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Item 5 (d) of the provisional agenda*

Matters related to the implementation of the Convention: implementation plans

Revised draft guidance for the inventory of perfluorooctane sulfonic acid and related chemicals listed under the Stockholm Convention

Note by the Secretariat

As referred to in the note by the Secretariat on implementation plans (UNEP/POPS/COP.7/16), the annex to the present note sets out the revised draft guidance for the inventory of perfluorooctane sulfonic acid and related chemicals listed under the Stockholm Convention prepared by the Secretariat based on the comments received from parties (UNEP/POPS/COP.7/INF/28) and from the Basel Convention small intersessional working group on the development of technical guidelines on persistent organic pollutants wastes (UNEP/CHW/OEWG.9/INF/30/Rev.1). The revised draft guidance is set out in the annex to the present note for consideration by the Conference of the Parties. The present note, including its annex, has not been formally edited.

* UNEP/POPS/COP.7/1.

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Annex

Guidance for the inventory of perfluorooctane sulfonic acid (PFOS) and related chemicals listed under the Stockholm Convention on Persistent Organic Pollutants

Draft
Revised March 2015

Disclaimer

The designations employed and the presentations in this guidance document are possible options, based on expert judgment, for the purpose of providing assistance to parties in undertaking inventories of perfluorooctane sulfonic acid (PFOS) and related chemicals listed under the Stockholm Convention, in order to develop, revise and update national implementation plans under the Stockholm Convention. The Stockholm Convention Secretariat, UNEP or contributory organizations cannot be liable for misuse of the information contained in it.

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Abbreviations and acronyms

AFFF	aqueous film-forming foams
AR-AFFF	alcohol-resistant aqueous film-forming foams
AR-FFFP	alcohol-resistant film-forming fluoroprotein foams
BAT	best available technologies
BEP	best environmental practices
CAS	Chemical Abstract Service
CCD	charge-coupled device (technology for capturing digital images)
ETFE	ethylene tetrafluoroethylene
EtFOSA	*N*-ethyl perfluorooctane sulfonamide (sulfluramid)
EtFOSE	*N*-ethyl perfluorooctane sulfonamidoethanol
EtFOSEA	*N*-ethyl perfluorooctane sulfonamidoethyl acrylate
EtFOSEP	di[*N*-ethyl perfluorooctane sulfonamidoethyl] phosphate
EU	European Union
FC-53	Potassium 1,1,2,2-tetrafluoro-2-(perfluorohexyloxy)ethane sulfonate/perfluoro[hexyl ethyl ether sulfonate]
FC-53B	Potassium 2-(6-chloro-1,1,2,2,3,3,4,4,5,5,6,6-dodecafluorohexyloxy)-1,1,2,2-tetrafluoroethane sulfonate
FC-248	PFOS tetraethyl ammonium salt
FFFC	fire fighting foam coalition
FFFP	film-forming fluoroprotein foams
MeFOSA	*N*-methyl perfluorooctane sulfonamide
MeFOSE	*N*-methyl perfluorooctane sulfonamidoethanol
MeFOSEA	*N*-methyl perfluorooctane sulfonamidoethyl acrylate
NIP	national implementation plan
OECD	Organisation for Economic Co-operation and Development
PFAS	perfluorinated alkyl sulfonates
PFBS	perfluorobutane sulfonic acid/potassium perfluorobutane sulfonate
PFCs	perfluorinated chemicals
PFCA	perfluoroalkyl carboxylic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonic acid
PFOSA	perfluorooctane sulfonamide
PFOSF	perfluorooctane sulfonyl fluoride
PTFE	polytetrafluoroethylene

1. Introduction to the guidance document

1.1 Purpose of this guidance document

At its fourth meeting, the Conference of the Parties (COP) of the Stockholm Convention agreed to list nine new persistent organic pollutants (POPs) in Annexes A, B, and C of the Convention. In light of this decision, Parties must review and update their national implementation plans (NIPs) in accordance with paragraph 1 (c) of Article 7 of the Convention. The updated NIPs should be transmitted to the COP within two years of the date in which these amendments entered into force in August 2012, for most Parties.[1]

The *Guidance for Developing a National Implementation Plan for the Stockholm Convention* (UNEP 2006a) document was developed to assist countries with the process of developing a NIP on the initial 12 POPs. For the review and update of the NIP, the COP adopted by Decision SC-1/12 , a guidance for the review and updating of national implementation plans.

In May 2012 the COP in its Decision SC-6/12 took note and encouraged Parties to use the updated version of the *Guidance for Developing a National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants* (UNEP, 2014) including the POPs listed in 2009 and 2011. This document outlines the steps to be followed for reviewing and updating the NIPs. The COP also requested the Secretariat to update the document on the basis of the comments received. The revised document is available at the convention website.

Other related guidance documents to be consulted during NIP development include the *Guidance on Socio-Economic Assessment for National Implementation Plan Development and Implementation under the Stockholm Convention* (UNEP, 2007) and the *Guidance on Calculation of Action Plan Costs for Specific Persistent Organic Pollutants* (UNEP, 2012b).

Perfluorooctane sulphonic acid (PFOS), its salts, and perfluorooctane sulfonyl fluoride (PFOSF) were listed in Annex B of the Stockholm Convention in 2009. Parties to the Convention are encouraged to develop an action plan for PFOS, its related substances[2] as part of their updated NIP. The aim of the national action plans is to reduce and subsequently eliminate the use and production of PFOS and its related substances. To implement the restrictions on production and use of PFOS and its related substances, and to reduce the impact on human health and the environment, the sources of the releases and exposure of PFOS have to be identified. This is achieved by developing a national inventory of products and articles, production, use, and disposal of waste containing PFOS, as well as landfills, stockpiles and contaminated sites.

The national inventory is an important part of the NIP and gives valuable direction for the development of a national action plan. The COP through its Decision SC-5/5 encouraged Parties to implement where appropriate, taking into account national circumstances, the

[1] Amendments shall not enter into force for those Parties that have submitted a **notification** pursuant to the provisions of paragraph 3(b) of Article 22 of the Stockholm Convention. Also, in accordance with paragraph 4 of article 22, the amendment will not enter into force with respect to any Party that has made a **declaration** regarding the amendment to the Annexes in accordance with paragraph 4 of Article 25. Such Parties shall deposit their instruments of ratification regarding the amendment, in which case the amendment shall enter into force for the Party on the ninetieth (90) day after the date of deposit with the Depositary.

[2] This is the terminology used by POPRC to cover the PFOS precursors containing the PFOS moiety.

recommendations of the Persistent Organic Pollutants' Review Committee (POPRC), which is a subsidiary committee of the Convention, when conducting the inventory of PFOS and its related substances (UNEP, 2010a).

Although the existing guidelines provide a useful starting point for the review and update of the NIPs, more comprehensive and specific technical guidance is needed for Parties to fulfil their obligations under the Convention with regard to the nine new POPs. Parties have identified access to information on the new POPs as the main challenge in meeting the obligations.

Mindful of the need to deal with the complex issue of production and use of PFOS and its related substances, the United Nations Industrial Development Organization (UNIDO) Expert Group on PFOS has developed this comprehensive inventory guidance document. The guidance aims to aid countries to develop, review and update their NIP with information on PFOS and its related substances. This document, developed under a UNIDO/GEF project, is part of the updated and consolidated *Guidance for Developing a National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants* (UNEP 2014). In developing the PFOS inventory guidance, the experts have followed closely the recommendations listed in the *Report of the Persistent Organic Pollutants Review Committee on the Work of its Sixth Meeting* (UNEP, 2010a).

In particular developing countries have challenges to manage POPs due to the lack of integrated POPs management (Weber et al., 2013). Therefore PFOS and related substances often end up in landfills and dump sites with related challenges of releases (Eggen et al., 2010; Kim et al., 2013; Weber et al., 2011). To support countries in the management of PFOS use, a draft BAT/BEP guidance has been developed in the frame of the Stockholm Convention for a better management of PFOS in current use (Secretariat of the Stockholm Convention 2014). Also a draft guideline for the environmentally sound management of wastes consisting of or containing PFOS and related substances have been developed in the frame of the Basel Convention (Secretariat of the Basel Convention 2014).

1.2 Structure of the guidance

The document is divided into seven chapters that gives guidance to the development of the PFOS inventory in nine distinct steps (see figure 1-1).

Chapter 1, Introduction to the guidance document, outlines the purpose of the guidance, its key features, how it is structured, and how to use it, along with the objectives for undertaking an inventory.

Chapter 2, Background information, provides in-depth information on the kinds of articles that might contain PFOS and its related substances. The chapter also lists the industries that use and produce PFOS and its related substances, and then describes the supply chain (suppliers, importers and exporters, producers, manufacturers, downstream users). PFOS and its related substances at end-of-life and recycling are also discussed.

Chapter 3, How to conduct a PFOS inventory, outlines the five main steps involved in conducting a general inventory.

Chapter 4, Inventory of production and use of PFOS and its related substances in industrial sectors, provides a step-by-step guidance for the industrial sectors. It is based on the tiered approach described in chapter 3: an initial assessment, preliminary inventory and in-depth

inventory. This chapter also contains management tools for the compiled data from the industrial sectors.

Chapter 5, Inventory of product and articles containing PFOS and its related substances on the consumer market, provides step-by-step guidance for the consumer market. It is based on the same tiered approach used in chapter 4. This chapter also contains management tools for the compiled data from the consumer market.

Tools for screening and verifying the presence of PFOS and its related substances in collected samples are provided. These tools can also be used in the in-depth (tier III) inventory steps described in chapters 4, 6 and 7.

Chapter 6, Inventory of fire fighting foams, aviation hydraulic fluids and insecticides containing PFOS and its related substances, provides step-by-step guidance for other areas of relevance, such as different sectors for professional use of products containing PFOS and its related substances. It is based on the same tiered approach featured in previous chapters. This chapter also contains management tools for the compiled data from the different use areas.

Chapter 7, Inventory of waste, stockpiles and contaminated sites containing PFOS and its related substances, helps identify potential waste fractions, stockpiles and contaminated sites. Step-by-step guidance based on the tiered approach is provided. This chapter also contains tools for the management of the compiled data from the different use areas.

The key design and content features of this guidance are:

Step-by-step approach: The guidance is designed to provide a clear step-by-step approach that can be followed and implemented by a wide variety of users. A five-step approach is provided for the overall inventory, from the planning stage to preparation of the inventory report (also see chapter 3). More detailed and specific guidance for key sectors can be found on stakeholders, data collection, etc. in chapters 4 to 7.

Questionnaires and reporting format: The guidance includes various model questionnaires (annexes 3 through 11), and an inventory reporting format (annex 14), for use and adaptation by users in countries to meet their own needs.

1.3 Objectives of the PFOS inventory

The main objective of the inventory is to obtain the information needed for several important decisions related to the management of PFOS and its related substances and implementation of the obligations in the Stockholm Convention. More specifically, the objectives are to:

- Provide the basis for development of a strategy in the NIP (i.e. identify the economic sectors that should be prioritized and the type of actions required for those sectors).
- Provide a basis for the evaluation whether the current national use, production, chemical and waste management meet the requirements of the Convention and identify areas where they do not.
- Provide a basis and information to support the report to the COP of the Convention on progress made to eliminate PFOS, its salts, and PFOSF.

- Identify areas where financial or technical support are needed (when resources are limited, to fill the gaps in the inventory/fulfil the obligations of the Convention).

The quantities of PFOS produced, used, stored as stockpiles, and generated as waste provide important information about the magnitude of the sources for the development of the NIP for PFOS, including the action plan for registered acceptable purposes and specific exemptions. This information will also be necessary for the evaluation of progress made on reduction of these sources and for future reports to the Convention. Some use categories engage extensive and dispersive use in open applications that are considered to pose a potential risk of direct exposure to humans and releases to the environment. Therefore, it is important to identify these uses in an inventory of PFOS and prioritize them in a NIP. The entire life cycle of PFOS has to be considered in an inventory and important stakeholders have to be identified.

The information to be obtained for the inventory includes:

- Production and uses of PFOS and its related substances at the national level.
- Presence of products and articles containing PFOS and its related substances on the consumer market.
- Flows into a country of products and articles containing PFOS and its related substances.
- Waste fractions of importance.
- Disposal practices for products and articles containing PFOS and its related substances when they become wastes.
- Stockpiles.
- Releases to the environment from point sources.
- Potential contaminated sites.
- Potential harmful exposure of humans and environment.

The inventory process is usually iterative. In establishing the inventory for the first time, Parties can also identify resources and technical capacity needed to further improve the accuracy of the inventory.

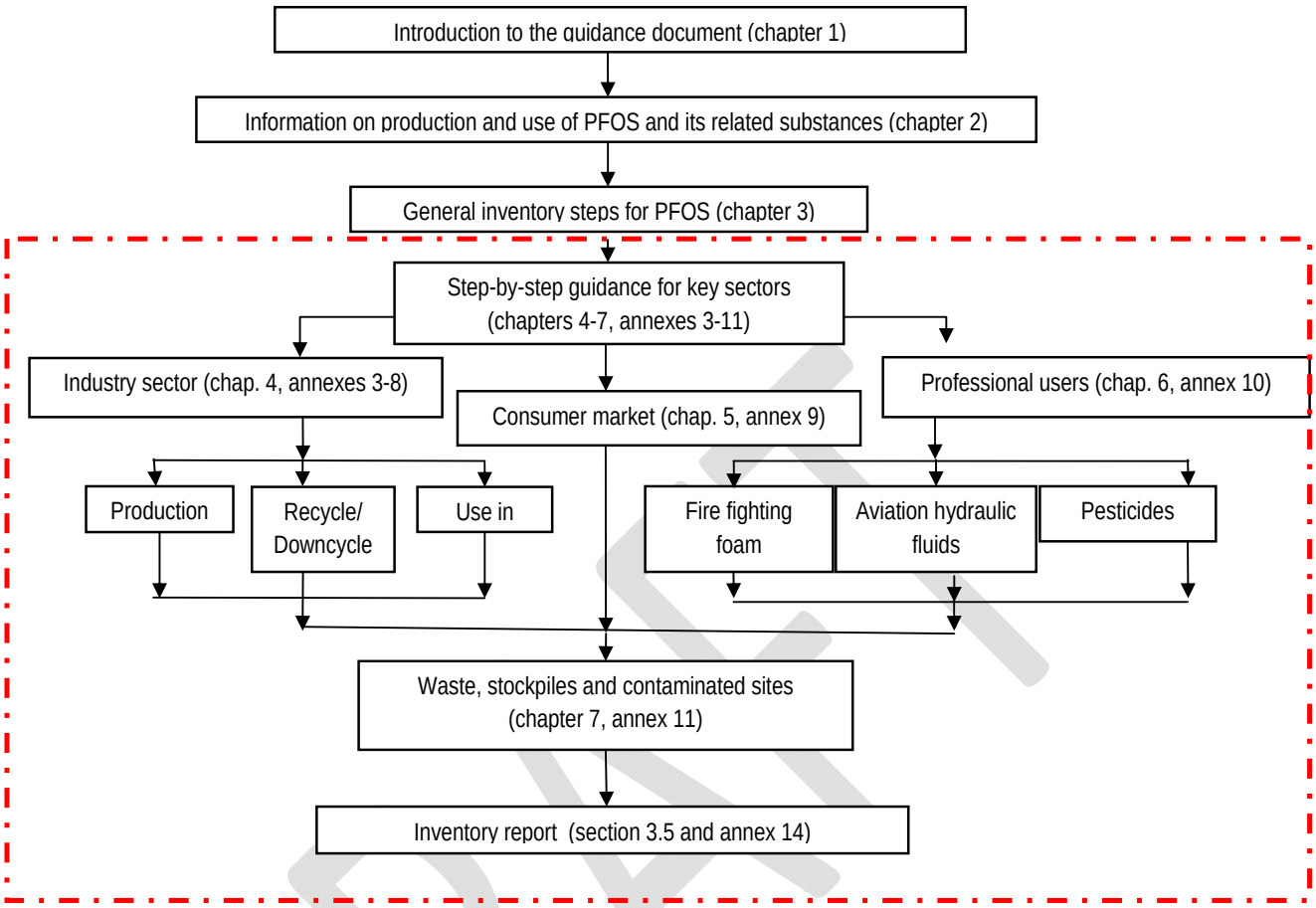

Figure 1-1 Guidance structure

2. Background information

2.1 PFOS, its related substances, characteristics and the listing in the Stockholm Convention

PFOS is a fully fluorinated (perfluorinated) substance, which is commonly used as a salt in some applications. PFOS is also commonly incorporated into polymers or other substances such as sulfluramid. While PFOS can exist in anionic, acid and salt forms, the PFOS anion is the most common form in the environment and in the human body (Environment Canada, 2006). The aim of listing PFOS, its salts and PFOSF in the Stockholm Convention is to restrict the use and production of PFOS and its related substances. The term "PFOS-related substances" is used for all substances that contain one or more PFOS moiety (defined as C8F17SO2). Since PFOS-related substances are considered PFOS precursors, the related substances will be considered to have the same POPs characteristics as PFOS. These PFOS-related substances are restricted through the listing of PFOSF, the basic material for their manufacture, and the listing of PFOS in the Convention. PFOSF is an intermediate material for production of all PFOS related substances, and they are all restricted to the uses listed as acceptable purposes and specific exemptions under the Convention.

Many more PFOS-related substances exist, and they are all regulated under the Convention. There are several references listing the PFOS-related substances, of which the most comprehensive is the list compiled by the Organisation for Economic Co-operation and Development (OECD, 2007). PFOS-related substances refer to a larger group of substances containing perfluorinated sulfonyl with eight-carbon chain length, which may be simple salts of PFOS (e.g. potassium, lithium, ammonium, diethanolamine) or polymers that contain PFOS. Figure 2-1 illustrates the structural formula of PFOS shown as its potassium salt (UNEP, 2006b).

Any molecule containing the PFOS precursor moiety (C8F17SO2) can be a precursor to PFOS and is called PFOS-related substance. Although the net contribution of individual PFOS-related substances to the total environmental load of PFOS cannot be readily predicted, there is a potential that any molecule containing the PFOS carbon chain could be a precursor to PFOS. PFOS can be formed by environmental microbial degradation or by metabolism in larger organisms from PFOS-related substances (UNEP, 2006b).

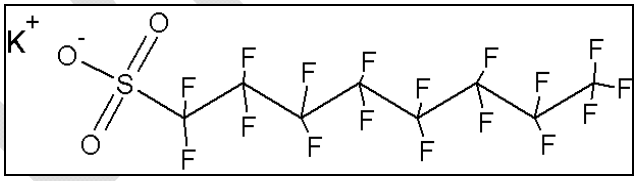

Figure 2-M Structural formula of PFOS shown as its potassium salt.

PFOS, its salts and PFOSF belong to the group of chemicals called perfluorinated compounds (PFC). Other PFCs that have raised concern due to their properties are long chain perfluorinated carboxylic acids (PFCA) such as perfluorooctanoic acid (PFOA) and perfluorononanoic acid (PFNA) or long chain fluorotelomer alcohols (FTOH) which can degrade to PFCAs. Because those compounds are not listed under the Stockholm Convention, they are out of scope for this inventory guidance. It is important to be aware of the distinction between them and the listed PFC when doing the inventory, since they are used in many of the same areas as PFOS.

The POPRC concluded in its Draft risk profile on perfluorooctane sulfonate (PFOS)[3] that PFOS is very persistent and has substantial bioaccumulations and biomagnifying properties, although it does not follow the classic pattern of other POPs by partitioning into fatty tissues; instead it binds to proteins in the blood and liver. It also fulfils the toxicity criteria of the Stockholm Convention. PFOS and related substances have a capacity to undergo long-range transport (UNEP 2006b) and PFOS and PFOS-related substances can be released to the environment from manufacturing processes and during their use in industrial and consumer applications, as well as from disposal of the chemicals or products and articles (Bossi et al., 2008; Oliaei et al., 2011; UNEP, 2006b; Weber et al., 2011).

Risks that have been highlighted in the work program on new POPs under the Stockholm Convention refer to the following findings reported in the scientific literature: It is likely that significant quantities of the chemical reach humans and the environment during the use of PFOS in particular in open applications including the transfer to indoor dust or food (Ahrens et al., 2014; Brambilla et al., 2014; D'Hollander et al., 2010; Trudel et al., 2008; UNEP, 2006b). However also PFOS from closed applications can be released into the environment if the resulting waste is not managed in an environmentally sound manner (Secretariat of the Basel Convention, 2014; Weber et al., 2011a).

Studies have indicated adverse effects of PFOS-related substances on reproductive health for humans, where high levels of PFOS detected in serum and plasma samples have been correlated e.g. with fewer normal sperm (Joensen et al., 2009) and delayed pregnancy (Fei et al., 2009). Other studies have highlighted the risk of developmental effects. Reported findings have been correlations between prenatal exposure to PFOS and reduced foetal growth (Washino et al., 2009), and a linkage between cord serum concentrations of PFOS and reduced weight and size at birth (Apelberg et al., 2007). Increased odds of attention deficit hyperactivity disorder (ADHD) have also been observed in children with higher serum levels of PFOS and related substances (Hoffman et al., 2010). The United States (US) reported on a study on the extent of pollution, including potential routes of exposure and potential health effects, caused by biosolids containing PFOS-related substances (USEPA, accessed in 2012). Additional information on PFOS, can be found at www.pops.int.

In 2009 the COP decided to list PFOS and its related substances under Annex B with acceptable purposes[4] and specific exemptions[5]. The Convention allows Parties to register[6] specific exemptions and acceptable purposes for the production or use of certain POPs listed under its annexes A and B when alternatives do not exist yet or are not readily available.

This is intended to provide Parties with time to take measures to reduce or eliminate releases of POPs from intentional production and use. Registers are established to identify Parties that have specific exemptions and acceptable purposes and a range of countries have meanwhile listed for certain exemptions[4,5]. Meanwhile for most applications alternatives are available which have been compiled by the POPRC in a draft paper (UNEP 2012c) and are also continuosly updated in the publication on *POPs in articles and phasing out opportunities*[7].

[3] UNEP/POPS/POPRC.2/11.

[4] http://chm.pops.int/Implementation/Exemptions/AcceptablePurposesPFOSandPFOSF/tabid/794/Default.aspx

[5] http://chm.pops.int/Implementation/Exemptions/RegisterofSpecificExemptions/tabid/1133/Default.aspx

[6] http://chm.pops.int/Implementation/Exemptions/Overview/tabid/789/Default.aspx

[7] http://poppub.bcrc.cn/col/1408693347502/index.html

Specific exemptions expire five (5) years after the date of entry into force of the chemical under the Convention unless the Party indicates an earlier date when registering for an exemption. Under certain circumstances other provisions of the Convention (Articles 4, 22 and 25) are also relevant when considering expiry of specific exemptions. Acceptable purposes have no limited time frame, unless specified otherwise by the Conference of the Parties.

The Convention also allows registration for 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. Similarly, Parties can register for chemicals listed as closed-system site-limited intermediate.

2.2 Production and use of PFOS and its related substances

PFOS-related substances have been manufactured for more than 50 years. Their unique physical properties, being both fat and water repelling, have made them popular in several products. They are typically used for surface treatment, and are common in non-stick products, stain-resistant fabrics and all-weather clothing. Due to their surface-active properties, they have historically been used in a wide variety of applications, including fire fighting foams and surface resistance/repellence to oil, water, grease or soil. The global use pattern is described in table 2-1 (Lim et al., 2011), in which estimates of the global usage amount were 4481 tonnes are based on 3M Company estimates from 2000 (3M Company, 2000). Since then, PFOS has been phased out for several uses in some regions. The major PFOS producer 3M, for example, ended its production in 2002 and by beginning of 2003 all 3M production has stopped (UNEP, 2006b). At around the same time, production started in Asia with a rapid increase in production volume to approximately 200 tonnes/year (Lim et al., 2011; Zhang et al., 2012). The current production of approx. 200 tonnes and use is therefore only approximately 5% of the former production of 3M (Table 4-1). In total it is estimated that approximately 96,000 tonnes of PFOSF has been produce and additionally 26,500 tonnes of unusable waste (Paul et al., 2008). Therefore also for PFOS a major task is the management of the legacy of historic productions.

Table 2-1: The global use of PFOS and its related substances

Main category	Setting	Applications	Global usage amount, 2000[a] (metric tons)
Surface treatments	Industrial	Textile mills, leather tanneries, finishers, fibre producers, carpet manufacturers	2,160
	General public or professional applicators aftermarket treatment	Apparel and leather, upholstery, carpet, automobile interiors	
Paper protection	Paper mills	Food contact applications (plates, food containers, bags, and wraps), non-food contact applications (folding cartons, containers, carbonless forms, masking papers)	1,490
Performance chemicals	Industrial, commercial, and consumer applications	Fire fighting foams	151
		Mining and oil well surfactants, surfactant/wetting agent and mist suppressants for metal plating, electronic etching baths, photolithography, electronic chemicals, hydraulic fluid additives, alkaline cleaners, floor polishes, photographic film, denture cleaners, shampoos, chemical intermediates, coating additives, carpet spot cleaners, insecticide in bait stations	680

[a]Global usage amounts from 3M Company estimate (3M Company, 2000)

Manufacturers use PFOSF or its secondary derivatives as the intermediates to produce PFOS and its related substances. PFOSF, which is the starting material for other PFOS-related chemicals, is manufactured by using 1-octanesulfonyl fluoride and anhydrous hydrogen fluoride through an electrochemical fluorination (ECF) process (known as the Simons (ECF) process). PFOSF can then be used as a chemical intermediate to produce other kinds of PFOS-related substances. For example, PFOSF is reacted with methyl or ethyl amine to produce either N-methyl or N-ethyperfluorooctanesulphonamide (FOSA). FOSA is subsequently reacted with ethylene carbonate to form either N-Methyl or N-ethylperfluorooctanesulphonamidoethano l (FOSE). Figure 2-2 shows the production of PFOSF and the major product categories of PFOS-related substances/perfluorooctanesulfonate, and their applications (OECD, 2002).

