Lebanon PFAS Situation Report

Innodev
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Summary

This report summarizes regulations, inventory information and scientific studies on per- and polyfluoroalkyl substances (PFAS) in Lebanon. The country ratified the Stockholm Convention in 2004 and the amendment listing PFOS went into legal force in 2010.

The updated Stockholm Convention National Implementation Plan, scientific studies of PFAS and examination of regulatory policy in Jordan raise concerns about these substances and reinforces the need for regulatory action. Key findings of this study are:

PFAS substances are poorly regulated in Lebanon

The Stockholm Convention entered into force for Lebanon in 2004 and the treaty added PFOS to its global restriction list in 2009. This amendment went into legal force in Lebanon in 2010 While some actions have been taken on PFOS, other PFAS substances are not regulated.

A recent inventory shows that many industries do not use PFOS

A 2017 government inventory found that most companies are not using PFOS in the following sectors: textile, synthetic carpet, apparel and leather industries, paper and packaging, metal plating, paints, aviation hydraulic fluids, firefighting foams, and plastic and rubber products. One food packaging company was quite explicit in not using commonly added PFAS substances, perfluoroalkyl phosphates, or other PFAS substances. Note that response rate varied from 50 – 100% and the military did not respond on the firefighting foam inquiry. In addition, PFAS-containing firefighting foams have been the main substitute.

Firefighting foams are a likely major source of PFAS

A 2017 government inventory showed 6,240L of PFOS-containing firefighting foam was used for 10 fire incidents between 2006 – 2014 and that that PFAS-containing AFFF foams are imported into Lebanon, primarily for use at gas stations. PFOS releases from firefighting foams are estimated at 5.5 – 16.5 kg based on imports from one supplier; 0.11 – 0.34 kg PFOS released in 2001 from the activities of Middle East Airlines; and 50 – 150 kg PFOS released between 2006 – 2014 from the Beirut Fire Department. The Beirut Fire Department has moved to PFAS-containing AFFF and fluoroprotein foams and the current foam composition used by the military

is not known. Potential contaminated sites include firefighting practice areas in the country and sites of fires where foams were used including warehouses and factories.

What are per- and polyfluoroalkyl substances (PFAS)?

PFAS is a large class of more than 4,500 persistent fluorinated chemicals. PFAS are both hydrophobic and lipophobic in nature and extremely persistent due to the strength of the carbon-fluorine bond. They are widely distributed in the global environment due to their high solubility in water, low/moderate sorption to soils and sediments and resistance to biological and chemical degradation. The properties of PFAS have resulted in extensive use as surfactants and surface-active agents in products. Two widely-used members of this class have been perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). As these two substances have come under regulatory pressure, the industry has shifted to other PFAS with similar properties.

Human exposure to PFAS is mainly by ingestion of contaminated food or water. These substances bind to proteins (not to fats) and persist in the body where they are mainly detected in blood, liver and kidneys. Studies indicate that PFOA and PFOS can cause reproductive and developmental, liver and kidney, and immunological effects in laboratory animals. Both chemicals cause tumors in animal studies along with a variety of other effects on infant birth weight, growth, learning, infant behavior, pregnancy, endocrine system, increased cholesterol, and thyroid function. Recent studies have linked a variety of PFAS substances to many human health effects: cardiovascular disease, markers of asthma, damage to semen quality, ovarian insufficiency, altered glucose metabolism, lower testosterone levels in male adolescents, association with shorter birth length in girls, elevated blood pressure, abnormal menstruation, lower birth weight in infants, possible increased risk of female infertility due to endometriosis, and decreased lung function in children with asthma.

The manufacture and use of PFAS and their use in a multitude of products has caused widespread pollution. PFAS are found in wildlife, accumulating in the blood, liver and kidneys of wildlife such as dolphins, polar bears, seals, birds, fish, and other marine wildlife. PFAS substitutes for PFOS and PFOA have been identified as potential global surface water contaminants and they have been found in more than 80% of 30 surface seawater samples from the North Pacific to Arctic Ocean. PFAS use in firefighting foams at military bases and airports is responsible for water pollution and contaminated communities in many countries, including Australia, Canada, China, Germany, Italy, Japan, Netherlands, New Zealand, South Korea, and Sweden.

Safer cost competitive non-fluorinated alternatives for PFAS use in firefighting foams have been adopted by an increasing number of major airports, including Auckland, Copenhagen, Dubai, Dortmund, Stuttgart, London Heathrow, Manchester, and all 27 major airports in Australia. Increasing awareness about the negative characteristics of PFAS has driven efforts to identify and market safer substitutes for other uses. Increasing awareness about the negative characteristics of PFAS has driven efforts to identify and market safer substitutes for other uses.

Due to the complexity and negative characteristics of PFAS, there is increasing interest in regulating PFAS as a class rather than as individual substances.

PFOS

PFOS and its related substances have been used in a variety of products and processes including firefighting foams, carpets, leather goods, upholstery, packaging, industrial and household cleaning products, pesticides, photographic applications, semiconductor manufacturing, hydraulic fluids, catheters and metal plating. PFOS is extremely persistent and has shown no degradation under any environmental condition that has been tested. It is toxic to mammals and high concentrations have been found in Arctic animals, far from anthropogenic sources. PFOS is regularly detected in human blood and breast milk. For example, in one study of 299 infants, PFOS was found in the blood of 297 of them and PFOA was found in all of them.

PFOA

PFOA has been used to make non-stick pans, and is found in textiles, fire-fighting foams, and medical devices, and is used in many other products and processes. In 2017, the Stockholm Convention POPs Review Committee noted the link between PFOA and serious illnesses in humans, including diagnosed high cholesterol, ulcerative colitis, thyroid disease, testicular cancer, kidney cancer and pregnancy-induced hypertension. PFOA has contaminated the global environment, including wildlife and people of remote regions such as the Arctic and Antarctic.

For more information about recent research on the impacts of PFAS, including fluorinated substitutes for PFOS and PFOA, please see Annex 1. Information about the high cost of PFAS pollution cleanup is available in Annex 2. Global regulation of PFAS through the Stockholm Convention and evaluations of its expert committee is discussed in Annex 3.

