain.

Information on POPs in the country should be sought from different actors, depending on which are relevant for the country. The following elements are adapted from the decaBDE example in RPA (2014):

- Production of the chemical: Production of industrial POPs is mostly very specialized industry and does not take place in all countries. Countries where manufacture takes place have usually been identified in the risk profile documents prepared by the POPRC (see www.pops.int);
- Import of chemicals, mixtures, and articles: POPs could be imported for use as chemicals or already formulated mixtures (such as extended polystyrene (EPS) raw material (beads) or surface treatment chemicals) or products and articles containing POPs (such as spare parts for autos) for further processing or retail. Importers of chemicals may have information on the downstream use in the country or be retailers themselves;
- Formulation: Formulation refers to the mixing and blending of the substance in a mixture for textiles or plastics, adhesives, sealants or coatings. In the case of e.g. decaBDE and HBCD, this could mean the compounding process where the flame-retardant is mixed with plastic and other additives (e.g. EPS raw material production), or the formulation of the coating mixture for textiles. Formulators may have information on the subsequent users of the POPs in the country;
- Industrial use of chemical or mixture: This refers to the use of the mixture or substance in an industrial context. Flame-retardants and surface treatment chemicals are intended to be included in or on the article matrix. Conversion of plastic compounds in semi-finished or finished articles and coating of textiles fall in this category;
- Article manufacture with textile or plastic components or by application of adhesives, sealants or coatings: This life cycle stage concerns use by a large number of users. This could include e.g. the use of textiles as upholstery by professionals.

Table 1. Industrial sectors and relevant POPs. (x) = production discontinued, but could be formed as a by-product for continued use. Note that the table reflects substances believed to be in current use and placed on the market. No production and hence use of c-penta-BDE, c-octa-BDE, HBB, PCB, PCN, and PeCB is believed to take place anymore. They can be found in articles in use, especially in energy and construction sectors, where the waste must be managed according to Article 6 of the Convention.

Production Sector	DecaBDE	HBCD	HCB	HCBD	PCP	PFOA, its salts and PFOA-related compounds	PFOS	SCCPs
Chemicals industry ¹	x	x	(x)	(x)	x	x	x	x
Construction materials	x	x			x		x	x
Electric and electronic appliances	x	x		x				
Semi-conductors						x	x	
Automotive parts	x	x				x	x	
Aviation parts	x					x	x	
Medical equipment						x	x	
Leather					x	x	x	x
Plastics	x	x				x	x	x
Rubber				x				x
Textile	x	x			x	x		
Metal industry							x	x
Mining								x
Petrochemical							x	x
Forestry					x			
Agriculture							x	
Fire-fighting						x	x	
Fireworks			x					

¹ Chemicals industry contains the production of chemicals as well as production of mixtures such as glues and paints.

6. Chemicals industry

Chemicals industry either produces industrial POPs (e.g. flame-retardants or solvents), uses them as intermediates (e.g., perfluorooctanoic acid (PFOA)) or ingredients for preparations (e.g. SCCPs in metalworking fluids). Most of the industrial POPs are brominated flame retardants (c-decaBDE, HBCD, also SCCPs) which are produced by a specialized industry and small number of companies. Some POPs are still in use (PeCB, HCB) as industrial solvents or pesticides. HCB may also be formed as a by-product in the production of other chlorinated solvents.

There is no specific guidance available for addressing the chemicals industry. It is recommended to contact chemicals industry associations or stakeholder directly.

Guiding questions:

Is there chemicals industry producing chlorinated, brominated or fluorinated chemicals in the country?

Is there industry in the country that produces flame-retardants?

Where are chemicals imported from?

7. Construction sector

Construction sector covers construction materials containing POPs. These include piping, insulation materials, adhesives, sealants, paints, and textiles (predominantly public buildings). Use of POPs could be driven by e.g. fire-safety specifications for materials but POPs also have technical functions in materials, as plasticizers or making them repellent against dirt and water or corrosion.

In construction materials POPs are used as flame retardants (decaBDE and HBCD) and plasticizers (SCCPs, formerly also PCB and PCN) (Table 2). The use of flame retardants may be dictated by material flammability standards that define specific ignitability requirements for different materials and fire-safety regulations. Flame-retardant properties represent an extra cost for the material producers and the same materials may be available without flame-retardant.

In the past, other POPs (mainly penta-BDE and octa-BDE, PCB) have been used in various materials used in construction, but as there is no known production, they are currently only believed to be present in articles in use and waste.