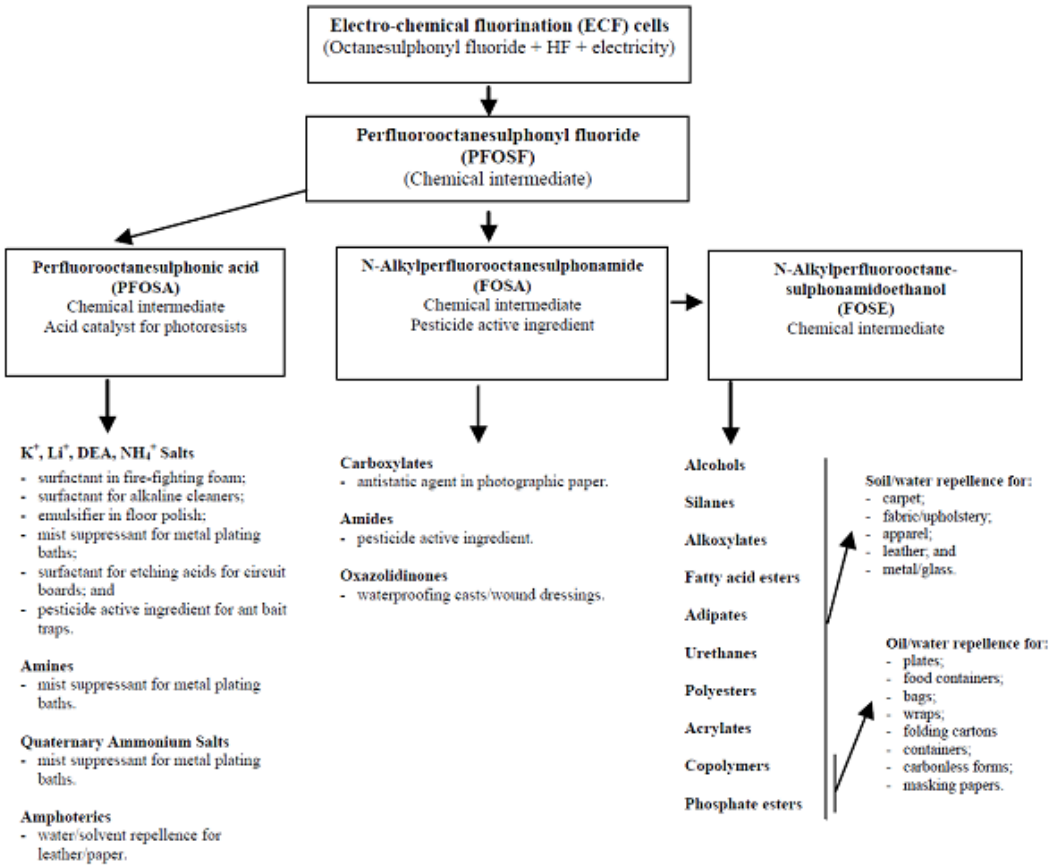

Figure 2-H: Process scheme and major product categories and applications of PFOS

PFOS and its related substances were widely used in many applications and type of industries, and are widely spread in the product chain. Some uses are in open applications with potential exposure of humans and environment, while others are in closed controlled systems. The current major PFOS uses are for chromium plating (30 to 100 t), fire fighting foams (25-80 t), pesticide (4 to 20 t) and for oil drilling while other uses such as for semi conductor production are considerably smaller (Lim et al., 2011; Zhang et al., 2012). It seems that textile treatment has also been a major use until 2011 (Zhang et al., 2011) but that regulatory pressure phased out the use in textiles (Lim et al., 2012).

Deposition from (former) PFOS production, industrial PFOS users and from PFOS-containing products and articles and landfills have been identified as important sources of PFOS contamination and releases (Bossi et al., 2008; Eggen et al., 2010; Kallenborn et al., 2004; Li et al., 2012; UNEP, 2010a; Weber et al., 2010a) with the potential of environmental contamination and exposure to humans (Skutlarek et al., ; Kröfges et al., 2007 ; Kowalczyk et al., 2013; Oliaei et al., 2013; Trudel et al., 2008). Considering the recommendations of the POPRC, sites were PFOS and related substances have been produced, used by industries and other users and related depositions to landfills have to be investigated (UNEP 2010a). Also the management of contaminated sludge that has been applied as a biosolid in particular from the producers and users of PFOS and related substances to agricultural areas or other soils need to be assessed (Brambilla et al., 2014; Kröfges e al. 2007; Skutlarek et al., 2006; Sepulvado et al., 2011; UNEP 2010a). In many countries the safe management of waste, stockpiles and contaminated sites is of special importance because of its major and dispersive use in the past. Some articles are recycled (e.g. aviation hydraulic fluid, synthetic

carpets and paper) and the content of PFOS in new articles made from the recycled articles can be of concern.

The manufacture of products and articles containing PFOS can comprise several producers, suppliers and downstream users and the supply chain can involve import and export across borders (as described in figure 2-3). The preparations used in the manufacture of articles are often imported and distributed by suppliers to the professional users in the national manufacturing industry. For most countries only the professional users of PFOS, the national supply chain and the downstream users in the product chain for articles containing PFOS have to be identified and described.

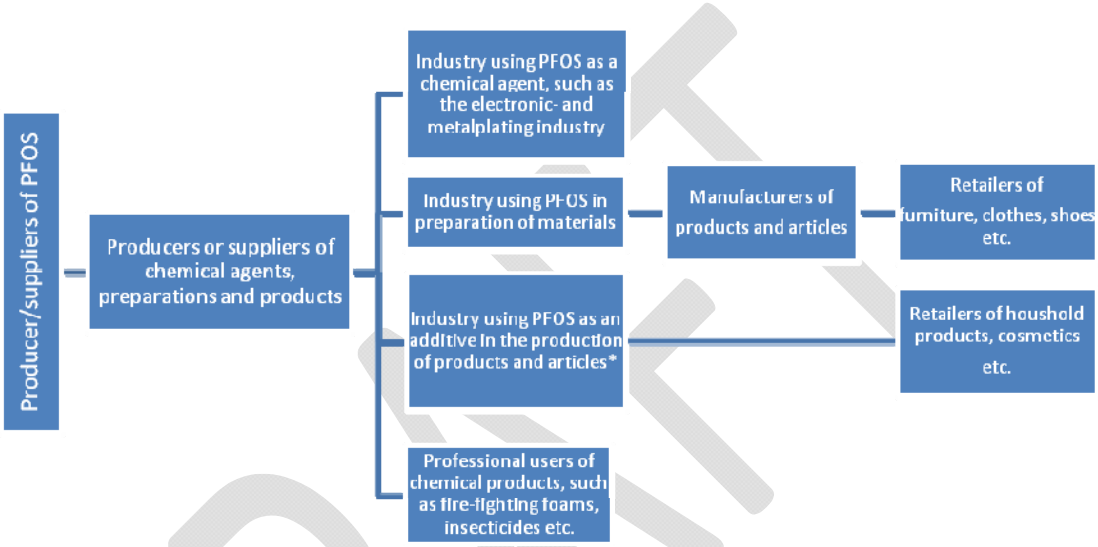

Figure 2-3: Description of the PFOS supply chain.
(*Compounders)

More detailed descriptions of the processes are found in the *Draft Guidelines on Best Available Techniques and Best Environmental Practices for the Use of PFOS under the Stockholm Convention on POPs (Draft PFOS BAT/BEP Guidelines*; Secretariat of the Stockholm Convention, 2014).

2.3 Manufacture of articles and products using PFOS as a chemical

PFOS and its derivatives are used in numerous manufacturing processes because of their non-reactive properties, low surface tension, chemical stability, resistance to acids and high temperature. PFOS-related substances have various specific uses as a chemical agent in the electronics, semiconductor and photographic industries. They are/were used in these industries in small quantities in closed systems and are not intended to be a content of the final end products. The production chain can be complicated and downstream users may not know that PFOS has been used in the preceding manufacturing processes.

PFOS and PFOS-related substances are also used as surfactants for oil well stimulation in the oil and gas industry, drilling fluids in the mining industry, and as surfactants or wetting agents in the metal plating industry. The metal plating process can be in a closed system; the baths are then reused. However at the end of life the wastes need to be treated as hazardous waste and the recommendation is not to landfill PFOS containing wastes (UNEP

2010a). However, in many countries the plating process is not closed and can represent an important point sources of releases of PFOS-related substances to the environment.

The use of PFOS in the oil and mining industries has the potential of releases to water and the ground at the production sites, resulting in contaminated sites.

The industrial sectors identified as users of PFOS and its related substances for specific and acceptable manufacturing purposes are described in the following sections.

2.3.1 Electronics industry

Electrical and electronic equipment often requires hundreds of parts and thousands of processes. PFOS has many different uses in the electronics industry and is involved in many of the production processes needed for electric and electronic parts (see figure 2-4). PFOS-based chemicals are used in the manufacturing of digital cameras, cell phones, printers, scanners, satellite communication systems, radar systems and the like. The PFOS-related compounds are process chemicals, and the final products are mostly PFOS-free.
Some of the processes are related to semiconductors, and are also used in the semiconductor industry. Many electronic articles have plated metal parts that are supplied by the metal plating industry.

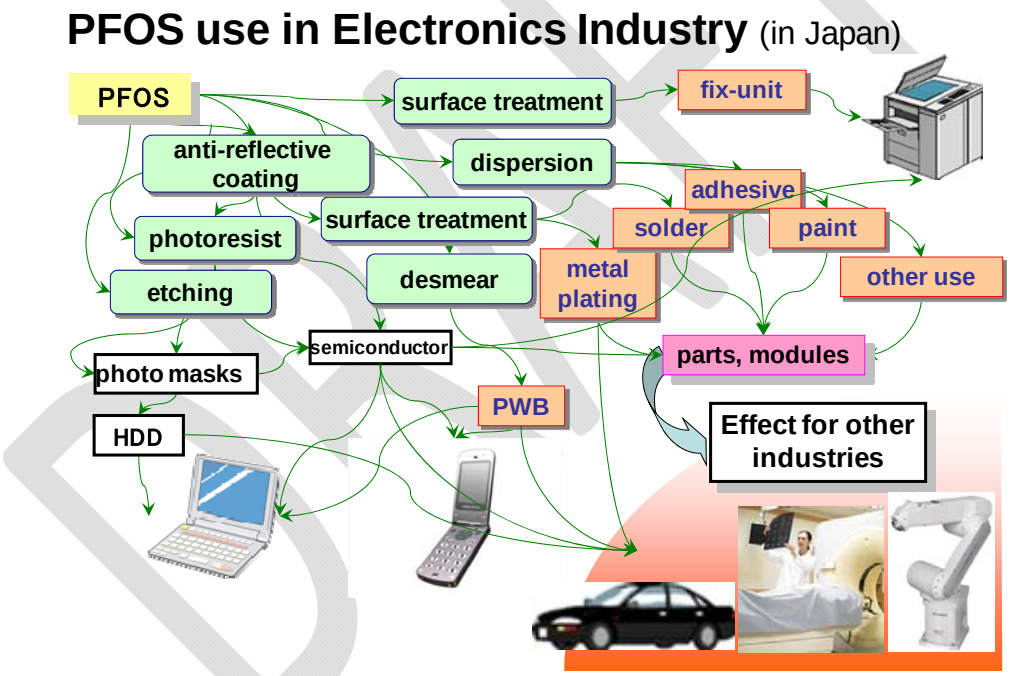

Figure 2-4: PFOS use in electronics industry supply chain

Most uses of PFOS-related substances in the electronics industry are closed uses, but open uses can exist in the manufacture of final products like cars and mobiles. The closed uses of PFOS in the electronic industry are etching, dispersion, desmear, metal plating in loop condition, surface treatment, photolithography and photomicrolitography. Open uses of PFOS in the electronic industry are metal plating, solder, adhesive and paint.

PFOS can be used as a surfactant in etching processes in the manufacture of compound semiconductors and ceramic filters. PFOS is then added as part of an etching agent, and rinsed out during the subsequent washing treatment. Since the lifetime of etching agents is quite short (less than 6 hours), PFOS is added into an etching agent just before use.

Therefore, there is no stockpile of etching agents that contain PFOS, and this use has been phased out in several countries.

Desmear processes smooth the surface of a through-hole in printed circuit boards. PFOS can be used as a surfactant in the desmear agent, i.e. etching agent. PFOS is added into a desmear agent, and rinsed out during the washing treatment. Since 2008 PFOS has been substituted in desmear agents in some regions.

The other processes involved are described in section 2.3.2 (the semiconductor industry) and section 2.3.4 (metal plating).

2.3.2 Semiconductor industry

PFOS and PFOS-based substances are chemicals required by the semiconductor industry for formulation of resists and anti-reflective coatings in high-end lithography. PFOS is a process chemical; it does not remain in the final product – the semiconductor device.

Semiconductor manufacturing comprises up to 500 steps (see figure 2-5), involving four fundamental physical processes:

- Implant
- Deposition
- Etch
- Photolithography

Photolithography is the most important step out of the four processes. It is essential for the successful performance of the other three steps and of the overall production process. It shapes and isolates the junctions and transistors; it defines the metallic interconnects; it delineates the electrical paths that form the transistors; and it joins them together. Photolithography reportedly represents 150 of the total 500 steps. Photolithography is also integral to the miniaturization of semiconductors.

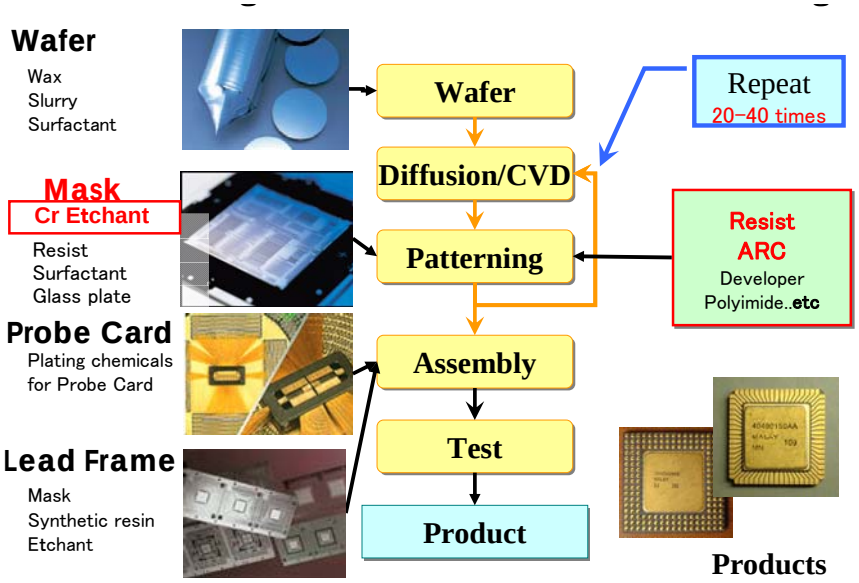

Figure 2-p: Different steps in semiconductor manufacturing where PFOS is used as an intermediate (The process in red is related to PFOS related substances. Source: Japan Electronics and Information Technology Industries Association Semiconductor Board)

PFOS reduces the surface tension and reflection of etching solutions, properties that are important for precise photolithography in the semiconductor industry (photo resists and photo masks). Small amounts of PFOS-based compounds are used during the following photolithography applications, which are crucial for achieving the accuracy and precision required to manufacture miniaturized high-performance semiconductor chips:

- Ultra-fine patterning/photo resists as photo-acid generators and/or surfactants
- Anti-reflective coatings as uniquely performing surfactants

No alternatives are available that would allow for the comprehensive substitution of PFOS in these critical applications. Non-critical uses of PFOS are as edge bead removers, de-gluing agents and developing agents.

PFOS is used as a component of a photoresist substance, including a photo acid generator or surfactant; or of an anti-reflective coating, used in a photomicrolithography process to produce semiconductors or similar components of electronic or other miniaturized devices.

The manufacture of semiconductors includes a series of photolithography processes. Since diffused reflection would possibly disorder the shape of a circuit in design, anti-reflective coating is necessary to avoid disturbance during photolithographic processes. PFOS is used in anti-reflective coating agents to give surface activity and to regulate refractive index. Since anti-reflective coating agents are rinsed out during the photolithographic process, PFOS does not remain in semiconductors.

2.3.3Photographic industry

PFOS-based chemicals are used for the following purposes in mixtures, in coatings applied to photographic films, papers, and printing plates:

- Surfactants
- Electrostatic charge control agents
- Friction control agents

- Dirt repellent agents
- Adhesion control agents

The uses of PFOS in this industry include coatings for surface tension, static discharge, and adhesion control for analogue and digital imaging films, papers, and printing plates; and as a surfactant in mixtures used to process imaging films.

2.3.4 Metal plating industry

PFOS-related substances are mainly used as surfactants/wetting agents and mist suppressants in hard and decorative chromium plating, which can reduce the emission of chromium from the process and also improve the working environment in this sector. In addition to chromium plating, fluorosurfactants (including PFOS) are also used in other metal plating applications, such as agents to prevent haziness of plated copper by regulating foam and improving its stability, non-foaming surfactants in nickel-plating baths to reduce surface tension, and agents added to tin-plating baths to ensure that plating has uniform thickness.

The PFOS-related substances most commonly used in chromium plating are tetraethylammonium perfluorooctane sulfonate (CAS No. 56773-42-3, with trade names such as Fluorotenside-248, SurTec 960, FC-248 and FT-248m) and potassium perfluorooctane sulfonate (CAS No. 2795-39-3, with trade name FC-80); lithium, diethanolamine, and ammonium salts of PFOS may also be used. Although new plating chemistry using chromium-III instead of chromium- VI is now available for decorative chromium plating applications and as a result has made PFOS based fume suppressants in decorative chromium plating obsolete, it is still used in many countries. PFOS will typically remain in the chromium plating solution after the metal plating process. The plating baths are often used several times before they are discarded. If treated as hazardous waste, the process is considered to be a closed process with minor releases of PFOS depending on the level of technology and waste water treatment used.

2.3.5 Chemically driven oil and gas production

PFOS and its related substances may be used as surfactants in the oil and gas industries to enhance oil or gas recovery in wells, as evaporation inhibitors for gasoline, and as jet fuel and hydrocarbon solvents. As late as 2009 and 2012, PFOS and its related substances were reportedly used as a surfactant in old oil fields in some regions to recover oil trapped in small pores between rock particles. At the same time, oil and gas production and mining were reportedly carried out without the use of PFOS and its related substances in other countries, including developing countries, thus indicating the existence of alternative processes that did not require PFOS.

2.3.6 Mining industry

PFOS derivatives may occasionally be used as surfactants in the mining industry to enhance the amount of recovery in copper and gold mines. Tetraethylammonium perfluorooctane sulfonate and potassium perfluorooctane sulfonate have also been used as acid mist suppressing agents (Corado 2011). There can be large-scale mining activities in developing countries, as well as mining operations of the artisanal-small scale type still using PFOS. Other activities also include quarrying operations by construction companies. Since the major challenge in many developing countries is addressing the problem of mercury and lead poisoning from artisanal small-scale gold mining, the use of PFOS has usually not been addressed.

2.3.7 Manufacture of plastic and rubber products

Because of good surfactant properties with extremely stable and non-reactive characteristics, perfluorocarbons (PFCs), including PFOS, are used in release agents for plastic and rubber products manufacture. A release agent is a chemical, often wax, silicone or fluorocarbon fluid, used in moulding and casting, that aids in the separation of a mould from the material being moulded. It reduces imperfections in the moulded surface; it is also known as a parting agent, mould lubricant, mould release lubricant and de-moulding agent.

PFCs, however, were only used as a low concentration additive for a release agent, in which wax, hydrocarbons and organosilicons would be the basic ingredients. There is no survey on the use of PFCs/PFOS in industrial sectors using PFOS-containing release agents.

2.4 Manufacture of articles and products containing PFOS and its related substances

For a more detailed description of the processes, see the *drat PFOS BAT/BEP Guidelines*.

2.4.1 Impregnation and coating industry

Fluorosurfactants and polymers have been used to treat textiles and leather to provide oil and water repellence and soil and stain release properties, and to provide oil, grease and water repellence for paper. Fluorinated polymers are used to render textiles stain- and waterproof when required, but they also have to keep their breathability (air and water-vapour permeability.

Fluorinated finishes are the only technology known to deliver durable and effective oil and water repellence and release properties. Historically, fluorinated polymers based on perfluorooctane sulfonyl electrochemical fluorination chemistry have been used (for more information, see sections 2.5.1 to 2.5.4).

2.4.2 Compounders

Compounders are manufacturers of commercial chemical mixtures, like aviation hydraulic fluids and impregnation formulas. They use manufactured PFOS and related substances provided by the chemical industry upstream in the supply chain in their production. Manufacturers of PFOS and its related substances can also be compounders. For example 3M produced PFOS and its related substances and is also a compounder of fire fighting foams.

2.4.3 Manufacture of articles

Manufacturers of articles containing PFOS and its related substances are at the end of the supply chain producing textiles, furniture, clothes, leather apparel, food paper packaging, etc. Major items that could contain PFOS and PFOS-related substances, in the form of consumer articles made available on the market, are synthetic carpets, paper, textiles, furniture, leather and surface coating. Information on the application of PFOS-related substances in 2000 indicated that over 75% of total PFOS consumption was in consumer articles (3M Company, 2000).

Applications with a potential risk of direct exposure, such as textiles, sports clothes, apparel, shoes, cosmetics, shampoos, food packaging, have been of special concern due to possible implications for human health. The use of PFOS in synthetic carpets, textiles and home furnishing is of concern because of findings of the presence of PFOS in house dust and indoor air, and of the direct exposure of humans, especially babies and smaller children (Moriwaki et al., 2003; Harada et al., 2005; Calafat et al., 2006a, 2006b).

PFOS has been measured in elevated levels in waste water effluents, sludge and sewage. The sources are wastewater from households and industry. Surveys of landfill sediments and effluents have also revealed elevated levels of PFOS, with waste from production, industrial use but also households as the primary source (Oliaei et al., 2013; Kallenborn et al., 2004; Økland et al., 2008; Woldegiorgis et al., 2006). For more information, see section 2.5.

2.4.4 Recycling and reuse of synthetic carpets

Synthetic carpets in particular polyacylic carpets (GUT 2011) may have been treated with PFOS and its related substances, while it has usually **not been used for natural fibre carpets**. Since a major historic use of PFOS has been in synthetic carpets this use is a major stockpile of PFOS (Zangl et al., 2012). Carpets are recycled to some extent. There are several major methods of recycling[8] (Carpet Recycler, accessed in 2012):

- **Chemical**: Chemical recycling involves breakdown of the nylon fibre to be reprocessed into new carpet fibre. Only certain kinds of virgin nylon compounds can be converted into new fibres.
- **Fiberizing:** Carpet fibres can be harvested and converted into padding and matting for use in laying new carpet.
- **Mechanical:** Carpet fibres can be separated from their backing material and, if possible, recycled into new carpet or backing. The leftover materials can be processed into products such as parking barriers, geotextiles, lumber alternatives, roof shingles, fibreboard, sod reinforcement, carpet tack strip, automobile parts, high energy fuel, erosion control and soil absorbent, among other products.

Several companies also facilitate or manage leasing programs with the reuse of synthetic carpets.

Recycling and reuse for synthetic carpets containing PFOS and its related substances are banned by the Stockholm Convention, and many of the products produced from recycled synthetic carpets represent a direct exposure of the environment and humans. Therefore a strategy and actions to end recycling and reuse of synthetic carpets containing PFOS and a system for collecting and manage this waste stream in an environmentally sound manner will be important in the development of the NIP.

2.5 Consumer articles containing PFOS, its salts, PFOSF and its related substances

2.5.1 Textiles and upholstery

PFOS-related substances have been used in large quantities to provide soil, oil and water resistance for textiles, apparel, home furnishing and upholstery in particular until 3M stopped production in 2002. It seems that textile treatment has also been a major use for the Chinese production until 2011 (Zhang et al., 2011) but that regulatory pressure phased out the use in textiles (Lim et al., 2012).Today largely other PFCs are used for textile impregnation and only limited amount of PFOS related substances are detected (Knepper et al., 2014; Hanssen & Herzke 2014). They are mainly applied to home textiles (e.g. upholstery, apparel) and to outdoor wear, especially workwear including uniforms. PFOS is found in sports socks and sportswear because of its sweat-repellent and dirt-repellent properties. These uses are still important in several countries, and are often found in imported goods.

[8] www.doi.gov/greening/buildings/CarpetOct05.pdf

Water-repellent and dirt-repellent textiles are impregnated with a chemical formula, a dispersion polymer containing PFCs. The acrylate, methacrylate, adipate and urethane polymers of N-ethyl perfluorooctane sulfonamidoethanol (EtFOSE) were one of the main PFOS derivatives previously used for textile surface applications (UNEP, 2010b).

PFOS in house dust and indoor air can be a result of releases from textiles, furniture and upholstery. The washing of textiles is one of the sources of the releases of PFOS to water. PFOS is found in sewage sludge and releases from municipal treatment facilities.

Figure 2-c: Description of the supply chain in the textile industry

In the supply chain associated with treated textiles, the textile formulas used for textile impregnation are usually manufactured by a producer using PFOS and then distributed downstream for textile impregnation by a textile manufacturer. The impregnated textiles are then further distributed to manufacturers of clothes, apparel or furniture (see figure 2-6).

2.5.2 Synthetic carpets

Fluorinated compounds are widely used during manufacture of synthetic carpets to provide stain protection, especially for synthetic carpets based on synthetic fibres being impregnated. A small market share of synthetic carpets based on wool fibres is also impregnated.

PFOS itself is not directly applied to the fibre, but is first chemically bound in a polymer, which is then applied to the carpet. The chemical formulas used for synthetic carpets impregnation are usually manufactured by one producer using PFOS and then distributed downstream for carpet impregnation by a carpet manufacturer.

Examples of products used before 2003 for surface treatment of synthetic carpets include:

- Scotchgard (3M)
- Baygard (Bayer)
- Zonyl (Dupont)

Dupont, Bayer and 3M have stated that they have not used PFOS in their preservatives since 2003, and that they use fluorotelomers instead. But PFOS and its related substances ,might still be used in production of carpets in some countries. PFOS and its related substances may also be used, to make synthetic carpets stain proof after cleaning.

The major concern are PFOS-containing carpets producted before 2003 which may be used until today even in countries where the use of PFOS and its related substances is phased out in the production of carpets (Zangl et al., 2012).

Use in synthetic carpets is of concern because of the possible direct exposure of small children and babies. The washing of synthetic carpets can be a source of the releases of PFOS into water. The levels in house dust and indoor air can be a result of releases from synthetic carpets, among other sources in the home environment. Synthetic carpets remain in use for several years, and will eventually be deposited in landfills (Fricke et al., 2004; Zangl et al., 2012).

Recycling and use of synthetic carpets for other purposes have been reported, e.g., in the US (Carpet American Recovery Effort, accessed in 2012) and the United Kingdom (UK) (Carpet Recycling UK, accessed in 2012). Several reports have indicated that deposition of PFOS-related substances at dump sites and landfills result in releases of PFOS and related substances with the potential to contaminate the surrounding environments, potentially posing risks to human health and the environment (Bossi et al., 2008; Eggen et al., 2010; Li et al., 2012; Økland et al., 2008; Oliaei et al., 2013; Weber et al., 2010a; Woldegiorgis et al., 2006).

2.5.3 Leather and apparel

Leathers without finish have been impregnated with PFOS. These leathers have often been used for upholstery and belong to the higher price segment. The aim was to give surfaces the most natural look possible. For this purpose, PFOS was only sprayed onto the surface of such leathers to give them water- and stain-repellent properties. But PFOS has also been used for impregnation of leather shoes, domestic upholstery and in the automotive industry (European Commission, 2011).

Leather used in shoes, bags and apparel can be impregnated with water and dirt repellents. Using impregnation with PFOS preserves the product's ability to ventilate and transport the moisture to the outside. Since the chemical formulas are rather expensive, the manufacturers usually use formulas without PFOS.

For the supply chain associated with treated leather, the chemical formulas used for leather impregnation are usually manufactured by a producer using PFOS and then distributed downstream for impregnation by a leather manufacturer. The impregnated materials are then further distributed to manufacturers of shoes, apparel and furniture, and to the automotive industry.

2.5.4 Paper and packaging

PFOS-related substances can be used in the packaging and paper industries in both food packaging and commercial applications to impart grease, oil and water resistance to paper, paperboard and packaging substrates, or a glossy finish. Today mainly PAPS are used for impregnation of paper and PFOS relate substances are hardly detected but other long chain

PFCs (Trier et al., 2011). PFCs are applied to the paper, cardboards or cartons as a part of a polymer. Some of these articles are recycled and if PFOS or related substances are include then are transferred into new articles.