Actions on PFAS and the Sustainable Development Goals

Actions to control and phase-out PFAS as a class contribute to achievement of several key Sustainable Development Goals (SDGs) due to the impacts of the substances on health and ecosystems including water pollution. These include

Sustainable Development Goal 3: Ensure healthy lives and promote well-being for all at all ages. Targets under SDG3 include:
3.4: *"reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being"*
3.9: *"substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination."*

Sustainable Development Goal 6: Ensure availability and sustainable management of water and sanitation for all. Targets under SDG6 include:
6.3: *"improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally."*

Sustainable Development Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Targets under SDG9 include:
9.4: *"greater adoption of clean and environmentally sound technologies and industrial processes."*

Sustainable Development Goal 12: Ensure sustainable consumption and production patterns. Targets under SDG12 include:
12.4: *"By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frame works, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment."*
12.5: *"substantially reduce waste generation through prevention, reduction, recycling and reuse."*
12.6: *"Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle."*
12.7: *"Promote public procurement practices that are sustainable, in accordance with national policies and priorities."*

Sustainable Development Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development. Targets under SDG14 include:
14.1: *"By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution."*

Sustainable Development Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. Targets under SDG15 include:
15.1: *"By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements."*
15.5: *"Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species."*
15.9: *"By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts."*

Sustainable Development Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels. Targets under SDG16 include:
16.7: *"Ensure responsive, inclusive, participatory and representative decision-making at all levels."*
16.10: *"Ensure public access to information…"*

PFAS production, use, and waste management in Lebanon

Assessment of PFOS

Perfluorooctance Sulfonic Acid (PFOS) and related substances are currently not produced in Lebanon. The following three (3) categories were identified as potential sources of PFOS and related substances and have been investigated in Lebanon as part of the 2016 government assessment (carried out from January - November 2016):
Category 1: Surface Treatment
Category 2: Paper Production
Category 3: Performance Chemicals

Note that inventory focused on PFOS and did not include any other PFAS substances. However, the inventory did reveal some information about other PFAS substances.

All products are both locally manufactured and imported, with the exception of firefighting foams and aviation hydraulic fluids which are only imported. It is also to be noted that textiles in raw form is not produced in the country, but rather imported and further processed in Lebanon to produce secondary products.

Once these products reach their end-of-life, they are either disposed of with municipal solid waste (open dumping or landfilling) or exported for recycling (e.g. used aviation hydraulic fluids).

Inventory

Category 1 - Surface Treatments

Textile and Upholstery

Primary textile production is absent in the country. Fourteen (14) establishments were found to process fabric (for clothing, uniforms, upholstery, etc.). Nine (9) establishments (64%) provided information and mentioned that their textiles are not treated with any PFOS-containing material; their raw material and products are EU- standardised for the international market. The remaining five (5) were however non-responsive. Thus, complete quantification of PFOS related to textile industries was not possible.

Synthetic Carpets

A total of eight (8) synthetic carpet manufacturers and retailers were identified in Lebanon. Five (5) of them (63%) were responsive stating that they do not produce any type of stain repellent carpets or use commercial stain repellents. The remaining three (3) were however non-responsive. Thus, quantification of PFOS related to synthetic carpets was not possible in this first assessment. There are no identified facilities for the recycling of synthetic carpets in Lebanon.

Apparel and Leather

Eleven (11) leather manufacturers and processors were identified in Lebanon. According to interviewees, the tanneries' products are mainly exported to EU countries and thus strict

production measures are applied for the use of the impregnation chemicals. Results of the survey showed that the relevant POPs chemicals are not currently being used by leather tanneries.

Category 2 - Paper Production

Paper and Packaging

A total of ten (10) paper mills and food packaging manufacturers were contacted. Out of the seven (7) that responded (70%), four (4) stated that they do not use chemicals during the production cycle. One (1) explained that he sublets his products to secondary retailers such as printing houses which might add a coated layer for protection based on demand and manufacturers have no information about the type of chemicals used in these coatings.

Two (2) industries which use chemicals stated that they follow strict EU standards, thus were PFOS-free:

• One (1) listed the used chemicals:
- Defoamer (HS code: 34.02.13)
- Retention agent (HS code: 39.06.90.90) - Flocculent (HS code: 39.06.90.90)
- Alum (HS code: 28.33.22.10)
- Cationic starch (HS code: 35.05.10.50)
- ASA (HS code: 38.09.92.00)
- PVOH (polyvinyl alcohol) (HS code: 39.05.30.00)

• One (1) stated that the following chemicals are not added to any of their paper and packaging products:
- Diethanolamine salts of mono- and bis(1H, 1H, 2H, 2H perfluoroalkyl) phosphates where the alkyl group is even numbered in the range C8-C18 and the salts have a fluorine content of 52.4% to 54.4%as determined on a solids basis;
- Pentanoic acid, 4,4-bis [(gamma-ome- ga-perfluoro-C8-20-alkyl)thio] derivatives, compounds with diethanolamine (CAS Reg. No. 71608-61-2); and
- Perfluoroalkyl substituted phosphate ester acids, ammonium salts formed by the reaction of 2, 2-bis [(omega-perfluo- ro-C4-20-alkylthio) methyl] –1,3-propanediol, polyphosphoric acid and ammonium hydroxide.

Additionally, a random selection of restaurants and cafes, which use paper in their food packaging, were surveyed. They all confirmed that their products, whether locally produced or imported, follow EU REACH standards for food safety and packaging and thus contain no PFOS – though other PFAS chemicals were not mentioned.

Note that one food packaging company above was quite explicit in not using commonly added PFAS substances, perfluoroalkyl phosphates, or other PFAS substances.

Category 3 - Performance Chemicals

Firefighting Foams

In Lebanon, there is no production of firefighting foams; however, nine (9) main retailers and filling establishments were identified and surveyed. All of them confirmed that firefighting foams are imported into Lebanon following strict European standards and regulations. Three (3) suppliers confirmed distributing PFAS-containing AFFF foams in fire extinguishers primarily for use in gas stations.

Based on the available data and calculations *(noting that UNEP guidance documents state that on average 0.5 to 1.5 % of the total weight of fluorinated fire- fighting foams is made of PFOS)*, an estimated 56 to 167 kg of PFOS were released between 2004 and 2014 and are divided as follows:

- 5.5 to 16.5 kg of PFOS released during the study period based on the imported quantities provided by one supplier;
- 0.11 to 0.34 kg of PFOS released in 2001 from the activities of the Middle East Airlines (MEA) at Beirut International Airport; and
- 50 to 150 kg of PFOS released between 2006 and 2014 from the activities of Beirut Fire Department.

The national airline company, Middle East Airlines (MEA), uses firefighting systems like FM-200 and CO_2 fire suppression systems. Note that DuPont manufactures FM-200 and it contains a variety of fluorinated substances and the company admits it is "not readily biodegradable." One principal component of FM-200 is heptafluoropropane or HFC227ea. HFC227ea has a global warming potential of 3,220 and is listed as a controlled substance under the Kigali Amendment of the Montreal Protocol. MEA also used 14 liters of AFFF Foams in 2001 to extinguish a fire in fuel tanks (AFFF 3% under the brand name SFFECO-FX100 manufactured in the Kingdom of Saudi Arabia). The AFFF foams used by MEA have a density of 1.6 kg/L before expansion, so the 14 liters correspond to 22.4 kg.

The Beirut Fire Department have used between 2012 and 2015, A- and A/B types of firefighting foams supplied by Solberg and Bio-Ex respectively. Nonetheless, they were supplied with Fluoro-Protein foams (FP), Aqueous Film-Forming foams (AFFF), Film-Forming Fluoro-Protein foams (FFFP), and Alcohol-Resistant Aqueous Film-Forming foams (AR- AFFF); which all contain PFAS substances.