PCN and PCB have been used from 1930s to 1980s in construction, in particular in sealants, coatings, paints, adhesives and cables (UNEP 2017f). PCP was a major wood preservative for buildings, stables and other constructions (UNEP 2017g; Huwe et al. 2004). Other POPs pesticides such as DDT, lindane, mirex, chlordane, and endosulfan were used as wood preservatives in construction.

DecaBDE has been used in the building and construction sector e.g. in polyurethane (PUR) and extruded polystyrene (XPS) insulation, cladding panels, PE/PP films, cables and electrical ducts and fittings or piping insulation. Continued use is allowed for the manufacturing of polyurethane foam for building insulation under Stockholm Convention. DecaBDE is used in a range of other polymers such as polyolefins (polyethylene (PE), polypropylene (PP), ethylene-vinyl acetate (EVA)), styrenics (polystyrene (PS), high impact polystyrene (HIPS), acrylonitrile butadiene styrene (ABS)), engineering Thermoplastics (polyethylene terephthalate (PET), polybutylene terephthalate (PBT), polyamide (PA), polycarbonate (PC), PC-ABS, PEE-HIPS), thermosets (unsaturated polyester (UPE), epoxies, melamine-based resins), elastomers (ethylene propylene diene monomer (EPDM) rubber, thermoplastic PUR, EVA), and waterborne emulsions and coatings (acrylic-, polyvinyl chloride (PVC)-, ethylene vinyl chloride- and urethane-emulsion) (UNEP/CHW.14/7/Add.3; UNEP 2021a).

SCCPs have been used as plasticisers in sealants and adhesives. SCCPs were contained in polymers such as acrylic and butyl sealants, polyurethanes, and polysulfides. In the construction sector these types of polymers were used for various applications, for example (RPA 2021):

- Filling of expansion and movement joints (horizontal and vertical);
- Filling of gaps around doors and windows;
- Sealants for water storage applications (reservoirs) and for protecting areas from oil and fuel spillages, areas around petrol stations, sewage treatment works;
- Sealants for underground facilities such as basements and subways but also for the waterproofing of constructions such as bridges and culverts;

- Sealants in waterproof roof coating.

HBCD has been a common flame-retardant for self-extinguishing grades of EPS and XPS insulation materials, furniture and decoration (and also packaging materials). Pure styrenic polymers like HIPS, EPS and XPS require flame retardants to reach the desired fire safety standards. HBCD has been used especially in 'one-step' EPS manufacturing process². A non-POP alternative has replaced HBCD in many countries starting from 2015, but HBCD is still used in many countries. As a bulky material, EPS is often expanded domestically, although the raw material ('beads') can be also imported. The concentrations at which HBCD is used depend on the polymer it is used with as well as the fire safety requirements the product needs to meet (UNEP/POPS/POPRC.7/19/Add.1). Therefore, there are regional differences in the amounts HBCD is applied³.

Use of PFOA, PFOS and other per- and polyfluoroalkyl substances (PFAS) in construction materials has been reported (Becanova et al. 2016; Green Science Policy Institute 2021). A specific application reported was phenolic insulation foams. These could also be present in stain and water repellent finishes (DWR) applied on the surface of carpets and upholstery. Both PFOS and PFOA, as other PFAS, have been produced for direct use in commercial products and use in industrial product streams.

The major worldwide use of PCP, since it was first produced in 1936, has been as a heavy-duty wood preservative, used for utility poles and cross-arms, pilings, railway ties, outdoor construction materials and as a remedial treatment of timber and as a surface biocide for masonry (UNEP 2021e). Use of PCP for impregnation of utility poles and cross-arms is an exempted use in the Convention listing.

Table 2. Known applications of industrial POPs in construction materials.