The use of PFOS and its related substances in food packaging is particularly of concern because of the direct exposure and possible implications for human health (Stahl et al., 2011), as well as the source for PFOS releases to the environment when it becomes waste, especially since the spread of this kind of waste is difficult to control. It is often mixed with other waste and thus cannot be sorted. It could have been landfilled or loaded on dump sites or given to domestic animals used for food production.

Following uses in food contact applications have been reported by different surveys (UNEP 2010 b; Begley et al., 2005, Trier et al., 2011):

- plates,
- food containers,
- popcorn bags,
- pizza boxes and wraps,
- baking paper,
- disposable plates

Following uses in non-food contact applications have been reported by different surveys (UNEP , 2010b; Begley et al., 2005):

- folding cartons,
- containers,
- carbonless forms and masking papers,
- table clothes
- wall paper

Paper protection by PFOS derivatives has been achieved by using one of the following (UNEP 2010b):

- Mono-, di- or triphosphate esters of N-ethyl perfluorooctane sulfonamidoethanol
- (EtFOSE)
- N-Methyl perfluorooctane sulfonamidoethanol acrylate polymers

The use of PFOS in paper and packaging applications is being reduced or phased out in many countries. PFOA and fluorotelomers are more frequently used today (UNEP 2010b). Common fluor-free applications, like denser paper, plastic films, and silicone emulsions, also fulfil the same purpose in consumer articles (UNEP 2010b).

Before 2000 about 32% of the total use of PFOS in the European Union was for paper coating; the use of PFOS for this purpose is no longer allowed and PFOS has been replaced mainly by other fluorinated chemicals (UNEP 2010b).

Before 2000, a Canadian study of fast food composites revealed that more than 55% of the composites contained *N*-ethyl perfluorooctane sulfonamide (EtFOSA). The highest level measured (23.5 mg/kg) was in a pizza. The degradation product or impurity PFOS was also detected in three samples. Most samples taken after 2000 were free of these contaminants because fluorotelomers had since been substituted for PFOS (Tittlemier et al., 2003, 2006).

Following are the main suppliers of fluorochemicals in the paper industry, with their brand names (UNEP 2010b):

- 3M Scotchban®

- Bayer Baysize S®
- Ciba (BASF) Lodyne®[9]
- Clariant Cartafluor®21[10]
- DuPont Zonyl®

2.5.5 Industrial and household surfactants

PFOS derivatives have been used as surfactants to lower surface tension and improve wetting and rinse-off in a variety of industrial and household cleaning products such as automobile waxes, alkaline cleaners, denture cleaners and shampoos, cosmetics and hand cream, dishwashing liquids, waterproof sprays and car wash products. PFOS derivatives have also been used in carpet spot cleaners. A PFOS derivative potassium N-ethyl-N-[(heptadecafluorooctyl) sulfonyl] glycinate (CAS No. 2991-51-7) has often been used in cleaning agents, floor polishes and auto polishes. The concentration of that PFOS precursor in the final product was generally between 0.005% and 0.01% but might have been 10 times as high (UNEP, 2010b).

2.5.6 Coatings, paint and varnishes

PFOS derivatives have been used in coatings, paint and varnishes to reduce surface tension – for example, for substrate wetting, for levelling, as dispersing agents, and for improving gloss and antistatic properties. PFOS derivatives can be used as additives in dyes and ink, as pigment grinding aids, and as agents to combat pigment flotation problems. The concentrations used were below 0.01 wt %. Information from suppliers in the paint and varnish industries suggests that fluorosurfactants are in general much more expensive than other alternative surfactants. Therefore, they are used in paint and varnishes only in situations where a very low surface tension is needed that no other (non-fluorinated) alternatives can currently achieve (e.g. in articles where an extremely smooth surface is necessary).

2.5.7 Toner and printing ink

According to the information from the OECD (2006) survey, less than 1 tonne of N-ethyl-N-[3-(trimethoxysilyl)propyl] perfluorooctane sulfonamide (CAS No. 61660-12-6) has been used globally as an additive in toner and printing inks. This use is considered to have been discontinued in most regions.

2.5.8 Sealants and adhesive products

PFOS-related substances have historically been used in sealants and adhesive products (UNEP, 2010b).

2.5.9 Medical devices

Video endoscopes are used to examine and treat patients at hospitals. Around 70% of the video endoscopes used worldwide, or about 200,000 endoscopes, contain a CCD43 colour filter that contains a very small amount (150 ng) of PFOS. Repairing such video endoscopes

[9] www.ciba.com/pf/default.asp?search=1&DApname=lodyne

[10] www.paper.clariant.com/businesses/paper/internet.nsf/vwWebPagesByID/65137D7B8419F6EDC12571E0003D5C16

requires a CCD colour filter containing PFOS. Although it is technically possible to produce PFOS-free CCD filters for use in new equipment, the existing 200,000 endoscopes use PFOS-containing filters would have a total amount of only 0.03 g of PFOS. Gradual phase-out of the existing endoscopes will permit use of PFOS-free equipment (UNEP, 2010b).

PFOS is also used as an effective dispersant when contrast agents are incorporated into an ethylene tetrafluoroethylene (ETFE) copolymer layer. PFOS plays an essential role in radio-opaque ETFE production, allowing the achievement of the levels of accuracy and precision required in medical devices (e.g. radio-opaque catheters, such as catheters for angiography and in-dwelling needle catheters). PFOS is only used as an agent in the manufacturing process and will normally not be a part of the final product as a result of this use (UNEP, 2010b).

2.5.10 Fire fighting foams

Fire fighting foams with fluorosurfactants are used for extinguishing liquid fuel fires, and are normally used to suppress fires in flammable liquids like oil, petrol, other non-water-soluble hydrocarbons, and flammable water soluble liquids like alcohols, acetone etc. They are especially used at installations and plants where larger quantities of flammable liquids are stored. Table 2-2 contains locations that may use and store PFOS containing fire fighting foams.

The consumption of fire fighting foams depends on the frequency of fire drills and the rate of fire accidents. There are different types of fire fighting foams and agents containing PFOS or related substances:

- **Fluoro-protein foams**: used for hydrocarbon storage tank protection and marine applications.
- **Aqueous film-forming foams (AFFF)**: used for aviation, marine and shallow spill fires; developed in the 1960s.
- **Film-forming fluoroprotein foams (FFFP)**: used for aviation and shallow spill fires.
- **Alcohol-resistant aqueous film-forming foams (AR-AFFF)**: multi-purpose foams.
- **Alcohol-resistant film-forming fluoroprotein foams (AR-FFFP)**: multipurpose foams; developed in the 1970s.

Fire fighting foams containing PFOS have been in focus due to the dispersive and extensive use and risk of high releases to the environment. Fire drills and leakage from stockpiles of fire fighting foams have led to large contamination of soil, ground- and surfacewater and fish (Ahrens et al., 2014; Awad et al., 2011; Buncefield Major Incident Investigation Board, 2008; Martinsen 2012; Minor, 2012; Moody et al., 2000, 2003; Herzke et al., 2007; Seow, 2013; Weber et al., 2011). Because of the environmental problem this use represents, many countries have started to phase out PFOS-containing fire fighting foams (e.g. the EU restricted the use and marketing of PFOS containing foam already in 2006 with the exemption of stocks which could be used until 2011)[11].

Table 2-2: Locations with possible use of fire fighting foams containing PFOS and its related substances

[11] Directive 2006/122/EC on the approximation of the laws, regulations and administrative provision of the Member States relating to restriction on the marketing and use o certain dangerous substances an preparations (perfluoro sulfonates) and restricted the marketing and use of PFOS-based foams.

(SFT 2005).

Location	Quantities stored	Use of PFOS and its related chemicals
Fire fighting training sites and fire rescue brigades	Varies	The use of PFOS-containing fire fighting foams at fire fighting training sites and by fire fighting departments varies, and the sites need individual assessment on the foams (formerly) used.
Airports	Limited quantities stored	Airports do not have stationary fire extinguishing installations with fire fighting foams. The fire fighting foam is used in the fire fighting vehicles and the quantities stored are limited. However they have frequent fire drills with associated contamination of ground water.
Petrochemical and other relevant industry	Varies	Use depends on type and size of the industrial installations and fire risk. Most industries consume smaller quantities of fire-fighting foam. But larger chemical enterprises may have large quantities stored.
Armed forces	Depends on type of installations	The use of fire fighting foams containing PFOS in military areas depends highly on the type of installations and the fire risk. Access to information is usually very limited.
Car parks	Large quantities	High quantities of stored fire fighting foams containing PFOS have been reported from underground parking areas.
Ships and ferries	Smaller quantities	It is less common to use fire fighting foams containing PFOS or its related substances in ships and ferries, although some tank ship companies have reported that some of their ships store smaller quantities on board.
Tank farms	Large quantities	Large quantities of fire fighting foams are stored at tank farms, and many of them use fire fighting foams containing PFOS. The consumption is less than at offshore installations because of less frequent fire drills.
Onshore gas terminals, installations for gas and oil extraction, oil refineries	Large quantities	Large quantities of fire fighting foams are stored at petroleum installations on shore, and many of them use fire fighting foams containing PFOS. The consumption is less than at offshore installations because of less frequent fire drills.
Offshore installations and mobile rigs	Large quantities	Offshore installations often use large quantities of fire fighting foams containing PFOS, and have larger quantities stored at the platforms in a limited space. There are large variations between platforms in consumption per year, depending on the frequency of fire drills and if they use and release fire fighting foams when testing the fire safety equipment. Smaller quantities of foams are stored at mobile rigs and are usually kept at the helicopter deck.

While fire fighting foam present still a major application of todays global PFOS production (Lim et al., 2011; Zhang et al., 2012), today most fire fighting foams are manufactured without PFOS, which has often been replaced by fluorochemical/telomers based on a perfluorohexane (C6) chain. In spite of a reduced production in many regions, there are still significant amounts of fire-fighting foams containing PFOS stored, and as fire-fighting foams

have a long shelf life (10–20 years or longer), PFOS-containing fire fighting foams may still be used for some time around the world in actual accidental fires. In addition, some regions have reported that fire fighting foams with PFOS are still manufactured in high quantities, and that they were phased in during the 1990s as an alternative to halones, an ozone depleting compound.

Ciba produced Lodyne™ grades with PFOS up to 2003 (Chemguard, accessed in 2012), but discontinued its manufacture of fire fighting foams in 2003. The same products are now manufactured by Chemguard under new trade names (S grades). Newer brands manufactured by Chemguard do not contain PFOS or its related substances (Chemguard, accessed in 2012). 3M phased out its manufacture of fire fighting foams with PFOS (3M™ Light Water™ foam agents - AFFF or AFFF-ATC) in 2003. Tyco FS&BP also manufactured some fire fighting foam agents containing PFOS before 2000. Significant amounts of fire fighting foams containing PFOS, from Tyco FS&BP, Ciba, Chemguard and 3M, may still be stored at professional users because of the long shelf life.

2.5.11 Aviation hydraulic fluids

Hydraulic oils containing PFOS have been used as an anti-erosion additive in civil and military airplanes since the 1970s to prevent evaporation, fires and corrosion (UNEP, 2010b). Hydraulic fluids are necessary to transfer the break pressure to the breaking system of the tyres. PFOS is added to inhibit erosion (and to control damages) of mechanical parts of hydraulic systems such as servo valves that are used in aircraft. The lower corrosion effect appears by altering the electrical potential at the metal surface and preventing its electrochemical oxidation (DEFRA, 2004).

Hydraulic fluids becoming waste are downcycled and handled by physical chemical treatment to generate a new product by oil recycling companies or incinerated in specialized treatment facilities (European Commission, 2011).

2.5.12 Insecticides

N-Ethyl perfluorooctane sulfonamide (EtFOSA; CAS No. 4151-50-2) is on the list of registered chemicals for use by farmers and grain merchants in several developing countries. The IUPAC name is 1-octanesulphonamide-N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro, and the substance is often called sulfluramid.

EtFOSA is used both as a surfactant and an active substance in insecticide products used in tropical areas such as Brazil against termites, cockroaches and other insects. It is one of the major PFOS uses (Lim et al., 2011; Zhang et al., 2012). It is registered in some developing countries for producing bait to control leaf-cutting ants in sugar plantations. According to information from the OECD (2006) survey, the substance has been used in insecticides at a concentration of 0.01-0.1% at an annual volume of up to 17 tonnes.

2.6 Stockpiles, waste and contaminated sites

Since the major use of PFOS and related substances has been between 1970s and 2002 (Paul et al., 2008), the inventory and management of stockpiles, waste and contaminated sites is a major task for the inventory development and NIP update in respect to PFOS. In particular since after PFOS is released to the environment, it is not known to undergo any further chemical or microbial degradation and is, therefore, extremely persistent (Environmental

Canada, 2013). Furthermore the PFOS related substances are transformed to PFOS in the environment and biota over time (Armitage et al., 2009; Benskin et al., 2009, Martin et al., 2010; UNEP, 2006).

To develop the inventory of practices employed in the management of PFOS waste, stockpiles and contaminated sites, a wide range of stakeholders must be contacted. These include stakeholders involved in the production and use of PFOS applications, as well as waste management authorities and the different operators of waste management situated across the country.

There will be a need for an environmental waste strategy for waste containing PFOS in the future (figure 2-7), and an appropriate inventory of stockpiles and wastes need to be developed as an important part of the NIP and the action plan for PFOS to reduce or eliminate releases from stockpiles and wastes. Important waste fractions are discussed in the next sections.

For the environmental sound management of wastes a “Draft technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOSF)” has been developed in the frame of the Basel Convention (Secretariat of the Basel Convention 2014).

2.6.1 Stockpiles

For countries phasing out the use and production of PFOS, the best strategy to avoid considerable pollution would be to collect and destroy stocks of PFOS instead of using them. Used chemical formulas, stocks or fire fighting foams and plating baths as well as synthetic carpets, textiles and leather treated with PFOS and related substances the last 40 years could have been stockpiled, and thus need to be collected and destroyed in an environmentally sound manner. This requires good waste treatment and destruction facilities for hazardous waste that meet BAT and BEP requirements and ensure the destruction of the very stable PFOS.

The issue of stockpiles is very important in developing countries because excess PFOS in fire fighting foams and from local oil production or possibly imported from developed countries is stored for further use. For example, in most developing countries of the ECOWAS sub-region, the potential sites for stockpiles of PFOS and its derivatives are oil industry facilities and airports, warehouses and storage facilities of chemical importers. There can also be stockpiles at mines. The use of PFOS in open application such as the mining and oil industry in developed countries is most likely phased out. However, large stockpiles of fire fighting foams locally stored at production sites for oil and gas facilities and at airports are important targets during the inventory. Stockpiles with aviation hydraulic fluids at the airports and stockpiles of fire fighting foam agents at industrial sites are also prioritized targets of the inventory. It is important that they are managed in an environmentally sound manner when identified. Section 7.2 lists possible locations with storage facilities for stockpiles containing PFOS and its related substances.

2.6.2 Waste from consumer articles containing PFOS

Articles like textiles, carpets, furniture and paint containing PFOS have in the past been dumped at landfills or dumpsites. Carpets can represent a huge amount of contaminated waste, depending on the age of the carpets and if they are regularly re-impregnated at homes and institutions. A strategy for collecting and managing this waste is important in the development of the action plan for PFOS.

Developing countries are already faced with many challenges in coping with old POPs stockpiles, and often do not have appropriate technology or capacity to manage and destroy POPs (Weber et al., 2011). PFOS and related substances (like PBDEs) are often in small quantities in large volumes of household waste representing a new challenge for inventory development and waste management. A robust inventory to decide if some of the PFOS-containing materials need to be exported to countries with appropriate destruction capacity or if some of the waste fractions could be treated in the country (e.g. in cement kilns). Finally it needs to be ensured that PFOS containing waste is subjected to environmentally sound management (Secretariat of the Basel Convention, 2014) to limit environmental releases and human exposure.

2.6.3 Waste and contamination from treatment of effluents

With the production or use of PFOS in industries (e.g. plating plants), direct releases to the surface and groundwater can occur at the facilities as well as contamination of (sewage) sludge from waste water treatment plants (Harada et al., 2003; Kunacheva et al., 2011; Oliaei et al., 2013). However also municipal waste water treatment plants in industrial countries can have elevated PFOS levels in sludges (Clarke & Smith, 2011; Petersen et al., 2009) while the PFOS levels in first monitored sewage sludges from different waste water treatment plants in developing countries were low (Shivakoti et al., 2010; Sindiku et al., 2014, Yan et al., 2012). These sludges are partly used as biosolids on agricultural soil or deposited in the environment with associated contamination (Sepulvado et al., 2011). This indicate that a large share of the PFOS used probably ends and ended up in the environment and partly results in contaminated sites from (former) application of highly contaminated sludges (Brambilla et al., 2014; Kröfges e al. 2007; Skutlarek et al., 2006; Sepulvado et al., 2011).

2.6.4 Contaminated sites

Due to the high persistence in the environment (Environmental Canada 2013) all sites where PFOS has been produced, used or disposed can be considered as potential PFOS-contaminated sites. PFOS-containing fire fighting foam used in airports, mines, oil and gas drilling, refineries, industrial sites, military installations and large power plants including fire sensitive installations that have frequent fire fighting practice might have resulted in contaminated soils, ground- and surface water fishes (Ahrens et al., 2014; Awad et al., 2011; Buncefield Major Incident Investigation Board, 2008; Martinsen 2012; Minor, 2012; Moody et al., 2000, 2003; Seow, 2013; Weber et al., 2011).
Also the release and waste from PFOS used in oil extraction operations could result in PFOS-contaminated sites. In insecticide application, any facilities and larger areas where sulfluramid (a PFOS precursor) was applied as a bait for ants and cockroaches are potential contaminated sites.

Since a large share of PFOS was produced mainly from 1970 to 2002 (Paul et al., 2010) and has been used to a large extent in consumer products such as carpets, textiles, furniture and paper (see table 2-1) the landfills and dumpsites represents the largest reservoir of PFOS and related substances. PFOS and related substances are released from landfills to a different degree. Depending on the deposition history of the landfill PFOS can be major pollutant (Egger et al., 2010; Kallenborn et al., 2004; Oliaei et al., 2013; Woldegiorgis et al., 2008) while in other landfills PFOS might present only a small share of overall PFCs release and other PFCs might be major pollutants in leachates (Busch et al., 2010; Kim et al., 2013). Therefore landfills have to be considered as PFOS source to the environment and some might need to be classified as PFOS contaminated sites depending on the deposition history. Also, as mentioned above (2.6.3), the application of PFOS-containing bio solids in agricultural land partly results in contaminated sites in particular from (former) application of highly

contaminated sludges (Brambilla et al., 2014; Kröfges e al. 2007; Skutlarek et al., 2006; Sepulvado et al., 2011).

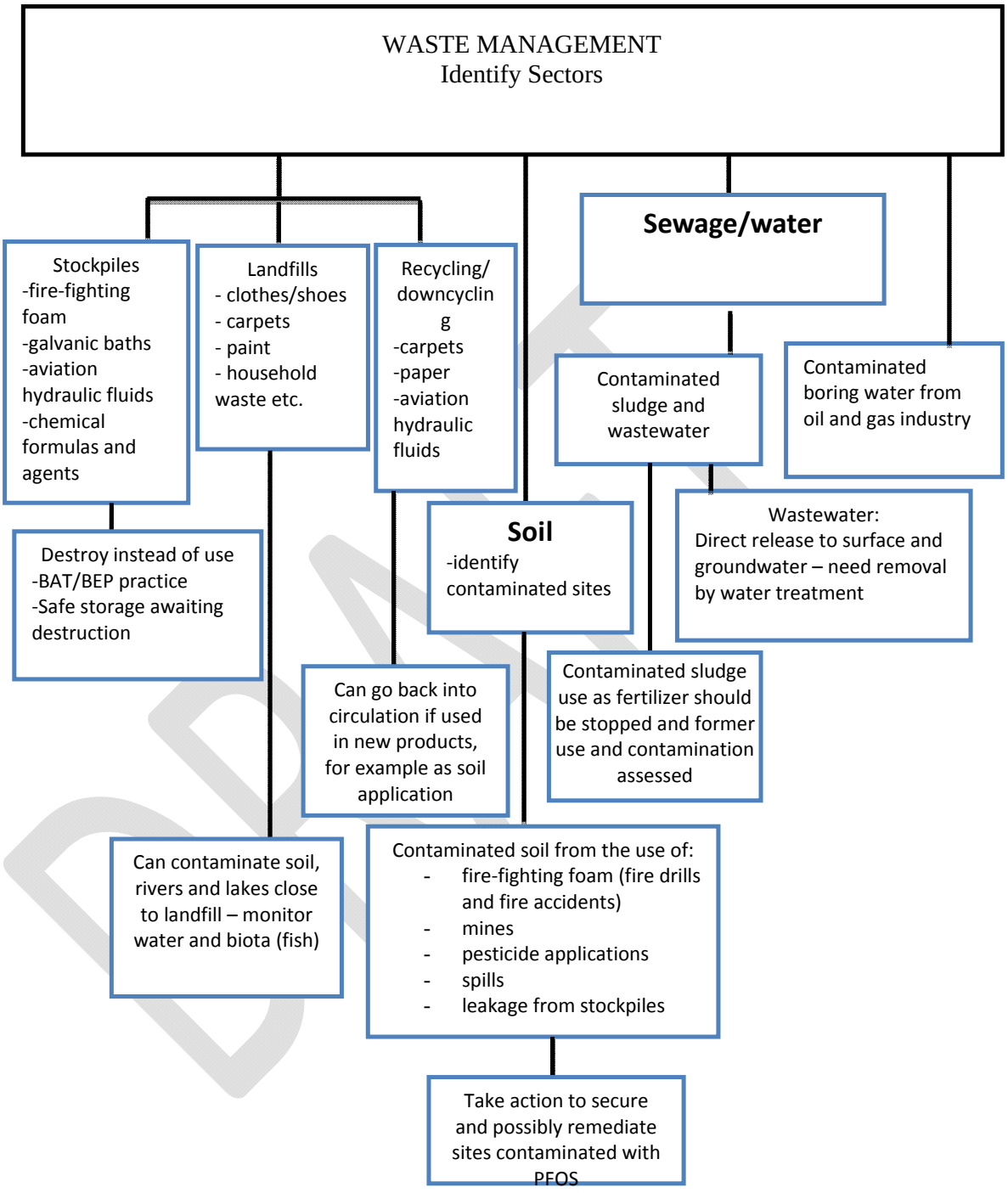

Figure 2-Y Summary of the steps to be considered in PFOS waste management

3. How to conduct a PFOS inventory

This chapter outlines a general step-by-step approach to carry out a national PFOS inventory (figure 3.1). This approach involves planning (step 1), choosing data collection

methodologies (step 2), collecting and compiling data (step 3), managing and evaluating the data (step 4) and preparing of an inventory report (step 5).

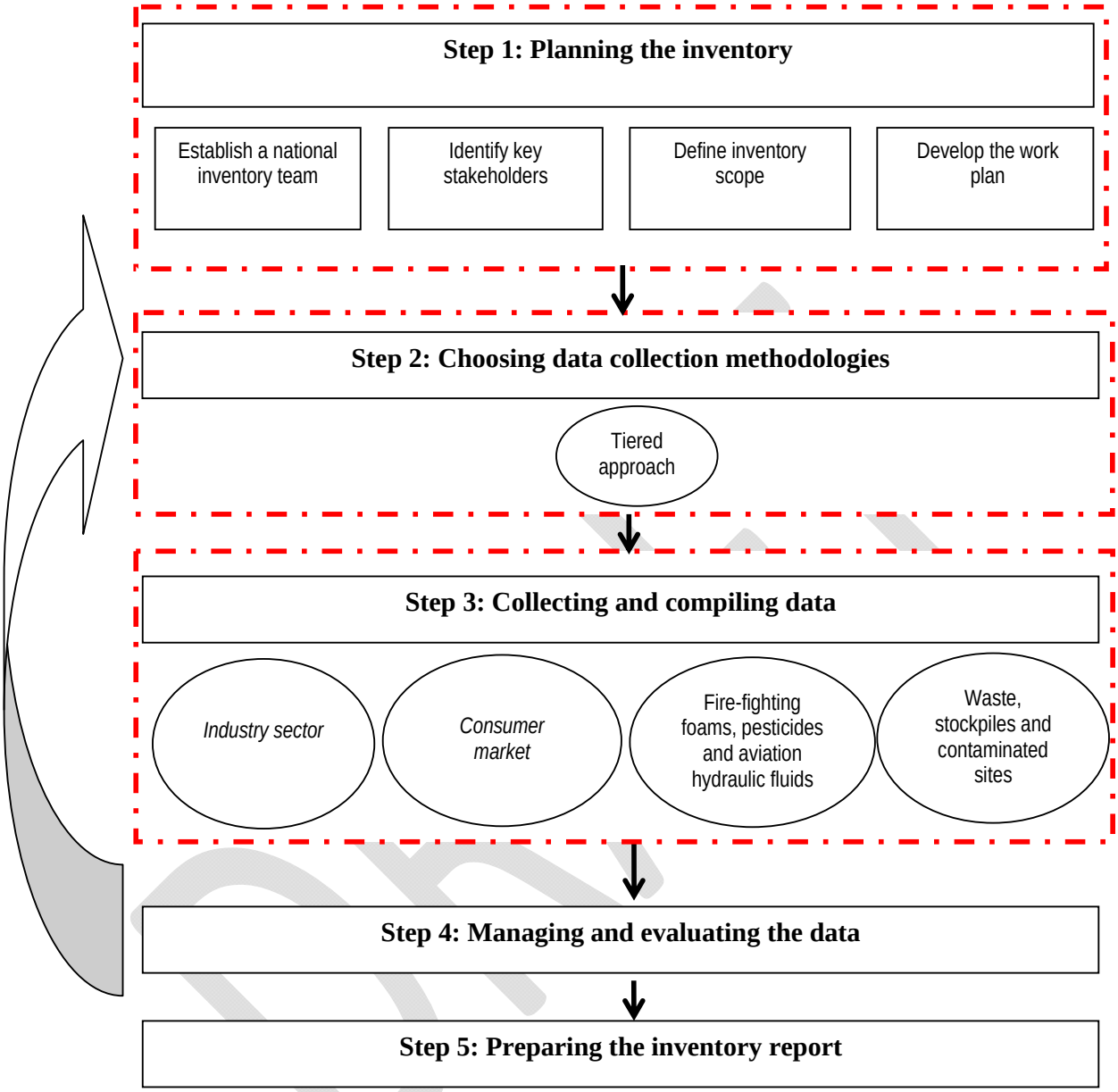

Figure 3-ᴍ Overview of the national PFOS inventory development process

The relevant sectors of use and production of PFOS and its related substances are identified in step 1. When choosing data collection methodologies in step 2 a tiered approach is recommended. If national statistical information on production, use, import and export is available, this information can be collected in step 3 and the estimation method provided in section 3.4.2 can be applied in step 4. If the information available on production and use is too limited for the sectors identified, the step-by-step key sector inventories provided in chapters 4 to 7 can be chosen in step 2 and used when collecting and compiling data in step 3.

Chapters 4 to 7 also describe how to manage data collected by tiered approach or step-by-step key inventories in step 4. Steps 2 to 4 can be repeated until the data quality and coverage of the inventory reach a satisfactory level.

