National Implementation Plan for the Stockholm Convention Sweden

Update 2017

SWEDISH ENVIRONMENTAL
PROTECTION AGENCY

Orders
Phone: + 46 (0)8-505 933 40
Fax: + 46 (0)8-505 933 99
E-mail: natur@cm.se
Address: Arkitektkopia AB, Box 110 93, SE-161 11 Bromma, Sweden
Internet: www.naturvardsverket.se/publikationer

The Swedish Environmental Protection Agency
Phone: +46 (0)10-698 10 00 Fax: +46 (0)10-698 16 00
E-mail: registrator@naturvardsverket.se
Address: Naturvårdsverket, SE-106 48 Stockholm, Sweden
Internet: www.naturvardsverket.se

ISBN 978-91-620-6794-6
ISSN 0282-7298

Print: Arkitektkopia AB, Bromma 2018

Preface

The objective of the Stockholm Convention on Persistent Organic Pollutants is to protect human health and the environment from the substances listed in the Convention. Under the Convention, each Party is to develop and endeavour to implement a plan for the fulfillment of its Convention obligations. The Government has commissioned the Swedish Environmental Protection Agency to review and update the National Implementation Plan in cooperation with the Swedish Chemicals Agency and the Swedish Agency for Marine and Water Management. In preparing this report, the three agencies have consulted several other agencies.

The Eighth Meeting of the Conference of the Parties to the Stockholm Convention was held 24-27 April 2017 in Geneva, Switzerland. The meeting adopted 27 decisions. Some of the main outcomes of the Conference include the listing of three new chemicals which had been recommended by the POPRC, namely decaBDE and short-chain chlorinated paraffins (SCCPs) in Annex A and hexachlorobutadiene (HCBD) in Annex C. All substances listed up to the conference of the Parties in 2015 have been included in this report and references to legislation and work in the EU have been made.

A decision on this report was taken by the acting Director General, on 23 November 2017, in collaboration with the Swedish Chemicals Agency and the Swedish Agency for Marine and Water Management.

Swedish Environmental Protection Agency,

Martin Eriksson, acting Director General

Contents

Summary

Objective and purpose

The Stockholm Convention was formally adopted with the objective to protect human health and the environment from persistent organic pollutants. According to the Stockholm Convention on Persistent Organic Pollutants, each Party to the Convention is to develop and endeavour to implement a plan for the implementation of its obligations under the Convention.

The Swedish national implementation plan, the third in the scheme, aims at describing what Sweden has done and intends to do to fulfil the obligations of the Stockholm Convention. The plan describes the situation in Sweden for persistent organic pollutants, identifies on going actions and presents strategies for future work. The plan contains updates in accordance with the decisions taken at the Conferences of the Parties in 2013 and 2015 regarding the addition of four chemicals to the Convention.

Background

Persistent organic pollutants (POPs) are chemical substances that persist in the environment, bio-accumulate, and pose a risk of causing adverse effects on human health and/or the environment. These pollutants are transported across international boundaries far away from their sources, even to regions where they have never been used or produced. The Baltic regions are examples of sinks of POPs within the EU. Given the long-range transport through air, water and products, international action is necessary to reduce and eliminate production, use and release of POPs.

The Convention entered into force in 2004 and requires Parties to take measures to eliminate or reduce the release of POPs into the environment. The Convention include POP substances in Annex A, B and C. For chemicals listed under Annex A, Parties must take measures to eliminate the production and use. Specific exemptions for use or production only apply to Parties that have registered for them. For chemicals listed under Annex B, parties must take measures to restrict the production and use in light of any applicable acceptable purposes and/or specific exemptions listed in the Annex. Regarding chemicals listed under Annex C, Parties must take measures to reduce the unintentional releases of chemicals with the goal of continuing minimization and, where feasible, ultimate elimination.

Parties are required to eliminate or reduce releases of POPs into the environment, and ensure safe management of stockpiles containing or consisting of POPs. Waste containing, consisting of, or contaminated with POPs, must also be disposed of in such a way that the POPs content is destroyed, or irreversibly transformed so that it does not exhibit POPs characteristics.

FOUR NEW SUBSTANCES

The initial clusters of 12 POP substances have been significantly increased since 2001. At present 28 substances, or groups of substances, are covered by the Convention. During the Conference of the Parties held in 2013 and 2015, it was agreed to add four additional substances to the Annexes of the Convention. The three industrial chemicals hexabromocyclododecane (HBCDD), hexachlorobutadiene (HCBD) and polychlorinated napthalenes (PCNs), and the pesticide pentachlorophenol (PCP). HBCDD, HCBD and PCP were added to Annex A, and PCN was added to both Annex A and Annex C. These additions entered into force in 27 November 2014 for HBCDD and in 16 December 2016 for the others. In total, four new substances are included in the updated Swedish national implementation plan 2017.

Additional POPs have been regulated after 2015. The substances are mentioned in the report but are not further processed within the national implementation plan 2017.

Rules and monitoring addressing POPs

Sweden is also party to the 1979 UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP) and its Protocol on POPs. The convention and its protocol regulate the limitation, reduction and prevention of air pollution, including long-range transboundary air pollution. The objective is to eliminate any discharges, emissions and losses of certain POPs substances.

All provisions on POPs are contained in the Regulation (EC) No 850/2004 of the European Parliament and of the Council of 29 April 2004 on persistent organic pollutants (the POPs Regulation) and directly applicable in all EU Member States. The Stockholm Convention and the CLRTAP are both transposed into EU law through the POPs regulation. Export is controlled under Regulation (EU) No 649/2012 of the European Parliament and of the Council of 4 July 2012 concerning the export and import of hazardous chemicals, and subject to the prior informed consent procedure under the Rotterdam Convention.

In Sweden the Swedish Environmental Code provides for the enforcement of the POPs Regulation. The Code entered into force on the 1 of January 1999. The POPs regulation and other relevant EU legislation have been incorporated into the Code and its ordinances. Chapter 14 of the Code and the adjacent legislation have changed considerably during the past five years due to the adoption of the REACH, the Regulation (ECU) No 1907/2006 of the European Parliament and of the Council.

Chapter 5 of the Code and adjacent legislation implements the water framework directive (WFD) and its daughter directive on priority substances (2008/105/EC). The latter was recently revised by the 2013/39 /EU directive, adding e.g. PFOS and

dioxin- and dioxin like compounds to Annex X of the WFD. The Annex X substances of the WFD are divided into priority hazardous substances (PHS) and priority substances (PS), see table below. According to article 4 of the WFD, member states shall implement necessary measures with the aim to progressively reduce pollution from PS and ceasing or phasing out emissions, discharges and losses of PHS. Some environmental quality standards (EQSs) were also revised and several EQSs expressed for biota were added to Annex I to 2008/105/EC.

The pursuit of the convention is similar to that of Sweden's environmental quality objective "A Non-Toxic Environment". This includes enhancing knowledge and information about chemical substances, phasing out substances of particular concern such as POPs, and reducing the risks posed by the use of other chemicals.[1]

POPs in Sweden

Annex A, B and C list the chemicals included in the Stockholm Convention, see table below. For each chemical, an assessment has been done. The assessments are based on use of the chemical, import and export, stockpiles, waste and contaminated sites, occurrence and emissions to the environment. The assessments conclude the situation in Sweden regarding the chemicals and describe the need for action.

Chemicals included in the Stockholm Convention up to 2015, CAS No, use and whether the substance is included in Annex 1 of the directive on priority substances (2008/105/EG) and in annex X of the water directive (2000/60EC) as a priority substance (PS) or priority hazardous substance (PHS).

Annex A (elimination)	CAS No	Use	Included in annex I to 2008/105/EC
Added substances in NIP 2017			
Hexabromocyclododecane (HBCDD)	25637-99-4 3194-55-6	Time limited ongoing use as flame retardant in expanded polystyrene and extruded polystyrene.	Yes (PHS)
Hexachlorobutadiene (HCBD)	87-68-3	No ongoing use, prohibited in the EU 2004. Historically used as solvent for other chlorine-containing compounds	Yes (PHS)
Pentachlorophenol (PCP) sodium pentachlorophenate as monohydrate pentachlorophenyl laurate pentachloroanisole	87-86-5 131-52-2 27735-64-4 3772-94-9 1825-21-4	No ongoing use, prohibited in Sweden 1978. Historically used as herbicide, insecticide, fungicide, algaecide, disinfectant and as an ingredient in antifouling paint. Some applications were in agricultural seeds, leather, wood preservation, cooling tower water, rope and paper mill system.	Yes (PS)

[1] Reed more about Sweden's environmental objectives at: http://www.swedishepa.se/Environmental-objectives-and-cooperation/Swedens-environmental-objectives/Environmental-objectives---a-film/

Polychlorinated naphtalenes (PCN)	70776-03-3	No ongoing use, prohibited in Sweden 2004. Historically used as insulating coatings for electrical wires, wood preservatives, as rubber and plastic additives, for capacitor dielectrics and in lubricants	
Other chemicals in alphabetical order			
Aldrin	309-00-2	Pesticide prohibited in Sweden 1970	Yes
Chlordane	57-74-9	Pesticide prohibited in Sweden 1971	
Clordecone	143-50-0	Pesticide never used in Sweden. Prohibited 2000.	
Dieldrin	60-57-1	Pesticide prohibited in Sweden 1970	Yes
Endosulfan	115-29-7 959-98-8 33213-65-9 1031-07-8	Insecticide prohibited 1997	Yes (PHS)
Endrin	72-20-8	Insecticide prohibited 1966	Yes
Heptachlor	76-44-8	Insecticide Prohibited 1978	Yes (PHS)
Hexabromobiphenyl (HBB)	36355-01-8	No ongoing use, prohibited in in the EU 2004. Historically used as flame retardant in electronic equipment, may still be imported in some articles.	
Hexa- and heptabromodiphenyl ether	68631-49-2 207122-15-4 446255-22-7 207122-16-5 and others	No ongoing use, prohibited in the EU 2004. Historically used as flame retardant, may still be imported in some articles.	Yes (PHS)
Hexachlorobenzene (HCB)	118-74-1	Fungicid prohibited in Sweden 1980	Yes (PHS)
Hexachlorocyclohexane (alpha-HCH)	319-84-6	Pesticide consituent in production of Lindane	Yes (PHS)
Hexachlorocyclohexane (beta-HCH)	319-85-7	Pesticide consituent in production of Lindane	Yes (PHS)
Lindane (gamma-HCH)	58-89-9	Pesticide prohibited in Sweden 1989	Yes (PHS)
Mirex	2385-85-5	Insecticid never used in Sweden. Prohibited in the EU 2004.	
Pentachlorobenzene (PeCB)	608-93-5	No ongoing use, prohibited in Sweden in 1985. Historically used as fungicide, flame retardant, chemical intermediate.	Yes (PHS)
Polychlorinated biphenyls (PCB)	all PCBs and their mixtures have different CAS numbers	No ongoing use, prohibited in Sweden in 1980s. Historically used as insulating fluids (transformer oil)	Yes (PHS) – twelve dioxin-like PCBs
Tetra- and pentabromodiphenyl ether	5436-43-1 60348-60-9 and others	No ongoing use, prohibited in the EU 2004. Historically used as flame retardant	Yes (PHS)
Toxaphene	8001-35-2	Insecticid prohibited in Sweden 2000.	
Annex B (restriction)	**CAS No**	**Use**	**Included in annex I to 2008/105/EC**
DDT	50-29-3	Insecticid prohibited in Sweden 1975	Yes
Perfluorooctane sulfonic acid (PFOS), it's salts and perfluorooctane sulfonyl fluoride	1763-23-1 307-35-7	Regulated with exemptions for some uses. Ongoing use of PFOS for hard chrome metal plating	Yes (PHS)

Annex C (unintentionally produced)	CAS No	Use	Included in annex I to 2008/105/EC
Polychlorinated dibenzo-p-dioxins (PCDD)	all PCDDs have different CAS numbers	Not applicable	Yes (PHS)
Polychlorinated dibenzofuranes (PCDF)	all PCDFs have different CAS numbers	Not applicable	Yes (PHS)
Polychlorinated biphenyls (PCB)	all PCBs and their mixtures have different CAS numbers	Not applicable	Yes (PHS) – twelve dioxin-like PCBs
Polychlorinated naphtalenes (PCN)	70776-03-3	Not applicable	
Pentachlorobenzene (PeCB)	608-93-5	Not applicable	Yes (PHS)
Hexachlorobenzene (HCB)	118-74-1	Not applicable	Yes (PHS)

New POPs in the Stockholm Convention

Below, the new chemicals included in the Stockholm Convention are described more in detail, together with an assessment for every chemical. Then the assessments for the other chemicals are concluded, divided in Annex A, B and C.

PENTACHLOROPHENOL (PCP)

PCP was banned in Sweden 1978 but had previously been used as a wood preservative. The substance was also used for control of slime growth in the pulp industry, for impregnation of textiles, and for treatment against moths and other insects.

The PCP used as wood preservative often ended up in outdoor constructions such as wooden fences, balconies and terraces that can serve for several decades before they end up as waste. Wood waste suspected to contain PCP could still arise from some construction and demolition activities, but the amounts are declining. It is estimated that no stockpiles or wastes of PCP remain in Sweden. As a precautionary measure the guideline is that preserved wood waste should be regarded as hazardous waste until the opposite has been shown.

Due to its broad spectra of previous use, PCP could be found in a wide range of contaminated sites, for example garden centers, pulp mills, wood impregnation sites and marinas. It has been identified that treatment of wood has occurred at approximately 1 200 sites in Sweden, according to what is registered in the national database today. At these sites PCP or similar chemicals have been used as impregnation agents. Almost half of the sites are classified with high or very high risk for negative impacts on human health or the environment. This means they are prioritized for further investigations and remediation. It is important to note that the risk classification could be explained by occurrences of other toxic substances than PCP, for example dioxins. This being said, when working with contaminated sites, PCP is considered to be a

constituent of potential concern and is evaluated and remediated to the extent assessed necessary at each individual site.

PCP is included in the annual monitoring of effluent water and sewage sludge at nine sewage treatment plants. PCP was below detection limit at all sewage treatment plants according to the last report with samples taken in 2015. PCP has been detected in air and deposition at industry areas, herring muscle and in serum from pregnant women.

Assessment

Even though PCP has been prohibited for almost 40 years, it still occurs in the environment. Swedish EPA will continue to monitor PCP. The guideline that preserved wood waste should be regarded as hazardous waste until the opposite has been shown remains valid. Most waste in Sweden that is not recycled end up in advanced solid waste incineration plants where the PCP is destructed, in accordance with the nomenclature and assessment in the Basel-guideline on POPs. Additional national actions are not foreseen.

HEXABROMOCYCLODODECANE (HBCDD)

HBCDD is a brominated flame retardant which has been extensively used across the EU within expanded polystyrene (EPS) and extruded polystyrene (XPS) insulation boarding used within roof and cavity wall insulation. It is also used for example in electrical goods, such as computer monitors, and for back-coating of textiles.

Imports of HBCDD to Sweden have declined sharply since 1997. In 2015, no HBCDD was imported as a pure substance but was found in the form of plastic raw material for manufacturing of EPS. HBCDD was not imported to Sweden 2016. E-waste plastics containing brominated flame retardants are most commonly incinerated in Sweden in high temperature incineration of hazardous waste. Recycling of plastics containing brominated flame retardants is not performed in Sweden and there is currently no demand for this kind of plastics by Swedish industry.

HBCDD is only occasionally detected in air and deposition at two out of three the sampling stations. In both serum and mother’s milk from first time mothers, HBCDD has decreased over time. HBCDD also shows a decreasing trend in herring from the Baltic Sea as well as the west coast for the years 2000-2014. The concentration of HBCDD is below EQSbiota for all species of fish at all sampling sites. In guillemot eggs, s significant decrease is seen during the last ten years.

Assessment

Monitoring data for HBCDD show decreasing time trends, the import of HBCDD has decreased and the production of products where HBCDD is used has been phased out. According to the Basel guidelines on Environmentally sound management of POPs-waste, HBCDD is destroyed in advanced solid waste incineration

plants which is the normal route for waste in Sweden. Sweden will continue to monitor HBCDD and further actions are not considered needed.