DecaBDE ⁴	PUR insulation (formerly also XPS)	Facing laminates for insulation panels	PE/PE films/plastic sheeting used under the roof and to protect building areas	Cladding panels	Cables	Electrical ducts and fittings	Piping insulation and pipes	Blinds and curtains	Paints and adhesives
HBCD	Expanded and extruded polystyrene insulation (EPS/XPS)	Molded EPS decorative elements, ornaments	Flame retardant textiles (HBCD in polymer dispersion)						
SCCPs	PUR foam insulation	PVC materials	Painted articles	Sealants					
PFOA, its salts and PFOA related compounds	Upholstery	Floor coverings, carpets	Composite wood materials	Wood fibre insulation					
PFOS	Upholstery	Floor coverings	Composite wood materials	Wood fibre insulation					
PCP	Wooden indoor and	Utility poles, cross-arms							

² 'One-step' EPS manufacturing process is used at least in Europe and generally in North America. In the 'one-step' production process all additives are mixed in the styrene solution prior to polymerisation. In the alternative 'two-step' process the beads are polymerized in the first step without the flame retardant additive and pentane; the possible flame retardant and pentane are added in the second step. In the 'two-step' process, the flame retardant must be able to penetrate into the ready-made bead. HBCD penetrates the beads poorly after polymerization, and therefore other flame retardants must be used in the "two-step" process (see HBCD Risk Management Evaluation UNEP/POPS/POPRC.7/19/Add.1).

³ Typically EPS 5,000-10,000 mg/kg; XPS 8,000-25,000 mg/kg (UNEP 2021b).

⁴ DecaBDE has been used in a wide range of polymers in the construction sector including polyurethane, polyethylene, polypropylene, and PVC (see Table 40 in UNEP 2021).

	outdoor structures								
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Addressing the construction sector for information on POPs

The inventory process should begin by addressing country specific fire-safety requirements for construction and building materials (e.g. building code). Depending on the local or national fire-safety regulations insulation materials, cladding panels, electrical ducts, textiles in public buildings (including hospitals and prisons), airports or hotels may be required flame retardant (UNEP/POPS/POPRC.6/13/Add.2; UNEP 2010a; Horrocks 2013).

A known challenge in making an inventory of use or POPs in construction materials or import of materials containing POPs is the likely large number of stakeholders. Production could be of different scales, from small and medium sized enterprises manufacturing e.g. plastic construction materials from raw-materials from a supply chain that could even be in another country. Usually, however, the need for flame-retardant properties is in the specifications.

For guidance on general approach to developing an inventory of POPs used in the construction sector, please consult the General inventory guidance (UNEP 2020). Also, specific guidance documents for HBCD (UNEP 2021b), PBDE including decaBDE (UNEP 2021a), PCP (UNEP 2021e), PFOS (UNEP 2017a and UNEP 2019a), and SCCPs (UNEP 2021c).

Basel Convention technical guidelines for environmentally sound management of waste containing, consisting or contaminated with POPs contains detailed information in uses of POPs in different stages of production cycle. The relevant guidelines are available for PBDEs (UNEP 2015a), HBCD (UNEP 2015b), PFOS (2015c), and PCP (UNEP 2017c).

Guiding questions:

What kind of construction material producers and suppliers are there in the country?

What fire-safety regulations or standards exist for construction materials in the country, e.g. in the building code, or even local requirements or regulations by fire authorities? Are there specific requirements for flame-retardancy in public buildings such as offices, hotels and theatres?

Are polystyrene insulation materials used in the country? Domestic production or imported?

Is there production of EPS raw material ('compounders') in the country or is it imported? From where?

Are there down-stream users producing EPS insulation panels, decorative elements or ornaments in the country? Where do they get their raw-material?

Is XPS used in construction? Imported or domestic?

8. Electronics industry

Electronics industry covers producers of electrical and electronic equipment (EEE) and components (Table 3). The most typical uses of POPs in electronics are as flame retardants in appliances that generate heat. Component where flame retardants are used include plastic housings, panels, and printed circuit boards of e.g. TVs, computers and monitors. There are several alternative flame retardants on the market that are not POPs, many of them brominated. Therefore, it should not be assumed that e.g. the presence of bromine would automatically indicate the use of POPs.

PFOA and its salts are used for the production of in fluoropolymer and fluoroelastomer coatings for high-voltage electrical wire and cables as well as in electronics, and semiconductor production (RPA 2021). Both PFOS and PFOA, as other PFAS, have been produced for direct use in commercial products and use in industrial product streams.

SCCPs have been generally used as plasticizers in flexible plastics and rubbers, and electronics are not their main application. Some uses have been identified, however, although some might be unintentional.

Table 3. Known applications of industrial POPs in electronics industry.