3.1 Step 1: Planning the inventory

It is important to clearly assign the responsibility for developing the inventory. The national focal point of the Stockholm Convention should be responsible for initiating the inventory process. The existing Steering Committee on POPs, which was formed for the original NIP development, could be re-established for updating the NIP and involved in the planning of the inventory.

The first issue to consider in developing a national inventory is to define the scope of the inventory and target the national relevant sectors for PFOS. The development of a national inventory of products and articles requires cooperation with the relevant authority in charge of producers of PFOS and its related substances, professional users, suppliers, retailers and the customs service, as well as other relevant authorities and organizations. Parties that have no regulations on PFOS and consider to do a full inventory are advised to establish a multi-stakeholder national inventory team.

3.1.1 Establish a national inventory team

Members of the national inventory team could include the authorities with the mandate for chemicals management, the national customs service, representatives from larger stakeholders involved in the production and use of PFOS in the private sector, universities and research institutes working on old and new POPs, non-governmental organizations (NGOs), etc.

The national focal point for the Stockholm Convention could serve as leader or convener of the team. National and/or international consultants with PFOS issues expertise could be hired to facilitate the work of the team.

The national focal point and/or consultants would brief and educate the team on the Stockholm Convention's mandates, obligations and the new POPs.

3.1.2 Identify key stakeholders

Key stakeholders to be involved in the national inventory team can be relevant government authorities, official agencies and national institutes of statistics and research, larger organisations for producers, manufacturers and distributors, community based organisations and NGOs, organized labour and trade unions, industrial enterprises, other private-sector organizations, the waste management and recycling sector. In developing countries the customs service can often provide valuable help since it is involved in granting imported goods.

Valuable stakeholder feedback can help target the production and supply of PFOS and its related substances and the relevant areas of industrial and professional use, making the inventory as practical and effective as possible.

The lists of stakeholders in table 3-1 and annex 2 can be used as guidance when identifying the relevant key stakeholders to be involved in the team and the defining of the inventory's scope.

If PFOS and PFOS-related substances have been locally produced or imported into the country, the industries involved should also be included in the scope setting exercise (see section 3.1.3). These companies may be able to give estimates or even exact amounts of the

compounds or commercial products/preparations that are used in domestic applications. These estimates can be critical in determining how much of the PFOS in a country has been accounted for by an inventory. Unfortunately, in some cases, these records may no longer exist, or authorities may have only limited access to them.

In some countries stakeholders are obliged to report their use of chemical compounds, including the amount used and type of use, to the authorities. This information is registered in a database together with the identity of the substance, providing a national register of products.

3.1.3 Define the scope of the inventory

Defining the scope of the inventory involves identifying the relevant national sectors to be investigated further, use of resources and the extent of the activities needed.

The following criteria are important in defining the scope of the inventory:

- Life cycle impact of PFOS and its related substances (see table 3-1)
- Obligations for PFOS under the Stockholm Convention (see table 3-1)
- Objectives of an PFOS inventory (see section 1.1)
- Existing resources and capacity
- National priorities

Identification of relevant national sectors to be investigated further can be achieved by doing a desktop study of existing information as described in section 3.2.2 paying special attention to the use categories and processes with use of PFOS and its related substances listed in chapter 2. To get feedback on the existing information and identifying gaps and relevance of the information the key stakeholders identified in section 3.1.2 can be consulted.

The degree and depth of the inventory can be defined by consulting the sections below on data methodology (section 3.2) and data collection (section 3.3), and considering the resources needed for an inventory in relevant national sectors using a tiered approach. Minor uses should be considered in the inventory only if manufacturers in this category are established in the country or existing information indicates that those uses could be relevant.

Table 3-M: Life cycle impact of PFOS and its related substances

Production and use	**Obligation under the Stockholm Convention**	**Type and magnitude of source**	**Possible waste fractions and stockpiles**	**Exposure**
Production of PFOS and its related substances	Solely for the uses listed as acceptable purposes or specific exemptions	Point sources	Stockpiles	- Environment - Occupational health - Contaminated sites
Compounders	Solely for the uses listed as acceptable purposes or specific exemptions	Point sources	Stockpiles	- Environment - Occupational health - Contaminated sites

Manufacturers of finished materials and articles	Solely for the uses listed as acceptable purposes or specific exemptions	Point sources	- Stockpiles - Sewage sludge	- Environment - Occupational health - Contaminated sites
Recycling and downcycling operations	Banned	Point source	- Stockpiles - Sewage sludge	- Environment Occupational health
Fire fighting foams	Acceptable purpose	Widespread and dispersive use	Stockpiles	- Environment - Occupational health - Contaminated sites
Aviation hydraulic fluids	Acceptable purposes	Diffuse source	Stockpiles	Environment
Medical devices	Acceptable purposes	Small amounts Minor use	Waste	Limited
Electric and electronic parts in colour printers and colour copy machines	Specific exemption	Minor use	Waste	Limited
Textiles and upholstery	Specific exemption	Diffuse sources	Waste	- Environment - Public health
Synthetic carpets	Specific exemption	Diffuse source	Waste	- Environment - Public health
Paper and packaging	Specific exemption	Diffuse source	Waste	- Environment - Public health
Insecticide:				
- *Insect bait for leaf-cutting ants*	Acceptable purpose	Widespread and dispersive use	Stockpiles	- Environment - Occupational health - Public health - Contaminated sites
- *Insecticide for fire ants and termites*	Specific exemption			
Leather and apparel	Specific exemption	Diffuse source	Waste	- Environment - Public health
Coatings and coating additives	Specific exemption	Diffuse source	Waste	- Environment - Public health
Industrial and household treatment products:				
- *Waterproof spray* - *Denture cleanser* - *Shampoos* - *Cleaning agents* - *Cosmetics and hand cream* - *Toner and printing ink* - *Sealants and adhesive products*	Banned	Diffuse source	Waste	- Environment - Public health
Rubber and plastic*: Release agent in the manufacturing process*	Specific exemption	Minor use	Waste	Limited
Articles from recycled synthetic carpets, paper and packaging, and downcycled aviation hydraulic oil	Banned	Diffuse source	Waste	- Environment - Public health
Photographic industry: *Photoimaging*	Acceptable purpose	- Small amounts - Closed-loop application	Stockpiles	limited

		- Not in the final article		
Semiconductor industry:				
- *Photoresist and anti-reflective coating*	Acceptable purpose	- Small amounts - Closed-loop application - Not in the final article	Stockpiles	Limited
- *Etching agent for compound semiconductors and ceramic filters*	Acceptable purpose			
- *Photomask*	Specific exemption			
- *Edge bead removers*	Banned			
- *De-gluing agents*	Banned			
- *Developing agent*	Banned			
Electronics industry:				
- *Photoresist and anti-reflective coating*	Acceptable purpose	- Small amounts - Closed-loop application	Stockpiles	Limited
- *Etching agent for compound semi-conductors and ceramic filters*	Acceptable purpose			
- *Photomask*	Specific exemption			
- *Desmear agent*	Banned			
- *Dispersion*	Banned			
- *Surface treatment*	Banned			
- *Solder*	Banned	Diffuse sources	Stockpiles	Limited
- *Paint*	Banned			
- *Adhesive*	Banned			
- *Metal plating in closed-loop system*	Acceptable purpose	Closed-loop application	Stockpiles	Limited
- *Hard chromium plating*	Specific exemption	Open application	- Stockpiles - Sewage treatment	- Environment - Occupational health - Contaminated sites
- *Decorative chromium plating*	Specific exemption			
Chemically driven oil and gas production	Specific exemption	Open application	Stockpiles	Environment
Mining industry	Banned	Open application	Stockpiles	Environment
Metal plating industry:				
- *Metal plating in closed-loop system*	Acceptable purpose	Closed-loop application	Stockpiles	Limited
- *Hard chromium plating*	Specific exemption	Open application	- Stockpiles - Sewage treatment	- Environment - Occupational health - Contaminated sites
- *Decorative chromium plating*	Specific exemption			

Note: The end products of some of the processes described will not contain PFOS and its related substances; therefore those end products are not included in the table.

3.1.4 Develop the work plan

The national inventory team is expected to develop a work plan for the inventory including:

- Inventory strategy
- Methodologies to be used
- Activities needed
- Resource allocation including responsibility and budget
- Timeline and milestones

Depending on national team capacity it has to be decided whether only an overall inventory of production, use, stockpiles and potentially contaminated sites will be undertaken, or if for some sectors more in depth inventories with potential measurements might be carried out. If the latter is chosen it has to be decided if all relevant sectors will be targeted, or if some will be more investigated than others.

The tiered approach and data collection methodologies that can be used, as described in section 3.2.3 and chapters 4 to 7, may serve as guidance. Activities, methodologies used and time needed differs between the tiers in the different key sectors. The degree and depth of the inventory depend on tier chosen and have to be determined from available resources and capacity. A detailed inventory may not be possible for all sectors. Assembling basic inventory-related information, however, is essential to indicate the main sources of PFOS and its related substances.

3.2 Step 2: Choosing data collection methodologies

3.2.1 Indicative, qualitative and quantitative methodologies

A number of different methodologies can be used for gathering information about hazardous substances such as PFOS. The methodologies can be divided into three groups:

- **Indicative method**: provides initial information for further planning of the inventory depending on the amount of resources (i.e. human and financial situation). This method is quick and does not require significant human and financial resources. Activities include desk study of existing information, workshops, and interviews.
- **Qualitative method**: uses questionnaires to obtain more specific data. Data management is based on estimations from known levels of quantities of PFOS used and total production volumes in production processes, and manufacture of products and articles. Workshops and interviews with stronger obligations (legal tools) may also be helpful in obtaining data from the industry.
- **Quantitative method**: provides accurate and specific numerical information, but needs to be carried out by experts in the relevant fields of PFOS and the sectors of investigation. This is an advanced stage of the inventory that includes site inspection, sampling and analysis. The extensive investigations and labour intensive and chemical analysis is costly.

Examples of different data collection methodologies:

- **Desk study of existing information:** involves gathering information about existing past and current national data on production and use of PFOS and its related substances, articles containing PFOS and alternatives. This information can be obtained from the customs service, national bureau of statistics, and national central bank; published literature in scientific journals, technical reports or notes, commissioned research reports, development assistance study reports; phone books and Internet searches. The information can be collated, evaluated and verified if possible, and a gap analysis of the data could be undertaken as well.
- **National sensitization workshop on Stockholm Convention and new POPs including PFOS:** This national workshop would involve major stakeholders from all sectors and groups in which products and articles containing PFOS and its related substances have been used or are still being used. The national importance of the inventory exercise would be emphasized to participants while

also demanding their full cooperation and unhindered release of available data in their custody in the national interest.

Breakout sessions and group meetings could be organized during the workshop to ensure that all sectors in which PFOS has been used are adequately covered as well as to get consensus on how best to collect and compile data.

- **Questionnaire surveys:** are valuable instruments for primary data collection in inventory programs. Based on preliminary contact and consultation meetings with stakeholders, a questionnaire with guidance can be developed and sent to the relevant stakeholders. Examples of questionnaire formats that can be used for different sectors are provided in annexes 3 to 11.

  Questionnaires can be administered through various outreach mechanisms, including postal distribution; supply chain distribution; distribution via trade unions, NGOs, local governments and community leaders; and hand delivery in one-on-one interviews, etc. The use of questionnaires together with stakeholder meetings has been successful in previous inventories of PFOS.

  In cases where the sheets of declarations on health and safety attached to the products do not contain information about the content of PFOS and its related substances, professional users are encouraged to consult the suppliers of products to provide this information. Suppliers are encouraged to consult with the manufacturers to obtain this information if it is missing.
- **Site inspection, sampling and analysis:** Samples of products and articles can be gathered in site inspections of relevant installations and facilities, as well as at local retailers. Also for potentially contaminated sites the locations would be inspected and samples of e.g. ground water, soils or fishes would be selected. Products and articles can then be investigated using the verification method in annex 12 and analytical methods briefly described in annex 13 and the *Draft Guidance on Sampling, Screening and Analysis of Persistent Organic Pollutants in Products and Articles* (Secretariat Stockholm Convention 2013).

3.2.2 Identification of stakeholders in a key sector

PFOS use categories are listed in annex 2 for the different production and use categories of PFOS and its related substances, along with relevant stakeholders for the sectors under investigation. Important stakeholders can be identified using this list and involved in the inventory as required.

The following tools can be used to identify and get contact details to stakeholders of relevance in the country:

- Email/Web-based information sourcing
- Phone books
- National registers
- Consulting with other stakeholders

The contact can be made by using

- Face-to-face interviews
- Telephone interviews
- Postal communication

How to effectively and efficiently contact the identified stakeholders depends on the type of information needed and at which step of the inventory (see chapters 3 to 7) the contact is occurring. Examples of possible strategies that can be used:

- **Making preliminary contact**: It may be useful to make contact with the stakeholders at the beginning of the inventory to inform them about its background and scope. This can give them a better understanding of the aim of the inventory and an opportunity to communicate their views and questions. Stakeholder feedback can help target the right areas of use, thus making the inventory as practical, effective and accurate as possible.

- **Holding stakeholder group meetings:** Since PFOS is widely used in many different applications, the inventory may have to include some smaller users for specific uses with many stakeholders involved. For example, an inventory of fire fighting foams is extensive and needs thorough planning because of the many potential professional users across the country. The inventory of waste categories and management may also involve a range of stakeholders at different levels.

- **Consulting relevant stakeholders**: During the inventory planning stage, it may be more efficient to only contact and consult a small number of relevant stakeholders such as larger manufacturers, national industrial associations and the customs service. Gap analyses conducted in the evaluation of an inventory could result in the need to contact some of these stakeholders again to get more information or identify other stakeholders to be contacted to help fill in the information and data gaps.

3.2.3 Tiered approach

Collecting inventory-related data is a multi-step process that can be based on a tiered approach.
The tiered approach to a PFOS inventory illustrated in figure 3-2 is the basis for the step-by-step process described for key sectors in chapters 4 to 7.

This approach provides flexibility to a wide range of Parties with varying priorities and capacities. The suggested methodologies for data collection are described in section 3.2. Each tier represents a level of methodological complexity. Moving from lower to higher tiers implies a Party is opting for approaches that are progressively more demanding in terms of complexity and data requirements, and therefore more resources may be needed. Tier I methods usually rely on available statistics in combination with estimates for key parameters (provided in this guidance).

Higher tier methods involve more resource-intensive data collection activities and should also yield more accurate results. For some applications country- or region-specific measurements might be conducted possibly in cooperation with regional centres.

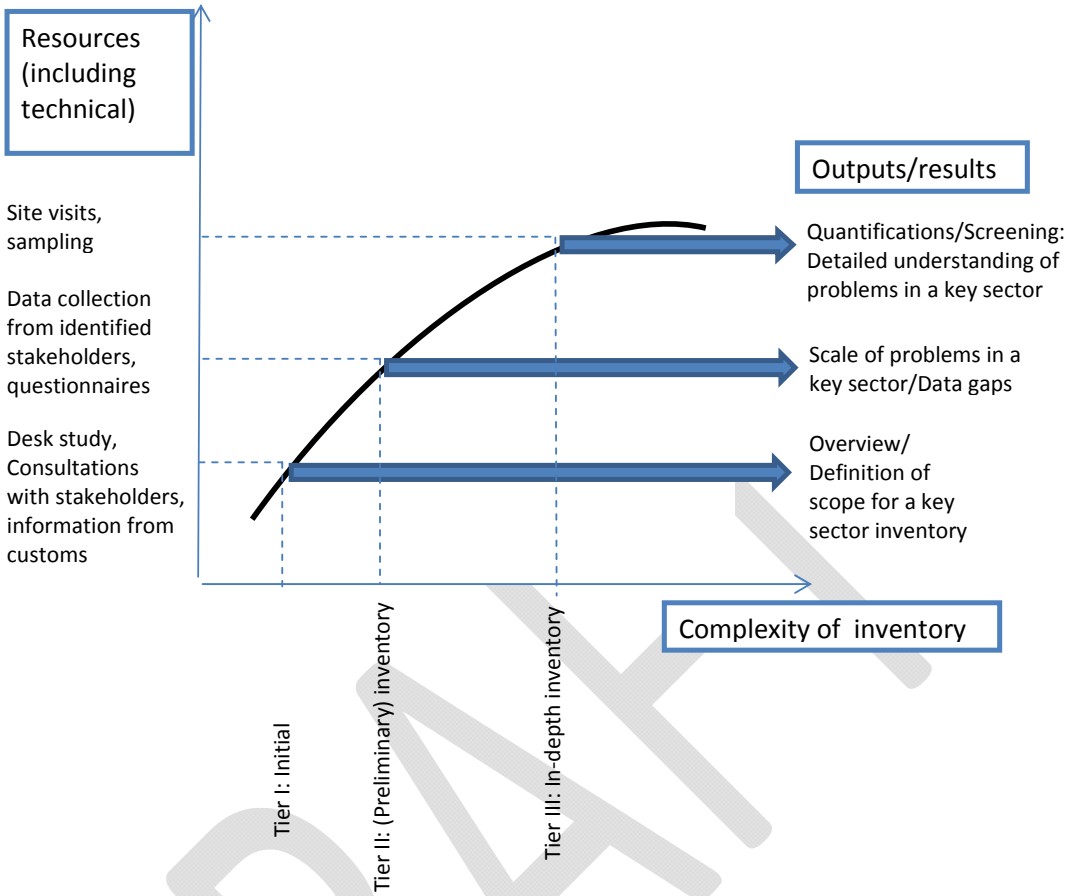

Figure 3-2: The tiered inventory approach

An initial assessment (tier I) is carried out to get an overview of the relevant stakeholders to be contacted in the key sector under investigation. This can be followed by a (preliminary) inventory (tier II) to generate data and identify missing and incomplete data sets. If needed and resources are available, a more in-depth inventory (tier III) can be initiated after evaluation of the data gathered in the preliminary inventory.

3.3 Step 3: Collecting and compiling data from sectors

3.3.1 Data collection in key areas

The inventory team needs to investigate if the following exist in the country:

- **Production** of PFOS, its salts and PFOSF; PFOS-related substances; and chemical preparations containing PFOS. Most countries do not produce PFOS and its derivatives. And only some countries produce chemical agents and preparations

used in the manufacture of textiles and upholstery, leather and apparel, synthetic carpets, and electronic and electrical articles and devices.

- **Industrie**s using chemicals containing PFOS and its related substances.
- **Products and articles** containing PFOS and its related substances on the national consumer market.
- **Professional users** of articles or products containing PFOS and its related substances.
- **Waste fractions** containing PFOS and its related substances, and how they are managed.
- **Stockpiles** containing PFOS and its related substances, and how they are managed.
- **Contaminated sites** with PFOS and its related substances.

The following types of numerical data need to be collected and compiled in the inventory

- Quantities in products, waste and stockpiles
- Quantities used in industrial processes and manufacture of articles and products
- Quantity manufactured/imported

Steps 1 to 4 in this chapter present a general approach to the national inventory. Chapters 4 to 7 outline the detailed steps to be followed for each key sector. The key sectors to be investigated fall under four main inventory areas:

- Production and use of PFOS and its related substances in the industrial sectors (chapter 4)
- Products and articles containing PFOS and its related substances on the consumer market (chapter 5)
- Fire fighting foams, aviation hydraulic fluids and insecticides containing PFOS and its related substances (chapter 6)
- Waste, stockpiles and contaminated sites containing PFOS and its related substances (chapter 7)

If statistics on import, manufacture and export are available for relevant sectors, the net consumption of PFOS and its related substances can be calculated using the template for calculations in table 3.2 (see section 3.4). If statistics are not available, the step-by-step approach for the key areas (in chapters 4 to 7) can be used. The data collected can be compiled using the compilation formats/templates in annex 15. Each stakeholder sector is described in chapter 2 to give the background needed for an informed inquiry.

The data collected using the questionnaires in the annexes in the first three areas (chapters 4 to 6) will form the basis for the preliminary inventory of the fourth area, waste and stockpiles (chapter 7).

3.3.2 Identification of PFOS and its related substances

When collecting data, PFOS and its related substances produced or used in the country have to be identified and awareness of the list of related substances that are regulated by the Stockholm Convention among the stakeholders is crucial. The OECD (2007) has compiled a list containing 165 PFOS-related substances[12] including derivatives and polymers of perfluorooctane sulfonate, perfluorooctane sulfonamide and perfluorooctane sulfonyl

[12] The listed 165 PFOS related substance cover most but not necessarily all PFOS related substances. To ensure that all PFOS precursor are covered by regulation, Canada has included in its "Toxic Substance List – Schedule 1" chemicals that contain the moiety which determines a PFOS precursor (Environment Canada 2013).

chemicals and their chemical names and CAS numbers. This list is an important tool for national inventories. It helps the inventory team to judge whether the substances and/or mixtures identified in production processes, materials and articles contain PFOS and its related substances, as regulated by the Convention, and subsequently if they should be included in the inventory.

Producers, suppliers and users may be unaware of this list and that the listed substances contain the PFOS structure in the polymers and are regulated by the Convention. Material safety data sheets are sometimes not reliable source for the PFOS content in products and preparations/mixtures. A producer may not be obliged to mention PFOS in the material safety data sheet because of its low content in the product. As a result, downstream users of the chemical may consider the chemical preparations or products, materials they use or articles they produce to be PFOS-free.

If information on the content of PFOS and its related substances in commercial mixtures, formulas and articles is lacking or not provided by professional users and producers, other methods can be used to establish the content for key sectors (see chapters 4 to 7). Some of the trade names that may be relevant are listed in the *draft Guidance for the Control of the Import and Export of POPs*.

3.3.3 Trade secrets and confidentiality

Stakeholders may wish to keep information such as annual sales or production data confidential from their market competitors. In such cases, it is important to provide guarantees to the companies that the information they provide will not be passed on to third parties and it will not be possible to deduce PFOS quantities for individual stakeholders from the data provided in the reports. Data in the inventory report do not need to be reported with stakeholder-specific information. Furthermore, the archives in which stores inventory data or database must be secure. If this is not possible, background data have to be coded or destroyed after use.

Alternatively, stakeholders can calculate their yearly consumption or sales of PFOS and its related substances themselves; if needed, using the equations provided in this guidance with guidance from inventory technical team. Again, stakeholders must be assured that this calculated information will not be passed on. The inventory team can visit the stakeholders with questionnaires and provide the necessary support for filling them out. If the inventory is conducted by consultants, they will need a letter from the authorities describing the purpose and requirements for the inventory as well as granting the consultants authorization to collect data and conduct the inventory on behalf of the authorities.

The following legal framework may need to be provided:

- Control mechanisms and legal actions to promote adherence to the Stockholm Convention obligations on the use and production of PFOS and its related substances
- Regulations providing data security to protect trade secrets

The authorities will need information on use and production of PFOS and its related substances to be able to notify the Convention of acceptable purposes and specific exemptions, and reflect them in their national regulations. For this reason, some stakeholders may wish to provide information to authorities to help them make well-informed decisions based on the production and use of PFOS in the country.

3.4 Step 4: Managing and evaluating the data

3.4.1 Data management

Since Parties have different designs and levels of legal framework, political organization and economic support for environmental management, different methodologies have to be applied in the data gathering process (as described above). Management of the collected data should be done as consistently and transparently as possible.

During the data conversion, all the assumptions and conversion coefficients adopted as a result of expert judgement, should be noted when the results are presented. Before the inventory starts, all the data formats including questionnaire survey formats should be determined to anchor the consistency of data to the extent possible.

If some data conversions and estimations are done by stakeholders, the inventory team must provide training on how to estimate the amount of PFOS and its related substances and how to fill out the questionnaire. This will reduce the possibility of errors during the data processing.

Estimations will be needed to provide the total quantities in a country, after quantitative measurements have been performed on representative samples. Estimations are a valuable tool for providing data with limited resources. Since direct measurements of PFOS in products and articles are resource intensive, a preliminary inventory could be fully based on estimations.

If statistics on import, manufacture and export are available, some estimated amounts of PFOS, can be calculated for the relevant national sectors by following the procedures described in section 3.4.2. If statistics are not available, data management strategies are described for focal sectors in chapters 4 to 7. If the questionnaires in annexes 3 to 11 are used, they can be compiled using the compilation formats/templates in annex 15 and the equations provided in chapters 4 to 7 can be used to estimate the amounts of PFOS and its related substances produced or used in the focal sectors.

3.4.2 Estimations based on statistics

If statistics on import, manufacture and export are available, annual net consumption of PFOS and its related substances can be estimated. To quantify the amounts of PFOS in all use categories (listed in annex 2), data can be processed through statistics on manufacture, export and import volumes from a national statistics bureau. The net consumption can be calculated by using the following formula:

Annual net consumption of PFOS in [country] = [manufacture + import – export] of PFOS containing products or articles x PFOS content*

The average content of PFOS in various articles or preparations is given in table 3-2.

The statistics bureau may provide foreign statistics (import and export) for different product [article/preparation] codes. Calculations based on the statistics must be regarded as estimates of real net consumption of PFOS. Table 3-2 provides a template for calculations of annual net consumption of PFOS.

Table 3-H: Template for calculations of annual net consumption of PFOS

Category of article or	**Year of phase-**	Process	**Import**	**Manufacture**	**Export**	**Approx. PFOS**	**PFOS quantity**

preparation	**out**	*Steps, if applicable*	**(kg per year)**	**(kg per year)**	**(kg per year)**	**content* (mg PFOS/kg** article or preparation)**	**(kg per year)**
Photographic sector		• Surfactant • Electrostatic charge control agent • Friction control agent • Dirt repellent agent • Adhesion control agent				100	
Semiconductor sector		• Etching agent • Photoresist substance • Photo-acid generator • Surfactant • Anti-reflective coating agent				200 - 1000	
Electronics sector		• Etching agent • Surface treatment agent • Photoresist substance • Photo-acid generator • Surfactant; • Anti-reflective coating agent				200 - 1000	
Aviation hydraulic fluids						500-1000	
Fire fighting foams						5000-60 000	
Metal plating Decorative plating of metal, rubber and plastics						50 000 – 500 000	
Certain medical devices						150 ng/CCD filter	
Insecticides						100-1000	
Coating and impregnation of - paper and packaging -synthetic carpets - leather and apparel - textiles and upholstery						500-5000	
Coating and coating						1000-10 000	

additives							
Toner and printing inks						100	
TOTAL quantity of PFOS per year							

* *Draft PFOS BAT/BEP Guidelines* (Secretariat of the Stockholm Convention, 2012)
**1mg/kg=1ppm=0,0001%

Statistics on the manufacture of articles may not be on the same detailed level as import and export statistics for a country. The production statistics may not necessarily follow the same product codes, and may only cover a portion (unknown) of existing companies in the country. It is also expected that some statistical data on the manufacturing activities will be confidential (= non-available). This means that the calculations based on the statistics must be regarded as estimates.

It needs to be stressed that the inventory practice revealed that the use of statistic data such as import data and related HS codes might not lead to useful results (Korucu et al., 2014). E.g. Turkey, used statistical data based on import data of HS codes and discovered and documented that the HS codes are not specific enough to estimate the amount of PFOS imported (Korucu et al., 2014). The simulation of PFOS content based on HS codes and import data gave, at the upper levels, highly unrealistic results above PFOS global production volumes (Korucu et al., 2014). Also the tracking of PFOS from the inventory team using GHS codes did not result in useful information since at custom level GHS codes are not used for controlling imports and the concentration in which PFOS is used in articles and products are below the GHS threshold levels of 1000 ppm (see table 3-2). The study concluded that the current approaches of controlling PFOS (and other hazardous chemicals) in products have considerable gaps and need to be improved (Korucu et al., 2014). It is expected that the control of PFOS and related substances[13] by the custom will improve after specific HS codes for goods, articles, and products containing PFOS will be introduced via the Rotterdam Convention process.