This first inventory did not include PFOS-containing firefighting foams used from 1970s to 2003 which is the time period of major PFOS use.

The Lebanese Army has old equipment for firefighting including flame retardant outfits. These equipment and outfits might contain PFOS. However, no responses were provided. Noting that, the use in military has been found to be a major release and contamination source in other countries.

The Civil Defence Department and the Fire Departments of Tripoli and Beirut were surveyed to provide information on the types of foams used in their trainings and drills, in addition to accidental fires' locations and year of occurrence. The Tripoli Fire Department was further contacted and followed-up with, but no information was received until the day of this publication.

As for the Civil Defence, the flame retardant fabric they use is Para-Amid and they purchase foams and PPE according to the following standards:

- UL 162: Standard for foam equipment and liquid concentrates;
- NFPA 18: Standard on wetting agents;
- NFPA 1971: Standard on protective ensembles for structural firefighting and proximity firefighting; and
- EN 469: Protective clothing for firemen.

The Civil Defense claims that foams and equipment contain neither PFOS nor their related substances. However, UL 162 does include PFAS-containing foams. No information is currently available on the chemical content of the foams in use.

Concerning firefighting training sites, none of the respondents used PFOS-based foams and according to the Civil Defense Department in Beirut, very little foam is used in Lebanon for training purposes in general. Most training relies on the use of powder-based firefighting equipment as being more affordable. Thus, it was stated that the used powders are environmentally friendly and not harmful to humans. However, no information on the chemical content of the powders is available.

Metal-Plating

The ten (10) main metal plating industries in Lebanon were surveyed to determine their use of PFOS:

- One (1) explained that the use of PFOS in metal plating is outdated in the field. All big producers in the country now use the "silver strike" method where the main ingredients used are sodium and potassium cyanide; which are mainly imported from the Czech Republic. Small illegal metal platers might still be using PFOS. However, in the author's opinion, this statement is most likely inaccurate since even the German chromium platers are continuing using PFOS and the EU has further registered the use of PFOS;

- One (1) listed the chemicals used in its process: Nickel Chloride ($NiCl_2$), Nickel Sulfate ($NiSO_4$), Pure Silver, Potassium Cyanide (KCN), Tin Chloride ($SNCl_2$), diluted Sulfuric Acid ($H2SO_4$), Sodium Hydroxide (NaOH), Sodium Carbonate ($Na2CO_3$), and Sodium Tripolyphosphate (STPP).

A gap that could be mentioned here, is the lack of information on the nature of the alternative chemicals used. Additionally, only 50% of metal-platers responded, all of which were decorative silver metal-platers. Chromium platers who did not respond may be still using PFOS.

Historically, decorative silver platers may have used PFOS. Therefore, the landfills and open dumps where plating sludge is disposed of are expected to be contaminated with PFOS, heavy metals and cyanides.

Paints, Coatings and Varnishes

In Lebanon, a total of twelve (12) paint and varnishes factories were surveyed. All ten (10) responders (83%) stated that they do not use any chemicals containing PFOS in their production. In addition, the MSDS of an additional two (2) paint and varnishes factories previously audited were reviewed and no PFOS containing materials were detected.

Compounders

Aviation Hydraulic Fluids

A survey of MASCO (Middle East Airlines maintenance department) was conducted to retrieve the quantities of Skydrol (Commercial name of the hydraulic fluid) used. Based on the received data, the following two (2) types of hydraulic oils were used during the study period (2004-2014):

- HYJET IV-A PLUS: a synthetic base stocks and additives composed of the following compounds (not fluorinated):
    - 2,6-Di-Tert-Butyl-P-Cresol,
    - Aliphatic Epoxide,
    - Calcium Sulfonate,
    - Triphenyl Phospohate, and
    - Tributyl Phosphate.
- Radcolube RHP5606 Hydraulic Fluid: a petroleum base hydraulic fluid composed of the following compounds (not fluorinated):
    - Distillated (petroleum), Hydrogenated light Naphtenic,
    - Hydrogenated Polyalphaolefin,
    - Acrylic Polymer,
    - Thiophenolic derivative,
    - Alkylated Amine,
    - 1H-Benzotriazole-1-methanamine,N,N-bs(2-ethylhexyl)-armethyl, and
    - Red dye.

Based on the above, both used hydraulic fluids that do not contain PFOS.

Plastic and Rubber Products

During the assessment, eight (8) rubber manufacturers were contacted for indicative purposes, and all confirmed not to have used any PFOS containing chemicals in their production.

Stockpiles, Waste and Contaminated Sites

No PFOS stockpiles were identified as part of the assessment. All wastes generated from the relevant categories are disposed of with municipal waste in landfills of MSW and bulky waste where carpets and furniture are expected to go; open dumps (MSW and CDW) and controlled dumps throughout the country.

Potential contaminated sites, in addition to landfills and dumps, are all firefighting practice areas in the country and fire incidents sites (industries, warehouse, etc.) in which PFOS- and PFAS-containing firefighting foams were used or assumed to be used.

Summary of PFOS Releases

A summary of PFOS releases assessed by sector shows:

TEXTILE: Primary textile production is absent in the country.

SYNTHETIC CARPET: 63% of synthetic carpet manufacturers responded and do not use PFOS. There are no facilities for the recycling of synthetic carpets in Lebanon.

LEATHER: Relevant POPs chemicals are not currently being used by leather tanneries.

PAPER PRODUCTION: 70% of producers responded, none use PFOS with the exception of 1 that sublets products to printing house and has no information about chemicals they use. Selected restaurants and cafes use food packaging PFOS-free.

FIREFIGHTING FOAMS: An estimated 56 to 167 kg of PFOS were released between 2004 and 2014. Current foams are PFAS-containing foams.

METAL PLATING: Out of the 50% respondents, none used PFOS.

PAINTS: Out of the 84% respondents, none used PFOS.

COMPOUNDERS (Aviation Hydraulic Fluids): Private users do not use PFOS. Public users (army) did not respond.

PLASTIC AND RUBBER PRODUCTS: 8 rubber manufacturers were contacted for indicative purposes, and all confirmed not to have used any PFOS containing chemicals in their production.

PFAS impacts

Assessment of Stockpiles, Potentially Contaminated Sites, and Wastes

For the various categories and forms of POPs, the 2016 inventory assessed and determined the stockpiles, wastes and potentially contaminated sites.

As for PFOS, no stockpiles were identified, generated wastes were either landfilled or disposed of in open dumps throughout the country, and potential contaminated sites were mainly areas of fire accidents, as well as areas of firefighting incidents, where PFOS foams were used.