DecaBDE ⁵	Plastic housings, panels, printed circuit boards in flat screens, TV, CRT monitors & displays and small household	Cables and connectors		
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⁵ DecaBDE has been used in a wide range of polymers in the construction sector including polyurethane, polyethylene, polypropylene, and PVC (see Table 40 in UNEP 2021).

	appliances, IT & telecommunications consumer electronics			
HBCD	Production of casings for electronic and electric equipment (HIPS)	Styrene-acrylonitrile plastics		
PFOS	Semiconductor production; Photoresist and anti-reflective coatings for semiconductors; Etching agent for compound semiconductors and ceramic filters	Certain medical devices (such as ethylene tetrafluoroethylene copolymer (ETFE) layers and radio opaque ETFE production, in-vitro diagnostic medical devices, and CCD colour filters)	Photo masks in the semiconductor and liquid crystal display (LCD) industries	Electric and electronic parts for some colour printers and colour copy machines
PFOA, its salts and PFOA-related compounds	Semiconductor production; Photolithography or etch processes in semiconductor manufacturing	Fluoropolymer and fluoroelastomer coatings for high-voltage electrical wire and cables	Invasive and implantable medical devices	Manufacture of polytetrafluoroethylene (PTFE) and polyvinylidene fluoride (PVDF) for the production of industrial waste heat exchanger equipment
SCCP	Insulation of wire and cables	Consumer articles (such as toys, yoga mats, game controllers, water heaters)		

Addressing the electronic industry sector for information on POPs

For guidance on general approach to developing an inventory of POPs used in the electronics sector, please consult the General inventory guidance (UNEP 2020). Also, specific guidance documents for HBCD (UNEP 2021b), PBDE including decaBDE (UNEP 2021a), and SCCPs (UNEP 2021c) are relevant. Basel Convention technical guidelines for environmentally sound management of waste containing, consisting or contaminated with POPs contains detailed information in uses of POPs in different stages of production cycle. The relevant guidelines are available for PBDEs (UNEP 2015a), HBCD (UNEP 2015b), and PFOS (2015c).

Guiding questions:

What types of electronic and electrical appliance productions, including cables and printed circuit boards, exist in the country?

Is there semiconductor production?

Are the plastic raw materials for production of casings domestic or imported?

9. Automotive sector

Vehicles are complex articles made of thousands of parts. According to the European car manufacturers 75% of the parts in a car have been manufactured by about 1800 suppliers in up to 7 levels of supply chain (ACEA, XXXX) suggesting there could be a number of players in different levels belonging to this sector in the country. Even in countries where vehicles or their parts are not produced, they are serviced, parts are used and there are importers and distributors for parts.

Use of POPs in vehicles could be driven by e.g. fire-safety specifications for materials but POPs have also technical functions in materials, as plasticizers or making them repellent against dirt and water or corrosion. An example of specific materials used in cars and potentially containing POPs are fluoropolymers, which could be found in tubing and sealants.

Addressing automotive industry requires identifying all companies in the manufacturers' supply chain using POPs. Information on this could be requested from the end users, i.e. the manufacturer of the vehicle. However, the information on the chemical content seldom follows the product in the supply chain to the retail level and there is likely a significant number of companies with little understanding on the chemical content of parts that produce or import aftermarket spare parts for vehicles on the market.

Similar to construction sector, country-specific or regional product specifications, e.g. with regards to fire-safety, apply to vehicles. Chemical composition of a certain make and model could, therefore, vary in different regions and

data from one region is not automatically valid for others. In addition, the composition of parts and components has varied over time and applications for POPs may not be valid anymore.

DecaBDE has been used in upholstery and other textiles (e.g. seats, visors), reinforced plastic parts, and certain under the hood or dash polymers and cables (Table 4) (RPA 2021; UNEP 2021a). Such parts are commonly available from parts distributors and could be produced domestically or imported. DecaBDE could also be as a flame retardant in plastics for electric and electronic equipment (EEE) used in cars, such as radios and displays⁶.

HBCD has been used at least as a flame-retardant in upholstery (back-coating of fabrics especially for public transport vehicles). Little information, however, is available on which automotive textiles may contain HBCD, as various flame-retardants have been used for different fabrics. HBCD was detected in door trim fabrics and floor coverings but in none of the analysed seat fabrics in Japan (Kajiwara et al. 2014). HBCD has also been used in seat belts and thermal covers (protection from heat sources), as well as in the EPS insulation in cold storage trucks. Use of HBCD in vehicles is less common than decaBDE and it is assumed that especially in fabrics HBCD has been replaced because its high costs already long time ago.

PFOS has apparently been used in car interior foams. PFOA, its salts and PFOA-related compounds have been used in many different applications which could be found in vehicles as well.