HEXACHLOROBUTADIEN (HCBD)

HCBD was historically used as solvent for other chlorine-containing compound.s No intentional use and production of hexachlorbutadien (HCBD) has occurred in Europe for many years. HCBD is mainly formed as an unintentional by-product during several industrial processes. The main source of leakage of the chemical is from old landfills sites.

Monitoring data show that HCBD has been found in air samples and in deposition has not been detected in surface water or any biotic matrices. It was concluded by the Swedish EPA in 2005 that HCBD is not an environmental problem in Sweden.

Assessment

HCBD is a prioritized substance within the Water Framework Directive and is recommended to monitor, especially in biota. Since HCBD cannot be found in biota from repeated sampling occasions in fish, nor surface water and sediment, the Swedish EPA has concluded not to continue to monitor HCBD. Further actions are not considered needed.

POLYCHLORINATED NAPHTHALENES (PCN)

All production, import and use of PCNs are prohibited by the POPs-regulation. PCNs were in the past produced as mixtures of several congeners. The main use was in the electrical industry, for example as separators in storage batteries. PCNs have also been used for impregnation of wood, paper and textiles to attain waterproof, flame resistance and protection against insects, moulds and fungi. Additionally, they were used as additives in gear and cutting oils, in lacquers and underwater paints and as raw material for dyes. Today, PCNs are formed mainly unintentionally during various thermal processes.

The historical use of PCNs in electrical equipment will be acknowledged when this equipment phases end of life through the special treatment requirements for waste electrical and electronic equipment. Although PCNs have been widely used in the past it is not a substance primarily associated with contaminated sites.

Concentrations of PCNs are expressed as the sum of 25-30 different congeners. PCNs were subjected for a screening study in 2010 and were detected in several matrixes as sludge from sewage treatment plants, in air from both background areas and point sources, in soil, leakage, herring muscle and in guillemot eggs. Time trends data from both herring and guillemot eggs show declining concentrations over time. PCNs have also been detected in mother’s milk from primiparous women from Uppsala.

Assessment

The use of PCNs is banned in Sweden since 2004 and waste still containing PCNs is required to be treated in an environmentally sound way. Monitoring data show declining levels in the environment. Further actions are not considered needed.

Assessment for other chemicals

Annex A

Pesticides

None of the pesticides included in Annex A have been produced in Sweden and all use and import are prohibited. The Swedish EPA will continue to monitor the pesticides that already are included in the monitoring programmes. Further actions are not considered needed.

For hexachlorobenzene (HCB), the levels in biota is generally decreasing since 1988 but the last ten years levels in fish and guillemot eggs have increased. The levels also seem to increase in marine sediments. The Swedish EPA will continue to monitor HCB and have also initiated further studies on sediment together with the Swedish Geological Survey.

Industrial chemicals

Brominated flame retardants (BFR) are generally entering Sweden incorporated in products and not as raw material, i.e. materials flame-retarded with BFRs are only to a minor extent manufactured in Sweden. Although polybrominated biphenyls (PBB, including hexabrominated biphenyl (HBB)) and polybrominated diphenyl ethers (PBDE, including pentaBDE and octaBDE) are prohibited in new electrical and electronic equipment they may still be present in e.g. electrical and electronic equipment and vehicles in use in Sweden. The Swedish EPA will continue to follow the development of waste treatment of PBDE-containing products at the end of their life.

For most PBDE-congeners levels decrease in the Swedish environment including biota. Dispite this, the levels in fish exceeds the biota EQS of 0.0085 ug/kg wet weight, referring to the sum of BDE- 28, -47, -99, -100, -153 and -154 and the chemical status of PBDE is considered “not good” on a national level. The Swedish EPA will continue to monitor the PBDEs.

Polychlorinated biphenyls (PCBs) are included in all environmental monitoring programmes run by the Swedish EPA that are relevant for the Stockholm Convention. Several actions have been conducted over the decades, and are still being performed regarding PCBs in electrical equipment and in sealants in buildings. Actions to ensure the elimination of PCB will continue in the future as well.

The Swedish EPA will also continue to monitor pentachlorobenzene (PeCB).

Annex B

Perfluorooctane sulfonic acid (PFOS) and per- and polyfluorinated alkylsubstances (PFASs) are widespread in the environment and are found in surface- and drinking water throughout Sweden. The highest levels have been found in the vicinity of firefighting practise areas. In areas with only atmospheric deposition the levels are generally very low. PFASs are found in groundwater but mainly in contaminated areas. Measured concentrations in the environment show that humans and the environment risk exposure to PFASs at levels that may cause adverse effects. Exposure occurs both through water and through fish. The Swedish EPA will continue to monitor PFOS and several PFASs. Several actions are being performed regarding PFASs.

The Swedish EPA will continue to monitor DDT. Further national actions are not considered needed.

Annex C

One of the most important problems related to POPs in Sweden today is that levels of dioxins and dioxin-like PCBs in fatty fish from the Baltic Sea and certain lakes are unacceptably high and constitute a risk to human health. Individuals who regularly consume these types of fish are at increased risk of exceeding the TDI. Furthermore, fish that exceed the maximum levels cannot be exported to other EU-countries. The levels in breast milk and fish from the Baltic Sea are decreasing but are not acceptable, and levels should therefore be further reduced. The rate of decline of dioxins in the environment has become less and less pronounced in many areas in recent years. In order to reach levels within a few decades that do not constitute a risk to human health, the rate of the decline needs to be dramatically increased.

Dioxin and dioxinlike PCBs

NEED FOR ACTION

Levels of dioxins and dioxin-like PCBs in human breast milk and in fatty fish from the Baltic Sea and the large lakes in Sweden are still unacceptably high and constitute a risk to human health. Dietary recommendations have been given for more than 30 years. Children, women and commercial- and recreational fishermen and their families are possible risk groups with high consumption of dioxin-contaminated fish. The exposure of breast-fed babies to dioxins and dioxin-like PCBs clearly exceeds the tolerable daily intake and the levels of compounds in human breast milk must be reduced. The average exposure to dioxin and dioxin-like PCBs from food among children and adults in Sweden is below the tolerable daily intake, but the margin is small. Individuals who regularly consume these types of fatty fish have an increased risk of exceeding the tolerable daily intake.

In the USA equivalent levels of maximum tolerable intake of dioxins per day has recently been substantially lowered by the US EPA due to new facts about the negative health effects of exposure to dioxins. The European Scientific Committee on Food is currently reviewing the same information and is shortly expected to also reduce the tolerable intake of dioxins for the EU. This will even further emphasize the need for enhanced national action in Sweden, to be able to reach levels of dioxin and dioxinlike PCBs where all fish are safe to eat, also for vulnerable groups.

The yearly decline in dioxin levels in the environment has stabilised around 5-7 % in the recent decade. In order to reach an acceptable situation within a decade or two, where dioxins and dioxin-like PCBs in the environment no longer constitute a risk to human health, very ambitious improvements need to be made.

STRATEGY

The objective of the strategy is to protect human health and the environment from dioxin and dioxin-like substances by decreasing human exposure via food intake, and by decreasing releases to the environment from diffuse, secondary and primary sources.

The Swedish EPA will initiate work together with other stakeholders with the ambition to reach low levels of dioxin and dioxin-like PCBs where all fish are safe to eat, also for vulnerable groups, by 2030 at the latest. These low and safe levels are anticipated to be in the range of one tenth compared to today's levels in fatty fish.

In order to reach such a situation within little over a decade, very ambitious actions need to be taken;

- National emissions of dioxins to air, as well as international emissions that affect Sweden, needs to be substantially reduced to a fraction compared with today's emissions. The current reduction rate of dioxin in fatty fish from the Baltic and some other lakes, 5-7 % each year, needs to be more than doubled.
- This reduction of emissions is especially important from sources that use different methods for incinerating waste (metal-scrap recycling, pure waste incineration, co-incineration of waste with other fuels, residential wood burning, landfill fires and other accidental or open fires),
- Relevant sources and exposure pathways need to be identified in much more detail, both for airborne emissions and for waterborne emissions like fiberrich sediments in the vicinity of older pulp- and paper industries. This is a necessity to be able to design precise policy actions.

PFOS and PFASs

NEED FOR ACTION

Enhanced levels of PFOS and per- and polyfluorinated alkylated substances (PFASs) in surface waters outside airports were first discovered in 2005. This has been confirmed by several studies and the usage of PFAS-containing Aqueous

Foam Forming Films (AFFF) during fire extinguishing was later shown to be the main source. Elevated levels in drinking water were discovered for the first time in 2011 in Botkyrka community and have thereafter been found at several places due to the use of PFAS containing AFFF used by the Swedish Armed Forces and Swedavia. Further compilation of existing and new data is needed to fully overview the situation and to evaluate further possible action.

STRATEGY

Since autumn 2014, the government agencies concerned with PFAS issues meet on a regular basis to coordinate activities and improve the dissemination of information to society.

A Swedish national action programme is under development with several authorities that participate in order to reduce use of PFAS and implement more knowledge and other measures. http://www.kemi.se/pfasguide. The Swedish Chemicals Agency initiated a declaration of intent signed by 37 authorities and research organizations to increase the cooperation to gain more knowledge and to reduce the use of PFAS. The Swedish Chemicals Agency is also dedicated to regulate PFASs within EU.

There are several ongoing actions in Sweden to reduce risks to human health and the environment and to increase knowledge of PFOS and PFAS. The actions aim to reduce human exposure through food and drinking water, restrict the use, release and distribution and enhanced national environmental monitoring. To reduce human exposure through food and drinking water, the National Food Agency (NFA) has a recommended action limit of 90 ng/L for sum of 11 PFAS based on the current EU tolerable daily intake for PFOS and for food the NFA developed a risk management for local authorities to use when high PFOS contamination of fish has been discovered. Examples to restrict the use, release and distribution are to improve knowledge about the use of and alternatives to PFAS and to strengthen regulatory guidance on PFASs. There is an existing proposal from the Swedish Chemical Agency on national legislation for PFASs in firefighting foam, including investigation on the need for notification of use of all types of firefighting foam. Actions for enhanced national environmental monitoring are screening of less well-known PFASs and analysis of total organic fluorine in several matrixes. The Swedish EPA also has an assignment from the Swedish government to further investigate all areas where firefighting foams could have been used.

PCB

NEED FOR ACTION

Despite the fact that Sweden has taken action against PCB spreading in the environment for over 40 years now, more actions are still needed and are carried out at a high priority. The Swedish ordinance (2007:19) on PCB sets the rules for handling PCB in closed applications such as equipment as well as in open applications such as building materials.

STRATEGY

It is likely that PCB can still be found in small electronic equipment. However, all electronic waste in Sweden is considered to be hazardous waste and is collected for further treatment at a hazardous waste treatment facility. Sealants and flooring materials will be a source of PCB wastes for a few more years. Estimations show there could be 20 – 50 tonnes PCB still to remove from buildings.

All equipment with PCB levels higher than 500 ppm was decontaminated before the end of 2010. Most equipment with levels 50-500 ppm has been decontaminated and the major part of equipment within the range 2-50 ppm has been decontaminated up until today. According to the Swedish ordinance, fluids containing more than 2 ppm PCB are considered being PCB-products. According to the ordinance PCB contaminated equipment has to be decontaminated immediately. An exemption can be granted in individual cases if there are specific reasons and if it does not contradict the requirements of the directive 96/59/EC. As a rule economic reasons are not considered sufficient for granting an exemption. In all cases where an exemption has been granted the equipment is expected to be decontaminated or disposed of within a certain time limit, normally a few years.

Materials in buildings and constructions containing PCB in levels higher than 500 ppm had to be remediated by 2014 or by 2016 depending on the type of building. PCB levels in the range of 50-500 ppm have to be decontaminated before rebuilding, renovation or demolition is conducted.

In addition to these national activities Sweden participates in international collaboration to assist countries to phase out PCB.

The Swedish monitoring programme

Environmental monitoring has been conducted in Sweden for more than quarter of a century. The monitoring covers all areas in the environment and for POPs, the marine monitoring, freshwater monitoring, urban monitoring and health related monitoring are all relevant. With the exception of the monitoring in agricultural areas, national environmental monitoring generally focuses on the state of the environment in ‘reference areas’, i.e. areas that are not appreciably affected by local disturbance. An accurate picture of Sweden as a whole therefore requires the addition of data from more significantly affected areas, obtained for example by monitoring of receiving bodies of air and water, monitoring of the effects of lake liming, and monitoring programmes for agriculture and forestry.

Samples from the following matrices are included in the monitoring programmes; air, deposition, sediment, biota from fresh- and marine waters, guillemot egg, surface water, human breast milk and blood. Most of these matrices are analysed for POPs annually. Samples from the following matrices are included in the monitoring programmes; air, deposition, sediment, biota from fresh- and marine waters, guillemot egg, surface water, human breast milk and blood. Most of these matrices

are analysed for POPs annually. Freshwater fish are sampled at 32 sites but analysed annually for POPs at nine of the sites. The rest is being analysed every second or third year. Off-shore sediment are sampled analysed every sixth year. All biological material is placed in a specimen bank. This material can if necessary be used to measure and perform retrospective analyses. For some matrices and substances, data from the late 60's are available.
The substances covered by the national monitoring programmes are shown in the table below. The programmes do not cover all the substances included in the Convention. Substances that have been excluded are e.g. banned for a number of years and others are known not to be found in Sweden.

Summary of relevant matrices and substances included in the Stockholm Convention that are measured within the national environmental monitoring programmes in Sweden.

Matrix	Sampling frequency	Substances included in the Stockholm Convention	Remarks
STP Sludge and effluent water	Annually at 9 STPs	HCB, PBDE, PCB, PCDD/F, PCP, PeCB, PFOS	Data available from 2004 for sludge for seven of the STPs
Fish fresh water	Annually at 32 sites	DDT, HBCDD, HCB, HCH, PBDE, PCB, PCDD/F, PFOS	Data for 1967 for some locations and substances
Fish and blue mussels, marine waters	Annually for fish 25 sites	DDT, HBCDD, HCB, HCH, PBDE, PCB, PCDD/F, PFOS	Data from 1972 for some locations
Guillemot eggs	Annually at 1 site	DDT, HBCDD, HCB, HCH, PBDE, PCB, PCDD/F, PFOS	Data available from 1969
Sediment, offshore marine waters	Every 6 years	chlordanes DDT, endosulfan, HBCDD, HCB, HCBD, HCH, PBDE, PCB, PCDD/F, PCP, PeCB,	First undertaken in 2003
Surface water	Annually at 4 sites with intensive agriculture	aldrin, chlorodanes, DDT, endosulfan, HCH, heptachloro, HCB	Data available from 2002
Long-range transport, air and deposition	Annually at 3 sites, every month	aldrin, chlordanes, DDT, endosulfan, HBCDD, HCB, HCH, heptachlor, PBDE, PCB, PCDD/F, PFOS	Data available from 1996
Human breast milk and serum	Breast milk sampling annually at 2 locations and serum at 1 location	chlordanes, DDT, HBCDD, PBDE, PCB, PCDD/F, PFOS	Breast milk data available from 1972. Serum from 1996

General obligations

In addition to control measures, the Stockholm Convention contains several general obligations. Each party must develop and endeavour to implement a national implementation plan, enable or implement exchange of information as well as promote and facilitate awareness and public access to information about POPs. The Parties shall furthermore promote appropriate research, development, control and cooperation regarding POPs and, where appropriate, their alternatives. As a Party, Sweden shall also regularly report the Conference of the Parties which measures have been taken to implement the Stockholm Convention. The effectiveness of the convention is monitored through environmental monitoring programmes and reporting of data. The Stockholm Convention takes account of the special needs of developing countries and countries with economies in transition, and therefore there are general conditions for technical assistance and financial resources.