Between 2006 and 2014, ten (10) fire incidents were considered potential contaminated sites for PFOS (in addition to potential PCDD/PCDF contaminated sites), where 6,240L of firefighting

foam was used Since the major use of PFOS was from 1970s to 2002 the environmental and in particular groundwater contamination is at considerably more sites but was not included in the first inventory.

The contaminated hotspots in Lebanon need to be properly localised, where POP levels would be measured and identified. And since the infrastructure to properly quantify POPs and identify their location is not developed in Lebanon, its establishment will have an additional cost. Nevertheless, the greatest portion of the costs will be the remediation of these sites.

In 2011, the MoE and UNDP had published the "Master Plan for the Closure and Rehabilitation of Uncontrolled Dumps in Lebanon". As part of the preparation of that Master Plan, existing uncontrolled dumps were surveyed. A total of 670 dumps sites were identified; of which 504 are Municipal Solid Waste (MSW) dumps and 166 are Construction and Demolition Waste (CDW) dumps.

This report identified the most critical sites to be closed and rehabilitated, but due to shortage in funds, the only closed and rehabilitated site was the Saida dumpsite.

This report is currently being updated and a new inventory of uncontrolled dump sites is being prepared by the MoE and UNDP as well.

These sites are all considered as potentially contaminated with UPOPs given that the below Table 34 shows that most generated waste are openly dumped in the country and also based on the fact that open burning of waste is a common practice in Lebanon.

In addition to open dump sites, the landfills of Naameh, Bsalim, Zahle, and the controlled dumpsite of Tripoli are considered as potential contaminated sites.

Various fire accidents that occurred in Lebanon were expected to have released POPs, due to the nature of their facilities, and are therefore considered potentially contaminated sites. These include;

Bourj Hammoud-Tires Burning (tire burning occurred multiple times during the study period for the purpose of reclaiming steel wires);

Ain El Remmaneh-Chemicals Storage Fire Incident (approximately 1,000 tonnes of chlorine-based products caught fire during the incident);

Jnah-UNHCR Warehouse (3,753 tents, 36,642 blankets, 3,753 mattresses, 2,730 plastic sheets and 62 rolls of plastic caught fire);

Warehouse of Transmed (PUR insulated structure that can contain flame retardants and detergents which may contain chlorinated compounds as well as consumer product packaging that may contain PFOS);

Safra-Carpet Factory (carpets may contain flame retardant and stain resistant additives, thus brominated flame retardants and/or PFAS substances);

Dbayeh-Carpet Plus Show Room (carpets may contain brominated flame retardants and/or PFAS substances);

Mazraat Yashou-General Packaging Industry (potential presence of PBDEs in disposable cups and dishes);

Energy Sector Fire Incidents (key energy related infrastructure was damaged during the 2006 war including the Jieh power plant fuel storage tanks, the kerosene fuel storage tanks of the Beirut Rafic Hariri International Airport, transmission and distribution networks, and petrol stations);

Petrol Station Fire Incidents (several petrol stations were directly hit during the July 2006 war);

Industrial Fire Incidents

According to the 2006, Lebanon Rapid Environmental Assessment for greening Recovery Re- construction and Reform, thirty-one (31) industrial facilities in South Lebanon, Bekaa and Beirut Suburbs were reported to have been completely or partially destroyed. A total of seven (7) might have potentially contributed to PCDD/PCDF and possibly PFAS emissions, these being:

- Al Arz Textile Factory (Bekaa),
- Ghabris Detergent Factory (South),
- Saffieddine Plasti-med (South),
- Maliban Glass Factory (Bekaa),
- Fine Tissue Factory (South), and
- Lebanon Co. for Carton Mince & Industry (Mount Lebanon),
- Dalal Steel (Bekaa)

The identified segments of the population that are more prone to exposure include (i) stakeholders that directly interact with POPs in their professional settings, (ii) segments of the general public that are within the areas of contaminated sites and (iii) segments of the population that are more prone to the food intake exposure pathway. The socioeconomic assessment also identified populations that are likely living in dwellings with poorer indoor air quality. The focus was done on residents of houses that have poor ventilation or little natural light as these are likely located in denser urban areas with poor circulation and therefore worse indoor air quality.

The external health cost estimated for the endocrine effects of POPs are high for the general population. For the United States it was estimated that due to PBDE exposure about 11 million IQ points were lost costing US$ 266 billion.

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To enable Parties to the Convention to take measures to reduce or eliminate releases of POPs from intentional production and use, for which alternatives do not exist yet or are not readily available, the Convention allows Parties to register specific exemptions for a specific period of time. Annexes A and B to the Convention describe specific exemptions, as well as acceptable purposes, that are available with respect to the relevant POPs. Parties need to register in order to benefit from the Convention's provisions on specific exemptions listed in Annexes A or B.

For Annex B substances, Lebanon has not registered for any exemptions for the use of PFOS.

During the 2016 POPs inventory, specifically for PFOS, a main gap was defined in the metal plating sector as;

- Potential inaccurate statement from national manufacturer stating that big producers in the country now use the "silver strike" method where the main ingredients used are sodium and potassium cyanide; which are mainly imported from the Czech Republic;
- Statement from big manufacturers that small illegal metal platers might still be using PFOS;
- Lack of cooperation from some industries in providing information on production quantities and processes as well as alternative chemicals used in production processes;
- Only 50% of metal-platers responded, all of which were decorative silver metal-platers.

Given the above, and due the common presence of the chroming industry in Lebanon, the government might consider registering an acceptable purpose for this use in the future.

Scientific studies on PFAS in Lebanon

Currently there is no established national program for monitoring of releases and environmental levels of POPs. The monitoring of POPs releases and environmental levels is mainly taking place at academic and research levels. No peer-reviewed studies on PFAS in Lebanon were identified.

Press reports on PFAS

The Lebanese Ministry of Environment, being the national leading agency for the implementation of Stockholm Convention on POPs in Lebanon, has implemented measures under the Article 15 of the Stockholm Convention on reporting mechanism as follow: information collection from related ministries and stakeholders, follow up on the 2006 NIP

implementation and outputs, following reporting regime for meeting among parties and as required by the Convention's Secretariat.

To ensure Stockholm Convention's regulations, Lebanon has deployed different solutions such as establishing an implementing unit for the PCBs management in the power sector.

At this stage of the new requirements for POPs management and control as well as reporting regime, and in order to secure optimal implementation, Lebanon shall establish a national implementing unit at the Ministry of Environment to provide oversight for implementation of the 2017 NIP as a near-term priority. The unit should be supervised by a steering committee made of representatives of key ministries and their agencies involved with POPs management for instance: MoE-Ministry of Environment, MoI-Ministry of Industry, MoPH-Ministry of Public Health, MoA-Ministry of Agriculture, MoIM-Ministry of Interior and Municipalities, MoET-Ministry of Economy and Trade, MoEW-Ministry of Energy and Water, MoPWT-Ministry of Public Works and Transport, MoL-Ministry of Labor, Customs Authority and EDL-Electricité Du Liban. This broadened constituency, including stakeholders, is needed to implement specific actions.