PFOA, its salts or PFOA-related compounds are used for automotive applications for manufacture of polyfluoroethylene propylene (FEP) for the production of coating for high-voltage electrical wire and cables for power transmission and manufacture of fluoroelastomers car accessories. FEP are used in insulators, solder sleeves, use in various mechanical components (e.g. semiconductors, wiring, tubing, piping, seals, gaskets, cables) and (ECHA 2018; RPA 2021). Fluoroelastomers are used for O-rings, V-belts and plastic accessories for car interiors and as raw material for components such as low-friction bearings, seals, and lubricants.

SCCPs have been used as lubricant additives and as plasticisers in sealants and adhesives. SCCPs were contained in polymers such as acrylic and butyl sealants, polyurethanes, and polysulfides. In the automotive sector these types of polymers were used for various applications, for example sealants for windows and sealants that may act as intumescent (fire protection) coatings (RPA 2021).

Table 4. POPs used in automotive sector and their applications. Data are not exhaustive.

DecaBDE	Fabrics (upholstery)	Reinforced plastics	Under the hood polymeric parts: terminal/fuse block; high power wire and cable jacketing (e.g. spark plug wire);	Cables and heat shrinkable tubing/products	Electric and electronic components
HBCD	Upholstery	Seat belts	Thermal covers	Insulation (e.g. in cold storage trucks)	
PFOS	Car interior foam ⁷				
PFOA, its salts and PFOA-related compounds	Insulators, solder sleeves, use in various mechanical components (e.g. semiconductors, wiring, tubing, piping, seals, gaskets, cables) (ECHA 2018)	O-rings, V-belts and plastic accessories for car interiors; raw material for components such as low-friction bearings & seals, lubricants (ECHA 2018)	Electronics	Textiles and leather: Car seats and carpets	

⁶ According to a Swiss study deca-BDE was the dominant BDE in EEE (Taverna et al. 2017) but this could vary regionally.

⁷ Becanova et al. 2016.

SCCP	Lubricant additives				
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Addressing the automotive sector for information on POPs

For guidance on general approach to developing an inventory of POPs used in the automotive sector, please consult the General inventory guidance (UNEP 2020). Also, specific guidance documents for HBCD (UNEP 2021b), PBDE including decaBDE (UNEP 2021a), PFOS (UNEP 2017a), and SCCPs (UNEP 2021c) are relevant. Basel Convention technical guidelines for environmentally sound management of waste containing, consisting or contaminated with POPs contains detailed information in uses of POPs in different stages of production cycle. The relevant guidelines are available for PBDEs (UNEP 2015a), HBCD (UNEP 2015b), and PFOS (2015c).

Typically, automotive spare parts are imported by either official importers or retail directly. Addressing the origin and the composition of the parts may therefore be laborious. The supply chains can also be complex and have many levels and it will require thorough investigation and communication with the stakeholders to be able to gain understanding on production and supply issues.

Guiding questions:

Does automotive manufacture exist in the country?

Are there industries producing components, such as cables, gaskets or plastic parts for vehicles?

Are the raw-materials domestic or imported (e.g. plastic pellets)?

What fire-safety regulations or standards apply for transportation sector?

Are the importers of automotive parts and spare parts recognizable?

Is there direct import from abroad by retailers? Where do they import the parts?

10. Textile industry and leather

Textiles and leather are produced in some form in almost every country, although majority of textiles is nowadays produced in Asia. POPs are used in textiles to e.g. achieve fire-safety, durability, dirt and water repellence or protection against microbial decay (Table 5). Information on the chemical contents of textiles seldom accompanies the final product so accessing the information on the retail level may be difficult. Chemicals are used in the supply chain and communicated through specifications, if any.

In the textile sector, c-decaBDE has been used to treat a wide range of synthetic, blended and natural fibres. Main end uses are upholstery, window blinds, curtains, mattress textiles, tentage (e.g. military tents and textiles, also commercial marquees, tents and canvasses) and transportation (e.g. interior fabrics in cars, rail passenger rolling stock and aircraft) (UNEP 2021a). Although use has been restricted with the listing into Stockholm Convention in 2019, several exemptions were granted and few countries have ratified the amendment.