Abbreviations and explanations

AFFF	aqueous foam forming film
AMAP	the Arctic Monitoring and Assessment Programme
ASWI	advanced solid waste incineration
BFR	brominated flame retardants
EFSA	European Food Safety Authority
EMEP	European Monitoring and - Evaluation Programme
E-PRTR	The European Pollutant Release and Transfer Register
EQS	environmental quality standards
HELCOM	Baltic Marine Environment Protection Commission/ Helsinki Commission
KemI	Swedish Chemicals Agency
CLRTAP	Convention on Long-Range Transboundary Air Pollution
NFA	National Food Agency
NIP	national implementation plan
OSPAR	Commission for the Protection of the Marine Environment of the North-East Atlantic / Oslo-Paris Convention
PBDE	polybrominated diphenyl ethers
PBT	persistent, bio-accumulating and toxic substances
PFASs	per- and polyfluorinated alkylated substances
PHS	priority hazardous substances
POPRC	Persistent Organic Pollutants Review Committee under the Stockholm Convention
POPs	persistent organic pollutants
PS	priority substances
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals

SAICM	Strategic Approach to International Chemicals Management
STP	sewage treatment plan
Swedish EPA	Swedish Environmental Protection Agency
WFD	Water Framework Directive
TDI	tolerable daily intake
TEQ	toxicity equivalent
UNEP	United Nations Environment Programme

1 Introduction

1.1 Background

Persistent organic pollutants (POPs) are chemical substances that persist in the environment, bio-accumulate, and pose a risk of causing adverse effects on human health and/or the environment. These pollutants are transported across international boundaries far away from their sources, even to regions where they have never been used or produced. The Baltic regions are examples of sinks of POPs within the EU. Given the long-range transport through air, water and products, international action is necessary to reduce and eliminate production, use and release of POPs. The Stockholm Convention on POPs was formally adopted in 2001 with the objective to protect human health and the environment from POPs.

The Convention entered into force in 2004 and requires Parties to take measures to eliminate or reduce the release of POPs into the environment. Specific reference is made to a precautionary approach as set forth in Principle 15 of the 1992 Rio Declaration on Environment and Development. Parties are required to review and update their national implementation plan (NIP) specified by a decision of the Conference of the Parties (SC 1/12). Among others the guidance identifies changes in the obligation arising from amendments to the Convention or its annexes, including the addition of chemicals to Annexes A, B or C as an external factor that triggers the need for a Party to review and update its NIP.

The Convention include POP substances in Annex A, B and C. For chemicals listed under Annex A, Parties must take measures to eliminate the production and use. Specific exemptions for use or production only apply to Parties that have registered for them. For chemicals listed under Annex B, parties must take measures to restrict the production and use in light of any applicable acceptable purposes and/or specific exemptions listed in the Annex. Regarding chemicals listed under Annex C, Parties must take measures to reduce the unintentional releases of chemicals with the goal of continuing minimization and, where feasible, ultimate elimination.

The initial clusters of 12 POP substances have been significantly increased since 2001. At present 28 substances, or groups of substances, are covered by the Convention. The Annexes A, B and C to the Convention have been amended five times, see Annex III List of POPs for an updated overview and amendments to the Convention. During the Conference of the Parties held in 2013 and 2015, it was agreed to add four additional substances to the Annexes of the Convention. The three industrial chemicals hexabromocyclododecane (HBCDD), hexachlorobutadiene (HCBD) and polychlorinated napthalenes (PCNs), and the pesticide pentachlorophenol (PCP). HBCDD, HCBD and PCP were added to Annex A, and PCN was

added to both Annex A and Annex C. These additions entered into force in 27 November 2014 for HBCDD and in 16 December 2016 for the others. In total, four new substances are included in the updated national implementation plan 2017.

1.2 Purpose

According to the Stockholm Convention on Persistent Organic Pollutants, each Party to the Convention is to develop and endeavour to implement a plan for the implementation of its obligations under the Convention.

The Swedish national implementation plan, the third in the scheme, aims at describing what Sweden has done and intends to do to fulfil the obligations of the Stockholm Convention. The plan describes the situation in Sweden for persistent organic pollutants, identifies on going actions and presents strategies for future work. The plan contains updates in accordance with the decisions taken at the Conferences of the Parties in 2013 and 2015 regarding the addition of four chemicals to the Convention.

1.3 Implementation

In the beginning of 2016, the Swedish Government commissioned the Swedish Environmental Protection Agency (Swedish EPA) to review and update the national implementation plan and report back by 30 November 2017. In accordance with the commission, the update was done in cooperation with the Swedish Chemicals Agency and Swedish Agency for Marine and Water Management.

In preparing this report the three agencies have consulted several other Swedish agencies. For more information on the responsibilities of ministries and government agencies in Sweden, see Annex 1.

This plan is an update of the NIP from 2012 and the updated NIP from 2014. In this NIP, the four substances added to the Convention in 2013 and 2015 are included: HBCDD, HCBD, PCP and PCNs. The update of the NIP made in 2014 to include endosulfan was prepared in a separate report (Swedish Chemicals Agency, 2014). The update on endosulfan is incorporated in this plan. Thus, this NIP includes all POPs listed up to the meeting of the Parties in 2015. The updated NIP is to be submitted to the Secretariat of the Stockholm Convention on POPs (Stockholm Convention), to which Sweden has been a party since 2002.

1.4 Rules and monitoring addressing POPs

As Party to the Stockholm Convention, Sweden is required to ban and/or take the necessary legal and administrative steps to eliminate the production, use, import and export of the listed POPs, eliminate or reduce releases of POPs into the environment, and ensure safe management of stockpiles containing or consisting of POPs. Waste containing, consisting of, or contaminated with POPs, must also be

disposed of in such a way that the POPs content is destroyed, or irreversibly transformed so that it does not exhibit POPs characteristics.

Sweden is also party to the 1979 UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP) and its Protocol on POPs. The convention and its protocol regulate the limitation, reduction and prevention of air pollution, including long-range transboundary air pollution. The objective is to eliminate any discharges, emissions and losses of certain POPs substances.

All provisions on POPs are contained in the Regulation (EC) No 850/2004 of the European Parliament and of the Council of 29 April 2004 on persistent organic pollutants (the POPs Regulation) and directly applicable in all EU Member States. The Stockholm Convention and the CLRTAP are both transposed into EU law through the POPs regulation. The only gap identified in the EU legislation is the obligation to prohibit production and export of PCP. Production is however prohibited for a volume above 100 tonnes per year under Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC. It is expected to be prohibited for a volume above 1 ton as of 31 May 2018, unless a registration has been submitted by that date. Export is controlled under Regulation (EU) No 649/2012 of the European Parliament and of the Council of 4 July 2012 concerning the export and import of hazardous chemicals, and subject to the prior informed consent procedure under the Rotterdam Convention.

In Sweden the Swedish Environmental Code provides for the enforcement of the POPs Regulation. The Code entered into force on the 1 of January 1999. More detailed provisions have been laid down in government ordinances. The POPs regulation and other relevant EU legislation have been incorporated into the Code and its ordinances. Chapter 14 of the Code and the adjacent legislation have changed considerably during the past five years due to the adoption of the REACH, the Regulation (ECU) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC and the Regulation (EC) no 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (the CLP-Regulation).

Chapter 5 of the Code and adjacent legislation implements the Water Framework Directive (WFD) and its daughter directive on priority substances (2008/105/EC). The latter was recently revised by the 2013/39 /EU directive, adding e.g. PFOS and

dioxin- and dioxinlike compounds to Annex X of the WFD. The Annex X substances of the WFD are divided into priority hazardous substances (PHS) and priority substances (PS), see Table 1, Table 2 and Table 3. According to article 4 of the WFD, member states shall implement necessary measures with the aim to progressively reduce pollution from PS and ceasing or phasing out emissions, discharges and losses of PHS. Some environmental quality standards (EQSs) were also revised and several EQSs expressed for biota were added to Annex I to 2008/105/EC.

The pursuit of the convention is similar to that of Sweden's environmental quality objective "A Non-Toxic Environment". This includes enhancing knowledge and information about chemical substances, phasing out substances of particular concern such as POPs, and reducing the risks posed by the use of other chemicals.[2]

Sweden has an established environmental monitoring programme that has been conducted for a quarter of a century. The monitoring covers all areas in the environment and for POPs the marine monitoring, freshwater monitoring, urban monitoring and health related monitoring are relevant. Samples from following matrices are included in the monitoring programmes; sludge and effluent water from sewage treatment plants (STPs), air, deposition, sediment, biota from fresh- and marine waters, guillemot egg, surface water, human breast milk and blood. All matrices, besides fresh water fish, are sampled annually, and most of these samples are analysed for POPs annually. The environmental monitoring is described in chapter 4 were also the substances included in the Convention are shown.

[2] Reed more about Sweden's environmental objectives at: http://www.swedishepa.se/Environmental-objectives-and-cooperation/Swedens-environmental-objectives/Environmental-objectives---a-film/

2 POPs in Sweden

The following chapter describes the situation in Sweden for the different POP substances. The chapter is based on Annex A, B and C chemicals from the Stockholm Convention. For each chemical, the sections describe use, import and export, stockpiles, waste and contaminated sites, occurrence and emissions to the environment and finishes with an assessment. Each section also includes a table containing the different chemicals in the respective annexes up to 2015.

2.1 Overview of Annex A chemicals

For chemicals listed under Annex A, Parties must take measures to eliminate the production and use. Specific exemptions for use or production only apply to Parties that have registered for them. Import and export of the intentionally produced POPs listed in Annex A or B are severely restricted by the Stockholm Convention. After all the substance specific exemptions have expired, import and export is allowed only for the purpose of environmentally sound disposal of the waste under restricted conditions. The generic exemptions allowed in the convention are laboratory-scale research, use as a reference standard and unintentional trace contaminants in products and articles. For an overview of substances listed in Annex A up to 2015, see Table 1.

Table 1. Chemicals included in Annex A up to 2015, CAS No, use and whether the substance is included in Annex 1 of the directive on priority substances (2008/105/EG) and in Annex X of the Water Directive (2000/60EC) as a priority substance (PS) or priority hazardous substance (PHS).

Annex A (elimination)	CAS No	Use	Included in Annex I to 2008/105/EG
Added substances in NIP 2017			
Hexabromocyclododecane (HBCDD)	25637-99-4 3194-55-6	Time limited ongoing use as flame retardant in expanded polystyrene and extruded polystyrene.	Yes (PHS)
Hexachlorobutadiene (HCBD)	87-68-3	No ongoing use, prohibited in the EU 2004. Historically used as solvent for other chlorine-containing compounds	Yes (PHS)
Pentachlorophenol (PCP) sodium pentachlorophenate as monohydrate pentachlorophenyl laurate pentachloroanisole	87-86-5 131-52-2 27735-64-4 3772-94-9 1825-21-4	No ongoing use, prohibited in Sweden 1978. Historically used as herbicide, insecticide, fungicide, algaecide, disinfectant and as an ingredient in antifouling paint. Some applications were in agricultural seeds, leather, wood preservation, cooling tower water, rope and paper mill system.	Yes (PS)
Polychlorinated naphtalenes (PCN)	PCNs and their mixtures have different CAS no	No ongoing use, prohibited in Sweden 2004. Historically used as insulating coatings for electrical wires, wood preservatives, as rubber and plastic additives, for capacitor dielectrics and in lubricants	
Other substances in alphabetical order			
Aldrin	309-00-2	Pesticide prohibited in Sweden 1970	Yes
Chlordane	57-74-9	Pesticide prohibited in Sweden 1971	
Clordecone	143-50-0	Pesticide never used in Sweden. Prohibited 2000.	
Dieldrin	60-57-1	Pesticide prohibited in Sweden 1970	Yes
Endosulfan	115-29-7 959-98-8 33213-65-9 1031-07-8	Insecticide prohibited 1997	Yes (PHS)
Endrin	72-20-8	Insecticide prohibited 1966	Yes
Heptachlor	76-44-8	Insecticide Prohibited 1978	Yes (PHS)
Hexabromobiphenyl (HBB)	36355-01-8	No ongoing use, prohibited in in the EU 2004. Historically used as flame retardant in electronic equipment, may still be imported in some articles.	
Hexa- and heptabromodiphenyl ether	68631-49-2 207122-15-4 446255-22-7 207122-16-5 and others	No ongoing use, prohibited in the EU 2004. Historically used as flame retardant, may still be imported in some articles.	Yes (PHS)
Hexachlorobenzene (HCB)	118-74-1	Fungicid prohibited in Sweden 1980	Yes (PHS)
Hexachlorocyclohexane (alpha-HCH)	319-84-6	Pesticide consituent in production of Lindane	Yes (PHS)
Hexachlorocyclohexane (beta-HCH)	319-85-7	Pesticide consituent in production of Lindane	Yes (PHS)
Lindane	58-89-9	Pesticide prohibited in Sweden 1989	Yes (PHS)

Mirex	2385-85-5	Insecticid never used in Sweden. Prohibited in the EU 2004.	
Pentachlorobenzene (PeCB)	608-93-5	No ongoing use, prohibited in Sweden in 1985. Historically used as fungicide, flame retardant, chemical intermediate.	Yes (PHS)
Polychlorinated biphenyls (PCB)	all PCBs and their mixtures have different CAS numbers	No ongoing use, prohibited in Sweden in 1980s. Historically used as insulating fluids (transformer oil)	Yes (PHS) – twelve dioxinlike PCBs
Tetra- and pentabromodiphenyl ether	5436-43-1 60348-60-9 and others	No ongoing use, prohibited in the EU 2004. Historically used as flame retardant	Yes (PHS)
Toxaphene	8001-35-2	Insecticid prohibited in Sweden 2000.	

2.1.1 Pesticides

None of the listed pesticides have been produced in Sweden. All use and import are prohibited.[3]

2.1.1.1 PENTACHLOROPHENOL (NEW)

During the Conference of the Parties (COP-7) held in May 2015 it was agreed to add the pesticide pentachlorophenol (PCP) and its salts to Annex A.

Use, import and export

PCP was banned in Sweden 1978 but had previously been used as a wood preservative. The substance was also used for control of slime growth in the pulp industry, for impregnation of textiles, and for treatment against moths and other insects (Swedish EPA 2014a). Between 1956 and 1978, about 640 tons of PCP was used in Sweden for pressure treatment of wood products (approx. 800 000 m^3), 1000-1500 tons by dipping the freshly sawn wood, about 200 tons in do-it-yourself products and 15 tons in the sanitation sector (Swedish EPA 2009).

Stockpiles, waste and contaminated sites

The PCP used as wood preservative often ended up in outdoor constructions such as wooden fences, balconies and terraces that can serve for several decades before they end up as waste. Wood waste suspected to contain PCP could still arise from some construction and demolition activities, but since the assumed lifetime for PCP treated wood is 15-30 years, the amount of waste would be low and declining. It is estimated that no stockpiles or wastes of PCP remain in Sweden. As a precautionary measure the guideline is that preserved wood waste should be regarded as hazardous waste until the opposite has been shown.

[3] Import is regarded as placing on the market in the EU and thus import of all Annex A and B chemicals is prohibited with some exceptions mainly for laboratory-scale research or as a reference standard and as unintentional trace contaminant in substances, preparations or articles.

According to the latest version of the Basel Technical Guidelines for sound management of POP-wastes, PCP is efficiently destructed (at least 99,9 %) in advanced solid waste incineration (ASWI).

Due to its broad spectra of previous use, PCP could be found in a wide range of contaminated sites, for example garden centers, pulp mills, wood impregnation sites and marinas. It has been identified that treatment of wood has occurred at approximately 1 200 sites in Sweden, according to what is registered in the national database in October 2017 (EBH-stödet 2017). At these sites PCP or similar chemicals have been used as impregnation agents. Of the sites, half of them are classified with high or very high risk for negative impacts on human health or the environment. This means they are prioritized for further investigations and remediation. It is important to note that the risk classification could be explained by occurrences of other toxic substances than PCP, for example dioxins (SGU 2016). PCP is not specifically registered in the database for contaminated sites, other than that it is included in the category of chlorinated aromatic compounds. This being said, when working with contaminated sites, PCP is considered to be a constituent of potential concern and is evaluated and remediated to the extent assessed necessary at each individual site.