For developing an inventory of current uses, detailed information of PFOS use from the industry and direct communication with the industry is essential (Korucu et al., 2014). Based on this information, a robust inventory can be established to formulate conclusive actions of controlling products and production processes (Korucu et al., 2014).

[13] However, this will only change the situation for PFOS and related chemicals but, e.g., not for the other approximately 600 POP-like chemicals in current use (Scheringer et al. 2012) where no specific HS codes are available. Therefore, further activity for improving the overall frame of the control of chemicals in products and articles is necessary (Korucu et al., 2014).

Example:
Calculation of the quantity of PFOS in synthetic carpets manufactured and sold on the market per year based on information on import-manufacture and export. The result is in the last column of the table.

Annual net consumption of PFOS in country A in 2002 [country] = [manufacture + import – export] x PFOS content (in kg/kg)

In this example:
Low net consumption of PFOS = [6,876,257 – 0 – 10,081] x 500/1000000 =
3,433.088 kg PFOS = 3.4 tonnes per year

High net consumption of PFOS = [6,876,257 – 0 – 10,081] x 5000/1000000 =
34,330.88 kg PFOS = 34 tonnes per year

Table 3-3 is used as a template for the calculations in the example.

Table 3-0: The quantity of PFOS in synthetic carpets manufactured and sold on the market per year

Category of article or preparation	**Year of phase-out**	**Process-** *Steps, if applicable*	**Import** **(kg per year)**	**Manufacture** **(kg per year)**	**Export** **(kg per year)**	**PFOS content** *Approximate values* **(mg PFOS/kg article or preparation)**	**PFOS quantity** **[tonnes per year]**
Synthetic carpets	2003		6,876,257	0	10,081	500 - 5000	Low: 3.4 High: 34

Confidentiality or the lack of knowledge about the applied PFOS contents and if the chemicals used are PFOS and related substances or other PFCs can lead to inaccurate interpretation of the data. The company often only knows the total amount of used fluorinated compounds, rather than the exact PFOS content of each mixture or preparation. If this is the case, the calculation of annual use of PFOS-containing products in each category should be based on statistics available at national level, if possible, as follows:

To quantify the amounts of PFOS and related substances in all categories of accepted and exempted uses, these use categories are processed through statistics on manufacture, export and import volumes from a national statistics bureau. The net consumption can be calculated through the following formula:

Net consumption of products in [country] = manufacture + import – export.

Note: The statistics bureau may provide detailed foreign statistics (import and export) for different HS or product codes. These statistics may be given in amounts in kilograms as well as in export prices. Statistics on the manufacture of products may not be on the same detailed level as import and export statistics. The production statistics may not necessarily follow the same product codes, and may only cover a portion (unknown) of existing companies in the country. In addition, the manufacturing statistics may be only available in currency, meaning that a conversion to the amount (kg) must be made with the assumption that the cost per kg for the manufacture equals the cost per kg for the import/export. Finally, for some areas in manufacture statistics, the data may be confidential (= non-available). This means that the calculations based on the statistics must be regarded as rough estimates.

Authentic product information received from major companies, interviewed by the inventory team, in each relevant use sector is expected to be of a better quality and need to support the quantitative information from the statistics.

Based on this information, a robust inventory can be established to formulate conclusive actions of controlling products and production processes (Korucu et al., 2014).

3.4.3 Mechanism for evaluation of the inventory

The evaluation includes identification of the following:

- Gaps and limitations
- Need for validation of the information compiled in the inventory.
- Need for more information
- Further actions needed to make the inventory more complete
- Further actions needed to meet the requirements of the Stockholm Convention

An important element in this evaluation step is to identify any gaps and limitations, and the measures needed to make the inventory more complete. An evaluation of the process, strategy used and information collected must take place along with a decision on what further actions are needed to make the inventory more complete. Other ways to involve the stakeholders and other data collection strategies (see steps 2 to 4) could then be considered.

For inventory sectors with limited information, information campaigns and stakeholder meetings or workshops may be a necessary measure. In some cases, government regulations may be required to ensure that stakeholders report their holdings, cooperate with the national authorities and engage in the national inventory.

It is important to identify whether the current situation meets the requirements of the Convention, including the actions needed to fulfil the obligations in the NIP and the need of a notification to the registers for acceptable purposes and specific exemptions under the Stockholm Convention (Article 3, 6, 10, 11, 15 and Annex B Part I and III in the Convention). It is also important that in the communication with the different industrial sectors it is highlighted that the possible exempted uses (see table 3-1) will only be registered if the industry has informed the authorities on their need of an exemption and the related information.

Gaps, limitations and necessary actions to complete the inventory will also be valuable information for the NIP, especially for developing countries with need of financial support to conduct their inventory. It is important for developing countries to identify if technical and financial support will be necessary to complete the inventory. Even if the information gathered by a preliminary inventory is limited, the NIP is expected to provide information on gaps and the limitations of a country's resources and capacities — information that is useful in funding applications.

The evaluation of the inventory helps determine the certainty of the effectiveness of the recommended action plan for PFOS and its related substances. The action plan needs to address the critical uses, stockpiles and contaminated sites and articulate the necessary measures to reduce potential risks posed by PFOS and its related substances. The possibilities and options for substitution to alternatives and the timeframe needed for the phase-out of PFOS and its related substances are important elements in the development of the action plan. Information about the alternatives to PFOS and its related substances is provided in the guidelines on alternatives developed by the POP review committee under

the Stockholm Convention (UNEP, 2010b), and more recently by an online publication[14] on POPs in articles and phase-out opportunities. Information on BAT/BEP measures for PFOS are provided in the *draft PFOS BAT/BEP Guidelines*.

The inventory will also need to be updated at a later stage when the action plan is updated. This can also be done using the strategies described in this guidance.

3.5 Step 5: Preparing the inventory report

The final step for the inventory team is to prepare the PFOS inventory report. This report will include inventories of all key sectors investigated by the country, compiled in a single document. Although its aim is to support the development of the NIP, the report can be also used for other purposes such as feeding into Article 15 reporting from the COP, development of other projects, and developing effective strategies and action plans for managing PFOS and its related substances to meet the obligations under the Convention.

The essential elements of the inventory report are:

- Objectives and scope
- Description of data methodologies used and how data were gathered
- Final results of the inventory for each production and use sector considered as priority for the country (the reporting format provided in annex 14 can be used to present the amount of PFOS and its related substances produced or used in different categories. It can be used as such or adapted from that format)
- Information on stockpiles and wastes
- Information on potentially PFOS contaminated sites
- Results of the gap analysis and limitations identified
- Further actions (e.g. stakeholder involvement, data collection strategies) to be undertaken to complete the inventory
- recommendations

Other information (e.g. stakeholder list) could be included in the report depending on the national requirements.

[14] http://poppub.bcrc.cn/col/1408693347502/index.html

4. Inventory of production and use of PFOS and its related substances in industrial sectors

4.1 Step-by-step guide for industrial sectors

To narrow the scope of an initial assessment, the inventory team can conduct telephone and face-to-face interviews, and correspond by e-mail, with relevant stakeholders. The aim is to identify the industrial sectors producing and/or using PFOS and its related substances. Industrial sectors to be investigated have been described in sections 2.2 and 2.4. Relevant stakeholders to be contacted for different use categories are listed in annex 2.

It is important to make stakeholders aware of the OECD (2007) list of PFOS and its related substances. The list can be applied in the steps outlined below to ensure that the inventory of industrial sectors addresses the relevant national production and use, and that all relevant stakeholders are identified and contacted.

Tier I: Initial assessment

Expected outputs of the initial assessment include:

- *A list of products and articles containing PFOS or its related substances that are most likely manufactured in the country*
- *A list of relevant industrial associations and authorities*
- *A preliminary list of identified manufacturers, industries, and supply chain stakeholders*
- *Initial information on relevant processes involving PFOS or its related substances in the country*
- *A preliminary list of industries having potentially used PFOS in the past and might have generated contaminated sites and landfills (compiled for inventory in chapter 7)*

Step 1. Identify the products on the market and in use containing PFOS and its related substances

Inventory team representative contacts the customs service or another authority and asks for the following information:

- Import and export of products and chemical agents possibly containing PFOS or its related substances
- Receivers and shippers
- Material and safety data sheets

Use the international harmonized tariff codes (HS codes) to identify possible segments of import and export of products that could contain PFOS and its related substances (for more information, see the *Draft guidance for the Control of the Import and Export of POPs*).

Step 2. Identify industrial associations, authorities, and national registers

Identify stakeholders – industrial associations, authorities and national registers relevant to the fields listed in the chapter 2 and annex 2 - that can be useful sources for the inventory. Look for:

- Information on potential manufacturers in the country
- Knowledge on the use of PFOS and its related substances in industrial sectors

If there is a national institute of statistics that can provide information on manufactured, imported and exported amounts of PFOS or its related substances in the different industrial sectors, the initial assessment can be completed by using the method for calculation described in section 3.4.2.

Step 3. Identify national manufacturers

Compile information received in steps 1 and 2 and perform a desk study identifying supplementary information as described in 3.2.1. Focus on the following industrial sectors (for more details see chapter 2 and annex 2):

- Manufacturers that use PFOSF or its secondary derivatives as the intermediates to produce PFOS or its related substances
- Chemical industries producing chemical mixtures containing PFOS and its related substances, such as aviation hydraulic fluids, insecticides, fire fighting foams, chemical formulas, impregnation formulas, textile formulas, compounders, etc.
- Metal plating industry (considered a major user)
- Impregnation and coating industry
- Manufacturers of articles containing PFOS and its related substances such as shoes, paper and carbon products, clothes, furniture, etc.
- Electronics industry
- Semiconductor industry
- Photographic industry
- Mining, gas and oil industries
- Manufacturers of plastic and rubber
- Recycling industry (synthetic carpets, aviation hydraulic fluids, paper and packaging)

In case of finding that there are no products and articles manufactured – i.e that the country does not produce, import or use PFOS as chemical/mixture, then focus on articles and check in the waste streams whether you find PFOS there. Visit chapter 5 of this guidance and prioritize.

Tier II: (Preliminary) Inventory: Further investigation of the relevant industrial sectors

Expected outputs of the preliminary inventory include:

- *Questionnaires filled out with the responses of identified stakeholders*
- *Tables with data provided by major stakeholders and their supply chain stakeholders on total yearly production, use, and consumption of PFOS and its related substances*
- *Gaps identified between identified PFOS-related activities and available data in the country*
- *Additional stakeholders identified and contacted and key industries selected as most relevant sectors in the country.*
- *Domestic supply chain networks more clearly sketched out.*
- *Workshops (if any) held to disseminate the country's mandates required by the Convention and more stakeholders reached and identified.*

Step 4. Collect data (I)

Contact the largest stakeholders in each industrial sector (as identified in the step 2 and 3), by telephone, mail or letter, to:

- Inform them about the purpose of the inventory and its process
- Ask them if they use PFOS or its related substances in their processes
- Ask them to identify the downstream users and upstream suppliers

Step 5. Collect further data (II)

Collect information from the stakeholders identified in steps 1 to 4. The questionnaires in annexes 3 to 8 can be used for this purpose. The outcome can include:

- Total yearly production of PFOS and its related substances
- Total yearly consumption of PFOS and its related substances in industrial processes
- Downstream users and upstream suppliers

Step 6. Evaluate the information

The evaluation is intended to

- Identify gaps
- Identify actions for filling the gaps

If more information is needed:

- Identify additional stakeholders to be contacted or other sources of use for the inventory (see chapter 3 and background information in chapter 2). Use information on upstream suppliers and downstream users in the collected information in step 5.

When the information is as complete as possible, identify the most relevant sectors to be further investigated:

- Industries with use or production of PFOS and its related substances
- Industries where the use of PFOS and its related substances in processes is uncertain

Step 7. Collect more specific information from stakeholders

- Contact the additional relevant stakeholders identified in step 5 to collect more specific information on the industrial sectors under investigation. Questionnaires in annexes 3 to 8 can be used for this purpose.
- Identify the national supply chain for each industrial sector from information gathered in the previous steps.
- Conduct parallel investigations downstream and upstream in the national supply chain of a industrial sector and compare the results. For example, compare the total amount of PFOS in textile formulas delivered to textile manufacturers, as provided by suppliers, and the total amount used in manufacture of textiles, as provided by manufacturers. If there are gaps in the data, investigate them further in cooperation with the textile industry and textile industry associations.
- Organize national sensitization workshops on the Stockholm Convention and its new POPs. Such workshops could have breakout groups on the particular sectors to be investigated further or stakeholder meetings targeting these sectors with a need for further investigation.

Tier III: In-depth inventory

Expected outputs of the in-depth inventory include:

- *More in depth assessment of individual sectors including also those of minor uses*
- *Clarification of situation of individual facilities on their use pattern and waste management*
- *Samples of products and articles collected from manufacturers and other stakeholders.*

- *Analytical results of PFOS in those products and articles provided by a laboratory analysis that uses desktop chemical analysis equipment such as liquid chromatography with mass spectroscopy (LC-MS).*
- *Initial assessment of potential contaminated sites to decide on potential relevance*

Step 8. Screen manufactured articles and products to verify the presence of PFOS and its related substances

If the content of manufactured articles and products is still unknown after step 7, screening for PFOS and its related substances can take place:

- Identify and collect relevant samples, with the help of the manufacturers (using the list of producers and users in the relevant industrial sectors in annex 2). Industry uses are described in chapter 2.
- Qualitatively screen samples of manufactured articles like textiles and synthetic carpets for the presence of fluorine by using the contact angle method described in annex 12.
- Conduct qualitative and quantitative analysis of PFOS and its related substances in manufactured articles and products. Analytic methods for screening are described in annex 13 and in the Draft Guidance (Secretariat of the Stockholm Convention, 2013).

Data compilation and management

Step 9. Compile the data using the compilation formats provided in annex 15. Compile the different substances individually.

Step 10. Estimate produced and used PFOS and its related substances in the industrial sectors

Estimations of the use of PFOS and its related substances in manufacture of articles, chemical formulas and products are described in section 4.2.

Step 11. Transfer entries on yearly use and production of PFOS and its related substances in the compilation formats in annex 15 to the reporting format in annex 14. Report the different substances individually.

4.2 Estimation of produced and used PFOS and its related substances in the industrial sector

A qualitative or a quantitative approach can be used in the assessment and has to be selected based on the individual situation of the Party. Because of the technical limitations of the current analytic methods for perfluorinated substances, however, the qualitative approach is recommended in this guidance document.

The total quantity of PFOS and its related substances used in industrial processes can be estimated from the known levels of PFOS and its related substances in the chemical compounds used in the processes or manufactured. If the stakeholders have not provided the concentrations applied, the guidance values in tables 4-1 and 4-2 can be used.

Use the following equation to estimate the total quantity of PFOS (and its related substances) used in industrial processes with use of chemical agents, drilling fluids or chemical formulas like textile formulas:

$$Tc=L\cdot C$$

Tc= Total quantity of PFOS used in the industrial process per year
L= PFOS concentration or % of PFOS in the chemical agent /drilling fluid/chemical formula
C= Yearly consumption of the chemical agent/drilling fluid/ chemical formula

Use the following equation to estimate the total quantity of PFOS (and its related substances) used in manufacture of chemical agents, chemical formulas or articles, like fire fighting foams:

$$Tp=L\cdot P$$

Tp= Total quantity of PFOS used in the industrial process pr year
L= PFOS concentration or % of PFOS in the chemical agent /chemical formula or product
P= Yearly production of the chemical agent/ chemical formula or product

Table 4-M: Concentrations of PFOS in different chemical formulas and products

Chemical formulas and products	Concentrations of PFOS in chemical formula/product in wt %*	Sources	Guidance value in wt%
Aviation hydraulic fluids	0.05-0.1%	DEFRA, 2004	0.1 %
Fire fighting foam	0.5-1.5%	DEFRA, 2004	1.5 %
Textile formula/polymer	1.0-2.0%	Posner et al., 2011	2.0 %
Impregnation formula for synthetic carpets	2-5%	Posner et al., 2011	2 %
Impregnation formula for leather	about 1%	UKEA, 2004	1 %
Impregnation formula for paper and paperboard	about 1%	Posner et al., 2011	1 %
Coatings	0.1-1%	UKEA, 2004	1 %
Insecticide	0.01-0.1%	UNEP, 2010b	0.1 %

*1mg/kg=1ppm=0.0001%

Table 4-H: Concentrations of PFOS in chemical agents used as intermediates in industrial processes

Management process	Chemical agent	PFOS concentrations*	Sources	Guidance value
Photographic industry	Surfactant Electrostatic charge control agent Friction control agent Dirt repellent agent Adhesion control agent	about 0.01%	UKEA, 2004	0.01 %
Semiconductor	Etching agent			0.02-0.1

industry	Photoresist substance Photo-acid generator Surfactant Anti-reflective coating agent	0.02 – 0.1% about 0.01% about 0.1%	UKEA, 2004 UKEA, 2004 UKEA, 2004	%
Electronics industry	Etching agent Dispersion agent Desmear agent Surface treatment agent Photoresist substance Photo-acid generator Surfactant Anti-reflective coating agent Solder Adhesive Paint	0.02–0.1% about 0.01% about 0.1%	UKEA, 2004 UKEA, 2004 UKEA, 2004	0.02-0.1%
	Metal plating	5-10%	UKEA, 2004	5-10%
Chromium plating (hard and decorative)	Surfactant Wetting agent Mist suppressant	3-7%[15]	UNEP, 2010b; European Commission, 2011	3-7%

*1mg/kg=1ppm=0.0001%

The total quantity of PFOS used in manufacture of articles like furniture, shoes and clothes can be estimated from the concentrations of PFOS in the material used during manufacture of the articles. They are assumed to be the same as the concentrations of PFOS applied when impregnated. The concentrations applied to various materials during manufacturing processes are listed in table 5-1. The estimation is done by using the following equation:

$$Tm=A\cdot W\cdot M$$

Tm= Total quantity of PFOS used in manufacturing the article
A= PFOS concentration applied by fibre weight
W= Weight of material in one article, or fibre weight
M= Yearly consumption of material in manufacturing the article

[15] The concentrate for preparing the bath can contain up to 50% PFOS or might be prepared from the chemical.

5. Inventory of articles and products containing PFOS and its related substances on the consumer market

5.1 Step-by-step guide for the consumer market

To narrow the scope of an initial assessment, the inventory team can identify the type of articles or products on the consumer market that contain or have been treated with fluorinated chemicals. Use categories to be investigated are described in chapter 2 and relevant stakeholders to be contacted are listed in annex 2. It is important to make stakeholders aware of the OECD (2007) list of PFOS and its related substances. The list can be applied in the steps outlined below to ensure that the inventory of the consumer market addresses the relevant national production and use, and that all relevant stakeholders are identified and contacted.

Tier I: Initial assessment

Expected outputs of the initial assessment include:

- *A list of PFOS-containing articles and products that could contain PFOS and its related substances*
- *A list of relevant large retailers and suppliers of the identified articles and products*
- *A preliminary list of supply chain stakeholders*

Step 1. Identify the articles or products on the market containing PFOS and its related substances

Contact the customs service and ask for the following information on types of articles or products entering the national borders:

- Import and export of articles or products within the use categories of PFOS
- National importers/exporters of synthetic carpets, clothes, furniture, shoes, cosmetics and household products etc.

Use the international toll tariff numbers to identify possible segments of import and export of products that could contain PFOS and its related substances. For more information, see the *Guidance for the Control of the Import and Export of POPs*.

Step 2. Identify larger retailers and suppliers of articles or products

Compile the information collected in step 1 and perform a desk study for supplementary information as described in 3.2.1 and identify retailers/suppliers within the use categories (listed in annex 2) of PFOS and its related substances. The information gathered in the inventory of the industrial sectors in chapter 4 from manufacturers of articles or products with PFOS and its related substances will also be useful.

Step 3. Contact the larger retailers and suppliers

Contact those companies identified in steps 1 to 2 by telephone, mail or letter:

- Inform them about the purpose of the inventory and its process.
- Ask them if they use or know about the use of perfluorinated substances in their articles or products stock-in-trade.
- Ask them if their articles or products have or provide the following properties; stain resistance, water repellence, and anti-grease.
- Ask them to identify the downstream retailers and upstream suppliers.

Tier II: Preliminary inventory: Further investigation of the relevant categories of articles

Expected outputs of the preliminary inventory include:

- *A list of relevant stakeholders including waste sectors*
- *A list of gaps identified to help formulate further action plans*
- *Yearly sale of articles or products within the use categories of PFOS and its related substances*
- *List of articles or products having/providing the following properties: stain resistance, water repellence, and anti-grease on the national market*
- *Chemical contents of PFOS and its related substances, if available*
- *Downstream retailers and upstream suppliers*

Step 4. Collect information from the identified stakeholders

Collect information from the stakeholders identified in steps 1 to 3. The questionnaires in annex 9 can be used for this purpose.

Step 5. Evaluate the information

The evaluation is intended to:

- Identify gaps
- Identify actions for filling the gaps

If more information is needed:

- Identify additional stakeholders to be contacted or other sources of use for the inventory. See chapter 3 and background information in chapter 2.

Step 6. Collect more specific information from stakeholders

Contact the additional stakeholders identified in steps 2 to 4 to collect more information. Questionnaires in annex 9 can be used for this purpose.

Tier III: In-depth inventory

Expected outputs of the in-depth inventory include:

- *List of articles and products on the national market containing PFOS or its related substances*

Step 7. Screen articles and products to verify the presence of PFOS and its related substances

If information on contents of substances is lacking for some type of articles or products, representative samples can be screened to verify the presence of PFOS and its related substances:

- Identify and collect relevant samples, with the help of the information from the questionnaires collected in step 6.
- Qualitatively screen samples of manufactured articles like textiles and synthetic carpets for the presence of fluorine by using the method described in section 5.2.
- Analyse representative samples of products and articles containing perfluorinated substances, using the analytic methods described in annex 13.

Data compilation and management

Step 8. Compile the data using the compilation formats provided in annex 15. Compile the different substances individually.

Step 9. Estimate the quantity of PFOS and its related substances in articles or products on the national market

A qualitative or quantitative approach can be used in the assessment and has to be selected based on the individual situation of the Party. Because of the technical limitations of the current analytic methods for perfluorinated substances, the qualitative approach is recommended in this guidance (see section 5.3).

Step 10. Transfer entries on yearly use and production of PFOS and its related substances in the compilation formats in annex 15 to the reporting format in annex 14. Report the different substances individually.

5.2 Screening of articles and products to verify the presence of PFOS and its related substances

To determine the occurrence and quantities of PFOS and its related substances in different consumer articles, representative samples can be purchased from retail outlets and analyzed.

Step 1. Conduct an initial assessment

Before collecting samples, an initial assessment (see section 5.1) can be conducted to determine the availability of consumer articles that could contain or have been treated with fluorinated chemicals entering the national borders and/or being marketed within the borders.

Step 2. Collect samples

Samples can then be collected based on one of the following claims by the stakeholder: (i) the article/product contains fluorinated chemicals identifiable by their trade names; (ii) the article/product contains PFOS and its related substances identifiable by the chemical names; or (iii) the article/product was identified as having or providing certain properties that are common for articles/products containing PFOS and its related substances (e.g. stain resistance, water repellence, and anti-grease). Sample candidates can be identified from the use categories listed in chapter 2.

Step 3. Verify the presence of perfluorinated compounds in materials

Sampled materials can be qualitatively screened for the presence of perfluorinated compounds. The screening is based on the perfluorinated substances' extraordinary properties to provide both oil and water resistance to materials, which requires especially low surface energy that most of the alternatives are lacking. The screening method is explained further in annex 12.

Step 4. Verify the presence and quantity of PFOS

Articles and products with perfluorinated compounds can be investigated further to see if they contain PFOS. Different analytical methods can be applied to identify the articles in which PFOS is present (as described in annex 13). Because of the technical limitations of the current analytic methods, the results are not accurate, and the content of PFOS and its related substances in the articles is underestimated. The analyses are therefore not considered to be accurate enough to give a good estimate of the content, and their use is not recommended for quantification of those substances. In addition the content of PFOS and its related substances in articles will not be the same quantity that was used in the manufacture of the articles.

Another approach could be to contact the stakeholders again and ask for more information on the articles identified as containing PFOS. Stakeholders upstream can be valuable sources of information on quantities used in the manufacture of articles.

5.3 Estimation of quantity in articles and products on the national market

A qualitative or a quantitative approach can be used in the assessment and has to be selected based on the individual situation of the Party. This guidance recommends the qualitative method, in which the estimations are based on the amount of PFOS applied to the material, as the most accurate method. The existing analytical methods for PFOS and its related substances are under development and are currently not accurate enough. In addition can the quantity in the material already partly have been released or washed out when analysed.

5.3.1 The qualitative approach

The total quantity of PFOS in articles and products can be estimated from the known levels of PFOS and its related substances applied to the articles or products. If the concentrations applied have not been provided by the stakeholders, the concentrations shown in table 5-1 can be used.

$$Ts = A \cdot W \cdot S$$

Ts= Total quantity of PFOS in articles or products sold on the market per year

A= PFOS amount applied by weight of material, by fibre weight,[16] or % PFOS in the material, or product

W= Weight of material in one article, or the fibre weight, or weight of product

S= Average number of articles or product sold on the market per year

In the table 5-1 below the ranges for the applied concentrations of PFOS by weight of material, fibre weight or by weight of product is given for the different consumer articles and products. The guidance values in the table can be used if the exact concentrations have not been provided by the manufacturers of the articles.

Table 5-M: Concentrations of PFOS or related substances applied to different consumer articles and products

Consumer article	Concentrations of PFOS in material*	Sources	Guidance values in wt %
Textiles and upholstery	2-3% of the fibre weight	RIKZ, 2002	3 %
Synthetic carpets	0.03% of the fibre	European	0,03%

[16] Textiles have an established labelling requirement in major import markets. In the US, articles must be labelled as to their fibre content, country of origin and manufacturer (or other business responsible for marketing or handling the item). See The Textile Fiber Products Identification Act (Textile Act), 15 U.S.C. § 70, et seq., and the Wool Products Labeling Act of 1939 (Wool Act), 15 U.S.C. § 68, et seq. The Rules and Regulations under the Textile Fiber Products Identification Act (Textile Rules) are found at 16 C.F.R. Part 303 and the Rules and Regulations under the Wool Products Labeling Act (Wool Rules) are found at 16 C.F.R. Part 300. The labelling on fibre weight can be useful when calculating the quantity of PFOS in textiles (see section 5.3 on data management and table 5-1 on applied concentrations of PFOS in textiles per fibre weight).

	weight	Commission, 2011	
Leather	0.025-0.05% by weight of material	RIKZ, 2002; European Commission, 2011	0.05 %
Paper and paperboard	1%	Kara et al., 2010	1 %
Industrial and household cleaning products	0.005%-0.1% by weight of material	UNEP, 2010b	0.1 %
Surface coating, paint and varnishes	0.01% by weight of material	UNEP, 2010b	0.01 %
Medical devices	150 ng in one CCD-colour filter	UNEP, 2010b	150 ng in one CCD-colour filter
Toner and printing inks	0.01% by weight of material	UNEP, 2010b	0.01 %
Cleaning agents, waxes and polishes for cars and floors	0.005-0.01% by weight of material	UNEP, 2010b	0.01 %

*1mg/kg=1ppm=0.0001%

5.3.2 The quantitative approach using measurements

In selected cases where other approaches does not lead to useful results, the quantities can be assessed through direct measurements in typical samples of articles or products. Depending on the quality of data the measurements could be extrapolated to the total quantity of national production or use of that article or product or waste.