SCCPs have been used as a flame-retardant for textiles and as fat liquoring agents in the leather industry (RPA, 2121; UNEP 2021c). Commercial and military tents were impregnated (i.e. 'dry proofing' of heavy textiles) using SCCPs. SCCPs were used as a flame retardant in backcoating of textiles, for example textiles in upholstery or workwear of industrial workers. It is not known whether SCCPs are still used for these applications.

Chlorinated paraffins, including SCCPs, are used in leather treatment for light-fastness and a dry surface feel mainly in leathers for the top end of the quality range. This may include leather used for furniture, clothing or car seats. Different chlorinated paraffin mixtures are used in leather treatment and SCCPs were already phased out in some regions (e.g. EU). SCCPs have also been used in textile finishing as flame-resistant and water repellent in military tenting, sail cloths and industrial protective clothing and tarpaulins (ECB 2000). Typical applications for back-coated textiles included furniture upholstery, seating upholstery in transport applications, and interior textiles such as blinds and curtains (see UNEP; 2021c). These uses may be phased out, as need for them was not raised by any Party during the SCCP listing process.

A typical car contains 20-30 kg textiles (Sinha and Taylor 2015), and automotive industry is a large client for textile industry. Automotive textiles are, however, discussed in more detail under Automotive sector.

PCP, or rather its ester pentachlorophenyl laureate (PCP-L) has been used in the preservation of textiles and fabrics, particularly those used in heavy-duty/out-door military applications, which are subject to attack by fungi and bacteria during storage and use. These include wool, cotton, flax and jute fabrics and yarns used in covers, tarpaulins, awnings, tents, webbing, netting, sails and ropes (UNEP 2017g; RPA 2021).

Table 5. POPs used in textile industry and leather. Data are not exhaustive.

DecaBDE	Upholstery textile (sofas, office chairs, mattresses)	Blinds, draperies, blackout curtains	Geotextiles, wall coverings	Tents and tarps	Carpets	Automotive textiles	
HBCD	Residential and commercial upholstered furniture;	Seating and other textile interior in transportation (trains, air planes, ships);	Automobile interior textiles	Wall coverings and draperies	interior textiles e.g. roller blinds and curtains	Protective clothing and other technical textiles (e.g. fire-fighters and military);	Tents
PFOA-related substances – sidechain fluorinated polymers	Safety clothing	Outdoor clothing, tents, umbrellas, footwear	Car seats and carpets (see automotive industry)	Furniture	Carpets		
PFOA and its salts	Manufacture of polytetrafluoroethylene (PTFE) and polyvinylidene fluoride (PVDF) for the production of membranes for medical textiles						
PFOS	Surface treatment chemical at textile mills, leather tanneries, finishers, fibre producers, carpet manufacturers						
SCCP	Leather						
PCP, PCP-L	Heavy duty military textiles (tents, tarpaulins)	Wool, cotton, flax and jute fabrics and yarns used in covers, tarpaulins, awnings, tents, webbing, netting, sails and ropes					

Addressing the textile and leather sector for information on POPs

Textile industry is often small or medium sized and the number of stakeholders could be high. Textile industry is not only limited to clothing but are covers manufacture of apparel such as tents, backpacks, tarpaulins etc. Supply chain of textiles could be long, from producer of yarn to actual production of the fabric, and further on to production of the actual article. Some POPs are used already in the production of yarn, some could be applied at any point in the production chain as surface treatment chemicals or finishes, and studying the complex chains is likely to take time. Good communication with the supply chain is important.

For guidance on general approach to developing an inventory of POPs used in the textile and leather sector, please consult the General inventory guidance (UNEP 2020). Also, specific guidance documents for HBCD (UNEP 2021b), PBDE including decaBDE (UNEP 2021a), PFOS (UNEP 2017a), and SCCPs (UNEP 2021c) are relevant. Basel Convention technical guidelines for environmentally sound management of waste containing, consisting or contaminated with POPs contains detailed information in uses of POPs in different stages of production cycle. The relevant guidelines are available for PBDEs (UNEP 2015a), HBCD (UNEP 2015b), PFOS (2015c) and PCP (UNEP 2017c).

Guiding questions:

Is there production of yarn, fabrics, leather and articles made of textiles and leather?

Is there furniture production that uses textiles as upholstery? Where are the upholstery materials made?

How to the supply chains of articles produced for market work? Are raw materials imported or produced domestically?

What fire-safety regulations or standards apply to use of textiles for different applications (protective equipment, furniture upholstery, carpets, draperies)? How are they met (chemicals or inherently flame-retardant materials)?