Occurrence in the environment

PCP is included in the annual monitoring of effluent water and sewage sludge at nine sewage treatment plants (STPs). PCP was below detection limit at all STPs in both effluent water (< 0.01 ug/L) and sludge (< 0.05 mg/kg TS) in 2015 (Haglund 2017). A screening study regarding PCP was performed in 2001 and PCP was detected in air and deposition at industry areas, but not at background areas (www.ivl.se). Also herring muscle was examined and PCP was found in levels between 3.0 and 7.3 ng/g w.w. One study reports on PCP in serum from pregnant women from the Uppsala region with concentrations in the range 0.2-19 ng/g w.w. (Larsdotter et al. 2005).

Assessment

PCP is prohibited in Sweden since 1978. Swedish EPA will continue to monitor PCP. The guideline that preserved wood waste should be regarded as hazardous waste until the opposite has been shown remains valid. Most waste in Sweden that is not recycled end up in advanced solid waste incineration plants where the PCP is destructed, in accordance with the nomenclature and assessment in the Basel-guideline on POPs. Additional national actions are not foreseen.

2.1.1.2 ENDOSULFAN

At the fifth Conference of the Parties in May 2011, it was decided to include endosulfan, its related isomers and endosulfan sulfate in Annex A, as recommended by the POPs Review Committee (POPRC). Specific exemptions were agreed for

crop-pest complexes as listed in part VI of Annex A. Production is allowed to continue for parties listed in a register. The amendment entered into force on 27 October 2012.

Use, import and export

Endosulfan is an insecticide which occurs as two isomers, alpha and beta endosulfan, both of which are biologically active. There has been no manufacture of endosulfan in Sweden. Its production in the EU stopped in 2006/2007. Historic production in Europe amounted to 10.000 to 50.000 tonnes per year.

In Sweden endosulfan was used since the 1970s but has not been approved as a plant protection product since 1995. According to the Swedish pesticide register, the later uses of endosulfan were mainly in fruit farming and in green houses. During the period 1990 to 1995 the imported amount was about 2 tonnes of active substance. A complete ban of its use was decided in December 1997.

The export of endosulfan from the EU is banned since January 2013 when it was added to part 1 of the annex V in the Regulation (EC) 689/2008 on Export and import of dangerous chemicals.

Stockpiles, waste and contaminated sites

Due to the early phase-out of endosulfan and the capacity for incineration of hazardous waste, it is estimated that no stockpiles or wastes of endosulfan remain in Sweden. Concerning management of stockpiles, the POPs Regulation provides that all remaining stockpiles for which no use is permitted shall be managed as hazardous waste. If stockpiles are found the costs should be borne by the "polluter-pays" principles as laid down in the Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (Waste Framework Directive).
Endosulfan is not specifically registered in the database for contaminated sites. However endosulfan is considered to be a constituent of potential concern when working with contaminated sites, at a site by site basis.

A recent study carried out on former market gardens, indicate that endosulfan only to a limited extent occurs as a constituent of potential concerns at market gardens (SGI 2017). Endosulfan was only identified at 7 out of 101 sites included in the study. The occurrence of endosulfan-sulphate has been shown at a similar frequency, at corresponding levels to the original product.

Occurrence in the environment

α-Endosulfan, β-endosulfan and endosulfan-sulphate have been measured in air and deposition at the sampling stations Råö and Pallas since 2009. The temporal trends indicate decreasing concentrations for endosulfan in both air and deposition (Sjöberg et al 2016).

At a screening performed in 2004, endosulfan was below detection limit in biota and sediment, but endosulfan-sulphate was detected in sediment and in one sample of biota (Cousins et al 2005). In surface water, the detection frequency for endosulfan is 3.8 % for samples with concentrations > 0.1 µg/L for the time period 2002-2014 (Boström 2015).

Endosulfan and its related isomers has been found twice since 2010 in surveillance samples of fruit and vegetables in the Swedish National Food Agency's control programme for pesticide residues. Both times in vegetables imported from outside of the EU (Livsmedelsverket, 2013 and 2014).

Assessment

The Swedish EPA and the Swedish National Food Agency will continue to monitor endosulfan in the environment and in food. Further national actions are not considered needed.

2.1.1.3 PESTICIDES LISTED IN 2009 AND 2001

Use, import and export

With regard to the pesticides listed in 2009, chlordecone, was banned in 1978 and gamma hexachlorocyclohexane (*γ*-HCH) or lindane was banned in 1989. Lindane was previously used as an insecticide in pharmaceutical products against lice and scabies. Pentachlorobenzene (PeCB) was originally used in the production of pesticides, one of them being quintozene, in which it occurs as an impurity. The use of quintozene is prohibited in Sweden since 1985 and within EU since 2000.

With regard to the "old" pesticides listed in 2001, endrin was banned in 1966, followed by aldrin and dieldrin in 1970 and chlordane in 1971. The use of DDT in Sweden was banned in 1969. Heptachlor and toxaphene had never been used as pesticides in Sweden but were banned as active ingredients in pesticides through an administrative decision with effect from year 2000. Mirex has never been used in Sweden and was banned in 2004 through the EC Regulation on POPs (850/2004).

Stockpiles, waste and contaminated sites

It is estimated that no stockpiles or wastes of these pesticides remain in Sweden. Individual pesticides are not specifically registered in the database for contaminated sites. The pesticides, however, are taken into consideration as constituents of potential concern when evaluating a site, if it has been identified that the chemicals has been used as part of the operations. Pesticides are generally associated with former market gardens or greenhouses. Due to the extensive use of chemicals in this type of businesses, it has been specifically identified a business of potential concern in the database of contaminated sites. There are more than 2 700 sites where market gardens could have used pesticides, plus an additional 900 market gardens where the risk for use of pesticide is considered low (EBH-stödet 2017). Most of

the sites are estimated to have high risk or very high risk according to the national risk classification system.

A recent study carried out on former market gardens has focused on the occurrence of different types of pesticides specifically at market gardens (SGI 2017). The study showed that quintozene (and pentachloroaniline), aldrin and dieldrin and HCB are among the most frequently occurring pesticides in soil at former market gardens. 101 sites were investigated and these pesticides were found at several sites. The occurrence of the other pesticides listed in this section is limited and only found at few sites.

Occurrence in the environment

A compilation of the occurrence of pesticides in surface waters 1983-2014 was performed in 2015 (Boström 2015). Aldrin, chlordane, dieldrin, endrin, α-, β-HCH, heptachlor, PeCB are included. All of them were below 0.1 µg/L, the threshold value for drinking water (The Swedish National Food Agency). For lindane, the detection frequency above this limit was 0.7% between 2002 and 2014. Aldrin and heptachlor are measured annually in air and deposition but very seldom detected (Sjöberg et al 2016).

Both α-HCH and lindane show decreasing temporal trends since 1996 (6-7% per year until 2011) in air at the background stations Råö, Aspvreten and Pallas (Sjöberg et al 2016). In mother's milk from first time mothers from Uppsala, the concentrations of *β*-HCH are decreasing with 10% per year during 1996-2016 (Gyllenhammar et al 2017a). The same trend is seen in mothers from Stockholm sampled 1972-2014 and Gothenburg, sampled 2008-2015 (Nyberg et al 2017). Also in herring muscle and in guillemot eggs, temporal trend monitoring shows significant decreasing trends of HCH isomers over time (Bignert et al 2016).When assessing the *α*-HCH and lindane individually, all herring, cod, and perch time series are below the suggested target level of 0.0026 µg/g wet weight (based on The Swedish Environmental Research Institute conversion of the EQS for surface water to biota.)

Chlordanes have been measured in air and deposition since 1996 and the trend in air is decreasing (Sjöberg et al 2016). In deposition the concentrations are low or non-detectable. Oxychlordane and *trans*-Nonachlor are decreasing with 6% per year in mother's milk from first time mothers sampled during 1996-2016 (Gyllenhammar et al 2017a). Chlorodanes have also been found in human serum and adipose (Jogsten et al 2010, Bjermo et al 2013).

Mirex was included in a screening in 2004 (Cousins et al 2005) but was below limit of detection in all samples, i.e. air, deposition, biota and sludge.

Few studies have been performed regarding toxaphen, but it has been detected in blue mussel and cod liver with concentrations of 4.1 ug/g w.w. and 21 mg/kg d.w.,

respectively (www.ivl.se). In human adipose, toxaphenes could be detected in all samples and the concentrations were 0.82-17 ng/g l.w. (Ericson et al 2008, Jogsten et al 2010).

Chlordecone has not been subject for any screening studies and is not included in the monitoring programmes, i.e. no environmental data exist for this compound.

None of the newly added pesticides are used today in Sweden. This is one reason why there is not much data available concerning these substances.

Assessment

The Swedish EPA will continue to monitor the pesticides that already are included in the monitoring programmes (see Table 4). Further actions are not considered needed.

2.1.1.4 HEXACHLOROBENZENE

Use, import and export

Hexachlorobenzene (HCB) was historically used as a pesticide and was banned in 1980. It was listed in the Stockholm Convention in 2001. All use or import of HCB in articles is prohibited by the POPs-regulation. However, during market surveillance activities in 2010 and 2011 HCB was found in fireworks available on the Swedish market. New samples were taken in December 2015 when fireworks from ten importing companies were analysed. Illegal levels of HCB were detected in one of 18 analysed samples. The Swedish Chemicals Agency ensured no further selling of these fireworks, and the company has informed the Swedish Chemicals Agency that the product was destroyed.

In 2016, 0.4 kg of HCB was reported to the Swedish Chemicals Agency's Product Register in products used in the plastic industry. According to information from the company this amount should be considered as unintentional trace contaminants.

Occurrence in the environment

HCB are frequently detected in air, deposition and sludge (Sjöberg et al 2016) but have not been detected in surface water (Boström 2015).
There are also several reports of HCB in human serum, mother's milk and adipose (Jogsten et al 2010, Bergman et al 2010, Bjermo et al 2013, Salihovic et al 2016). Temporal trends in mother's milk from first time mothers from Uppsala, sampled 1996-2016, show a decreasing trend of 4.9% per year (Gyllenhammar et al 2017a). Also a decreasing trend (-7.2%) is seen in mothers from Stockholm sampled 1972-2014 (Nyberg et al 2017).

The concentrations of HCB in herring from several sites from the marine monitoring programme shows decreasing trends for 1987-2014 (Bignert et al 2016). How-

ever, when looking at time trends for more recent years, 2005-2014, it shows instead increasing concentrations. Even though, in all areas and species, except cod from Southeast of Gotland, HCB concentration is below the target level based on the EQSbiota 0.01 µg/g w. w. The same trend is seen for guillemot eggs, with decreasing trends for the whole time period 1988-2014, but slightly increasing trends if only looking from the year 2005 and forward. Generally, since 1988, the concentrations of HCB in herring, cod, and guillemot egg have decreased at a rate of about 5–10% per year from the Baltic Proper.

The concentrations of most of the presented organic substances in off-shore marine sediments have declined since 2008 (Apler and Josefsson, 2016). The levels of HCB on the other hand increase at almost all of the offshore stations. However, it is important to stress that no statistical analyses have been carried out to establish the statistical significance of the variations between years. As a result of these observations the Swedish EPA has initiated a project with the Swedish Geological Survey performing 1) statistical analysis of time trends of HCB in marine sediments as well 2) describing differences in HCB concentrations in sediments close to the coast compared to offshore sediment (samples from 1986-today). Data from other countries will also be used. A discussion on possible sources will be included. The results are expected December 2017 (1) and February 2018 (2).

Assessment
Swedish EPA will continue to monitor HCB in the different monitoring programmes (Table 4). Further actions are currently not considered needed.

2.1.2 Industrial chemicals

During the Conference of the Parties (COP-7) held in May 2015, two additional industrial chemicals were added to the Annexes of the Convention. Following the details of UNEP/POPS/COP.7/15, which was further orally amended during the meeting, it was agreed to add hexachlorobutadiene (HCBD) to Annex A, and polychlorinated napthalenes (PCNs) to Annex A and Annex C. This in part recognises unintentional sources of PCNs to environment, largely related to di-electric equipment. These additions entered into force in 2016.

HCBD was together with PCNs and short-chained chlorinated paraffins (SCCPs) listed in the POP Protocol at the 27th meeting of the Executive Body of LRTAP Convention held in December 2009, and was following this included in the POPs-regulation by Regulation (EU) 519/2012.

Hexabromocyclododecane (HBCDD) was added to Annex A of the Convention at COP-6 in 2013 with entry into force in November 2014. Since the process within the EU to regulate HBCDD was having a later time plan than the one of the Convention the EU requested an Opt-out as possible by Article 22(3)(b). HBCDD was regulated within the EU in April 2016.

The addition of HBCDD to the Stockholm Convention included a time limited specific exemption to allow the continued production and use of HBCDD for the production and use in expandedpolystyrene (EPS) and extruded polystyrene (XPS) in buildings. Each Party that has registered for the exemption shall take necessary measures to ensure that expanded polystyrene and extruded polystyrene containing HBCDD can be easily identified by labelling or other means throughout its life cycle. The POPs regulation includes the exemption on EPS but does not allow use in XPS. Additionally, the POPs-regulation, as amended 30 March 2016, lists maximum concentration of HBCDD in waste.

2.1.2.1 BROMINATED FLAME RETARDENTS (HBCDD (NEW), PBDE AND HBB)

Use, import and export

Brominated flame retardants (BFR) are generally entering Sweden incorporated in products and not as raw material, i.e. materials flame-retarded with BFRs are only to a minor extent manufactured in Sweden.

HBCDD is a brominated flame retardant which has been extensively used across the EU within EPS and XPS insulation boarding used within roof and cavity wall insulation. HBCDD also has a more limited application (around 1% of total HBCDD use) as a flame retardant for use in high impact polystyrene (HIPS) used for mouldings and housings of electrical goods such as computer monitors and CRT based televisions. Another use has been for back-coating of textiles.

Imports of HBCDD to Sweden declined sharply from about 120 tonnes in 1997. No HBCDD was imported into Sweden as a pure substance, there is thus no use (mixing / processing) of the pure substance in Sweden. In 2015, 263 kg of HBCDD was imported in the form of plastic raw material for manufacturing of expanded polystyrene (EPS). According to information from the company, this product has been phased out during 2016 and no import was reported for 2016.

Although polybrominated biphenyls (PBB, including hexabromianted biphenyl (HBB)) and polybrominated diphenyl ethers (PBDE, including pentaBDE and octaBDE) are prohibited in new electrical and electronic equipment they may still be present in e.g. electrical and electronic equipment and vehicles in use in Sweden.

Stockpiles, waste and contaminated sites

E-waste plastics containing brominated flame retardants are most commonly incinerated in Sweden in high temperature incineration of hazardous waste. Recycling of plastics containing brominated flame retardants is not performed in Sweden and there is currently no demand for this kind of plastics by Swedish industry. The Swedish Recycling Industries' Association has made a statement that BFR-

containing plastics must be phased out and not recycled. Since BFRs are still present in e.g. electrical and electronic equipment and vehicles in use in Sweden, the substances will be relevant in these future waste streams.

Sweden has two major facilities for shredding and recycling of metals from electrical and electronic equipment, located in Skellefteå. High levels of PBDE have been found in sediments and in fish caught in the sea next to Skellefteå[4]. One of the facilities has in their environmental permit an obligation to investigate possible measures to reduce diffuse emissions of metals and POPs, including brominated flame retardants.

Other than this site, there are no individual contaminated sites where brominated flame retardants are of great concern known so far. The greatest source of brominated flame retardants are believed to be landfills although contamination also may be expected close to textile- and plastic industries and possibly manufacture sites for electronic equipment.

HBCDD is not associated with any specific industry or location and is more known to be a substance that has diffuse leakage. Besides fabrics HBCDD could be found in furniture, electronics and there is a small leakage from a wide range of sources. There are no known locations of HBCDD contamination or registered in the Swedish database for contaminated soils.

Occurrence in the environment

Leakage of brominated flame retardants to the environment occurs from production and use of products, and long-range transport via air borne particles.