In addition, throughout the years, Lebanon has developed multiple reports tackling measures taken to implement the Convention, effectiveness of such measures, statistical data on production, import / export of the listed chemicals, revision of the strategies aimed in reducing UPOPs releases and progress reports on elimination of PCBs.

In addition, during the exercise of updating and developing the current 2017 National Implementation Plan (NIP), the following reports had been prepared:

1) Regulatory and Institutional Framework Assessment - 2016
2) Assessment of POPs Pesticides - 2016
3) Assessment of Industrial POPs and Unintentionally Released POPs - 2016
4) Socio-Economic Impact Assessment of POPs - 2016

The full 2016 assessment reports (POPs pesticides, IPOPs and UPOPs, socioeconomic and regulatory and institutional framework) had been published and disclosed on the Ministry of Environment's website (http://www.moe.gov.lb/The-Ministry/Reports.aspx).

PFAS regulations

Lebanon Recognizing the importance of the management of Persistent Organic Pollutants (POPs), the Government of Lebanon (GoL) signed the Stockholm Convention on POPs on May 23, 2001 through the Law 432 dated July 29, 2002 and became a Party to the treaty when it ratified on May 17, 2004. No specific PFAS regulations have been implemented yet.

PFAS regulations in other countries

Most PFAS are not regulated, but PFOA and PFOS have come under regulatory scrutiny, particularly in the US where a large number of contaminated drinking water sites have been identified. In 2016, the US established a federal health advisory limit in drinking water of 70 ppt

(parts per trillion) for PFOA and PFOS combined. This advisory limit is not enforceable but is used as a guideline. A recent US government review by the Agency for Toxic Substances and Disease Registry has proposed tightening exposures which would translate to drinking water limits of 7 ppt for PFOS and 11 ppt for PFOA.

In the absence of federal regulations, individual US states (California Colorado, Minnesota, Michigan, New Jersey, New Mexico, Texas, Vermont, and Washington) have moved forward to regulate PFAS in drinking water, firefighting foam, personal protective equipment and wastes. Another 11 states are considering or have already proposed similar regulatory actions. Information about individual state proposals can be obtained here.

In 2018, state regulators in California set interim notification limits of 13 ppt for PFOS and 14 ppt for PFOA in drinking water. Regulators noted that both substances were listed by the state as developmental toxicants and that the National Toxicology Program concluded that both substances are "presumed to be an immune hazard to humans." Colorado uses a 70 ppt combined limit of PFOS and PFOA as a groundwater quality standard. Colorado also regulates PFOS and PFOA as hazardous waste. Massachusetts sets a 70 ppt limit for PFOA, PFOS, PFHxS, PFNA and PFHpA combined. Michigan uses the federal 70 ppt combined PFOS and PFOA standard as a limit for drinking water. The Minnesota Department of health recommends the following guidance values: 2000 ppt for PFBS, 27 ppt for PFHxS, 27 ppt for PFOS, 7000 ppt for PFBA, and 35 ppt for PFOA. New Jersey added PFNA to its hazardous substances list and set a limit for PFNA of 13 ppt in drinking water. New Jersey proposed limits of 14 ppt for PFOA and 13 ppt for PFOS. Vermont sets a drinking water health advisory limit of 20 ppt for PFOA, PFOS, PFHxS, PFHpA and PFNA combined. In 2018, Washington banned PFAS in firefighting foams and personal protective equipment and began a rulemaking process to established drinking water limits. The New York Department of Health has proposed 10 ppt for PFOS and 10 ppt for PFOA. The proposal considered the fact that people already have exposure to these substances from other sources.

Recommendations

National recommendations

1. Lebanon should develop a national inventory of PFAS substances, including contaminated sites.

2. An action plan should be developed and implemented on how to collect wastes and non-combustion methods for destruction.

3. Specific regulations should be enacted to prohibit PFAS production, use, import, and export. To avoid costly mistakes, PFAS should be banned as a class.

4. To prevent PFAS pollution and subsequent costly remediation, Lebanon should make an inventory on firefighting foam stocks promptly and replace PFAS-containing foams with fluorine-free foams as early as possible.

5. The capabilities program for Customs Control and related stockholders should be improved to control imports of these chemicals.

6. Create awareness among workers and the general population regarding dangers of PFAS.

7. Further studies on PFAS monitoring and health impacts in Lebanon should be conducted.

Recommendations for Stockholm Convention COP9

1. PFOA should be listed in Annex A with no specific exemptions. If exemptions are granted, they should be for specific products and the listing should require labeling new products that contain PFOA so that Parties can fulfill requirements under Article 6 as done previously for HBCD (SC-6/13).

2. Due to the costly, highly polluting nature of firefighting foams, and the availability of cost-effective, technically feasible non-fluorinated alternatives, no specific exemptions should be adopted either for PFOS or PFOA production and/or use in firefighting foams.

3. Specific exemptions or acceptable purposes for the following 11 uses of PFOS should be ended: photo-imaging, photo-resist and anti-reflective coatings for semiconductors; etching agent for compound semiconductors and ceramic filters; aviation hydraulic fluid; certain medical devices; photo masks in semiconductor and LCD industries; hard metal plating; decorative metal plating; electric and electronic parts for some color printers and color copy machines; insecticides for control of red imported fire ants and termites; and chemically-driven oil production.

4. The following 3 acceptable purposes should be converted into specific exemptions: metal plating (hard metal plating only in closed loop systems); firefighting foams; insect bait for control of leaf-cutting ants from *Atta* spp. and *Acromyrmex*spp. Sulfluramid should be named in the PFOS listing and its use sharply limited to cultivation of specific crops.

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Annex 1. PFAS toxicity

The Stockholm Convention expert committee (please see Annex 3) evaluated the toxicity characteristics of PFOS in 2007 and PFOA in 2017. Since then, more scientific information has emerged for both these substances along with some of the shorter-chain PFAS aggressively promoted by the industry as substitutes.

Recent research shows the harmful impacts of PFAS

Recent studies have linked PFAS substances to a variety of human health effects: cardiovascular disease, markers of asthma, damage to semen quality, ovarian insufficiency, altered glucose metabolism, lower testosterone levels in male adolescents, association with shorter birth length in girls, elevated blood pressure, abnormal menstruation, lower birth weight in infants, possible increased risk of female infertility due to endometriosis, and decreased lung function in children with asthma.

The chemical industry promoted perfluorohexane sulfonate (PFHxS) as a substitute for PFOS. In 2018, the Stockholm Convention expert committee concluded that it "warrants global action." PFHXS is found in 2 – 4 month-old infants and associated with damage to semen quality. The Stockholm Convention expert committee found that PFHxS has been detected in human blood and breast milk in many regions, and is together with perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA) and perfluorononanoic acid (PFNA) one of the most frequently detected and predominant PFASs in human blood. The Committee noted that the fetus is exposed to PFHxS via umbilical cord blood and that animal studies show impacts on reproduction, liver function, thyroid hormone levels, and lipid and lipoprotein metabolism.