What surface treatment chemicals are used in the industry? Are surface treatment chemicals sold for the general public to treat carpets, furniture, car interiors? What do they contain?

11. Fire-fighting foams

Per- and polyfluoroalkyl substances (PFAS; among them PFOS and PFOA, its salts and PFOA-related compounds) have been used in firefighting foam at airports and industrial facilities handling flammable liquids for more than 50 years as well as being used by Municipal Fire Brigades. Fluorosurfactant containing foams are generally used for flammable liquid hazards (“Class B”). However, they have also been used in “general purpose” extinguishers for solid materials (wood, paper, etc.) fires in some cases. Other firefighting foams are available for special uses, such as forest fires, but generally speaking these do not contain fluorosurfactants.

Fire-fighting foams are sold and stored typically as concentrates, which are mixed with water and air to produce foam for extinguishing fires on site. The users and holders of the stockpile are municipal or industrial fire-brigades, industries, fuel storages, airports, harbours etc. Foams can, however, also be available on the market for households in hand-held portable extinguishers (typically 9 L), which may contain either the concentrate or a finished pre-mix for direct application.

Only two industrial POPs are known to be found in certain types of fire-fighting foams (Table 6). Aqueous Film-Forming Foam (AFFF) AFFF is the most commonly used foam that contains PFAS as surfactant, and but other fluoroprotein concentrates may also contain PFAS and have similar issues.

Table 6. POPs used in fire-fighting foams.

PFOA and its salts (APFO, primary ammonium salt of PFOA)	Fire-fighting foam
PFOS	Fire-fighting foam (0.5-6%)

Addressing fire-fighting foams for information on POPs

The main holders of AFFF fire-fighting foam are fire-brigades and industries dealing with flammable liquids and solvents. These include chemicals industry, petrochemical industry, pharmaceutical industry, mines, harbours, airports, military etc.

A specific challenge with foam concentrates is their long shelf-life: stakeholders may easily have usable stockpile awaiting use originating from 20-30 years ago. The composition of the foam, including the potential PFOS or PFOA content, may be unknown. Trade names are seldom sufficient for excluding the potential POP content, as the composition may have changed and the product name kept. Preparing an inventory may, therefore, require chemical analyses. For certain newer foams, information on low contamination with PFOA (“C6-Pure”) or PFAS in general may be visible. The origin of the foam and the requirements for the composition of the foam, if any, are important in defining the potential for finding PFOS or PFOA substances in the foam.

Information on the contents of foam concentrates may be available from the material safety data sheet, manufacturer, or importer.

Municipal fire brigades may also hold stockpiles of AFFF, which has been viewed by some as a “general purpose” foam. Large storages of AFFF are, however, expected to be found in facilities that have large storage tanks for fuels etc., such as refineries, oil terminals, chemicals industry, airports and harbours.

A reasonable approach for evaluating the potential stockpiles of PFOS or PFOA containing foam is to seek AFFF foams. For guidance on general approach to developing an inventory of POPs used in the fire-fighting sector, please consult the General inventory guidance (UNEP 2020). Also, specific guidance document PFOS (2015c) is relevant.

Guiding questions:

Are there activities typically related to use of AFFF foams, such as chemicals industry, petrochemical industry, pharmaceutical industry, mines, harbours, airports, or similar military activities? What kind of foams are used and stored for fire-protection?

Is there production of fire-fighting foams?

What kind of foams are marketed by the manufacturers or importers?

Are there portable AFFF extinguishers on the market? What is the origin of the content?

What foams are used by municipal and industrial fire-brigades in the country?

Are there requirements for fire-fighting equipment that would require use of AFFF?