HBCDD is only occasionally detected in air and deposition at the sampling stations Råö and Pallas (2009-2015) and has not been detected at Pallas (Sjöberg et al 2016). In both serum and mother's milk from first time mothers, HBCDD has decreased over time. In serum the decrease is 4.1% per year since 1996 (Gyllenhammar et al 2016a) and in milk the decrease is 2.0 (Gyllenhammar et al 2017a). In mother's milk from Stockholm and Gothenburg, no significant trends can be seen over the years (Nyberg et al 2017).

HBCDD also shows a decreasing trend in herring from the Baltic Sea as well as the west coast for the years 2000-2014 (Bignert et al 2016). The concentration of HBCDD is below EQSbiota (167 µg/kg w.w.) for all species of fish at all sampling sites. In guillemot eggs, the concentration of HBCDD is increasing about 1.8% per year for the whole time period 1969-2014. However, during the last ten years a significant decrease of 7.3% per year is seen (Bignert et al 2016).

[4] http://www.markochmiljooverdomstolen.se/Domstolar/markochmiljooverdomstolen/Avg%C3%B6randen/M%207429-13.pdf

For PBDEs (BDE-47, 99, 100) the levels in air and deposition have decreased since the monitoring programme started at the three sampling stations included in the monitoring programme (Sjöberg et al 2016). BDE-47, -99, -100, -153 and -154 are measured annually in sludge at nine STPs. In 2014 the concentration range was 0.30-18 µg/kg TS for individual congeners. Temporal trends for BDE-47 and BDE-99 show decreasing trends over the time period 2004-2015 at all STPs (Haglund 2017).

Serum from first time mothers from Uppsala show significant decreasing trends in concentrations for BDE-47, BDE-99 and BDE-100, 6-11% per year from 1996 to 2015, while the concentrations for BDE-153 show an increasing trend of +2% per year (Gyllenhammar et al 2016a). In mothers milk the levels of BDE-47, BDE-99 and BDE-100 show decreasing trends of 5.6-12% per year. For BDE-153 the decrease is 0.1% per year (Gyllenhammar et al 2017a). The concentrations of BDE-47, BDE-99 and BDE-100 in human milk from Gothenburg decreased significantly during 2007-2015 (Nyberg et al 2017). No trends were observed in the milk from Stockholm, which could be due to a change in analytical laboratory in 2010. Restrictions in the production and use of these compounds were initiated in the 1990s, and this is probably reflected in the more pronounced decline in mother's milk concentrations in recent years.

Looking at three sampling stations for herring from the marine monitoring programme, i.e. Ängskärsklubb, Harufjärden and Landsort, the concentrations of BDE-47, BDE-99 and BDE 153 show decreasing trends the last decades (Bignert et al 2016). However, BDE-153 has since 2005 started to increase at Harufjärden (+0.84% per year) and Ängskärsklubb (+14% per year). In guillemot eggs, the concentration trends are decreasing for BDE-47, BDE-99 and BDE 153 for the time period 1969-2014 (Bignert et al 2016). With the revision of the EQS directive (2008/105/EC) a biota EQS of 0.0085 ug/kg wet weight, referring to the sum of BDE- 28, -47, -99, -100, -153 and -154, was implemented. The value refers to concentrations in fish and the chemical status of PBDE is considered "not good" on a national level (Bignert et al 2015). The situation is similar in other European countries, with high concentrations in fish compared to the EQS. Besides elevated concentrations of brominated flame retardants outside the two largest Swedish cities, fish from Skelleftebukten, had elevated concentrations of BDE-47 and -154 (Danielsson et al 2014). The high levels of brominated flame retardants found in this area could be related to dismantlement activities.

HBB has not been subjected for any screening study nor is it included in the monitoring programmes. The only data to be found is HBB in sea eagle eggs from the Baltic region, levels 53-429 ng/g l.w. (Helander 2008).

Assessment

Monitoring data for HBCDD show decreasing time trends, the import of HBCDD has decreased and the production of products where HBCDD is used has been

phased out. According to the Basel guidelines on Environmentally sound management of POPs-waste, HBCDD is destroyed in advanced solid waste incineration plants (so called ASWI) which is the normal route for waste in Sweden. The Swedish EPA will continue to monitor HBCDD and further actions are not considered needed.

For most PBDE-congeners levels decrease in the Swedish environment including biota, but there are exceptions such as for BDE-153. The Swedish EPA will continue to monitor the PBDEs. The Swedish EPA will also continue to follow the development of waste treatment of PBDE-containing products at the end of their life. A Swedish study from Umeå university (Lundin and Jansson 2017) draws the conclusion that PBDEs are destroyed in AWSI according to the Basel guidelines but risks of reformation of POPs need to be monitored.

HBB is prohibited in Sweden but may be present in old electronic equipment and vehicles and in relevant waste streams. Actions are not considered needed.

2.1.2.2 HEXACHLOROBUTADIEN (NEW)

Use, import and export

Hexachlorbutadien (HCBD) has historically been used as solvent for other chlorine-containing compounds. No intentional use and production of HCBD has occurred in Europe for many years (UNECE 2007). HCBD is mainly formed as an unintentional by-product during several industrial processes (as a solvent for rubber and other polymers, in heat transfer fluids, as a transformer liquid or hydraulic fluid).

Stockpiles, waste and contaminated sites

The main source of leakage of the chemical is from old landfills sites.

Occurrence in the environment

HCBD has not been detected in surface water for the years 2002-2014 with concentrations above 0.1 ug/L (Boström 2015) and it has not been found in any biotic matrices (www.ivl.se, Danielsson et al 2014). However, in a screening study performed in 2003, HCBD was found in all air samples with the same concentrations in background areas as at point sources, i. e. approximately 0.16 ng/m3 (Kaj and Palm 2004). It was also detected in deposition (0.028 and 0.042 ng/m2/day). It was concluded in the Swedish EPA report 5449 from the year 2005 that HCBD is not an environmental problem in Sweden (Swedish EPA 2005).

Assessment

HCBD is a prioritized substance within the Water Framework Directive and is recommended to monitor, especially in biota. Since HCBD cannot be found in biota

from repeated sampling occasions in fish, nor surface water and sediment, the Swedish EPA has concluded not to continue to monitor HCBD (Swedish EPA 2014b). Further actions are not considered needed.

2.1.2.3 POLYCHLORINATED NAPHTHALENES (NEW)

Use, import and export

All production, import and use of polychlorinated naphtalenes (PCNs) is prohibited by the POPs-regulation. PCNs were in the past produced as mixtures of several congeners. The main use was in the electrical industry as separators in storage batteries, capacitor impregnates, as binders for electrical grade ceramics and sintered metals, and in cable covering compositions. PCNs have also been used for impregnation of wood, paper and textiles to attain waterproof, flame resistance and protection against insects, moulds and fungi. Additionally, they were used as additives in gear and cutting oils, in lacquers and underwater paints and as raw material for dyes.

Today, PCNs are formed mainly unintentionally during various thermal processes such as non-ferrous metal smelting, iron ore sintering, coking processes (Liu et al; 2014).

Stockpiles, waste and contaminated sites

The historical use of PCNs in electrical equipment will be acknowledged when this equipment phases end of life through the special treatment requirements for waste electrical and electronic equipment. Although PCNs have been widely used in the past it is not a substance primarily associated with contaminated sites.

Occurrence in the environment

Concentrations of PCNs are expressed as the sum of 25-30 different congeners. PCNs were subjected for a screening study in 2010 (Haglund 2011). These compounds were detected in sludge from three STPs (147-254 pg/g dw) and in air from both background areas (511-2641 fg/m3) and point sources (88-640 pg/m3). PCNs were also detected in soil, leakage, herring muscle and in guillemot eggs.
Time trend data from herring show declining concentrations and constant relationship among the congeners between 1982 and 2009. The decrease was roughly a 3-fold decrease in concentration over the period, but there were significant inter-annual differences in concentrations. In guillemot eggs, the time trend could be followed between 1974 and 2009 and over this period the PCN concentrations have dropped by one order of magnitude. PCNs have also been detected in mother's milk from primiparous women from Uppsala with a concentrations range of 0.9-8.2 ng/g l.w. (Haglund 2014).

Assessment

The use of PCNs is banned in Sweden since 2004 and waste still containing PCNs is required to be treated in an environmentally sound way. Monitoring data show declining levels in the environment. Further actions are not considered needed.

2.1.2.4 PENTACHLOROBENZENE

Use, import and export

The use of pentachlorobenzene (PeCB) as a flame retardant and as an agent for reducing the viscosity of materials containing PCB, that were used as heat conductor, is prohibited in Sweden since 1980s. Due to the low concentration and the achieved phase-out of PCB, this historic use is of no relevance. The most relevant current sources of PeCB are unintentional formation in thermal processes similar to those generating PCDD/PCDF, PCB, HCB, namely metallurgical industry, power production, thermal waste treatment and domestic incineration (BiPRO, 2011).

Occurrence in the environment

PeCB was included in a screening 2002 and low levels were detected in air and deposition (www.ivl.se, screening database)). PeCB is detected in sludge from all nine STPs included in the monitoring programme (Haglund 2017). In fish from potentially polluted sites, the concentrations were all below detection limit (Danielsson et al 2014).

Assessment

Swedish EPA will continue to monitor PeCB. Further actions are not considered needed.

2.1.2.5 POLYCHLORINATED BIPHENYLES

Production, placing on the market and use of Polychlorinated biphenyles (PCBs) as such and in preparations is fully prohibited by Regulation (EC) No 850/2004. Articles containing PCBs already in use are covered by specific provisions laid down in Council Directive 96/59/EC of 16 September 1996 on the disposal of PCB and PCT (PCB Directive). The Directive required Member States to compile inventories of equipment with PCB volumes of more than 5 liters, and to phase-out and destroy such PCB equipment before the end of 2010.

Use, import and export

There is still PCB in use mostly in transformers, cables, buildings, fluorescent lighting ballast and power factor correction/starter. However, there are very few examples, if any, of equipment still in use containing PCB-levels higher than 50 ppm.

The equipment identified and registered by the Swedish EPA in accordance with the requirements in 30 § of the PCB-ordinance (2007:19) is mainly the following.

There are about 270 identified transformers still in use. They together contain approximately 100 tons of oil. In some of the transformers the content of PCB is unknown. The assumption of PCB content is based on information on the equipment's date of manufacture. Based on former experience, PCB content in these transformers is generally low (less than 10 ppm) but PCB content up to 50 ppm could be present. By comparison with known data from similar transformers, total PCB in these transformers all together is estimated to less than 1 kg. Identified cables contaminated with PCB that are still in use contain approximately 32 tons of oil. The content of PCB is generally low, less than 10 ppm. The total content of PCB is estimated to 0.17 kg.

Stockpiles, waste and contaminated sites

Sweden does not have statistics for PCB products taken out of use. The hazardous waste treatment in Sweden has a capacity high enough to handle incoming PCB-waste within a reasonable time. Therefore, there are no stockpiles of used or waste PCB to be considered. The estimated total amount of waste containing PCB which was accepted at treatment facilities was 2014 approximately 880 tones.

There are about 130 sites with high or very high risk where PCB presumably is a primary or secondary contaminant of major concern, known up until today (EBH-stödet 2017). About one third if the known sites have been remediated, partly remediated or are in the process of being remediated.

Some of the sites are situated in sediments in lakes and water ways, and pose great concern. PCB is known to be a constituent of concern associated with fiber banks and fiber rich sediments, which have been built up from wooden waste from paper mills.

Often the PCB contamination originates from oils used as insulations or contaminated building materials. PCB contamination is a result of leakage from transformation stations and high voltage cables and from sealants in building into the soil and groundwater. Further transportation occurs through run off to surface water. Deposits where PCB contaminated construction materials previously have been tipped uncontrolled are presumed to be another major source.

Occurrence in the environment

PCBs (sum of seven congeners) have been measured in air and deposition at Råö, Pallas and Aspvreten since 1996 (Sjöberg et al 2016). The concentrations have decreased since the programme started (2-4% per year until 2012) but are similar during the last years. In general, the levels are higher at the west coast compared to the east coast and to the north.

In mother's milk from first-time mothers from Uppsala sampled between 1996 and 2016, the temporal trends show a decrease in concentrations of PCB 153, di-ortho PCB, mono-ortho PCB TEQ and non-ortho PCB TEQ decreased with about 5-6%

per year (Gyllenhammar et al 2017a). The same trends are seen in mothers from Stockholm sampled 1972-2014 and Gothenburg, sampled 2008-2015 (Nyberg et al 2017). Regional differences among the population are small (Glynn et al 2011) but consumption of fatty fish among Swedish adults 18–80 years old is associated with the human body burden of higher chlorinated PCBs (Bjermo et al 2013).

In herring muscle, PCB concentrations are in general lower on the Swedish west coast compared to the Baltic Sea. The concentrations of the sum of the measured PCBs in herring muscle from all herring sites in the Baltic and on the west coast, show significant decrease between 1978/80–2014. The average decrease varies between 4.9 and 8.7% per year. A similar significant decrease within the same range (4.8– 8.2% per year) is also seen in the two time series of spring-caught herring between 1972– 2014. However, for shorter time series (2007-2014) in herring, only 50% of the sites showed decreasing concentrations. PCB concentrations vary between species and sites but the temporal trends show the same decreasing trend in herring, perch and cod from Kattegatt, and in cod and perch from the Baltic Sea (approximately 5–10% per year) as well as for Guillemot eggs (Bignert et al 2016). At the sampling stations Ängskärsklubb and Utlängan, a total decrease of PCB concentrations in herring muscle is estimated to be about 70% and 90%, respectively since the beginning of the 1970s.

In all fish species from all areas, CB-153 concentration is below the suggested target level based on the OSPAR EAC (Environmental Assessment Criteria) of 1.6 µg/g lipid weight.

Assessment
The Swedish EPA will continue to monitor PCB. Several actions have been conducted over the decades, and are still being performed regarding PCBs in electrical equipment and in sealants in buildings. Actions to ensure the elimination of PCB will continue in the future as well.

2.2 Overview of Annex B chemicals

For chemicals listed under Annex B, parties must take measures to restrict the production and use in light of any applicable acceptable purposes and/or specific exemptions listed in the Annex. For an overview of substances listed in Annex B up to 2015, see Table 2.

Table 2. Chemicals included in Annex B up to 2015, CAS No, use and whether the substance is included in Annex 1 of the directive on priority substances (2008/105/EG) and in Annex X of the Water Directive (2000/60EC) as a priority substance (PS) or priority hazardous substance (PHS).

Annex B (restriction)	CAS No	Use	Included in Annex I to 2008/105/EG
Dichloro-diphenyl-trichloroethane (DDT)	50-29-3	Insecticid prohibited in Sweden 1975	Yes
Perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride	1763-23-1 307-35-7	Regulated with exemptions for some uses. Ongoing use of PFOS for hard chrome metal plating	Yes (PHS)

2.2.1 Pesticides

2.2.1.1 DICHLORO-DIPHENYL-TRICHLOROETHANE

Dichloro-diphenyl-trichloroethane (DDT) is listed since 2001 in Annex B to the Stockholm Convention with restricted use allowed only as a component of an integrated pest management strategy for public health protection from diseases such as malaria and encephalitis. The ultimate objective is to eliminate any production and use of DDT.

The UNECE Protocol on POPs under the UNECE Convention on Long-Range Trans-boundary Air Pollution (CLRTAP) listed DDT in 1998 for restricted use with elimination at a later stage.

In the EU, production, placing on the market and use of DDT as such, in preparations or in articles is prohibited by Regulation (EC) No 850/2004 since 2004. No country specific exemptions are allowed.

Use, import and export

The use of DDT in agriculture in Sweden was banned in 1970. Consumption peaked in the 1960s, when just less than 100 tonnes was applied yearly, above all to arable land. A special exception allowed forest owners to use this substance until 1975, when it was completely banned.

Stockpiles, waste and contaminated sites

There are no known stockpiles or specific waste streams containing DDT in Sweden. Pesticides are generally associated with former market gardens, gardening centres or greenhouses were these chemicals have been used. A recent study carried out on former market gardens has looked at the occurrence of different types of pesticides specifically at market gardens (SGI 2017). The study showed that DDT is the most frequently occurring pesticide in the study, identified at 77 of 101 sites.