Due to limitations of the current analytical methods, the amounts of PFOS and related substances are often underestimated. The analytical methods and their limitations are described in annex 13 and in the *Draft Guidance on Sampling, Screening and Analysis of Persistent Organic Pollutants in Products and Articles* (Secretariat of the Stockholm Convention 2013) .

A standardized method for analyses of perfluorinated compounds in materials of consumer articles has been described in more detail in national surveys for quantifications of perfluorinated compounds (USEPA, 2009a; SWEREA, 2004; Secretariat of the Stockholm Convention 2013). When using those methods it is important to be aware that the content of PFOS and its related substances in articles will most probably not have the same quantity that was applied on the articles when manufactured.

6. Inventory of fire fighting foams, aviation hydraulic fluids and insecticides containing PFOS and its related substances

6.1 Step-by-step guide for the inventory of insecticides

Contact national authorities to establish whether the sulfluramid or other insecticides containing PFOS or its related substances are registered, or were registered until recently, in the country and to obtain the total amount of insecticide (if registered). This information should be released by the national authorities for agriculture and/or national agency for food and drug administration.

If the insecticide is registered for use in the country, the guidance in Annex 2 in NIP Update Guidance (2012) should be applied. It contains a general guidance for inventory of POP pesticides including a list of UNEP developed useful guidance tools for obsolete pesticides.

The list below contains national authorities and other national organizations that could supplement information to facilitate the process or may need to be informed about the activities:

- National authorities for agriculture
- National agency for food and drug
- National customs service
- Agricultural research institutes
- National authorities for environment
- Agricultural development programmes
- Consumer protection authorities

Please note, that there may be more authorities than those mentioned above.

6.2 Step-by-step guide for the inventory of fire fighting foam

It is important to make stakeholders aware of the OECD (2007) list of PFOS and its related substances. The list can be applied in the steps outlined below to ensure that the inventory of fire fighting foams addresses the relevant national production and use, and that all relevant stakeholders are identified and contacted.

Professional users and the global enterprises manufacturing fire fighting foams with PFOS and its related substances can be a valuable source for identifying the national suppliers and manufacturers. Manufacturers, distributors and users of fire fighting agents and their chemical components have formed an international not-for-profit trade association, the FFFC *(*http://www.fffc.org/*)*. Table 6-1 lists large enterprises that are members of FFFC. Information on different grades of fire fighting foam and on regional/local suppliers can be found on their websites.

Tier I: Initial assessment

Expected outputs of the initial assessment include:

- *A list of sectors and professional users of PFOS and its related substances*
- *A list of manufacturers/suppliers of fire-fighting foam containing PFOS and its related substances*
- *A list of other stakeholders that might have valuable information for the inventory*
- *Compilation of data collected including feedback from stakeholders*

Step 1. Identify relevant sectors and stakeholders

- Perform a desk study of existing information as described in 3.2.1 to identify the relevant sectors and stakeholders (listed in annex 2) that can be professional users of fire fighting foams containing PFOS or its related substances in the country.
- Make preliminary contact with the identified professional users to obtain information about national producers and/or suppliers of fire fighting foams, and assess if the manufacture of fire fighting foams is a relevant national sector. If resources are limited, the largest professional users can be prioritized.
- Inform national authorities and other national organizations that may have a need to be informed about the activities, and ask for supplementary information that may facilitate the inventory process. Relevant authorities and organisations can be:
    - Authority for security and emergency preparedness
    - Authority for aviation
    - Authority for industry control
    - Authority for transport
    - National transport association
    - Relevant national industry associations
    - National petroleum association
    - Military defence authorities
    - Customs service

Tier II: Preliminary inventory – Further investigation of the relevant industrial sectors

Expected outputs of the (preliminary) inventory include:

- *Interaction with stakeholders to get detailed information in workshop or by phone contact, meetings or by site visits*
- *Questionnaires filled out or interviews with identified professional users, manufacturers/suppliers*
- *Compilation of data on stockpiled fire fighting foams, the consumption of fire fighting foams in fire drills or fires events, and waste management of expired fire fighting foams with gaps identified*
- *Information on brands or grades containing PFOS and its related substances and the content of PFOS and its related substances. Initial assessment of availability of alternative foams for the assessment of the need of exemptions*[17].
- *Additional information (if any) on suppliers of fire-fighting foam locally or in the region*
- *Overview information on potentially contaminated sites from fire fighting foam use in fire drills and fire events (see chapter 7)*

Step 2. Workshop or meetings with stakeholders

- Organize a workshop with stakeholders identified in step 1[18]

[17] There are a wide range of alternative foams available (http://poppub.bcrc.cn/col/1408693347502/index.html) and industrial countries have already switched to alternatives some years ago.

- Compile and discuss data received in the step 1

An inventory of fire fighting foams can be extensive involving many stakeholders and requiring thorough planning. It can be useful to contact or meet stakeholders at the beginning of the inventory process to inform them about compiled data, the background and scope and give them an opportunity to communicate their views and questions. Stakeholder feedback can be valuable and help target the relevant areas of use and make the inventory as practical and effective as possible. A list of relevant stakeholders is provided in annex 3.

Step 3. Collect further data

Contact other professional users and suppliers/manufacturers identified in steps 1 and 2 to collect more in-depth information. Questionnaires in annex 10 can be used for this purpose.

The aim of the inventory is to gather information on stockpiled fire fighting foams, the consumption of fire fighting foams in fire drills or accidental fires, the content of PFOS and its related substances and waste management of expired fire fighting foams.

Because of the relatively low content of PFOS, it is possible that the producer of fire fighting foams is not obliged to mention PFOS in the corresponding material safety data sheet for the product. This may lead consumers to believe that their substance is PFOS free. PFOS in such a product is often only listed in the data sheet as a fluorosurfactant, surfactant or surfactant agent. If this is the case, contact the supplier/manufacturer and ask for the chemical name and CAS number, or alternatively the name and contact information of the manufacturer. If no supplier/manufacturer is given in the questionnaire contact the submitter of the questionnaire. Other suppliers/manufacturers identified in previous steps may also be contacted for information.

Step 4. Evaluate the information

Compile and evaluate the information to:

- Identify gaps
- Identify actions for filling the gaps

If more information is needed:

- Identify additional stakeholders to be contacted, consult the list over stakeholders compiled in step 1.
- Collect and compile data from additional stakeholders

Tier III: In-depth inventory

Expected output of the more-in depth inventory:

- *Domestic supply chain networks more clearly sketched out.*
- *Supplementary information needed to fill gaps and validation of compiled data*
- *Possible measurement of foams where it could not be clarified if PFOS is contained.*
- *Detailed assessment on availability of alternative foams*

[18] Normally there is not a separate workshop for fire fighting foam but some key stakeholder are invited to the inventory workshop. Otherwise separate meetings with key stakeholders (fire fighting association; fire fighting foam importer) can be organised.

- *Detailed situation on sites where potentially PFOS containing foams have been used (see chapter 7)*
- *Preliminary assessment of management of PFOS fire fighting foam stockpiles*

Step 5. Conduct further investigations

- Identify the national supply chain from information gathered in the previous steps, desk study and stakeholder meetings (if relevant).
- Conduct parallel investigations upstream and downstream in the supply chain and compare the results.
- If more information is needed on brands of fire fighting foam containing PFOS and the alternatives, contact can be made with the Fire Fighting Foam Coalition (FFFC). They can provide some information on the use of PFOS in fire-fighting foams brands and its alternatives for different uses and in different regions (http://www.fffc.org/).

Table 6-M: Larger enterprises manufacturing fire-fighting foams and members of FFC (www.ffc.org)

Manufacturers of fire-fighting foams	Background information	Brands or grades	Distributors in different regions
Ansul, (a Tyco international Company)	https://www.ansul.com	Ansul, Ansulite, Ansulite Arc, Sivex, Jet X and Target 7 of different grades	Searchable at: https://www.ansul.com/en/Distributor/Distributor.asp
Chemguard	http://www.chemguard.com	Brand names can be found at http://www.chemguard.com/fire-suppression/catalog/foam-concentrates/	Searchable at: http://www.chemguard.com/customer-support/authorized-distributors.htm
Dupont (situated world wide)	http://www2.dupont.com/DuPont_Home/en_US/index.html	Brand: Forafac® grades.	Can be found at: http://www2.dupont.com/Our_Company/en_US/worldwide/index.html
Kidde (a UTC fire and security company)	http://www.kidde.com and http://www.kidde-fire.com	Brands: http://www.kidde-fire.com/utcfs/Templates/Pages/Template-50/0,8061,pageId%3D3497%26siteId%3D465,00.html	Can be found at: http://www.kiddeglobal.com/utcfs/Templates/Pages/Template-64/0,8069,pageId%3D5752%26siteId%3D719,00.html and http://www.kiddeglobal.com/utcfs/Templates/Pages/Template-64/0,8069,pageId%3D5751%26siteId%3D719,00.html
Dynax	http://www.dynaxcorp.com/	DX3001, DX5000, DX5011, DX1000 and DX2000 series (not PFOS related substances) Sample requests/technical inquiries email: techinfo@dynaxcorp.com	Customer service email: info@dynaxcorp.com

Data compilation and management

Step 6. Compile the data using the compilation format provided in annex 15. Compile the different substances individually.

Step 7. Estimate PFOS and its related substances in produced and used fire fighting foams

The PFOS quantity is estimated from the percentage of PFOS in the different grades of fire fighting foam. If information on the concentration is not provided by the stakeholders, the range of concentrations of PFOS used in different grades shown in table 4-1 can be used.

For the total quantity of PFOS in fire fighting foams consumed yearly and in stockpiles, the estimation can be done using the following equation:

$$T=L \cdot X$$

T= Total quantity of PFOS in fire fighting foam consumed yearly
L= Percentage of PFOS in the grade of fire fighting foam
X= National consumption of fire fighting foam or in stockpile in tons per year

Step 8. Transfer entries on yearly use and production of PFOS and its related substances to the reporting format in annex 14. Report the different substances individually.

6.3 Step-by-step guidance for aviation hydraulic fluids

It is important to make stakeholders aware of the OECD (2007) list of PFOS and its related substances. The list can be applied in the steps outlined below to ensure that the inventory of aviation hydraulic fluids addresses relevant national production and use, and that all relevant stakeholders are identified and contacted.

Tier I: Initial assessment

Step 1. Identify relevant sectors and stakeholders

- Perform a desk study of existing information as described in 3.2.1 to identify the relevant sectors that can be professional users of aviation hydraulic fluids (listed in annex 3) containing PFOS or its related substances in the country.

- Make preliminary contact with the identified professional users in step 1 to obtain information about national producers, recyclers and/or suppliers of aviation hydraulic fluids and assess if the manufacture and/or recycling of aviation hydraulic fluids is a relevant sector for the inventory. If resources are limited, the largest professional users can be prioritized.

- Inform national authorities and other national organizations that may have a need to be informed about the activities, and ask for supplementary information that may facilitate the inventory process. Relevant authorities and organisations can be:

  - Authority for aviation
  - Military defence authorities
  - Customs service

Tier II: Preliminary inventory

Expected outputs of the preliminary inventory include:

- *Questionnaires filled out or interviews with identified professional users, manufacturers/suppliers*
- *Compilation of data on stockpiled aviation hydraulic fluids, the consumption of aviation hydraulic fluids, and waste management of expired aviation hydraulic fluids with gaps identified*
- *Perform a web search on grades and brands of aviation hydraulic fluids identified in the inventory to get information on international and regional manufacturers and distributors, and content of PFOS and its related substances*

Step 2. Collect data

Contact the professional users and manufacturers/suppliers identified in step 1 to collect more in-depth information. Check against the listed stakeholders in annex 2. Modified questionnaires for fire fighting foams in annex 10 to address the issues related to aviation hydraulic fluids, can be used for this purpose.

The needed PFOS concentrations can be very low for aviation hydraulic fluids (according to 1907/2006/EC PFOS, for example, concentrations below 0.1 % do not have to be stated in the material safety data sheet). Thus, it may be possible that the producer of the hydraulic fluid is not obliged to mention PFOS in the corresponding material safety data sheet for the product. This may lead consumers to believe that their substance is PFOS free (European Commission, 2011).

If the content of PFOS and its related substances is unknown, contact the supplier/manufacturer and ask for the chemical name and CAS number, or alternatively the name of also minor components (0.1 % and less) and contact information of the manufacturer. If no supplier/manufacturer is given in the questionnaire contact the submitter of the questionnaire. Other suppliers/manufacturers identified in previous steps may also be contacted for information.

Step 4. Evaluate the information

Compile and evaluate the information to:

- Identify gaps
- Identify actions for filling the gaps

If more information is needed:

- Identify additional stakeholders to be contacted, consult the list over stakeholders compiled in step 1.
- Collect and compile data from additional stakeholders

Tier III: In-depth inventory

Expected outputs of the in-depth inventory:

- *Domestic supply chain networks more clearly sketched out.*
- *Supplementary information needed to fill gaps and validation of compiled data*
- *Contact international and regional manufacturers and distributors for more information*
- *Possible measurement of contamination of waste hydraulic oil related to recycling.*

Step 5. Conduct further investigations

- Identify the national supply chain from information gathered in the previous steps, desk study and stakeholder consultations
- Make parallel investigations upstream and downstream in the supply chain and compare the results.

Data compilation and management

The PFOS quantity is estimated from the percentage of PFOS in the different grades of aviation hydraulic fluids. If information on the concentration is not provided by the stakeholders, the range of concentrations of PFOS used in different grades shown in table 4-1 can be used. Follow the steps 6 to 8 in section 6.2. For the total quantity of PFOS in aviation hydraulic fluids consumed yearly and in stockpiles, the estimation can be done using the same equation as for fire fighting foams (see step 7, section 6.2).

7. Inventory of waste, stockpiles and contaminated sites containing PFOS and its related substances

The Stockholm Convention aims to protect human health and the environment from highly dangerous, persistent chemicals by restricting and ultimately eliminating their production, use, trade, release and storage. Article 6, paragraph 2 of the Stockholm Convention mandates its Parties to cooperate closely with the appropriate bodies of the Basel Convention on common issues of relevance.
Technical guidelines are developed under the Basel Convention for the environmentally sound management of the wastes falling under its scope. Technical guidelines provide for the foundation upon which countries can operate at a standard that is not less environmentally sound than that required by the Basel Convention.

The "*Draft technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOSF)"* provide guidance for the environmentally sound management (ESM) of wastes consisting of, containing or contaminated with perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOSF) (Secretariat of the Basel Convention, 2014).

The inventory of the wastes and stockpiles are the prerequisite for their environmental sound management and related project development.

7.1 Step-by-step guide for the waste sector

Tier I: Initial assessment

Expected outputs of the initial assessment include:

- *List of relevant stakeholders*
- *Larger waste fractions identified within the use categories for PFOS*
  - *How they are managed*
- *Yearly amount of wastes in the identified categories*

Step 1. Identify relevant stakeholders and waste fractions of importance

- Access the data from the sector analysis in the industrial sector and the consumer market or other relevant sector analysis on existing waste fractions containing PFOS and its related substances, waste quantities and treatment.

- Identify if there might be larger quantities of waste fractions containing PFOS and its related substances generated or traded inside the country. Use the data collected in the other key sector inventories

- Contact the custom and identify if there are imports or exports of larger quantities of waste fractions possibly containing PFOS and its related substances

Tier II: Preliminary inventory

Expected output of the preliminary inventory include:

- *List of additional relevant stakeholders*
- *Additional waste fractions identified within the use categories for PFOS*
- *How they are managed and if they are potentially recycled*
- *Yearly amount of wastes in the identified categories*
- *Prioritization of waste fractions representing a potential risk*

Step 2. Collect additional data

- Perform a desk study of existing information and identify additional stakeholders to be contacted. Use the following list of waste authorities and waste operators:
  - National and local waste management authorities
  - Incineration plants (operated by local authorities or private owners)
  - Operators of landfills (local authorities, industry, private operators)
  - Shredder plants (for cars etc.)
  - Recyclers/Downcyclers of aviation hydraulic fluids, carpets, paper and packaging
  - Sewage plants (operated by local authorities or private operators)
  - Waste importers and waste traders

- Contact the identified waste authorities and waste operators and send them a questionnaire to collect more information. Questionnaires in annex 11 can be used for this purpose.

Step 3. Evaluate the information

The evaluation is intended to:

- Identify gaps and missing information in the questionnaires
- Identify actions for filling the gaps

If more information is needed:

- Make direct contact with stakeholders not submitting questionnaires, or stakeholders only providing limited information in their submitted questionnaires in step 2 or on waste in the questionnaires submitted in the other key sector inventories

Step 4. Prioritize

Identify the waste fractions containing PFOS and its related substances that are of concern and need to be further investigated. Criteria for prioritization are:

- Large waste fractions that may contain PFOS and its related substances
- Waste fractions that may represent high emissions of PFOS to the environment and humans

Tier III: In-depth inventory

Expected outputs of in-depth inventory include:

- *Identification of additional waste fractions containing PFOS and its related substances*
- *How they are managed*
- *Yearly amount of wastes in the identified categories*
- *Validation of data collected in previous steps if needed*
- *Potentially monitoring key suspected waste fraction for their PFOS content*

Based on the step 4 results, conduct investigation on waste fractions representing a potential risk.

Step 5. Conduct further investigations

- If information is lacking on contents of PFOS and its related substances, conduct a qualitative screening of larger waste fractions within the use categories for PFOS and its related substances (in annex 2) to verify the contents of PFOS. Follow the methodology outlined in step 8 in section 4.1.
- Contact relevant stakeholders and send them a questionnaire targeting the waste fractions identified. A modified questionnaire in annex 11 can be used for this purpose

Data compilation and management

Follow the steps described for data compilation and management as described in the following sections:

- Waste from industrial sectors (see sections 4.1 and 4.2)
- Fire fighting foams (see section 6.2)
- Aviation hydraulic fluids (see section 6.2)
- Insecticides becoming waste (see section 6.1);
- Waste of articles and products (see sections 5.1 and 5.3)

7.2 Step-by-step guide for stockpiles

Tier I: Initial assessment

Expected output of the initial assessment:

- *List of relevant stakeholders*
- *List of identified stockpiles and their storage locations*
- *How they are managed*
- *Yearly amount of stockpiles in different sectors*
- *Condition of storage*
- *Content of PFOS and its related substances in the identified stockpiles*

Step 1. Identify relevant stakeholders and stockpiles

- Collect the information on stockpiles from the sample questionnaires from the inventories of industrial sectors and fire fighting foam.
- Contact the custom and identify if there are import of larger quantities of stockpiles containing PFOS and its related substances

Tier II: Preliminary inventory

Expected outcome of the preliminary inventory:

- *List of additional relevant stakeholders*
- *List of additional stockpiles and their storage locations*

- *How they are managed*
- *Yearly amount of additional stockpiles in different sectors*
- *Prioritization of stockpiles representing a potential risk*

Step 2. Collect additional data

- Perform a desk study of existing information and identify additional stakeholders to be contacted. PFOS can be stockpiled in various locations across the country at storage facilities for:
  - Fire fighting foams
  - Insecticides
  - Drilling fluids
  - Surfactants in mining industry
  - Aviation hydraulic fluids
  - Chemical formulas
- Contact the identified additional stakeholders and send them a questionnaire to collect more information. A questionnaire can be developed for this purpose using the entries for stockpiles in the questionnaires in the annexes for the type of industry or use category with identified stockpiles containing PFOS and its related substances

Step 3. Evaluate the information

- Identify gaps
- Identify actions for filling the gaps

If more information is needed:

- Make direct contact with stakeholders not submitting questionnaires, or stakeholders only providing limited information in their submitted questionnaires in the other key sector inventories

Step 4. Prioritize

Identify the stockpiles containing PFOS and its related substances that are of concern and need to be further investigated. Criteria for prioritization are:

- Use categories with large stockpiles
- Stockpiles that may represent high emissions of PFOS to the environment and humans

Tier III: In-depth inventory

Expected outcome of in-depth inventory:

- *Identification of additional stockpiles containing PFOS and its related substances and their storage locations*
- *How they are managed*
- *Yearly amount of stockpiles in different sectors*
- *Validation of data collected in previous steps if needed with analytical screening*

Based on the step 4, conduct investigation of prioritized categories of stockpiles

Step 5. Conduct further investigations

- If information is lacking on contents of PFOS or its related substances in use categories with large stockpiles, the methodology in step 8 in section 4.1 can be applied.

- Contact relevant stakeholders and send them a questionnaire targeting the identified additional stockpiles. The questionnaire developed in step 2 can be used for this purpose

Data compilation and management

Follow the steps described for data compilation and management as described in the following sections:

- Fire fighting foams (see section 6.2)
- Aviation hydraulic fluids (see section 6.2)
- Insecticides becoming waste (see section 6.1)
- From industrial sectors (see sections 4.1 and 4.2)
- Stockpiles of articles (see sections 5.1 and 5.3)

7.3 Step-by-step guide for contaminated sites

Since the major use of PFOS and related substances has been between 1970s and 2002 (Paul et al., 2008), a large part of PFOS has already entered the environment or landfills and dump sites. Since after PFOS is released to the environment, it is not known to undergo any further chemical or microbial degradation and is, therefore, extremely persistent (Environmental Canada, 2013) contaminated sites are generated along the life cycle of PFOS: production, use and disposal. Therefore the assessment of contaminated sites at production, use and disposal of PFOS and related substances is of key importance for the inventory development and further management of PFOS within the National Implementation Plan (UNEP, 2010).

Tier I: Initial assessment

The expected output of the initial assessment includes:

- *List of relevant stakeholders*
- *List of locations of potential contaminated sites with coordinates*
- *List of locations of sites contaminated with PFOS and its related substances*
- *Levels of PFOS and its related substances, if available*

Step 1. Identify contaminated sites and stakeholders

- Gathering overview information on PFOS contaminated sites (internet and literature survey). There are already a wide range of publications and reports on PFOS contaminated sites which might be consulted as a first step:
  - Production sites (Bao et al., 2010 ; Brambilla et al., 2014; Oliaei et al., 2013; Wang et al., 2010)
  - Fire fighting foam use (Buncefield Major Incident Investigation Board, 2008; Herzke et al., 2007; Minor, 2012; Moody et al., 2000, 2003; Seow, 2013; Weber et al., 2011;)
  - Air ports[19] (Ahrens et al., 2014; Awad et al., 2011; Martinsen, 2012; Minor, 2012)
  - Landfills and dump sites (Egger et al., 2010; Kallenborn et al., 2004; Oliaei et al., 2013; Weber et al., 2011a; Woldegiorgis et al., 2008)
  - Application of highly contaminated industrial sludge from (industrial) waste water treatment (Brambilla et al., 2014; Kowalczyk et al., 2013 ; Kröfges et al., 2007; Skutlarek et al., 2006; Sepulvado et al., 2011)

[19] The major contamination at airport stem from the use of fire fighting foam. However also sources like hydraulic fluids and possibly de-icing activities might have contributed to the pollution.

- Collect the information on contaminated sites from the sample questionnaires from the inventories of industrial sectors and fire fighting foam use in the country
- Identify relevant authorities and other stakeholders that might provide valuable information on identified contaminated sites, that might contain PFOS and it related substances, from the following list:
  - Environmental protection agencies
  - Municipal authorities
  - State governments
  - Ministries of environment
  - Ministries of land
  - Stakeholders of fire fighting foam use and identified industrial use
  - Oil producing and service companies
  - Urban and city planning authorities
  - Property development companies

Tier II: Preliminary inventory

Expected outputs of the preliminary inventory include:

- *List of additional locations of contaminated sites with coordinates*
- *Activity in the area*
- *Levels of PFOS and its related substances, if available*
- *Validation of data collected on potential sites in step 1, if relevant*

Step 2. Collect detailed information

- Contact the identified relevant authorities by e-mail or post and collect information on:
  - Locations with coordinates
  - Type and possible extent of contamination
  - Activity in the area, ground and surface water situation and potential exposure
  - If the site have been investigated for content of PFOS and its related substances and if available levels of PFOS and its related substances

- Perform a desk study of existing information and identify additional stakeholders to be contacted. To inventory the existence of contaminated sites, the stakeholders involved in the sectors listed in table 7-1 can be consulted. Stakeholders can provide locations and, if available, levels for sites of accidental spills and leakages, production sites with uncontrolled releases to soil and water, and other areas. Potential contaminated sites are listed in table 7-1.
- Contact the identified stakeholders by e-mail or post and collect information on:
  - Locations of with coordinates
  - Activity in the area
  - Levels of PFOS and its related substances, if available
- Compare the additional information with the list of potential contaminated sites in step 1

Table 7-1: Potential contaminated sites for PFOS

Life cycle stages	Location/activity	Facility
PFOS production	Chemicals industry	Production site
		Sites where production waste has been destroyed
		Landfills related to the

		production
		River sediment and banks related to releases from the production site
Use in production of PFOS-containing articles and preparations	Chromium plating	Production site and deposited wastes
	Coated paper, textile, leather and carpet industry	Production site and deposited wastes
	Semiconductor industry	Production site and deposited wastes
	Electronics industry	Production site and deposited wastes
	Photo imaging industry	Production site and deposited wastes
PFOS preparations in operation	Oil, mining and gas industry	Contaminated soil and groundwater
	Insecticides	Contaminated soil and groundwater
		Areas of accidental leakage or spill from stockpiles
	Fire fighting foam	Fire drill areas
		Areas of accidental leakage or spill from stockpiles *
	Aviation hydraulic fluids	Areas of accidental leakage or spill from stockpiles
Waste management of PFOS-containing articles and preparations	Waste	Landfills and dump sites
	Waste	Incineration
	Waste	Municipal waste water treatment plants
	Waste	Dump sites

*Possible contaminated sites will be the same as the locations identified in possible stakeholders

The information collected in step 1 from authorities on potential contaminated sites containing PFOS and its related substances can be validated by stakeholders in the relevant sectors listed in table 7-1.

It is highly recommended the information be recorded for future identification of contaminated sites and a prioritized remediation plan in the future.

Tier III: In-depth inventory

Expected output of the in-depth inventory includes:

- *Strategy and methodology for assessment of contaminated sites*
- *Advisory levels for different media and exposure routes*
- *Identification of and supplementary information on existing sites contaminated with PFOS and its related substances*
- *Monitoring of potentially PFOS contaminated sites*

Step 3. Conduct further investigations

Development of a strategy and methodology for assessment of PFOS contaminated sites.

A methodology for more in-depth investigations can be found in the *Persistent Organic Pollutants: Contaminated Site Investigation and Management Toolkit* (UNIDO, 2010).

- Identification of existing sites contaminated and supplementary information on existing sites contaminated with PFOS and its related substances
- If capacity allows, initial monitoring of potentially PFOS contaminated sites

To assess if the reported sites from stakeholders are contaminated, criteria and levels have to be developed. The examples of advisory levels in table 7-2 can provide some preliminary guidance.