References

- Blomqvist P, McNamee Simonson M and Thureson P. 2010. Compilation of International Building Regulations (Fire) Relevant for EPS/XPS. SP Technical Note 2010:10. SP Technical Research Institute of Sweden, Borås.
- BSEF 2011. Bromine Science and Environmental Forum. Format for submitting pursuant to Article 8 of the Stockholm Convention the information specified in Annex F of the Convention, January 2011.
- Jitka Bečanová, Lisa Melymuk, Šimon Vojta, Klára Komprdová, Jana Klánová 2016. Screening for perfluoroalkyl acids in consumer products, building materials and wastes, *Chemosphere*, Volume 164, 2016, Pages 322-329, ISSN 0045-6535, <https://doi.org/10.1016/j.chemosphere.2016.08.112>.
- Brosché, S., Strakova, J., Bell, L. and Karlsson, T. 2021. Widespread chemical contamination of recycled plastic pellets globally. International Pollutants Elimination Network (IPEN), December 2021. https://ipen.org/sites/default/files/documents/ipen-recycled-plastic-pellets-v1_1.pdf.
- ECB 2000. European Union Risk Assessment Report: Alkanes, C10-13, chloro. 1st Priority List, Volume 4. European Chemicals Bureau. http://esis.jrc.ec.europa.eu/doc/risk_assessment/REPORT/sccpreport010.pdf.
- ECHA 2018. Restriction background document. European chemicals agency. <https://echa.europa.eu/documents/10162/61e81035-e0c5-44f5-94c5-2f53554255a8>.
- Green Science Policy Institute. 2021. BUILDING A BETTER WORLD - Eliminating Unnecessary PFAS in Building Materials. Accessed 28.12.2021 at <https://greensciencepolicy.org/docs/pfas-building-materials-2021.pdf>.
- Horrocks AR. 2013. Regulatory and Testing Requirements for Flameretardant Textile Applications. In "Update on Flame Retardant Textiles: State of the Art, Environmental Issues and Innovative Solutions". Eds. Alongi J, Horrocks AR, Carosio F, Malucelli G. pp 53-122, ISBN 978-1-90903-018-3 (ebook) Smithers Rapra Publishing. Shawbury, United Kingdom.
- Kajiwara N, Takigami H, Kose T, Suzuki G, Sakai S. 2014. Brominated flame retardants and related substances in the interior materials and cabin dusts of end-of-life vehicles collected in Japan. *Organohalogen Compounds* 76, 1022-1025.
- Posner S, Roos S, Olsson E. (2010). Exploration of management options for HBCDD. Swerea Report 10/11. http://www.unece.org/fileadmin/DAM/env/lrtap/TaskForce/popsxg/2010/Updated%20documentns_June2010/Exploration%20of%20management%20options%20for%20HBCD.pdf.
- RPA 2014. Support to Annex XV dossier on bis-(pentabromophenyl) ether (decaBDE), ECHA. Reference: ECHA/2011/01. Available at: https://rpaltd.co.uk/uploads/report_files/multiple-fwc-competition-for-echa.pdf Accessed on 7.1.2021.
- Sinha & Taylor 2015. Systems thinking for sustainable textiles in the automotive sector, available at <http://eprints.whiterose.ac.uk/90134/3/full%20paper%20submission%20%281%29.pdf> Accessed at 6.1.2022.
- UNEP 2010. Risk profile on hexabromocyclododecane. UNEP/POPS/POPRC.6/13/Add.2.
- UNEP 2015a. Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with hexabromodiphenyl ether and heptabromodiphenyl ether, or tetrabromodiphenyl ether and pentabromodiphenyl ether (POP-PBDEs). Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.
- UNEP 2015b. Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with hexabromocyclododecane (HBCD). Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.
- UNEP 2015c. Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOSF). Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.
- UNEP 2017a. Guidance for the inventory of perfluorooctane sulfonic acid (PFOS) and related chemicals listed under the Stockholm Convention on Persistent Organic Pollutants. Draft January 2017. Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.
- UNEP 2017b. Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with hexachlorobutadiene (HCBD). Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.

UNEP 2017c. Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with pentachlorophenol and its salts and esters (PCP). Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.

UNEP 2019a. Guidance on the labelling of products and articles that contain POPs. Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.

UNEP 2019b. Guidance for the control of the import and export of POPs under the Stockholm Convention. Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.

UNEP 2019c. Guidance on the labelling of products and articles that contain POPs. Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.

UNEP 2019d. General technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants (General POPs). Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.

UNEP 2021a. Draft guidance on preparing inventories of polybrominated diphenyl ethers (PBDEs) listed under the Stockholm Convention on Persistent Organic Pollutants. Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.

UNEP 2021b. Guidance on preparing inventories of hexabromocyclododecane (HBCD). Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.

UNEP 2021c. Guidance on preparing inventories of short-chain chlorinated paraffins (SCCPs). Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.

UNEP 2021d. Draft guidance on sampling, screening and analysis of persistent organic pollutants in products and recycling. Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.

UNEP 2021e. Guidance on preparing inventories pentachlorophenol and its salts and esters. Secretariat of the Basel, Rotterdam and Stockholm conventions, United Nations Environment Programme, Geneva.