DDT is not specifically registered in the database for contaminated soils but is considered to be a constituent of potential concern at sites such as the above mentioned. Due to the extensive use of chemicals in greenhouses this type of activity have been identified and registered in the database of contaminated sites. There are in total of more than 2 700 sites where market gardens could have used pesticides, plus an additional 900 market gardens where the risk for use of pesticide is considered low (EBH-stödet 2017). Of these sites, about 750 are estimated to have high risk or very high risk according to the national risk classification system.

Occurrence in the environment

DDT, dichloro-diphenyl-dichloroethene (DDE) and dichloro-diphenyl-dichloroethane (DDD) are measured annually in air and deposition at Råö, Pallas and Aspvreten. The concentrations in air for DDE and DDT show a decreasing trend since (2% per year) 1996-2011 (Sjöberg et al 2016).

DDE has been detected in human serum, mother's milk and adipose tissue (Eriksson et al 2008, Bergman et al 2010, Salihovic et al 2016). A time trend for the Swedish population shows an annual decrease of 13% for the time period 1993-2007 (Hardell et al 2010). In mother's milk from first time mothers from Uppsala, sampled 1996-2016, decreasing trends were shown for DDE and DDT, 7.4% and 9.0% per year, respectively (Gyllenhammar et al 2017a). The same trends are seen in mothers from Stockholm sampled 1972-2014 and Gothenburg, sampled 2008-2015 (Nyberg et al 2017).

In the monitoring programmes, the DDT and DDD concentrations are below the limit of quantification at a majority of sites and matrices. Hence, comparisons with DDT such as DDT/ΣDDT-ratios are no longer performed. The concentrations of DDE in herring, perch, cod and blue mussel have decreased at a rate of between 3–10% per year from all investigated sites between the years 1980 and 2014. DDE concentration has decreased by 9% per year in guillemot egg. DDT has been shown in previous years to generally decrease faster than the sum of DDTs.
In all perch and eelpout time series, the DDE concentrations are below the suggested target level based on OSPAR EAC (Environmental Assessment Criteria) of 0.005 µg/g w.w.. The concentration of DDEs in herring and cod are higher from sites in the Baltic Proper compared to sites on the west coast of Sweden. DDE concentrations for cod from both the Baltic and the Swedish west coast and for herring from the Baltic Proper and spring caught herring from the Southern Bothnian Sea and Baltic Proper are above the suggested target level.

Assessment

The Swedish EPA will continue to monitor DDT. Further national actions are not considered needed.

2.2.2 Industrial chemicals

2.2.2.1 PERFLUOROOCTANE SULFONIC ACID

At the fourth Conference of Parties, COP4 in May 2009, Perflourooctane sulfonic acid/Sulfonyl fluoride (PFOS/PFOSF) was listed in Annex B of the Stockholm Convention by decision SC 4/17. A number of acceptable not time-limited purposes and specific, time-limited, exemptions were granted. In 2015 the Conference of the Parties to the Convention carried out the first review of these exemptions. This resulted in that exemptions for use of PFOS in carpets, leather articles, textiles and fillers, paper and packaging material, and rubber and plastics are not valid after 26 August 2015. The current process to remove any of the acceptable purposes also when alternatives are commonly available such as the use in fire fighting foam, requires consensus. In the EU the use of PFOS and related compounds has been restricted since 2008 by Directive 2006/122/EC. Decision SC 4/17 is implemented in the POPs-regulation via Regulation (EU) No 757/2010. The remaining production and use of PFOS is to be reported both to the Secretariat of the Convention and to the EU Commission.

Use, import and export

In the EU there are less exemptions than those granted under the Stockholm Convention. The following exemptions on use are possible according to the POPs-regulation:

- Photoresists or anti-reflective coatings for photolithography processes;
- Photographic coatings applied to films, papers, or printing plates;
- Mist suppressants for non-decorative hard chromium (VI) plating in closed loop systems;
- Hydraulic fluids for aviation.

PFOS or PFOSF has never been produced in Sweden but has been imported to Sweden over a long period for a variety of industrial applications. In the past, PFOS had many uses in articles such as textiles, leather, carpets, paint, paper, cardboard and fire-fighting foam. PFOS also has a number of ongoing industrial uses globally in a wide variety of products and processes, among them being microchips, chrome plating, and as a component of hydraulic fluids for aircraft (UNEP-risk profile, 2006).

In a study (Kemiinformation, 2013), commissioned by the Swedish Chemicals Agency, a detailed evaluation of the exempted uses of PFOS in Sweden 2012/2013 was carried out. In total, 190 kg of PFOS and its related salts were identified, most of it in hard chrome plating (some 95 %). Today the only remaining use is for hard chrome metal plating in accordance with BAT/BEP. There is no EU common definition of what is a closed-loop system in relation to PFOS and since the previous national implementation plan in 2012 the use in Sweden has been considered a closed-loop in relation to the POPs-regulation requirement. Resulting sludge is deposited in landfills specialized for hazardous waste.

In 2015, 55 kg PFOS was imported and about 1 kg exported. The use has further decreased to 25 kg in 2016 (Swedish Chemicals Agency's Product Register). The volume refers to one product used in hard chrome plating industry.

The Swedish EPA has been in contact with the supervisory authorities to the three operators in the hard chrome plating industry in order to do a follow up survey of the possible continued need for PFOS in these applications. Two of the operators have indicated that they since 2016 no longer have any use of PFOS in their process. The Swedish EPA will further follow up the development and phase out of the need for PFOS in these hard chrome plating industry applications.
An import of PFOS contained in articles could still remain. In 2012, the Enforcement Department of the Swedish Chemicals Agency (KemI) undertook an enforcement project on materials in the indoor environment with special focus on floor products (KEMI 2012). In this project, 21 companies were controlled and two floor articles (plastic or textile floors) from each company were analysed. PFOS was found in five samples. None of the companies with samples containing PFOS stated that they knew that the substance was being used in the manufacturing process. One of these companies has products which are only manufactured in Europe. A market surveillance (KEMI 2016) conducted in 2015 where samples of shoes and outdoor equipment were analysed did however not result in findings of highly fluorinated substances above 0.1 % in impregnated material.

Stockpiles, waste and contaminated sites

Sites known to be contaminated with PFOS are several; such as military and civilian airports and their surrounding water areas due to the use of PFOS-containing aqueous film forming foam (AFFF), industrial sites, discharge from waste treatment facilities and landfills and other areas where fire fighting foams have been used. Another source of PFOS is sewage treatment plants and diffuse discharge from households. Some contaminated sites have led to contamination of drinking water with the result of need for actions regarding water plants. Also fishing has been banned in some lakes with enhanced PFOS-concentrations.

There are no known stockpiles of PFOS or any known recycling of carpets or other textiles containing PFOS in Sweden. On-going recycling of paper or packaging material is according to the industry not affected by materials containing PFOS.

Occurrence in the environment

In 2015, the Swedish EPA was assigned by the Swedish Government to undertake a screening of per- and polyfluorinated alkylated substances (PFASs), with a focus of surface- and groundwater potentially contaminated with PFOS (Swedish EPA 2016). The study included approximately 500 water samples, including groundwater , surface water , landfill leachate, effluent water from sewage treatment plants. Twenty one of the surface water samples came from drinking water supplies. PFOS could be detected in 171 of the surface water samples with concentrations in the range of 0.21 to 2,300 ng/L. In 40% of the samples, PFOS concentrations were

above the Annual Average Environmental Quality Standard (AA-EQS) 0.65 ng/L in the priority substance directive. In ground water, PFOS could be detected in 18% of the samples and the highest level was 29 ng/L.

In herring liver, PFOS concentrations show inconsistent temporal trends at all sampling sites included in the marine monitoring programme (Bignert et al 2016). The concentrations are increasing at three sites (Ängskärsklubb, Landsort and Utlängan), decreasing in (Gaviksfjärden and Fladen) and no trend at the other sites. One explanation to this could be the varying length of the time series. However, the PFOS concentration in herring from all sites is below the calculated liver value of 155 ng/g w.w. corresponding to the biota EQS of 9.1 ng/g w.w., indicating which levels are safe from a human health perspective (Bignert et al 2016). At lakes close to contaminated sites, e.g. Halmsjön just outside Stockholm Arlanda Airport, PFOS-concentrations measured between 2009 and 2014 were in the range of 90-790 ng/ f.w. (Norström et al 2015).

Within the water framework directive, PFOS should also be assessed within chemical status classification. PFOS was added to the directive on priority substances in 2013 and the current status classification in Sweden is still to be considered preliminary but so far confirms the general picture that in remote areas the chemical status is generally good but in locations exposed to local sources chemical status is not good. After mercury and PBDE (causing not good chemical status in all Swedish surface water bodies), PFOS is the main reason why chemical surface water status of river water bodies is not considered good.

In guillemot eggs, an increasing trend of PFOS has been observed throughout the whole examined time period, 1968-2015 (+5.6% per year). However, during the most recent ten years the trend has changed direction and is now downward (-11% per year since 2005). Due to relatively high inter-annual variations in recent years, the future temporal trend for PFOS concentrations in the Baltic marine environment cannot be predicted.

Several studies report on PFOS levels in humans. Mother's milk from first time mothers in Stockholm, sampled between 1972 and 2014 show an non-significant trend of 0.62% per year, but from 2007 the trend is significant and a yearly decrease of 7.4% is seen (Nyberg et al 2017). The same trend is in Gothenburg. In serum, temporal trends of pooled samples from first time mothers from Uppsala 1997-2016 show a yearly decrease of 8.1% (Gyllenhammar et al 2017b) and in individual samples the yearly decrease is 9.3% (Glynn et al 2017b). Further, temporal trends in serum from children in Uppsala at 4, 8, and 12 years of age, time period 2008-2015, shown a decrease of 5.6% per year for all groups together (Gyllenhammar et al 2016b). Also in serum from young men from the south of Sweden sampled in 2010 and 2013 a decreasing trend in PFOS concentration is seen (Jönsson et al 2014).

PFOS has been measured annually in air and deposition at Råö since 2009 and there is no obvious trend in concentrations during the years (Sjöberg et al 2016). Concentrations in air and deposition over the time period 2009-2015 are 0.91-1.4 pg/m^3 and 0.75-3.7 ng/l, respectively.

PFOS is also detected in sludge and effluent waters from all nine STPs included in the monitoring programme (Haglund 2017). Time trends for 2004-2015 in sludge show decreasing concentrations for all STPs.

Mistra Council for Evidence-based Environmental Management is conducting a strategic review regarding time trends in the environment, to see how the phase-out of PFAS has affected their occurrence in the environment. The report will be published during 2017(http://www.eviem.se/sv/projekt/Utfasning-av-PFAS/)

Assessment

PFOS and PFASs are widespread in the environment and are found in surface- and drinking water throughout Sweden. The highest levels have been found in the vicinity of firefighting practise areas. In areas with only atmospheric deposition the levels are generally very low. PFASs are found in groundwater but mainly in contaminated areas. Measured concentrations in the environment show that humans and the environment risk exposure to PFASs at levels that may cause adverse effects. Exposure occurs both through water and through fish. The Swedish EPA will continue to monitor PFOS and several PFASs. Several actions are being performed regarding PFASs which are listed in chapter 3.

2.3 Overview of Annex C chemicals

To reduce the total releases of the chemicals listed in Annex C with the goal of continuing to minimize and where feasible, achieve their total elimination is also required under the Stockholm Convention.[5] Regarding chemicals listed under Annex C Parties must take measures to reduce the unintentional releases of chemicals with the goal of continuing minimization and, where feasible, ultimate elimination. For an overview of substances listed in Annex C up to 2015, see Table 3.

[5] Article 5 states: To reduce the total releases of the chemicals listed in Annex C (PCDDs, PCDFs, PCBs, HCB and PeCB) with the goal of continuing their minimization and, where feasible, achieving their elimination; To develop an action plan to identify, characterize and address the releases of by-product POPs; To promote the application of available, feasible and practical measures to achieve a reasonable level of release reduction or source elimination and to promote the development and require the use of materials, products and processes to prevent the formation and release of chemicals listed in Annex C; To promote and require the use of best available techniques (BAT) and best environmental practices (BEP) to prevent the release of chemicals listed in Annex C for new sources in main source categories; To promote the use of BAT and BEP for existing sources from the main source categories as well as other categories.

Table 3. Chemicals included in Annex C up to 2015, CAS No, use and whether the substance is included in the Annex 1 of directive on priority substances (2008/105/EG) and in Annex X of the Water Directive (2000/60EC) as a priority substance (PS) or priority hazardous substance (PHS).

Annex C (unintentionally produced)	CAS No	Use	Included in Annex I to 2008/105/EG
Polychlorinated dibenzo-p-dioxins (PCDD)	all PCDDs have different CAS numbers	Not applicable	Yes (PHS)
Polychlorinated dibenzofuranes (PCDF)	all PCDFs have different CAS numbers	Not applicable	Yes (PHS)
Polychlorinated biphenyls (PCB)	all PCBs and their mixtures have different CAS numbers	Not applicable	Yes (PHS) – twelve dioxinlike PCBs
Polychlorinated naphtalenes (PCN)	70776-03-3	Not applicable	
Pentachlorobenzene (PeCB)	608-93-5	Not applicable	Yes (PHS)
Hexachlorobenzene (HCB)	118-74-1	Not applicable	Yes (PHS)

Unintentional POPs releases remain an important POPs source in Sweden. Where regulation and policy have identified and reduced the emissions from industrial sources over the past two decades, diffuse sources linked to for example domestic combustion or open burning of waste become increasingly important unintentional POPs sources. However, such sources can be more difficult to monitor and tackle. Reduction and phase out of these emissions is complex, indeed impossible in the case of most thermal sources and of emissions from open burning. Furthermore, the sources of unintentionally produced POPs are rather disperse and thus measures cannot be as targeted as for intentionally produced and used POPs.

Sweden extensively reported monitoring data for the release of unintentionally produced POPs into the air, water and soil using three methodologies: Stockholm Convention's emission inventories, E-PRTR's and EMEP's. A remarkable amount of information is available on air and water emissions, in particular from the E-PRTR and EMEP databases that are standardized, user-friendly and readily available in electronic form for analysis. Yet, however, there have only been few cases of reported data related to the Stockholm Convention methodology. One possible reason for this lack of reported data may relate to the difficulty in accurately accounting for activity data in diffuse sources e.g. quantity of waste burnt on open fires for an entire nation. The Stockholm Convention has aimed to assist inventory compilers through the provision of guidance material such as the dioxins and furanstoolkit(http://chm.pops.int/Implementation/UnintentionalPOPs/ToolkitforUPOPs/Overview/tabid/372/Default.aspx)

2.3.1 Unintentionally produced chemicals

2.3.1.1 POLYCHLORINATED DIBENZO-P-DIOXINES/FURANES

Primary sources

Since the 1980s, a number of actions have been taken to reduce formation and emission of dioxins from a number of industry categories including waste incineration plants. It is likely that these actions also have resulted in reductions of formation and emission of PCBs and HCB.

Despite all national and international efforts to track primary sources over the decades, not enough is known and a satisfactory overall picture of the situation is still missing.

A Swedish EPA financed research programme, Baltic POPs (Wiberg et al 2013) showed that atmospheric deposition was the largest source of dioxins entering the Baltic Sea, that deposition is highest in the winter, and that non-industrial incineration is indicated to be the largest contributor as a primary source. Little is still known as to what kind of incineration contributes the most, may it be biomass-burning, backyard burning of waste, accidental landfill fires or other fires, in addition to advanced waste incineration plants.

A majority of the atmospheric deposition of dioxin and dioxinlike PCBs in Sweden originates from primary sources in other countries. However, approximately 30 % of the deposition in Sweden still have domestic origin, according to EMEP. And Swedish primary sources of dioxins and dioxinlike PCBs also export emissions to other countries, according to the same source.

Secondary sources

The total quantities of dioxins, PCBs and HCB currently to be found in and around contaminated sites may be substantial, although our knowledge about this is yet limited.