Studies showing the toxicity, environmental fate, and occurrence of PFAS in current use include:

Perfluorobutanoic acid (PFBA)

- Effects on thyroid and developmental delays in offspring exposed during pregnancy
- Similar toxicity to liver as PFOA
- Associated with damage to semen quality
- Found in home-produced eggs
- Found in the Arctic
- Efficiently translocated into plants
- Taken up by corn
- Found in fruits and vegetables
- Contaminates fish
- Found in humans in a community with known drinking water contamination
- Found in consumer products

Perfluorobutane sulfonate (PFBS)

- Associated with damage to semen quality
- Disrupts pancreas formation in zebrafish
- Associated with cardiovascular disease in humans

- Associated with markers of asthma in humans
- Increases fatty tissue formation in laboratory studies
- Impairs visual function in fish
- Damages thyroid function in fish in subsequent generations
- Induces reproductive toxicity in animal studies
- Found in 2 – 4 month-old infants
- Found in humans in community with known drinking water contamination
- Found in children
- Found in the Arctic
- Found in consumer products

Perfluorohexanoic acid (PFHxA)

- Similar toxicity to liver as PFOA
- Associated with damage to semen quality
- Negatively associated with testosterone levels in adolescent humans
- Alters zebrafish behavior
- Modulates immune response in vitro
- Contaminated drinking water linked to human body burden
- Alters amphibian embryogenesis
- Exposes the human fetus vis presence in amniotic fluid
- Found in human milk
- Found in house dust
- Found in US wildlife preserves
- Found in the Arctic
- Contaminates fish
- Found in Indo-Pacific humpback dolphins and finless porpoises
- Efficiently translocated into plants
- Resistant to sewage treatment
- Found in US wastewater treatment plants

Perfluoroheptanoic acid (PFHpA)

- Alters amphibian embryogenesis
- Exposes the human fetus via presence in amniotic fluid
- Found in human milk
- Manufacturing sites, military fire training, and wastewater treatment plants are predictors of pollution
- Use in airport firefighting foams pollutes groundwater, lakes, soils, and fish
- Found in remote mountain snow
- Bioaccumulates in plankton
- Contaminates fish
- Efficiently translocated into plants

PFAS in people

Numerous studies show PFAS contamination in people. For example, in one study of 299 infants, PFOS was found in the blood of 297 of them and PFOA was found in all of them.

The Stockholm Convention conducts global monitoring of substances listed in the treaty as part of its effectiveness evaluation. The most recent data is from a series of regional monitoring reports published in 2015.

In Africa, the treaty monitoring study noted that PFOS was detected in mothers' milk from all 11 countries that submitted samples with levels varying from 1 – 34 ppt. The report notes that, *"Assuming that there is no industrial production of PFOS in the region, exposure of humans to PFOS and related chemicals might probably come from different kinds of waste, releases from industrial applications in firefighting and the various consumer products."*

The monitoring report for the Asia-Pacific region notes that only a few countries reported data. The report shows PFOS in air in Fiji, Hong Kong, Japan and in blood including maternal plasma in Japan. PFOS was also measured in marine areas in China, Hong Kong, Japan, Macao and rivers and lakes in Philippines, South Korea, and Thailand.

In Central and Eastern Europe, the Stockholm Convention monitoring report notes that data on water monitoring are scarce and data for the presence of PFOS in human tissues is even more limited.

Stockholm Convention monitoring in Latin America and the Caribbean showed that only Uruguay reported data on PFOS in air and the report notes that at this time (2015) there was no formal monitoring program in the region for determination of PFOS.

In Western Europe and Other States, monitoring data also includes the Arctic where PFOS and PFOA in air were measured. The report notes that phaseouts of PFOS and PFOA are reflected in declining concentrations but that fluorinated substitutes show increasing levels in Arctic air. The study also reveals that of all the measured POPs, PFOS was the predominant substance in human plasma, with the highest level of 470 ppt reported in an Inuit resident of the Arctic.

Recent scientific studies show the widespread presence PFAS in humans. Data include the following:

- Perfluorohexane sulfonate (PFHxS), perfluorononanoate (PFNA), perfluorodecanoate (PFDA), perfluoroundecanoate (PFUnDA), and perfluorotridecanoate (PFTrDA) in human milk in Sweden
- PFOS, PFOA, PFNA, PFDA, PFUnA and PFHxS in maternal sera, placentas, and fetuses.
- PFOS, PFOA, PFHxS, and PFNA in New Zealand adults
- PFOS, PFDoDA, PFUnDA and PFTrDA in pregnant Japanese women

- PFOS, PFOA, PFHxS in >94% of community residents with drinking water contaminated by a former US Air Force base.
- 10 long-chain PFAS in California women.
- PFOS< PFOA< PFHxS, PFNA, PFUnDA, PFHpS found in maternal plasma in Norway.
- PFAS in amniotic fluid in Denmark.
- Prenatal exposure to PFOS, PFHxS, PFHpS, PFNA, and PDFA in Denmark.
- Prenatal exposure to PFBS, PFHxS, PFUA in China.
- Six PFAS in middle-aged US women.
- PFNA, PFDA, PFUnDA, PFHxS, PFOA, and PFOS in more than 99% of sampled pregnant Swedish women.
- PFAS in maternal and cord blood in mothers exposed to the US World Trade Center disaster during pregnancy.
- PFOA, PFOS, PFNA, PFHxS in cord blood of Slovak infants.
- PFOS, PFOS and 6:2 CL-PFESA in cerebrospinal fluid in China indicating ability to cross the blood-CSF barrier.
- PFOS, PFOA, PFNA, and PFHxS in children.
- PFOA, PFOS< PFNA, and PFHxS in pregnant US women.
- PFOS< PFOA< PFHxS and PFNA in maternal serum in the UK.
- PFOA, PFOS, and PFHxS in Chinese women.
- PFOA and PFNA in US children.
- PFAS in Alaska Natives.
- PFHxS, PFOA< PFOA, PFNA, PFDA, PFUdA, PFDoA, and PFTrDA in >85% of sampled pregnant women in China.
- PFAS in pregnant Chinese women.

Manufacturers knew PFAS were harmful

Recently obtained documents indicate that the original manufacturers of PFOS and PFOA knew about the harmful characteristics of both substances decades ago.