Table 7-2: Examples of advisory or normative levels of PFOS in different countries

Country	**Level of PFOS**	**Media**	**Source of information**
USA	0,4 µg/l	Drinking water	USEPA, 2009b
Germany	0,3 µg/l	Drinking water	UBA, 2006
Germany	0,1 µg/l	TDI*	Wölfle, 2006
Norway	0,1 mg/kg	Soil	KLIF, 2007

*TDI (Tolerable Daily Intake)

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Annexes

Annex 1: Glossary of poly/perfluorinated compounds[20].

Fluortelomer alcohols (FTOHs)
Fluorotelomer alcohol is a general term which describes a class of alcohols of the general structure F(CF2CF2)nCH2CH2OH.

Fluorosurfactant
A non-specific, general term used to describe a surface active, low molecular weight (<1000), substance where carbons bear fluorine in place of hydrogen.

Telomer Based Product
Chemical substances that have the fluoroalkyl portion of the molecule derived from telomers manufactured from low molecular weight polymerization of tetrafluoroethylene.

Perfluoro- / Perfluorinated
A fully fluorinated or perfluorinated chemical is one in which all the carbon-hydrogen bonds in a chain have been replaced by carbon-fluorine ones. All fully fluorinated chemicals are man-made. Examples include perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS).

Perfluoroalkyl Substance / Compound (PFA)
A substance which bears a perfluorocarbon, also known as a perfluororoalkyl, functional group. F(CF2)n-X where n is an integer and X is not a halogen, or hydrogen.

Perfluorocarbon (PFC)
Perfluorinated chemicals in which all carbon-hydrogen bonds in a chain have been replaced by carbon-fluorine bonds. Examples include perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). PFC term also refers to PFC precursors, chemicals which contain a perfluoroalkyl moiety attached to other atoms that may not be perfluorinated, and have potential to transform to produce PFCs.

Perfluorinated Surfactant / "Perfluorinated Tenside (PFT)"
A term used to describe a surface active, low molecular weight (<1000), substance where all carbons bear fluorine in place of hydrogen; the term Fluorosurfactant is less specific but misused synonymously; a perfluorinated example is F(CF2)6SO3-NH4+; while a fluorinated surfactant might be F(CF2)4CH2SO2-NH4+.

Perfluoroalkyl Acid / Perfluorinated Acid (PFAA)
Perfluoroalkyl acids

Perfluoroalkyl Carboxylic Acid / Perfluoroalkyl Carboxylate (PFCA)
Perfluorinated carboxylic acids and their salts are a series of substances whose anion has the general structure of CF3(CF2)nCOO-. Certain members of this class, including the PFCA with 8 carbons, called perfluorooctanoic acid (PFOA), are manufactured as

[20] http://www.oecd.org/document/54/0,3746,en_21571361_44787844_45162486_1_1_1_1,00.html

a processing aid to produce fluoropolymers.

Precursor
A chemical that can be transformed to produce another chemical. For example, some residual monomer chemicals from the telomer manufacturing process, such as telomer alcohols and telomer iodides, are PFOA precursors because they may remain in the final product and can be transformed into PFOA.

Specific poly/perfluorinated substances/polymers:

PFNA
Perfluorononanoic acid is a fully fluorinated, nine-carbon chain length carboxylic acid (C9) (CAS RN 375-95-1).

PFOA
Perfluorooctanoic acid is a fully fluorinated, eight-carbon chain carboxylic acid (CAS RN 335-67-1) sometimes used to refer to the anionic salt form.

Perfluoroalkyl (or Perfluoroalkane) Sulfonic Acid / Perfluoroalkyl (or Perfluoroalkane) Sulfonate (PFAS)
Perfluoroalkyl sulfonate is a generic term used to describe any fully fluorinated carbon chain length sulfonic acid, including higher and lower homologues as well as PFOS.

PFOS
Perfluorooctane sulfonic acid is a fully fluorinated, eight chain sulfonic acid (CAS RN 1763-23-1) sometimes used to refer to the anionic salt form.

PFOS-related substances
Chemicals which have the chemical moiety C8F17SO2. This can be salts of PFOS or other chemicals and polymers that can degrade to PFOS. These related chemicals include, but are not limited to: Carboxylates, amines, ethers, iodides, phosphonic/phosphinic compounds, alcohols, esters, phosphates, sulfonates, siloxanes, thioethers, urethanes, and acrylates.

Polytetrafluoroethylene (PTFE)
Polytetrafluoroethylene is a fluoropolymer that is resistant to heat and chemicals and is used in making Teflon®. It has an extremely low coefficient of friction, and is used as a coating on cookware, gaskets, seals, and hoses.

Annex 2: Production and use of PFOS and the different stakeholders that can be relevant for the inventory.

Production and use	Stakeholders
Production of PFOS and its related substances	Manufacturers of PFOS-related substances, who use PFOSF or its secondary derivatives as the intermediates to produce PFOS-related substances and those who have the feedstock supply relationship with the known manufacturers of PFOS Associations in chemical and polymers industries, especially associations of organic fluorine compound industries if they are exist in a country Ministries responsible for chemicals management or chemical industry, who normally operate a database or inventory of existing chemicals manufactured, imported and distributed in a country Manufacturers and suppliers of specific chemical formulations containing PFOS-related substances, such products may cover major PFOS uses including surfactant, surface treatments (for textile, paper, leather et.), fire fighting foam, mist suppressant in metal plating, aviation hydraulic fluids, insecticides, photographic industry, electrical and electronic parts manufacture etc. Research and development (R&D) institutions, including R&D institutes on specialized industrial technologies, academies and universities, who conducting scientific research and technical development on organic chemistry, chemical industry or chemical processes.
Fire fighting foams	Manufacturers of fire-fighting foams and their associations Local and regional suppliers of fire-fighting foams Professional users: • off shore industry • offshore installations • oil refineries • on shore gas terminals • onshore oil and gas manufacturers and their installations • Petrochemical, chemical plants and other relevant industry • airports • Local armed forces • shipping companies and ferry companies • fire and rescue brigades • fire fighting training sites • car parks, underground parking facilities and tunnels • tank farms and fuel storage facilities
Aviation hydraulic fluids	Manufacturers of aviation hydraulic fluids and their

	associations Recyclers of aviation hydraulic fluids and their associations Local and regional suppliers of fire fighting foams Professional users: a. Airports b. Armed forces
Medical devices	Larger manufacturers of medical devices Larger retailers of medical devices
Electric and electronic parts in colour printers and colour copy machines	Larger manufacturers of Electric and electronic parts in colour printers and colour copy machines Larger retailers of Electric and electronic parts in colour printers and colour copy machines
Textiles and upholstery	Larger manufacturers and suppliers of textile formulas and their associations Larger manufacturers in the textile impregnation industry and their associations Larger manufacturers of textiles, apparels, home furnishing and upholstery, and their associations Larger retailers of textiles, apparels, home furnishing and upholstery
Synthetic carpets	Larger manufacturers and suppliers of chemical formulas for carpet impregnation and their associations Larger manufacturers of synthetic carpets and their associations Larger retailers of synthetic carpets
Paper and packaging	Larger manufacturers of chemical formulas used in paper impregnation and their associations Larger manufacturers for manufacturers of paper, paperboards and packaging and their associations Larger manufacturers of food and their associations Larger fast food chains
Insecticide: Insect bait for leaf-cutting ants Insecticide for fire ants and termites	Producers, chambers, importers, associations Suppliers of insecticides and their associations: 1. Agrochemicals importers 2. Dealers, wholesalers and Retailers Professional users: - Farmers and their associations - Larger plantations
Leather and apparel	Larger manufacturers and suppliers of leather formulas and their associations Larger manufacturers in the leather impregnation industry and their associations Larger manufacturers of leather articles and apparel, home furnishing and upholstery and their associations

	Larger retailers of leather articles, apparel, home furnishing and upholstery
Coatings and coating additives - wax and polishes - Paint	Manufacturers and suppliers of chemical formulas, and their associations
Industrial and household treatment products - Water proof spray - Denture cleanser - Shampoos - Cleaning agents, - Cosmetics and hand cream - Toner and printing ink - Sealants and adhesive products	Manufacturers and suppliers of chemical formulas, and their associations Larger manufacturers and suppliers of cleaning products, surface treatments, paint, printing ink, adhesives and sealants, and their associations Larger retailers of cleaning products, surface treatments, paint, printing ink, adhesives and sealants.
Rubber and plastic i. Release agent in the manufacturing process	Manufacturers, associations and professionals on fluorocarbon surfactants and plastic products manufacture Manufacturers of PFOS-related substances and those who have the feedstock supply relationship with the known manufacturers of PFOS Associations in chemical and polymers industries, especially associations of organic fluorine compound industries if they exist in the country Manufacturers and suppliers of specific chemical formulations containing PFOS-related substances, such products may cover major PFOS uses in the manufacture of plastic products Ministries of chemicals management or chemical industry, who in some countries are operating a database or inventory of existing chemicals manufactured, imported and distributed,
Recycling of synthetic carpets	Manufacturers of synthetic carpets Distributors of synthetic carpets Retailers of carpets Construction and demolition companies Waste transfer stations Recyclers
Photographic industry • Photoimaging	The photographic industry and their associations Manufacturers of PFOS-related substances and those who have the feedstock supply relationship with the known manufacturers of PFOS Associations in chemical and polymers industries, especially associations of organic fluorine compound industries if

	they exist in the country, Manufacturers and suppliers of specific chemical formulations containing PFOS-related substances, such products may cover major PFOS uses in the photographic industry Ministries of chemicals management or chemical industry, who in some countries are operating a database or inventory of existing chemicals manufactured, imported and distributed,
Semi-conductor industry • Photoresist and anti-reflective coating • Etching agent for compound semi-conductors and ceramic filters • Photomask • Edge bead removers • De-gluing agents • Developing agent	The semiconductor industry and their associations Manufacturers of PFOS-related substances and those who have the feedstock supply relationship with the known manufacturers of PFOS Associations in chemical and polymers industries, especially associations of organic fluorine compound industries if they exist in the country Manufacturers and suppliers of specific chemical formulations containing PFOS-related substances, such products may cover major PFOS uses in the semi-conductor industry. Ministries of chemicals management or chemical industry, who in some countries are operating a database or inventory of existing chemicals manufactured, imported and distributed
Electronic industry • Photoresist and anti-reflective coating • Etching agent for compound semi-conductors and ceramic filters • Metal plating in closed loop-system • Photomask • Hard metal plating • Decorative metal plating • Desmear agent • Dispersion • Surface treatment • Solder • Paint • Adhesive	The electronic industry and their associations Manufacturers of PFOS-related substances and those who have the feedstock supply relationship with the known manufacturers of PFOS Associations in chemical and polymers industries, especially associations of organic fluorine compound industries if they exist in the country, Manufacturers and suppliers of specific chemical formulations containing PFOS-related substances, such products may cover major PFOS uses in the electrical and electronic parts manufacture Ministries of chemicals management or chemical industry, who in some countries are operating a database or inventory of existing chemicals manufactured, imported and distributed,
Metal plating industry	Metal plating companies and industry associations

• Metal plating in closed loop-system • Hard chromium plating • Decorative chromium plating	Manufacturers and suppliers of chemistry for plating applications which contain PFOS-related substances Research and Development (R&D) institutions, including specialized R&D institutes, academies and universities conducting scientific research and technical development on organic chemistry, chemical industry or specific chemical processes. Departments of occupational health and environmental protection (especially at local level), who can act as partners in the information collection of chromium plating plants Customs services Ministry of commerce and industry Consumer protection council
Chemically driven oil and gas production	National associations for the petroleum industry Oil and gas companies (Shell, Chevron, Mobil, NAOC, Addaz, Oando etc) Oil and gas service companies (Schlumberger, Baker Hughes etc.) Customs services Consumer protection councils Ministry of petroleum resources Ministries of Environment Department of Petroleum Resources National Environmental Standards and Regulations Enforcement Agency (NESREA) State Environmental Protection Agencies (SEPAs) Manufacturers Association Small and Medium Enterprises Development Agencies Petroleum Exchange Institute of Public Analysts Importers and suppliers of chemicals and reagents
Mining industry	Customs Services Mining and Blasting Industries

	Geological and Mining Society Ministries of Environment Ministries of Commerce and Industries Ministries of Mines and Steel Development Ministries of Science and Technology Research Institutes Raw Materials Research and Development Commissions Manufacturers Association Mining Institute Association of Miners Small and Medium Enterprises Development Agencies National Environmental Standards and Regulations Enforcement Agencies

Annex 3: Questionnaire for (metal) plating industry

1. Name and address of plating industry:

Name of industry	Address

2. Type of plating process

(a) Chromium ☐ (b) Nickel ☐ (c) Plastics ☐ Others (Please specify

3. Chemicals used in the process (List of chemical mixtures/attach list of chemical mixtures used in the process which contain or might contain PFOS or related substances; if possible with safety data sheets)

Name of chemical or chemical mixture	CAS number	Time span of use	Quantity (Yearly amount)	Contain PFOS or PFOS related chemicals (yes or unknown)

4. If you are aware that any of the chemicals used contain PFOS, salt of PFOS or PFOS precursors, list the chemical mixtures and their contents in the table. Fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixture	Name of PFOS or PFOS related chemical	CAS number	Function (foam suppressant, wetting agent etc.)	Content of PFOS or PFOS related chemical (%)	Quantity PFOS or PFOS related chemical used (Yearly amount)

5. Stockpiles of chemical mixtures

Product Name/Name of chemical mixture	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or PFOS related substance	CAS number	Content of PFOS or PFOS related chemicals (%)	Location

6. How is the waste from the metal plating process managed? (Fill in according to the following choices: A. deposited on the factory area, B. destroyed in a waste treatment facility, C. Sent to a landfill, D. Use on agricultural area, E. Reuse of plating bath, F. please specify)

Type of waste	**Waste treatment**
Chemicals becoming waste	
Plating bath when becoming waste	
Waste sludge from the waste water treatment of the rinse water	

7. Are you aware of locations contaminated with PFOS or its related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS and PFOS related substances (if available)**

8. Please name the suppliers/producers of the chemical mixtures used in the metal plating process

Name of company	Product	Contact information

9. Remarks

10. Respondent

Name	
Department	
Position	
Telephone	
Mobile Phone	
Email Address	
Signature	
Date	

Annex 4: Questionnaire for textile manufacturers and retailers

1. Name and address of the textile producer or (major) retailer:

Name	Address

2. Select the type of activity of your textile business that apply

Impregnation or coating of textiles	☐	Bulk sale of clothing, apparel, upholstery, furniture made with impregnated textiles	☐
Import of impregnated or coated textiles	☐	Retail sale of clothing, apparel, upholstery, furniture made with impregnated textiles	☐
Manufacturing of clothing, apparel, upholstery, furniture made with impregnated textiles	☐	Cleaning or repair of clothing, apparel, upholstery, furniture made with impregnated textiles	☐
Import of clothing, apparel, upholstery, furniture made with impregnated textiles	☐	Recycling of clothing, apparel, upholstery, furniture made with impregnated textiles	☐
Disposal of clothing, apparel, upholstery, furniture made with impregnated textiles	☐	Others (Please specify):	☐

3. Indicate the type of textiles you deal with

Textiles for clothing	☐	Textiles for apparel	☐
Textiles for upholstery	☐	Textiles for furniture	☐
Textiles for cleaning or repair?	☐	Textiles for recycling to produce other products	☐
Textiles for disposal	☐	Others (Please specify):	☐

4. Indicate the properties of the textiles you deal with:

Water resistant/repellent	☐	Stain resistant	☐
Synthetic	☐	Dirt resistant/repellent	☐
Oil and grease resistant	☐		☐
Other	☐	Please specify	

5. Please specify the amounts of textiles you deal with. (Yearly amount manufactured/ imported /sold/treated/recycled)

Types of textiles identified in part 3 of this questionnaire	Estimated amount per year [kg]
	[kg]
	[kg]
	[kg]
	[kg]

If other consumer products have been produced by recycling textiles produced before 2003, please specify the product and its annual production amount. The year of 2003 has been recognized as the threshold year when use of PFOS has been discontinued in commercial repellent chemicals.

Types of consumer products produced from old textiles	Estimated amount per year [kg]
	[kg]
	[kg]
	[kg]
	[kg]

6. What chemicals have been used for impregnation or coating of textiles in the textiles/products you deal with or manufacture? You might fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Product code or number/ CAS number	Type of textile/product	Weight ratio applied	Contain PFOS or PFOS related chemicals (unknown, yes or no)
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	

7. If you are aware that any of the chemicals used contain PFOS, salt of PFOS or PFOS precursors, list the chemical mixtures and their contents in the table. Fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Name of PFOS or PFOS related chemical	CAS number	Content of PFOS or PFOS related chemical (%)	Quantity PFOS or PFOS related chemical used (Yearly amount)

8. How are wastes managed in the facility (Fill in using the following categories: A. deposited on the factory area, B. destroyed in a waste treatment facility, C. Sent to a landfill, D. Use on agricultural area, E. please specify)

Type of waste	**Waste treatment**
Chemicals becoming waste	
Materials becoming waste	
Waste sludge from the waste water treatment of the rinsing water	

9. Stockpiles of PFOS containing chemicals or wastes

Product Name/Name of chemical mixture	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or PFOS related substance	CAS number	Content of PFOS or PFOS related substances (%)	Location

10. Are you aware of locations contaminated with PFOS or PFOS related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS and PFOS related substances (if available)**

11. If you are a supplier/producer or downstream user of textiles, upholstery, clothing or apparel please name the company you sell to or buy from:

Name of company	Product	Contact information

12. Please specify the suppliers/producers of the chemical mixtures/materials used in the manufacturing process

Name of company	Product	Contact information

13. Remarks

14. Respondent

Name	
Department	
Position	
Telephone	
Mobile Phone	
Email Address	
Signature	
Date	

Annex 5: Questionnaire for synthetic carpets sector

1. Name and address of the carpet producer or retailer:

Name	Address

2. Select all types of activity of your business that apply

Production of synthetic carpets	☐	Retailers of synthetic carpets	☐
Import of synthetic carpets	☐	Export of synthetic carpets	☐
Cleaning and reimpregnation of synthetic carpets	☐	Waste disposal of synthetic carpets	☐
Recycling of synthetic carpets to produce materials for other consumer products	☐	Others (Please specify):	

3. Select the type of synthetic carpets do you deal with

Synthetic carpets for households	☐	Synthetic carpets for any other indoor use	☐
Synthetic carpets for hotels	☐	Synthetic carpets for outdoor use	☐
Synthetic carpets for cars	☐	Old synthetic carpets for reuse or recycling	☐
Synthetic carpets for trains	☐	Others (Please specify):	☐

4. Indicate the properties of the carpets you deal with:

Water resistant/repellent	☐	Stain resistant	☐
Synthetic	☐	Dirt resistant/repellent	☐
Oil and grease resistant	☐	Contain flame retardants	☐
Other	☐	Please specify	

5. Please specify the amounts of synthetic carpets you deal with (amount manufactured/ imported /sold/treated/recycled)

Types of synthetic carpets identified above #3	3-year average amounts of synthetic carpets per year
	[kg]
	[kg]
	[kg]
	[kg]

If other consumer products have been produced by recycling synthetic carpets produced before 2003, please specify the product and its annual production amount. The year of 2003 has been recognized as the threshold year when use of PFOS has been discontinued in commercial repellent chemicals.

Types of consumer products produced from synthetic carpets produced before 2003	Average amounts of products per year
	[kg]
	[kg]
	[kg]
	[kg]

6. What chemicals have been used for impregnation or coating of carpets you deal with or manufacture? You might fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Product code or number/ CAS number	Type of carpet	Weight ratio applied	Contain PFOS or PFOS related substances (unknown, yes or no)
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	

7. If you are aware that any of the chemicals used contain PFOS, salt of PFOS or PFOS precursors, list the chemical mixtures and their contents in the table. Fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Name of PFOS or PFOS related substances	CAS number	Content of PFOS or PFOS related substances (%)	Quantity PFOS or PFOS related substances used (Yearly amount)

8. How are wastes managed in the facility (Fill in according to the following options: A. deposited on the factory area, B. destroyed in a waste treatment facility, C. Sent to a landfill, D. Use on agricultural area, E. please specify)

Type of waste	**Waste treatment**
Chemicals becoming waste	

Materials becoming waste	
Waste sludge from the waste water treatment of the rinsing water	

9. Stockpiles of PFOS containing chemicals or wastes

Product Name/Name of chemical mixture	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or related substance	CAS number	Content of PFOS or its related chemicals (%)	Location

10. Are you aware of locations contaminated with PFOS or its related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS and its related substances (if available)**

11. If you are a supplier/producer or downstream user of synthetic carpets please name the company you sell to or buy from:

Name of company	Product	Contact information

12. Please specify the suppliers/producers of the chemical mixtures/materials used in the manufacturing process

Name of company	Product	Contact information

13. Remarks

14. Respondent

Name	
Department	
Position	
Telephone	
Mobile Phone	
Email Address	
Signature	
Date	

Annex 6: Questionnaire for pulp and paper

1. Name and address of the paper producer or retailer:

Name	Address

2. State the type of technology you use in your production

_____

_____

_____

_____

3. What type of papers do you produce?

(a) Uncoated wood free printing and writing papers ☐

(b) Tissue paper ☐

(c) Coated wood free printing and writing paper ☐

(d) Recycled paper ☐

(e) Coated papers for water and oil/grease repellence ☐

(f) Speciality paper ☐

(g) Other paper (please specify) _____ ☐

4. What chemicals have been used for impregnation or coating of paper or paperboard in the products you manufacture or recycle? Fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Product code or number/ CAS number	Type of textile/product	Weight ratio applied	Contain PFOS or PFOS related substances (unknown, yes or no)
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	
			[wt%]	

5. If you are aware that any of the chemicals used contain PFOS, salt of PFOS or PFOS precursors, list the chemical mixtures and their contents in the table. Fill in the information available from safety data sheets or suppliers/producers.

Name of chemical mixtures	Name of PFOS or PFOS related substances	CAS number	Content of PFOS or PFOS related substances (%)	Quantity PFOS or PFOS related substances used (Yearly amount)

6. Does any of these chemicals contain other fluorinated carbons?

(a) Yes ☐ (b) No ☐ (c) Don't Know ☐

What chemicals and amount?

Name of chemical	Product code or number	Weight ratio applied per synthetic carpets
		[wt%]
		[wt%]
		[wt%]

7. How are wastes managed? (Fill in according to the following options: A. deposited on the factory area, B. destroyed in a waste treatment facility, C. Sent to a landfill, D. Use on agricultural area, E. please specify)

Type of waste	**Waste treatment**
Chemicals becoming waste	
Materials becoming waste	
Waste sludge from the waste water treatment of the rinsing water	

8. Stockpiles of PFOS containing chemicals or wastes

Product Name/Name of chemical mixture	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or related substances	CAS number	Content of PFOS or PFOS related substances (%)	Location

9. Are you aware of locations contaminated with PFOS or PFOS related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS or PFOS related substances (if available)**

10. If you are a supplier or downstream user of paper or packaging please name the company you sell to or buy materials/chemicals from:

Name of company	Product	Contact information

11. Please specify the suppliers/producers of the chemical mixtures used in the manufacturing process

Name of company	Product	Contact information

12. Remarks

13. Respondent

Name	Position
Department	
Telephone	Mobile Phone
Email Address	
Signature	
Date	

Annex 7: Questionnaire for semi-conductor industry, electronic industry and photographic industry

1. Name and address of facility:

Name of facility	Address

2. Tick process stages that apply for your company

Photoresist and anti-reflective coating	☐	Photo-mask	☐
Etching agent for compound semi-conductors and ceramic filters	☐	Edge bead removers	☐
De-gluing agents	☐	Developing agent	☐
Metal plating in closed loop system	☐	Hard metal plating	☐
Decorative metal plating	☐	Desmear agent	☐
Dispersion	☐	Surface treatment	☐
Solder	☐	Paint	☐
Adhesive	☐	Photoimaging	☐
Others (Please specify):			

Please complete the table below

Type of sector	3-year average production of electronic devices per year
	[kg]
	[kg]
	[kg]
	[kg]

Please indicate if your process uses PFOS-contained chemicals? No ☐ Yes ☐

If the answer is yes, please specify the annual amount of PFOS used

Chemical's agent	Name of chemical	Name of PFOS or PFOS related	Content of PFOS or	The amount of chemical mixture/agent used in the past and planned to be used

	mixture/agent	substances	PFOS related substances [wt%]	in the future [kg]					
				Year					
Etching agent									
Photoresist substance									
Photo-acid generator									
Surfactant									
Anti-reflective coating agent									
Solder									
Adhesive									
Paint									
Photoimaging									
Metal plating									
Photo-mask									
Edge bead removers									
Developing agent									
Hard metal plating									
Desmear agent									
Surface treatment									

3. Obsolete Stockpiles

Name of chemical agent	Product code or number/ CAS number	Storage conditions	Quantity [kg]	Name of PFOS or related substance	CAS number	Content of PFOS or related substance [wt%]	Location
Etching agent							
Photoresist substance							
Photo-acid generator							
Surfactant							
Anti-reflective coating agent							
Solder							
Adhesive							
Paint							
Photoimaging							

Metal plating							
Photo-mask							
Edge bead removers							
Developing agent							
Hard metal plating							
Desmear agent							
Surface treatment							
Mist supressant							
Galvanic bath							

4. How are the PFOS containing waste rejects from your sector processes managed?

(a) Deposited near the factory area ☐ (b) Destroyed in a waste treatment facility ☐

c) Sent to a landfill (name/address) ☐ (d) Other (please specify) _____ ☐

5. Are you aware of locations contaminated with PFOS or its related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS and its related substances (if available)**

6. If you are a supplier or downstream user of manufactured or semi-manufactured goods please name the company you sell to or buy from:

Name of company	Product	Contact information

7. Please name the suppliers/producers of the chemical mixtures used in the manufacture processes

Name of company	Product	Contact information

8. Remarks

9. Respondent

Name	
Department	
Position	
Telephone	
Mobile Phone	
Email Address	
Signature	
Date	

Annex 8: Questionnaire for chemical industries and product suppliers

1. Name and address of the chemical industry:

Name	Address

2. Are you a:

Producer of chemicals or products ☐
Supplier of chemicals or products ☐
Downstream user of chemicals or products ☐

Please specify type of chemicals or products you produce or supply:

PFOS or its related substances	☐	Impregnation/coating formulas for textiles	☐
Fire fighting foam	☐	Impregnation/coating formula for carpets	☐
Aviation hydraulic fluids	☐	Impregnation/coating formula for leather	☐
Insecticides	☐	Impregnation/coating formula for paper and packaging	☐
Drilling fluids			
Chemicals for use in the metal plating industry	☐	Chemicals for use in the electronic industry	☐
Chemiclas for use in the semi-conductor	☐	Chemicals for use in the photographic industry	
Chemical mixtures/agents, Please specify	☐	Products, such as waxes, shampoos, sealants, paint, coating, household and industrial surfactants etc. Please specify	☐
Others (Please specify):			

3. What kind of PFOS or PFOS related substances, chemicals or products containing those substances does your company produce, supply or use?