Timber treated with PCP, and with similar, previously dioxin-contaminated compounds, constitutes another potentially important secondary source for dioxins. This method of treatment was banned in Sweden in 1976.

Of the estimated total of 200 kg of dioxins (as TEQ) once incorporated in timber, up to 30 kg could still be present in treated wood in Swedish society. The extent of this problem, the potential for leaching and possible remedial action need to be studied more closely.

In 2007 the Swedish EPA made a compilation of knowledge about unintentionally produced compounds (Swedish EPA 2007) but more knowledge is needed. The sources for substances listed under Annex C, are from formation during different types of combustion processes and they are formed probably through similar mechanisms. There are ongoing emissions from combustion processes, industrial high

temperature processes, the metal industry, small-scale wood burning and chemical processes where chlorine is included. Also the contribution from the traffic is increasing due to the increasing amounts of cars even though they today release less amounts of impurities.

Occurrence in the environment

PCDD/Fs are measured in air and deposition annually, four times per year, at Råö and Aspvreten. There are no trends in concentrations between 2009 and 2015 and the concentrations are slightly higher at Råö (Sjöberg et al 2016). During this period, the concentrations in air are 0.6-0.18 fq TEQ/m^3 and 0.06-0.18 fq TEQ/m^3 at Råö and Aspvreten, respectively. The concentrations in deposition are 0.14-2.8 pg TEQ/m^2day at Råö and 0.17-0.97 pg TEQ/m^2day at Aspvreten.
In STP sludge, octachlorodibenso-p-dioxin and furan (OCDD/F) are the congeners detected in highest concentrations at all nine STPs that are included in the monitoring programme (Haglund 2017). For OCDF, a decreasing trend can be seen for 2004-2015.

In breast milk from first-time mothers in Uppsala sampled between 1996 and 2016, the decrease in trends of PCDD TEQ and PCDF TEQ are 6.7% and 3.5% per year respectively(Gyllenhammar et al 2017a), but there are indications that the declines have been slower during the latter part of the study.. In breast milk from Stockholm sampled between 1972 and 2014 the decrease for the sum of PCDD and PCDF is 5.9% and 5.6%, respectively per year (Nyberg et al 2017). However, no trend can be observed for the most recent ten years. The decline in breast milk levels of PCDD/Fs is in agreement with results from three Swedish market basket studies performed between 1999 and 2010 showing declining exposure to PCDD/Fs from food.

Different groups in the population show different levels of exposure. The average human exposure to dioxins and dioxin like PCBs in Sweden is currently below the tolerable daily intake (TDI) set by the EU. However 4-8% of the children and 1-2% of women in fertile age exceed the TDI.

In herring muscle, PCDD/F-TEQ levels (pg/g lw) are generally higher in the Baltic Sea compared to the Swedish West coast. The overall highest concentration from 2012-2014 was found at the Bothnian Sea offshore site (Bignert et al 2016). The same pattern is seen when levels are expressed on wet weight basis.

A significant downward trend for concentrations of PCDD/Fs is seen in herring for Ängskärsklubb and Fladen over the whole time period (lipid weight), but no trend is observed at Harufjärden and Utlängan when the ΣTEQ for PCDD/Fs are considered. However, two dioxin congeners decrease at both Utlängan and Fladen. In addition, two furan congeners decrease at Fladen and there is an indication that the dioxins decrease faster in concentration than the furans at Ängskärsklubb. The spring caught herring has consistently higher concentrations than the autumn

caught for all investigated congeners of PCDD/Fs at both Ängskärsklubb and Utlängan, 1.5–2 and 2–3 times higher concentrations, respectively.

All herring stations monitored on an annual basis show values below the suggested target level based on the EU food regulation of 3.5 pgWHO05-TEQ/g wet weight (Commission Regulation (EC), 2006)[6]. However the analyses above are performed on herring muscle only, excluding the subcutaneous fat. The NFA reports on levels of dioxins and PCBs show another picture, where levels repeatedly are above the maximum levels for both dioxins and the sum of dioxins and dioxinlike PCBs (6.5 pgWHO05-TEQ/g wet weight) in some areas of the Baltic Sea. The analyses performed by the NFA include also subcutaneous fat (Commission Regulation (EC), 2017), but there might also be other factors influencing the results and explaining the differences.

Within the water framework directive, dioxins and dioxinlike PCBs should also be assessed within chemical status classification. Dioxins and dioxinlike PCBs were added to the directive on priority substances in 2013 and the current status classification in Sweden is still to be considered preliminary but so far confirms the overall conclusions that can be made for the Baltic Sea according to the NFA reports, that is the chemical status is most likely not good along the northern Baltic Sea coast. The EQS in the directive is currently the same value as in the food legislation but in contrast to the handling of data within a food regulation context, the lipid content is also taken into account (European Commission 2014).

Furthermore, in the background document ("WFD dossier") on dioxins and dioxinlike PCBs another standard is mentioned, QSbiota (secondary poisoning). This value (0.6 pg WHO05-TEQ/g wet weight) indicates at what levels there could be a risk to predators through food chain exposure. Only herring from the two west coast stations Fladen and Väderöarna and Holmöarna in Southern Bothnian Bay is below this level. The concentrations in Harufjärden and Utlängan are, and have historically been, close to but slightly above that value. Herring from Ängskärsklubb on the other hand has been well above the QSbiota (secondary poisoning) historically, but during the last three years is below.

An EQS based on the TDI value for dioxin and dioxin-like compounds is not included in the WFD dossier. If calculating such a value using the current TDI and guidance document on how to establish an EQS based on human health risks, the value would be substantially lower than the current EQS in the directive of priority substances[7].

[6] Please note that this value refers to dioxins only, and not also dioxinlike PCBs.

[7] The basis for using the above mentioned food limit values also in the WFD context has been questioned and is currently an issue being discussed within the so called common implementation strategy (CIS).

In guillemot egg, significant downward trends were observed for TCDD, TCDF and PCDD/Fs during 1970–2014. For TCDFs, no trend can be observed between 1990 and 2014 (Bignert et al 2016).

Assessment

One of the most important problems related to POPs in Sweden today is that levels of dioxins and dioxin-like PCBs in fatty fish from the Baltic Sea and certain lakes are unacceptably high and constitute a risk to human health. Individuals who regularly consume these types of fish are at increased risk of exceeding the TDI. Furthermore, fish that exceed the maximum levels cannot be exported to other EU-countries. The levels in breast milk and fish from the Baltic Sea are decreasing but are not acceptable, and levels should therefore be further reduced. The rate of decline of dioxins in the environment has become less and less pronounced in many areas in recent years. In order to reach levels within a few decades that do not constitute a risk to human health, the rate of the decline needs to be dramatically increased.

2.3.2 Other Annex C chemicals

PCBs and PCNs are formed in approximately the same amount as the dioxins, about 100 grams per year, but the figures are very uncertain (Swedish EPA 2007) From a risk-perspective, it is of less importance compared to the leakage from historical use. Chlorobenzenes and chlorophenoles are formed as intermedieres in the process where larger molecules are formed, as the PCBs, PCNs and PCDD/Fs but are also released as single molecules. The chlorophenoles are one of the dominating groups regarding organic substances that contain chlorine that are released during combustion and industrial processes. For example the amount of chlorophenols that are released is about ten times higher compared to chlorobenzens and 10 000 times higher than the dioxins.

3 Actions and strategies

From the assessments in chapter 2, it can be concluded Sweden still needs to take action for dioxin and dioxinlike PCBs, PFOS and PFASs and PCB. This chapter aims to explain more closely why action needs to be taken and present strategies to reduce the amount of these substances in Sweden.

3.1.1 Dioxin and dioxinlike PCBs

NEED FOR ACTION

Levels of dioxins and dioxin-like PCBs in human breast milk and in fatty fish from the Baltic Sea and the large lakes in Sweden are still unacceptably high and constitute a risk to human health. Dietary recommendations regarding certain fish species with high levels of dioxin and dioxin-like PCBs have been given for more than 30 years. Children and women in their childbearing years in particular are recommended to limit their consumption of these fishes. Commercial- and recreational fishermen and their families have been identified as possible risk groups with high consumption of dioxin-contaminated fish. Based on the requirements regarding information to the consumers of the strict dietary recommendations, Sweden has had a derogation from the food regulation in the EU concerning maximum levels of dioxins and PCBs for certain fish species from the Baltic Sea area since 2012. Fish that exceed the maximum levels cannot be exported to other EU-countries. Moreover, the presence of the compounds in human breast milk is not acceptable, and the levels therefore must be reduced. Breast-feeding is beneficial for infant health, but, the exposure of breast-fed babies to dioxins and dioxin-like PCBs today clearly exceeds the tolerable daily intake.

Health effects of dioxins are described by the National Food Agency (Livsmedelsverket 2012). Long-term effects of low doses of dioxin and dioxin-like PCBs have in animal studies shown to effect the development of the brain and the nerve system which may lead to behavioural disorders. Dioxins also affect the immune system, the hormone system and reproduction as well as increase the risk of cancer in animal studies. TCDD is the most toxic dioxin and has been classified as carcinogenic for humans by WHO. Results from different epidemiological studies show that a fetal exposure to dioxin levels above background have an increased risk of effects on the reproduction system. At high doses dioxins can give rise to chlor acne.

In the EU, a tolerable weekly dioxin intake (TWI) of 14 picograms (pg) WHO-TEQ/kg bodyweight was in 2001 set by specialists from the Scientific Committee on Food. The TWI corresponds to a tolerable daily intake (TDI) of 2 pg WHO-TEQ/kg body weight. The tolerable intake represents the level considered safe over a lifetime of intake from all sources. The average exposure to dioxin and dioxin-like PCBs from food among children and adults in Sweden is below the current

TDI, but the margin is small. Individuals who regularly consume dioxin- and PCB-contaminated fatty fish have an increased risk of exceeding the TDI.

In the USA the health based tolerable intake of dioxins and dioxinlike-PCBs has recently been substantially lowered by the US EPA due to new facts about the negative health effects of exposure to dioxins. The European Food Safety Authority (EFSA) is currently reviewing the same information and is shortly expected to also reduce the tolerable intake of dioxins for the EU. This will even further emphasize the need for enhanced national action in Sweden, to be able to reach levels of dioxin and dioxin-like PCBs where all fish are safe to eat, also for vulnerable groups.

As releases of unintentionally formed POPs from the Swedish primary sources that were identified early now have been reduced, secondary and diffuse sources have become more important in relative terms. Not enough is known about the quantity, release, dispersal and cycling of dioxins and dioxin-like PCBs from all primary, secondary and diffuse sources, which makes efficient action difficult.

The yearly decline in dioxin levels in the environment has stabilised around 5-7 % in the recent decade. In order to reach an acceptable situation within a decade or two, where dioxins and dioxin-like PCBs in the environment no longer constitute a risk to human health, very ambitious improvements need to be made.

STRATEGY

The objective of the strategy is to protect human health and the environment from dioxin and dioxin-like substances by decreasing human exposure via food intake, and by decreasing releases to the environment from diffuse, secondary and primary sources.

The Swedish EPA will initiate work together with other stakeholders with the ambition to reach low levels of dioxin and dioxin-like PCBs where all fish are safe to eat, also for vulnerable groups, by 2030 at the latest. These low levels are anticipated to be in the range of one tenth compared to current levels in fatty fish.

In order to reach such a situation within little over a decade, very ambitious actions need to be taken;

- National emissions of dioxins to air, as well as international emissions that affect Sweden, needs to be substantially reduced to a fraction compared with today's emissions. The current reduction rate of dioxin in fatty fish from the Baltic and some other lakes, 5-7 % each year, needs to be more than doubled.
- This reduction of emissions is especially important from sources that use different methods for incinerating waste (metal-scrap recycling, pure waste incineration, co-incineration of waste with other fuels, residential wood burning, landfill fires and other accidental or open fires),

- Relevant sources and exposure pathways need to be identified in much more detail, both for airborne emissions and for waterborne emissions like fiberrich sediments in the vicinity of older pulp- and paper industries. This is a necessity to be able to design precise policy actions. The Swedish University of Agricultural Science is during 2017 in more detail studying the sources of dioxins in fish. Existing data of dioxins in herring and sediment from the Baltic Sea will be used to verify the impact of different sources. Chemical fingerprinting techniques will be used in order to detect signals of sources based on their unique chemical patterns. The chemical patterns of dioxin in the herring will be matched to the previously published source patterns that include potential local and distance sources and their relative contribution will be quantified.

3.1.2 PFOS and PFASs

NEED FOR ACTION

Enhanced levels of PFOS and per- and polyfluorinated alkylated substances (PFASs) in surface waters outside Göteborg Landvetter airport were first discovered in 2005 in a screening study (Woldegiorgis et al 2006) which was confirmed through further studies were also fish were included and showed to contain elevated levels. The usage of PFAS-containing Aqueous Foam Forming Films (AFFF) during fire extinguishing was later shown to be the main source. Studies of the effects of this distribution of PFOS and PFASs around firefighting training sites started in 2009 by the research project RE-PATH (Norström et al 2015). Elevated levels in drinking water were discovered for the first time in 2011 in Botkyrka community and have thereafter been found at several places mostly due to the use of PFAS containing AFFF used by the Swedish Armed Forces and Swedavia. Further compilation of existing and new data is needed to fully overview the situation and to evaluate further possible action.

STRATEGY

Since autumn 2014, the government agencies concerned with PFAS issues meet on a regular basis to coordinate activities and improve the dissemination of information to society. This network, which is growing, currently includes the Swedish Environmental Protection Agency, the Swedish Chemicals Agency, the National Food Agency, the Geological Survey of Sweden, the Swedish Geotechnical Institute, the Swedish Civil Contingencies Agency, the Swedish Agency for Marine and Water Management, the Defence Inspector for Medicine and Environmental Health, the Swedish Water Authorities and the Swedish Association of Local Authorities and Regions.

A Swedish national action programme is under development with several authorities that participate in order to reduce use of PFAS and implement more knowledge and other measures. http://www.kemi.se/pfasguide. The Swedish Chemicals

Agency initiated a declaration of intent signed by 37 authorities and research organizations to increase the cooperation to gain more knowledge and to reduce the use of PFAS. The Swedish Chemicals Agency is also dedicated to regulate PFASs within EU (KEMI 2017).

The following section describes ongoing measures to reduce risks to human health and the environment and to increase knowledge of PFOS and PFASs as a group.

REDUCE HUMAN EXPOSURE THROUGH FOOD AND DRINKING WATER

Recommendations for intake of fish and drinking water exist from the National Food Agency (NFA). The action limit is 90 ng/L for sum of 11 PFAS based on the current EU tolerable daily intake for PFOS. The assumption is that all PFASs have the same toxicity. In the modelling of the action limit it was assumed that the contribution of drinking water exposure should not exceed 10% of the tolerable intake. PFOS strongly bioaccumulates in fish and the NFA has also developed a risk management guideline for local authorities to use when high PFOS contamination of fish has been discovered. The EQS for PFOS in biota in directive 2008/105/EC is 9.1 ug/kg biota, referring to fish. The most critical protection objective is human health and therefore e.g. concentrations in fish muscle (filet) rather than liver are to be used when comparing to monitoring data for fish. Fish having concentrations at or below this level is assumed to be safe for unrestricted consumption. In the modeling of the EQS it was assumed that the contribution of PFOS exposure from fish should not exceed 10% of the current EU tolerable intake for PFOS.

RESTRICT THE USE, RELEASE AND DISTRIBUTION

- Improve knowledge about the use of and alternatives to PFAS (KEMI 2015).
- Strengthen regulatory guidance on PFASs (for instance regarding airports, contaminated sites and landfills). Project by Swedish EPA and Swedish Geotechnical Institute to develop a guideline is under way.
- Development of techniques for handling of PFAS contamination. The Swedish Geotechnical Institute and Swedish University of Agricultural Sciences are involved in different research projects (PFAS-Pure).
- Limit the use of PFAS-containing firefighting foam. Swedish recommendations to limit the use exist. http://www.kemi.se/global/broschyrer/rekommendationer-for-brandskum.pdf
- Existing proposal from the Swedish Chemical Agency on national legislation for PFASs in firefighting foam, including investigation on the need for notification of use of all types of firefighting foam (KEMI 2016 https://www.kemi.se/global/rapporter/2016/rapport-1-16-forslag-till-nationella-regler-for-hogfluorerade-amnen-i-brandslackningsskum.pdf).
- Proposal from the Swedish Chemicals Agency (in collaboration with Germany) to restrict C9-C14 perfluorinated carboxylic acids (PFCAs) and their precursors within the EU (https://echa.europa.eu/sv/registry-of-current-restriction-proposal-intentions/-/substance-rev/16121/term).