A lawsuit filed by the US State of Minnesota against 3M produced internal company documents that demonstrated that the company knew PFOS and PFOA were accumulating in people for more than 40 years. 3M had previously withheld required documents from US regulators which resulted in a USD$1.5 million fine in 2006. In 1975, university researchers found a fluorinated substance in human blood and 3M confirmed that it was PFOS. Subsequent company testing found PFOS levels in 3M personnel at levels 50 – 1000 times higher than normal levels. In 1978, tests on monkeys feed PFOS resulted in all the animals dying and those given PFOA developed lesions on their spleen, lymph nodes, and bone marrow, all relevant to a functioning immune system. By 1989, the company knew that PFOS suppressed the immune system, caused tumors in animals, and that rates of cancers of the digestive organs and prostate were elevated in its own workers. The company proceeded to produce the substance anyway.

Internal company documents reveal that DuPont knew decades ago that PFOA affected the livers of dogs and humans, encouraged the growth of testicular tumors in rats, and appeared to result in endocrine disorders and kidney cancer in workers. In 1978, the company documented

immunotoxicity and other adverse effects in tests on monkeys exposed to PFOA and PFOS. By 1984, DuPont knew that PFOA was toxic, didn't break down, accumulated in blood, transferred from mothers to the fetus, and polluted drinking water supplies. DuPont decided to keep producing it anyway as it became incorporated into a multitude of products and processes. The company's real attitude about the consequences of PFOA production is revealed in its internal documents as "the material 3M sells us that we poop to the river and into drinking water."

DuPont was fully aware of PFOA's hazards, but a study of the company's decision-making processes noted that DuPont made a calculated, rational decision to pollute anyway. The authors estimate that for DuPont, "it was value-maximizing to pollute if the probability of getting caught was less than 19%." In reality the probability was much less than that and now communities and governments bear the burden of that private sector decision.

Annex 2. The high cost of PFAS cleanup

PFAS manufacturing and use in a multitude of products such as firefighting foams has resulted in widespread pollution – especially in water due to the solubility of PFAS substances. PFAS-contaminated sites have been identified in Australia, Canada, China, Germany, Italy, Japan, Netherlands, New Zealand, South Korea, Sweden, and the US, including a large number of military bases that contribute to 172 PFAS contamination sites in 40 states. In 2018, the US State of Minnesota entered into an agreement with 3M for the company to pay the state USD$850 million for costs associated with cleanup of PFAS including PFHxS due to manufacturing and releases by the company.

Clean up of PFAS pollution is difficult and costly. According to the Polluter Pays Principle, and sound economic policy, these types of external costs should not be borne by taxpayers, the state or national treasury, or by any other third party. Rather, these costs should be internalized within producer industries to avoid market distortion. As noted by UN Environment in 2012, "The vast majority of human health costs linked to chemicals production, consumption and disposal are not borne by chemicals producers, or shared down the value-chain. Uncompensated harms to human health and the environment are market failures that need correction."

Examples of estimated and actual cleanup costs for PFAS pollution include:

- Recent US government agency estimates for the cost PFAS clean-ups and associated monitoring due to use of firefighting foams at US military bases are more than USD$2 billion. There are also expensive clean up costs and estimates in a variety of US states including Alaska, New Jersey, New York (see also here and here), Vermont, Virginia, and Washington.
- The World Bank estimates that if just 20% of fluorinated firefighting foam in China is used for training or fire extinguishing, remediation costs would exceed USD$800 million.
- Remediation of PFAS-containing firefighting foam at the Düsseldorf Airport in Germany will take years or even decades. Cleanup costs cited by the European Chemicals Agency exceed €100 million. There are additional documented remediation costs due to PFAS pollution in Germany – see here, here, and here.
- Clean up due to use of 3M's "Light Water" firefighting foam containing PFOS and PFHxS at 18 military bases in Australia is estimated to cost hundreds of millions of dollars. The cleanup of just a single firefighting training college in Australia is estimated to cost AUS$80 million.
- To clean up groundwater polluted by PFAS around firefighting areas in Norway costs €3.5-5.5 million per training site.
- Firefighting training sites are the main sources of PFAS pollution in Sweden leading to €1 million in annual costs for charcoal filtering of water in Uppsala and a new water supply in Ronne costing €3 million. Extrapolated estimates for advanced cleaning of all waste water treatment plants in Sweden would only moderately remove fluorinated compounds but still cost USD$230 million per year.
- New Zealand has budgeted NZE$1 million to investigate cleanup of PFAS associated with firefighting foam use by military bases.

Annex 3. PFAS and the Stockholm Convention

The Stockholm Convention objective is to protect human health and the environment from persistent organic pollutants. Persistent organic pollutants (POPs) are a class of highly hazardous chemical pollutants that are recognized as a serious, global threat to human health and to ecosystems. Substances can be added to the Stockholm Convention after evaluation and recommendation by the POPs Review Committee (POPRC). Lebanon became a Party to the treaty in 2004.

PFOS

Governments added PFOS to the treaty list at the 4th Conference of the Parties in 2009 and subsequently adopted a series of guidance documents on PFOS alternatives. Lebanon did not register any specific exemptions or acceptable purposes for PFOS. The amendment entered into force for Lebanon in 2010.

When PFOS was listed in Annex B of the treaty in 2009, a very large number of loopholes accompanied its listing that permitted continued production and use. At COP9 in April/May 2019, Parties will determine if these loopholes are still needed or if some can be ended. The decision will focus on 6 time-limited ones (specific exemptions) and 8 time-unlimited ones (known as acceptable purposes). The POPRC recommended the following changes to the PFOS listing in the Convention:

End loopholes for 11 PFOS uses: photo-imaging, photo-resist and anti-reflective coatings for semiconductors; etching agent for compound semiconductors and ceramic filters; aviation hydraulic fluid; certain medical devices; photo masks in semiconductor and LCD industries; hard metal plating; decorative metal plating; electric and electronic parts for some color printers and color copy machines; insecticides for control of red imported fire ants and termites; and chemically-driven oil production.

Convert two time-unlimited exemptions to time-limited exemptions: metal plating (hard metal plating only in closed loop systems) and firefighting foams. This gets the clock running on ending these uses in five years. On the firefighting foams, the Committee recommended stopping production and only allowing use for class B fires (ones involving solvents, oil etc.) and only in installed systems. The Committee also noted that, *"a transition to the use of short-chain per- and polyfluoroalkyl substances (PFASs) for dispersive applications such as fire-fighting foams is not a suitable option from an environmental and human health point of view…"* This is extremely important since the fluorinated alternatives are persistent, toxic and readily pollute drinking water.

Continue time-unlimited exemption for one use: insect bait for control of leaf-cutting ants from *Atta* spp. and *Acromyrmex* spp. This vaguely-worded listing actually refers to a pesticide called sulfluramid that degrades to PFOS. The POPRC recommended naming sulfluramid in the treaty under the PFOS listing and narrowing its use to agriculture.

IPEN recommendations for PFOS

Specific exemptions or acceptable purposes for the following 12 uses of PFOS should be ended: photo-imaging, photo-resist and anti-reflective coatings for semiconductors; etching agent for compound semiconductors and ceramic filters; aviation hydraulic fluid; certain medical devices; firefighting foams, photo masks in semiconductor and LCD industries; hard metal plating; decorative metal plating; electric and electronic parts for some color printers and color copy machines; insecticides for control of red imported fire ants and termites; and chemically-driven oil production. If a specific exemption is allowed for use in firefighting foams, the POPRC recommendations should be adopted.