Name of chemical or product	Product code or number/	Yearly amount produced,	Name of PFOS or PFOS	CAS number	Content of PFOS or

	CAS number	consumed or supplied (kg)	related substances		PFOS related substances (%)

4. How are the PFOS containing waste rejects from your sector processes managed?

(a) Deposited near the factory area ☐ (b) Destroyed in a waste treatment facility ☐

c) Sent to a landfill (name/address) ☐ (d) Other (please specify) _____ ☐

5. Stockpiles of PFOS containing chemicals or wastes

Product Name/Name of chemical mixture	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or related substance	CAS number	Content of PFOS or its related chemicals (%)	Location

6. Are you aware of locations contaminated with PFOS or its related substances?

Location	**Type of contamination**	**Type of activity at the location**	**Have the site been investigated? (do not know, yes or no)**	**Levels of PFOS and its related substances (if available)**

7. Please name the company you sell chemicals or products to or buy from:

Name of company	Product	Contact information

8. Remarks

9. Respondent

Name	Position
Department	
Telephone	Mobile Phone
Email	
Signature	
Date	

Annex 9: Questionnaire for (major) retailers of commercial products possibly containing PFOS

1. Name and address of retailer:

Name	Address

2. Does your store sell any of the following products?

a) Stain resistant Furniture Yes ☐ No ☐
b) Shoes Yes ☐ No ☐
c) Leather Yes ☐ No ☐
d) Textiles Yes ☐ No ☐
e) Clothing and apparel Yes ☐ No ☐
f) Synthetic carpets Yes ☐ No ☐
g) Industrial and household cleaning products Yes ☐ No ☐
h) Hygienic articles and cosmetics, Yes ☐ No ☐
i) Other Yes ☐ No ☐

3. Does the product(s)/article(s) you sell have or provide the following properties:

Water resistant/repellent	☐	Stain resistant	☐
Oil and grease resistant	☐	Dirt resistant/repellent	☐
Other	☐	Please specify	

4. To your knowledge do any of the products/articles you sell contain or has been surface treated with PFOS or its related substances?

Yes ☐ No ☐ Don't know ☐

If yes please specify:

Type of product	Name of chemical	CAS nr (if available)	Trade name	Content (wt %) (if available)	Sale per year

5. How do you manage wastes potentially containing PFOS? (deposited on a landfill/deposited in the company area/incinerated etc.)

Type of waste	**Waste treatment**

6. Do you have stockpiles of products/articles treated with or containing PFOS or its related substances?

Type of product/article	Storage conditions	Quantity	Name of chemical	CAS number (if available)	Content of PFOS or its related substances (wt %) (if available)	Location

7. Please name the supplier of the commercial products you sell potentially PFOS or other related substances containing articles or products

Name of company	Product	Contact information

8. Remarks

9. Respondent

Name	
Department	
Position	
Telephone	
Mobile Phone	
Email Address	
Signature	
Date	

Annex 10: Questionnaire for fire fighting foams

1. Name and address of fire fighting agency or factory/entity using or having used fire fighting foams with emphasize on fire fighting foam category:

Name of fire fighting agency/factory/facility/installation/organization	Address

2. Name and producer (seller) of currently used fire fighting foams (Please attach safety data sheet if available)

Name of currently used fire fighting foams	Producer of the fire fighting foams	Product code or number/CAS number	Amount in storage (wt)	Year of purchase

3. Content of chemicals (Check with the safety data sheet if available. Data on chemicals listed as fluorsurfactant, surfactant or surfactant agent, is especially of interest. Please indicate if data on those chemicals are not provided in the safety data sheet. If possible check with producer.)

Name of currently used fire fighting foams	Content of chemicals	CAS number	Content of PFOS or PFOS related substances (yes (wt%), unknown or no)

4. Usage frequency, location and amount of fire fighting foam use for training purpose

Number of times used/year	Total amount used/year	Training location (detail address)

5. Location and amount of fire fighting foam used in actual fire events (for the past 20 years)

S/N	Location of large fire event	Date	Type of fire fighting foam	Rough amount

			used	used

(Use additional sheets, if necessary)

6. How do you manage waste generated from application of fire fighting foam in your organization?

(a) Deposited in the area ☐ (b) Destroyed in a waste treatment facility ☐
(c) Sent to a landfill (name/address) ☐ (d) Other paper (please specify) ☐

7. Stockpiles of PFOS containing chemicals or wastes

Name of fire fighting foam	Product code or number/ CAS number	Storage conditions	Quantity	Name of PFOS or related substance	CAS number	Content of PFOS or related chemical (%)	Location	Year of purchase

8. Have the training site/site of accident fires been investigated?

Yes ☐ No ☐ Don't know ☐

If Yes:

Location	**Fire fighting foam used at the location**	**Levels of PFOS and its related substances in the fire fighting foam used (if available)**	**Levels of PFOS or its related substances at the site (If available: levels in soil/water/sediments)**

9. Please name the supplier of the fire fighting foam you use

Name of company	Product	Contact information

10. Remarks

11. Respondent

Name	
Department	
Position	
Telephone	
Mobile Phone	
Email Address	
Signature	
Date	

Annex 11: Questionnaire for waste treatment facilities

1. Name and address:

Name	Address

2. Please indicate the type of waste management facility you administer:

i. **a) Landfill** ☐
ii. **b) Incinerator** ☐
iii. **c) Waste water treatment facility** ☐

3a. If you administer a waste treatment plant, please indicate what type of waste water you receive:

i. **Industrial waste water** Yes ☐ No ☐
ii. **Waste water from households** Yes ☐ No ☐

3b. How do you manage the sewage sludge?

(a) Deposited on agriculture land ☐ (b) Destroyed in a waste treatment facility ☐

c) Sent to a landfill (name/address) ☐ (d) Other (please specify) _____ ☐

3 c. To your knowledge does the sewage sludge contain PFOS or PFOS related substances?

Yes ☐ No ☐ Don't know ☐

If yes, please specify if possible

Name of chemical	Content (wt %)

4 a. If you administer landfills or incinerators please indicate what kind of waste products you accept/receive:

a) Furniture Yes ☐ No ☐
b) Shoes Yes ☐ No ☐
c) Leather Yes ☐ No ☐
d) Textiles Yes ☐ No ☐
e) Clothing and apparel Yes☐ No ☐

f) Synthetic carpets Yes ☐ No ☐
g) Industrial and household cleaning products Yes ☐ No ☐
h) Hygienic articles and cosmetics, Yes ☐ No ☐
i) Chemical stockpiles Yes ☐ No ☐
J) Industrial waste Yes ☐ No ☐
i) Other Yes ☐ No ☐

4b. To your knowledge does any of the products you store or burn contain or has been surface treated with PFOS or PFOS related substances?

Yes ☐ No ☐ Don't know ☐

If yes please specify, if possible:

Type of product	Name of chemical	Content (wt %)	Yearly quantity (wt)

4c. Please name the supplier of the waste you deal with

Name of company	Waste	Contact information

5. Remarks

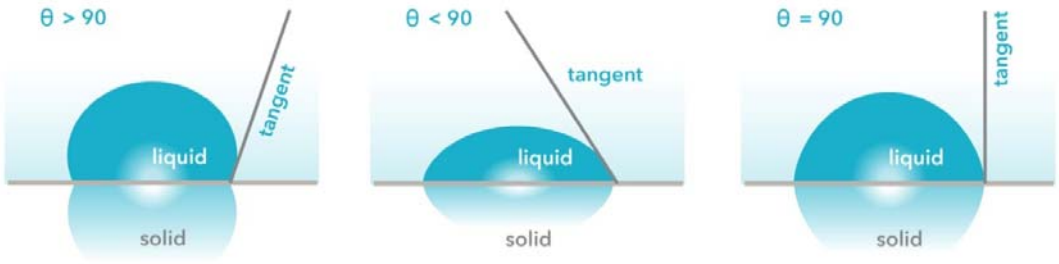
6. Respondent

Name	
Department	
Position	
Telephone	
Mobile Phone	
Email Address	
Signature	
Date	

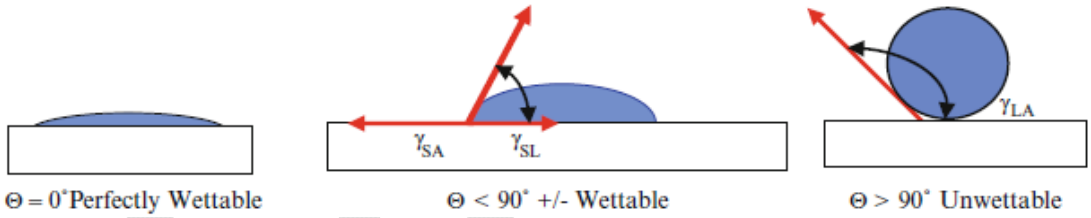
Annex 12: Method to verify the presence of perfluorinated substances

Methods for screening of PFOS in articles are compiled in the "*Draft Guidance on Sampling, Screening and Analysis of Persistent Organic Pollutants in Products and Articles*" (Secretariat of the Stockholm Convention 2013).

When a PFC is coated on a textile substrate and exposed to water with its surface tension of 72 mN/m or oily substances with surface tensions of 20 mN/m and more, they will not spread on the textile surface (Posner, 2011). The consumer can observe this phenomenon as "water and oil repellence". The spreading of a liquid on a surface is measured via contact angles and demonstrates well when a fabric is being wetted or not.

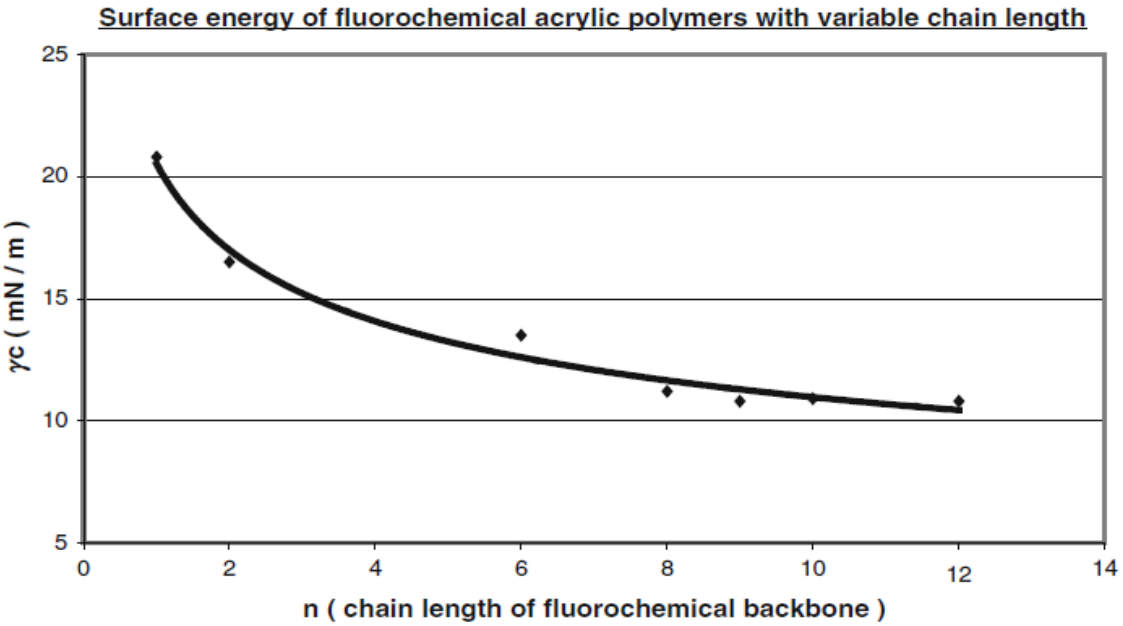


Contact angle ,θ , is a quantitative measure of the wetting of a solid by a liquid. It is defined geometrically as the angle formed by a liquid at the three phase boundary where a liquid, gas and solid intersect.



(S =solid, L = liquid, A = air. where γSA = surface energy of the substrate (e.g., polymer surfaces), γLA = surface tension of the liquid and γSL = interfacial tension).

Optimum reduction of the surface energy is achieved with perfluorinated chains with a sufficient chain length to obtain a large enough density of fluorinated carbons on the surface.
It has been demonstrated in the literature (Colbert et al., 1983, Corpart et al., 1997) on fluorochemicals that there is a relationship of the chain length of the perfluorinated chains that is related to the critical surface energy of the surface.



Most alternatives cannot achieve a surface energy lower than 22 mN/m or lower, the surface energy for oil (Posner, 2011). Materials with a high contact angle and low surface energy are therefore most probably been treated with perfluorinated substances. According to the above graph PFOS with 8 perfluorinated carbons achieve a lower surface energy than 12 mN/m. The PFOS-related substances contain at least one PFOS-group, or have more than 8 perfluorinated carbons. With a longer perfluorinated carbon chain the surface energy achieved is even lower. To measure the contact angle and surface energy (tension) of materials a Rame-hart goniometer is used.

Annex 13: Methods for analyses of PFOS and its related substances and their limitations

Methods for analysis of PFOS in articles are compiled in the "*Draft Guidance on Sampling, Screening and Analysis of Persistent Organic Pollutants in Products and Articles*" (Secretariat of the Stockholm Convention 2013).

The analytical methods for quantification of perfluorinated alkyl substances are under development, and very few technical standards have been defined. Due to their relative low volatility, good solubility in water and lack of chromospheres the analysis of per fluorinated alkyl substances is a challenging task. The analytical problems associated with the determination of neutral and anionic PFAS are multiple, and include diverse aspects such as unique physicochemical properties, lack of reliable standards, impurities, complicated mixtures of isomers and congeners, ion suppression, and contamination during all stages of the analytical procedure, including instrumental sources. When using the different available analytical methods for PFOS and its related substances caution should be given to follow the measures needed to assure that they provide reliable results. The challenges connected with quantification methods for PFOS and its related substances are described in the literature (Martin et al., 2004).

The analytical detection method of choice for PFAS is currently LC-MS or LC-MS/MS for the anionic compounds (including PFOS and PFOA), whereas both LC-MS(MS) and GC-MS can be used for the determination of the neutral per- and poly-fluorinated alkylated substances including several precursors of PFOS. Quadrupole tandem mass spectrometry applying negative electrospray ionization (ESI) interfaces (HPLC/ESI-MS/MS) seems to be the preferred instrumental method for the determination of ionic PFAS. In LC-MS of anionic PFAS, usually the dissociated acid (pseudo molecular) ion $[M-H]^-$ is observed, which can be used for quantitative purposes in LC-single quad MS, or as the precursor ion for multiple ion reaction monitoring in LC-MS/MS. Detection limits of LC-MS(MS) and GC-MS methods are sufficiently low to allow in principle for the determination of environmental levels of PFAS in drinking water and in food samples. Berger et al. 2004 compared three types of mass spectrometers for PFAS analysis, namely ion-trap MS(MS), time-of-flight (ToF)-high resolution (HR) MS and quadrupole MS(/MS). ToF-HRMS was found to be the superior method, combining high selectivity with optimal sensitivity. However, due to the low distribution of this type of instrument in analytical laboratories, quadrupole MS/MS is used most frequently (Berger et al., 2004). Quality assurance measures are applied to ensure best possible quality of the data. Liquid samples are diluted and extracted for both volatile and ionic compounds, followed by a cleaning step with activated carbon. Solid samples are homogenized prior to extraction and then treated similar to liquid samples. A summary of the methods discussed in this inventory guide is also given in a summary in the table below, in the European Food Safety Authority (2008) and the Strengthening POPs Regulatory Framework Guidance (2012).

Since PFOS and its related substances occur in a large range of materials and liquids, it is advisable to apply skilled and specialized laboratories where accreditation is one efficient way to verify these skills. A list of laboratories accredited for analysing POPs and using GLP (Good Laboratory Practices) can be found in (http://www.chem.unep.ch/gmn/gmnlabs/default.htm).

- *Table Summary of the results of a survey on standardized analytical methods and methods reported in literature to be considered for PFOS analysis (European Commission, 2011; Liu et al., 2009).*

Method	Matrix	Extraction	Clean-up	Detection	Congeners/Standards	Limits of method	Reference
Standard methods for determination of polyfluorinated substances in water							
E DIN 38407-42:2010-05 (D)	Water	SPE	No details available	LC-MS/MS	Polyfluorinated substances	No details available	[DIN 2010]
EPA 537	Drinking water	SPE	-	LC-MS/MS	perfluorinated alkyl acids (incl. PFOS)	1.4 µg/L (DL) 6.5 µg/L (lowest concentration minimum reporting level)	[EPA 2009]
ISO 25101:2009	Water	SPE	-	LC-MS/MS	PFOA and PFOS	2,0 ng/l to 10 000 ng/l	[ISO 25101]
Standard method for determination of PFOS under development							
FprCEN/TS 15968	Coated and impregnated solid articles, liquids, fire fighting foams	Depending from matrix – no details available	Depending from matrix – no details available	LC-MS/MS; LC-MS	PFOS	0,5 ng/ml to 50 ng/ml in extract	[CEN 15968]
Methods for determination ofg PFOS its salts and PFOA in different matrices reported in scientific literature							
Literature	Water	On-line extraction (turbulent flow chromatography)	-Column wash	LC-APPI/MS	PFOS	18 ng/L (LOQ)	[Takino et al., 2003]
Literature	Waste water STP sludge	Sedimentation, decantation Solvent liquid extraction after drying and grinding (aqueous acetic acid and MeOH)	SPE (OASIS HLB)	LC-APPI/MS	PFOS	2.5 ng/L (LOQ) 10 – 25 ng/g (LOQ)	[Sinclair and Kannan., 2006]
Literature	Water, waste water	Filtration	SPE mixed hemimicelle-based	HPLC-ESI-MS/MS	PFAs incl. PFOS	0.2 ng/L (LOD)	[Zhao et al., 2007]
Literature	Sediment, sludge	Solvent liquid extraction (aqueous acetic acid and MeOH)	SPE	HPLC-ESI-MS/MS	PFAs incl. PFOS	0.1 µg/kg (LOD sediment) and 0.9 µg/kg (LOD sludge)	[Higgins et al., 2005]
Literature	Sewage sludge	Freeze drying, Soxhlet extraction, hot vapour extr., PLE	-	HPLC-ESI-MS/MS GC—NCI-MS	PFSAs incl. PFOS	6.000 – 10.000 ng/g (LOD) 10.000 – 20.000 ng/g (LOQ)	[Schröder 2003]
Literature	Dust	Solvent liquid extraction (MeOH) sonication	Centrifugation, filtration	HPLC-ESI-MS/MS	PFSAs incl. PFOS	10 – 50 ng/g (LOQ)	[Moriwaki et al.,2003]
Literature	Dust	Solvent liquid extraction (AcN)	Centrifugation, SPE (C18)	HPLC-ESI-MS/MS	PFSAs incl. PFOS	0.99 – 4.56 ng/g (MDL)	[Kubwabo et al.,2005]
Literature	Fabrics and leathers	Sonication with 0.1 M HCl and MeOH	Zorbax SB-C18 column	LC-MS/MS	PFOS	1.5 mg/kg (LOD)	[Huang et al.,2007]
Literature	Packaging materials and textiles	Pressurized liquid extraction	-	GC-MS after silylation	PFOA and PFOS	13.9 ng/mL (LOD)	[Wang et al.,2009]
Literature	Paper products	Methanol by the accelerated solvent extractor	Purification, film-filtration	LC-MS/MS	PFOS	0.10 mg/kg (LOD)	[Ma et al.,2009]
Literature	Textile/carpet	SLE (water, MeOH) shaking PLE (MeOH)	Protein precipitation/centrifugation	LC-ESI-MS/MS	PFCAS	1-3 ng/g (LOQ)	[Mawn et al., 2005]
Literature	Paper/textile	SLE (MeOH)	Centrifugation	LC-ESI-MS/MS	PFCAS	1-2 ng/g (LOD)	[Stadillus et al., 2006]
Literature	Commercial articles	Methanol	Filtration	LC-MS/MS	PFCAs	0.9-6.8 ng/g	[Liu et al 2009]

Annex 14: Reporting format

Reporting under article 15 is an obligation of Parties and Conference of the Parties and a format was developed and has been used to compile information on PFOS and related chemicals. The following format is for consideration of parties so that the inventory can be presented.

Category of chemical agent used in industrial process/ articles or chemical products	Years of Inventory	Identified process-steps/chemical used (name/CAS nr)	Content of PFOS or ist related substances (wt %)	Annual amount of PFOS in chemical products (preparation or agent) and/or articles or used in industrial processes (kg/year)						
				Imported	Produced	Used in Industrial processes	In articles and chemical products on the market	Exported	Stockpiled	Waste
Acceptable purposes										
Chemical agent used in photo-imaging										
Photo-resist and anti-reflective coatings for semi-conductors										
Etching agent for compound semiconductors and ceramic filters										
Aviation hydraulic fluids										
surfactant/wetting agent/mist suppressants used in Metal plating (hard metal plating) only in closed-loop systems										
Certain medical devices (such as ethylene tetrafluoroethylene copolymer (ETFE) layers and radio-opaque ETFE production, in-vitro diagnostic medical devices, and CCD colour filters)										
Fire-fighting foam										
Insect baits for control of leaf-cutting ants from *Atta spp.* And *Acromyrmex spp.*										
Specific exemptions										
Photo masks agent in the semiconductor and liquid crystal display (LCD) industries										
surfactant/wetting agent/mist suppressants used in metal plating (hard metal plating)										
surfactant/wetting agent/mist suppressants used in metal plating (decorative plating)										
Electric and electronic parts for some colour printers and colour copy machines										
Insecticides for control of red imported fire ants and termites										
Agent used for chemically driven oil production										
Carpets										
Leather and apparel										
Textiles and upholstery										
Paper and packaging										
Coatings and coating additives in wax, polishes and paints										
Rubber and plastics										
Acceptable purposes/specific exemption*										
Production of PFOSF, PFOS and its related substances										
Production of other chemical agents, impregnation formulas and mixtures used in manufacture of articles and products										
Examples of Banned Categories										
Industrial and household cleaning agents such as - Water proof spray - Denture cleanser - Shampoos - Cleaning agents - Cosmetics and hand cream - Toner and printing ink - Sealants and adhesive agents										
Articles from recycled synthetic carpets										
Oils from downcycled aviation hydraulic fluids										
Articles from recycled paper and packaging										
Industrial and household treatment products such as Water proof spray - Denture cleanser - Shampoos - Cleaning agents - Cosmetics and hand cream - Toner and printing ink - Sealants and adhesive agents										
Edge bead removers, de-gluing agents, developing agent used in semiconductor industry										
Desmear agent, dispersion agent, surface treatment agent, solder, paint, and adhesive used in electronic industry										
surfactants in mining industry										

*Production only allowed for use for acceptable purposes as listed in annex B in the Stockholm convention. Production for uses listed as specific exemptions in Annex B only allowed for Parties listed in the register for specific exemptions under the Convention.

PFOS=PFOS or its related substances

Annex 15: Compilation formats

			Imported			Produced			Used in manufacturing of articles			Exported			Stockpiled			Waste		
			Yi	L	Ti	P	L	Tp	C	L	Tc	Ye	L	Te	Ys	L	Ts	Yw	L	Tw
Category of chemical agent used in industrial process	Years of Inventory	Identified process-steps/chemical agent used	Chemical agent (kg/year)	PFOS concen-tration (wt %)	Annual amount PFOS (kg/year)	Production of Chemical agent (kg/year)	PFOS concen-tration (wt %)	Annual amount PFOS (kg/year)	Consumption of chemical agent (kg/year)	PFOS concen-tration (wt %)	Annual amount PFOS (kg/year)	Chemical agent (kg/year)	PFOS concen-tration (wt %)	Annual amount PFOS (kg/year)	Chemical agent (kg/year)	PFOS concen-tration (wt %)	Annual amount PFOS (kg/year)	Chemical agent (kg/year)	PFOS concen-tration (wt %)	Annual amount PFOS (kg/year)
Acceptable purposes																				
Chemical agent used in photo-imaging																				
Photo-resist and anti-reflective coatings for semi-conductors																				
Etching agent for compound semiconductors and ceramic filters																				
surfactant/wetting agent/mist suppressants used in Metal plating (hard metal plating) only in closed-loop systems																				
Specific exemptions																				
Photo masks agent in the the semiconductor and liquid crystal display (LCD) industries																				
surfactant/wetting agent/mist suppressants used in metal plating (hard metal plating)																				
surfactant/wetting agent/mist suppressants used in metal plating (decorative plating)																				
Agent used for chemically driven oil production																				
Manufacture of Rubber and plastics																				
Acceptable purposes/specific exemption*																				
Production of PFOSF, PFOS and its related substances																				
Production of other chemical agents, impregnation formulas and mixtures used in manufacture of articles and products																				
Examples of banned categories																				
Edge bead removers, de-gluing agents, developing agent used in semiconductor industry																				
Desmear agent, dispersion, surface treatment, solder, paint, and adhesive used in electronic industry																				
Surfactants in mining industry																				

*Production only allowed for use for acceptable purposes as listed in annex B in the Stockholm convention. Production for uses listed as specific exemptions in Annex B only allowed for Parties listed in the register for specific exemptions under the Convention.
PFOS=PFOS or its related substances

Tx=L·Yx — Tx = Ti, Te, Ts, Tw; Yx = Yi, Ye, Ys, Yw

Tp=L·P — see subchapter 4.2

Tc=L·C — see subchapter 4.2

			Imported			Produced			On the market			Exported			Stockpiled			Waste		
			Yi	L or AW	Ti	P or M	L or AW	Tp or Tm	S	AW	Ts	Ye	L or AW	Te	Ys	L or AW	Ts	Yw	L or AW	Tw
Category of article or chemical product	Years of Inventory	Name of Chemical (CAS nr)	Article or chemical product (kg/year)	PFOS concent-ration (wt%)	Annual amount PFOS (kg/year)	Article or chemical product (kg/year)	PFOS concent-ration (wt%)	Annual amount PFOS (kg/year)	Article or chemical product (kg/year)	PFOS concent-ration (wt%)	Annual amount PFOS (kg/year)	Article or chemical product (kg/year)	PFOS concent-ration (wt%)	Annual amount PFOS (kg/year)	Article or chemical product (kg/year)	PFOS concent-ration (wt%)	Annual amount PFOS (kg/year)	Article or chemical product (kg/year)	PFOS concent-ration (wt%)	Annual amount PFOS (kg/year)
Acceptable purposes																				
Certain medical devices (such as ethylene tetrafluoroethylene copolymer (ETFE) layers and radio-opaque ETFE production, in-vitro diagnostic medical devices, and CCD colour filters)																				
Fire-fighting foam																				
Aviation hydraulic fluids																				
Insect baits for control of leaf-cutting ants from *Atta spp.* And *Acromyrmex spp.*																				
Specific exemptions																				
Electric and electronic parts for some colour printers and colour copy machines																				
Insecticides for control of red imported fire ants and termites																				
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Paper and packaging																				
Coatings and coating additives in wax, polishes and paints																				
Examples of banned categories																				
Articles from recycled synthetic carpets																				
Oils from downcycled aviation hydraulic fluids																				
Articles from recycled paper and packaging																				
Industrial and household treatment products such as Water proof spray - Denture cleanser - Shampoos - Cleaning agents - Cosmetics and hand cream - Toner and printing ink - Sealants and adhesive agents																				

PFOS=PFOS or its related substances

Tx=L·Yx	Tx = Ti, Te, Ts, Tw Yx = Yi, Ye, Ys, Yw
Tp=L·P	see subchapter 4.2
Tm=A·W·M	see subchapter 4.2
Ts=A·W·S	see subchapter 5.3