The following 2 acceptable purposes should be converted into specific exemptions: metal plating (hard metal plating only in closed loop systems); and insect bait for control of leaf-cutting ants from *Atta* spp. and *Acromyrmex* spp. Sulfluramid should be named in the PFOS listing and its use sharply limited to cultivation of specific crops.

PFOA

PFOA is extremely persistent and does not degrade under relevant environmental conditions. It bioaccumulates in air-breathing land and marine mammals, including humans. PFOA is found in water, snow, air, sediment and biota at remote locations including the Arctic. In 2017, the Stockholm Convention POPs Review Committee noted the link between PFOA and serious illnesses in humans, including diagnosed high cholesterol, ulcerative colitis, thyroid disease, testicular cancer, kidney cancer and pregnancy-induced hypertension. PFOA is transferred to the fetus through the placenta and to infants via breast milk. PFOA-related compounds such as fluorotelomer alcohols, fluoropolymers and fluorotelomer-based polymers must be included in actions designed to eliminate PFOA releases since they can degrade to PFOA.

In 2018, the POPRC recommended that governments list PFOA and related substances in Annex A of the Stockholm Convention for global elimination.

Ten time-limited exemptions accompany the PFOA listing recommendation, however, many of these are not justified.

Proposed PFOA Exemption	**Comment**
5 years	
3 exemptions connected to semiconductor manufacturing (equipment or plant infrastructure, legacy equipment, photo-lithography, etch process)	Alternatives without PFOS or PFOA are available for photolithography and etch processes. For example, IBM eliminated both in 2010. The other proposals are not sufficiently defined.
Photographic coatings applied to films	Obsolete use of PFOA replaced by digital imaging, including in developing and transition countries.

Textiles for oil and water repellency for workers	Proposal relies on industry claims and does not state what specific products the exemption would cover or how worker protection can be achieved without relying on a toxic chemical-impregnated textile.
Invasive medical devices	Alternative medical devices made without PFOA have passed all regulatory requirements, are available on the market, and in use.
Implantable medical devices	Alternative medical devices made without PFOA have passed all regulatory requirements, are available on the market, and in use.
Firefighting foams	Cost-effective non-fluorinated alternatives are in use at major airports and military installations and perform as well as PFAS-containing foams.
10 years For manufacture of semiconductor or related electronic devices; refurbishment parts containing fluoropolymers and/or fluoroelastomers with PFOA for legacy equipment or legacy refurbishment parts	See above for manufacturing. Legacy equipment proposal is not specific and include thousands of unnamed parts. Retrofitting with parts that do not contain PFOA should be utilized, instead of continuing PFOA production and use.
Until 2036 To use PFOI (a PFOA-related substance) to make PFOB for producing pharmaceutical products *"with a review of continued need for exemptions."*	In 2015, more than 100 governments agreed that environmentally persistent pharmaceutical products are an emerging policy issue of global concern in the SAICM process. A global exemption should not be adopted on behalf of a single company (Daikin) and exemptions for environmentally persistent pharmaceutical products should not be recommended.

IPEN recommendations for PFOA

PFOA should be listed in Annex A with no specific exemptions. If exemptions are granted, they should be for specific uses or products and the listing should require labeling new products that contain PFOA so that Parties can fulfill requirements under Article 6 as done previously for

HBCD (SC-6/13). In addition, due to the costly, highly polluting nature of PFAS-containing firefighting foams and the availability of effective fluorine-free foams, no exemption should be granted. If a specific exemption is allowed for this use, the POPRC recommendations on firefighting foams should be adopted.

PFHxS

PFHxS and related compounds are persistent in water, soil and sediment and unlikely to undergo degradation in the environment including hydrolysis, aqueous photolysis or under anaerobic conditions. PFHxS biomagnification factors (BMF) greater than 1 have been observed in food chains including Arctic bird/fish, Arctic polar bear/ringed seal, dolphin/fish, and fish/zoo plankton among others, indicating bioaccumulation. PFHxS has the longest half-life in humans determined for any PFAS. PFHxS undergoes long-range transport and is found in Arctic air, sediment, snow, ice, soil, sediment and biota (including humans) and in Antarctic biota and snow. *In vivo* and epidemiological studies show that PFHxS negatively affects liver function, thyroid, and the developing immune system resulting in reduced effects of vaccines and higher incidences of infections and asthma in children. A significant association between PFHxS exposure and breast cancer has been found in Greenlandic Inuit women. PFHxS is widely found in breast milk and is one of the most frequently detected and predominant PFAS in human blood, including maternal and infant cord blood. In September 2018, the POPRC determined that PFHxS "warrants global action" and moved the substance to the third and final evaluation during 2018 – 2019.

PFAS use in firefighting foams

There are many uses of PFAS, but one of the most highly polluting is in firefighting foams. This pollution occurs where the foam is used and quickly contaminates water and moves. Airports and military bases are common sources of PFAS pollution.

PFOS and PFOA were the original components in firefighting foams, but after regulatory pressure in the US, many companies switched to shorter-chain substances such as PFHxS, PFBA, PFBS, PFHxA, and PFHpA. These substances also are persistent and have hazardous properties. Some are found in the Arctic, suggesting ability to undergo long-range transport. Recently, IPEN assembled a group of fire safety experts who produced a detailed report on issues involving firefighting foams and the technical feasibility of fluorine-free firefighting foams. Safer cost competitive non-fluorinated alternatives to PFAS in firefighting foams have been adopted by major airports, including Auckland, Copenhagen, Dubai, Dortmund, Stuttgart, London Heathrow, Manchester, and all 27 major airports in Australia.

In September 2018, the POPRC recommended severe restrictions on the use of PFOS and PFOA in firefighting foams. In addition, the Committee also made an extremely important recommendation **not** to use the fluorinated alternatives to PFOA and PFOS, *"due to their persistency and mobility as well as potential negative environmental, health and socioeconomic impacts."*

The recommended restrictions on firefighting foams containing PFOA, PFOA-related substances, or PFOS include:

- No production.

- Use for 5 years only for liquid fuel vapor suppression and liquid fuel fires (Class B fires) already in installed systems.
- No import or export, except for environmentally-sound disposal.
- No use for training or testing purposes.
- By 2022, restrict use to sites where all releases can be contained.
- Ensure that all firewater, wastewater, run-off, foam and other wastes are managed in accordance with the treaty.

IPEN recommendations on PFAS use firefighting foams

Due to the costly, highly polluting nature of firefighting foams, and the availability of technically feasible, high-performing alternatives, no exemption should be granted for this use. IPEN supports the POPRC recommendation that fluorinated alternatives to PFOA and PFOS should not be used.