- Initiative by the Swedish Chemicals Agency for a common Nordic/EU strategy for PFASs (http://norden.diva-portal.org/smash/get/diva2:1120881/FULLTEXT01.pdf)
- Development of preliminary guideline values for highly fluorinated substances in soil and groundwater as a basis for developing generic guideline values (SGI 2015).
- Plans to develop national environmental quality standards for PFAS in surface water bodies used for drinking water purposes, to be implemented during 2018 (Swedish Agency for Water and Marine Management).
- Information and education efforts directed to Emergency Services regarding environmental effects from the usage of firefighting foams, handled by the Swedish civil contingencies agency
- Research project on evaluation and development of alternative fire extinguishing methods coordinated by the Swedish civil contingencies agency in co-operation with Lund University and Orebro University.
- Assignment from the Swedish government to the Swedish EPA on further investigation of areas where firefighting foams could have been used. (http://www.naturvardsverket.se/Miljoarbete-i-samhallet/Miljoarbete-i-Sverige/Regeringsuppdrag/Fordjupad-miljoovervakning-av-hogfluorerade-miljogifter-sk-PFAS-och-av-vaxtskyddsmedel-i-vatten/)
- The Swedish Waste Management Association has an ongoing desktop-study to identify possible PFAS-emissions from larger waste facilities.
- Take action through the Industrial Emissions Directive where relevant. Sweden is promoting that all mechanical, biological and physico-chemical treatment of waste should monitor, if foreseeable according to waste treated, emissions to water of PFOS. The standard for PFOS in water should be CEN/TS 15968:2010 or other standards that provide data of an equivalent scientific quality. Minimum monitoring frequency should be twice per year.
- Within the work with the Water Framework Directive, a Programme of Measures (PoM) has been produced. The main objectives of the measures suggested in the PoM are to reduce further release of PFAS substances through guidance, information and regulatory and by facilitating measures in contaminated soils.

ENHANCED NATIONAL ENVIRONMENTAL MONITORING

- Monitoring of organic pollutants, including PFASs, in surface water from 10 rivers to study the variation over the year in 2017 by sampling at four different times during this year.
- Monitoring of organic contaminants, including PFASs in groundwater
- Screening of less well-known PFASs and analysis of total organic fluorine in sewage sludge and in- and effluent waters from STPs, fish, bird eggs, mammals, rain water, ground water, surface water and run-off water from landfills.

- Screening of ultra-short PFAS in STP waters, ground water and surface water
- Extended monitoring of PFAS in air and atmospheric deposition. 12 PFAS are included and are measured every month at three sampling locations.
- Analysis of PFOS and PFASs in soil from background areas.
- Analysis of PFASs, precursors included in 1200 children.
- Analysis of PFASs in food baskets (Glynn et al 2017a)

3.1.3 PCB

NEED FOR ACTION

Despite the fact that Sweden has taken action against PCB spreading in the environment for over 40 years now, more actions are still needed and are carried out at a high priority. The Swedish ordinance (2007:19) on PCB sets the rules for handling PCB in closed applications such as equipment as well as in open applications such as building materials.

STRATEGY

It is likely that PCB can still be found in small electronic equipment, like starters for fluorescent tubes. However, all electronic waste in Sweden is considered to be hazardous waste and is collected for further treatment at a hazardous waste treatment facility. Sealants and flooring materials will be a source of PCB wastes for a few more years. Estimations show there could be 20 – 50 tonnes PCB still to remove from buildings.

All equipment with PCB levels higher than 500 ppm was decontaminated before the end of 2010. Most equipment with levels 50-500 ppm has been decontaminated and the major part of equipment within the range 2-50 ppm has been decontaminated up until today. According to the Swedish ordinance, fluids containing more than 2 ppm PCB are considered being PCB-products. According to the ordinance PCB contaminated equipment has to be decontaminated immediately. An exemption can be granted in individual cases if there are specific reasons and if it does not contradict the requirements of the directive 96/59/EC. As a rule economic reasons are not considered sufficient for granting an exemption. In all cases where an exemption has been granted the equipment is expected to be decontaminated or disposed of within a certain time limit, normally a few years.

Materials in buildings and constructions containing PCB in levels higher than 500 ppm had to be remediated by 2014 or by 2016 depending on the type of building. PCB levels in the range of 50-500 ppm have to be decontaminated before rebuilding, renovation or demolition is conducted.

In addition to these national activities Sweden is willing to participate in international collaboration to assist countries to phase out PCB.

3.2 Other actions

3.2.1 Brominated flame retardants in imported products

PBDE and HBCDD are used as flame retardants and can still be found in imported products and still need to be addressed. The identification, sorting, safe handling and treatment operations of waste which may contain these substances is still an important measure for safe destruction of POPs. It is carried out for several waste streams and there are specific waste requirements for waste from electric and electronic equipment and for waste cars. The Swedish EPA will also continue to follow the development of waste treatment of PBDE-containing products at the end of their life.

Another important action needed is improved national commitment to undertake the agreed measures in the Stockholm Convention and phase out the use of these POPs in products. Also to inform the whole value chain about where these POPs still are used is needed. A programme on global collaboration with stakeholders in providing information on the chemical composition of products through each step of its lifecycle has been developed within the Strategic Approach to International Chemicals Management, SAICM, actively supported by Sweden. Such an information exchange would, for example, enable improved prevention of the entry of substances that exhibit characteristics of persistent organic pollutants into the recycling stream. More information can be found at www.chem.unep.ch/unepsaicm/cip/ Furthermore actions are needed to continue the domestic waste management activities previously mentioned. Details about these measures are not further elaborated in this report.

3.2.2 Acceptable level of POP-destruction

Swedish capacity for destruction of hazardous waste through incineration is generally very good. However, the technical guideline on the environmentally sound management of POPs wastes under the Basel-convention, is rather vague in determining whether POPs waste is properly destructed or not in different processes with varying technologies.

To ensure that POPs waste are treated in accordance with Article 6.1d of the Stockholm Convention, Swedish EPA has asked world leading experts at Umeå University for a second opinion on destruction through a desktop study (Lundin and Jansson 2017). Their task was to give an opinion about what level of destruction can be secured in the type of cement kilns, advanced solid waste incinerators and hazardous waste incinerators that are available in Sweden. It is difficult to interpret and clarify what the requirement of "irreversible destruction" means in terms of temperature and residence times. That it requires incineration at a high temperature to effectively destroy several, if not all POPs, is clear. However, the knowledge about which or more precise treatment methods that may be considered as approved is unclear.

The substances included in the desktop study were PBDE, HBCD, PCDD/F and PFOS. The experts concluded that

- HBCD destruction to be confirmed in ASWI with a medium level of confidence,
- PBDE is destroyed in ASWI, and consider the level of confidence for PBDE destruction in ASWI as low,
- Stating that PFOS are destroyed in ASWIs can only be made with a low level of confidence,
- PCDD/Fs are destroyed in the combustion zone. With the large amount of scientific literature on formation and emissions of PCDD/F from ASWI, we find that this can be stated with a high level of confidence.

The experts also recommended that, provided that

1) Combustion takes place under optimum conditions, especially with respect to temperature, turbulence and residence time, and
2) The waste to be combusted is relatively homogeneous and without increased concentrations of any of the POPs in the waste

Then even without the sorting of specific waste streams, combustion will be able to degrade the POPs and act as a sink for these compounds. Start up and shut down of combustion plants is the major source of emissions from the plants if operated under optimal conditions during normal operation.

Based on these conclusions and recommendations Swedish EPA find the current overall methods of collection and treatment of POPs waste in Sweden satisfactory for the time being, with the exception of what is being discussed in 3.1.1 about dioxins.

3.2.3 Specific government action towards remediation of contaminated seas

As part of the budget proposal for 2018, the Swedish government has allocated and earmarked additional funds for managing of known sources of contamination in the Baltic Sea. These additional funds extend to 2020 and are in addition to the yearly funds for remediating contaminated land where no responsible polluter is to be found

4 Implementation of the obligations on supporting activities

4.1 Information exchange

Obligation

As a Party to the Stockholm Convention, Sweden is required to facilitate or undertake information exchange relevant to the reduction or elimination of the production, use and release of POPS and alternatives to POPs including information relating to their risks as well as their economic and social costs.

Implementation so far

PUBLIC INFORMATION

The consumers get information about hazardous chemicals via labelling and if necessary supplementing information which the producers and importers have to present when marketing chemicals.

The websites of the Swedish Chemicals Agency (KemI) and the Swedish EPA are continuously updated to provide relevant information on activities in the area of chemicals management and significant data on chemicals in both Swedish and English. KemI regularly produce information, both on its website and in leaflet form and as newsletters, about the roles and responsibilities of different stakeholders, e.g. manufacturers and importers, downstream users and regional and local supervisory authorities, with regard to sound management of chemicals. POPs management is an integral part of national chemicals management.

KemI invites regularly representatives for industrial branches, environmental organisations and the research sector to inform them about relevant developments within the EU and in international agreements, including the EU-regulation on POPs and the progress of the Stockholm Convention.

Measures to promote and facilitate the training of relevant personnel

The manufactures have the legal obligation to label chemical's used in the working places, to ensure that Material Data Sheets are available as well as appropriate safety instructions, for the kind of work carried out. This obligation is promoted by inspections. The curriculum in all levels of the educational system includes the provision of basic information about chemicals including when relevant the specific problems with persistent organic pollutants. PRIO is a web-based tool (in Swedish and English, www.kemi.se) developed and maintained by KemI, intended to be used to preventively reduce risks to human health and the environment from chemicals. The aim of PRIO is to facilitate in the risk assessment so that people who work as environmental managers, purchasers and product developers can identify

the need for risk reduction. To achieve this PRIO provides a guide for decision-making that can be used in setting risk reduction priorities.

The target groups for PRIO are primarily Swedish actors but also include chemical suppliers to Sweden in other countries. PRIO also provides a source of knowledge for environmental and health inspectors, environmental auditors, risk analysts and those who in some other way can influence the use and handling of chemicals. Linked to PRIO are a number of environmental and health criteria, including PBT for the substances to be prioritised in the risk reduction work, as well as a database containing examples of such substances. The recommendations on which chemicals are prioritised for risk reduction measures are based on the environmental quality objective "A non-toxic environment" adopted by the Swedish parliament, work towards sustainable development and are in line with the objectives in the EU chemicals legislation, REACH. Throughout PRIO reference is made to Swedish legislation and other Swedish considerations.

PRIO allows users to:

- search for substances and obtain information on properties hazardous to the environment and health
- obtain information on prioritised health and environmental properties
- identify substances contained in chemically characterised substance groups and product types
- obtain help in developing routines for purchasing, product development, risk management etc

4.2 Research, development and monitoring

Obligation

Article 11 request Parties that they shall within their capabilities, at the national and international levels, encourage and/or undertake appropriate research, development, monitoring and cooperation pertaining to persistent organic pollutants and where relevant, to their alternatives and to candidate persistent organic pollutants.

The Swedish monitoring programme

Environmental monitoring has been conducted in Sweden for more than quarter of a century. The monitoring covers all areas in the environment and for POPs the marine monitoring, freshwater monitoring, urban monitoring and health related monitoring are relevant. With the exception of the monitoring in agricultural areas, national environmental monitoring generally focuses on the state of the environment in 'reference areas', i.e. areas that are not appreciably affected by local disturbance. An accurate picture of Sweden as a whole therefore requires the addition of data from more significantly affected areas, obtained for example by monitoring of receiving bodies of air and water, monitoring of the effects of lake liming, and monitoring programmes for agriculture and forestry.

The substances covered by the national monitoring programmes are shown in Table 4. The programmes do not cover all the substances included in the Convention. Substances that have been excluded are e.g. banned for a number of years and some of them are known not to be found in Sweden. An example is Mirex, for which a screening study was performed in 2004, but no detectable levels could be observed in the Swedish environment.

Samples from the following matrices are included in the monitoring programmes; air, deposition, sediment, biota from fresh- and marine waters, guillemot egg, surface water, human breast milk and blood. Most of these matrices are analysed for POPs annually. Freshwater fish are sampled at 32 sites but analysed annually for POPs at nine of the sites. The rest is being analysed every second or third year. Off-shore sediment are sampled analysed every sixth year. All biological material is placed in a specimen bank. This material can if necessary be used to measure and perform retrospective analyses. For some matrices and substances, data from the late 60's are available and Figure 1 shows time trends for CB-153 in different matrices included in the Marine monitoring programme and the Health related monitoring programme. The concentrations are expressed as % of the value recorded in 1995 (Nyberg 2016).

In addition to the National Environmental Monitoring Programme, various regional programmes are being undertaken, on varying scales. Extensive monitoring is for example being conducted in the Lakes Vättern, Vänern and Mälaren.

Table 4. Summary of relevant matrices and substances included in the Stockholm Convention that are measured within the national environmental monitoring programmes in Sweden.

Matrix	Sampling frequency	Substances included in the Stockholm Convention	Remarks
STP Sludge and effluent water	Annually at 9 STPs	HCB, PBDE, PCB, PCDD/F, PCP, PeCB, PFOS	Data available from 2004 for sludge for seven of the STPs
Fish fresh water	Annually at 32 sites	DDT, HBCDD, HCB, HCH, PBDE, PCB, PCDD/F, PFOS	Data for 1967 for some locations and substances
Fish and blue mussels, marine waters	Annually for fish 25 sites	DDT, HBCDD, HCB, HCH, PBDE, PCB, PCDD/F, PFOS	Data from 1972 for some locations
Guillemot eggs	Annually at 1 site	DDT, HBCDD, HCB, HCH, PBDE, PCB, PCDD/F, PFOS	Data available from 1969
Sediment, offshore marine waters	Every 6 years	chlordanes DDT, endosulfan, HBCDD, HCB, HCBD, HCH,	First undertaken in 2003

		PBDE, PCB, PCDD/F, PCP, PeCB,	
Surface water	Annually at 4 sites with intensive agri-culture	aldrin, chlorodanes, DDT, endosulfan, HCH, heptaklor, HCB	Data available from 2002
Long-range transport, air and deposition	Annually at 3 sites, every month	aldrin, chlordanes, DDT, endosulfan, HBCDD, HCB, HCH, heptachlor, PBDE, PCB, PCDD/F, PFOS	Data available from 1996
Human breast milk and serum	Breast milk sam-pling annually at 2 locations and serum at 1 location	chlordanes, DDT, HBCDD, PBDE, PCB, PCDD/F, PFOS	Breast milk data available from 1972. Serum from 1996

SCREENING

The screening programme is a key part of the Swedish environmental monitoring programme for toxic pollutants that are not monitored on a regular basis. The purpose of the screening is to gain awareness of other chemical pollutants of importance, an understanding of the substances found in the environment, their respective concentrations, and the extent of human exposure to these substances. Many of these measurements are carried out in biota. Finding a substance in biota samples is a clear indication of its bioaccumulating potency.

POPS IN HUMAN BREAST MILK

Health effects on the developing fetus and infant, attributable to relatively high POP levels in women during pregnancy and nursing periods, cannot be excluded in Sweden. In order to estimate the body burdens of POPs among pregnant and breast-feeding women, POPs have been measured in pooled breast milk samples from the Stockholm area since the early 1970s. In another temporal trend study in the nearby County of Uppsala levels of dioxins, PCBs, brominated flame retardants (PBDEs, HBCDD), PFOS and several chlorinated pesticides have been measured in individual breast milk samples from primiparous mothers since 1996. PFOS and brominated flame retardants are also measured in serum.

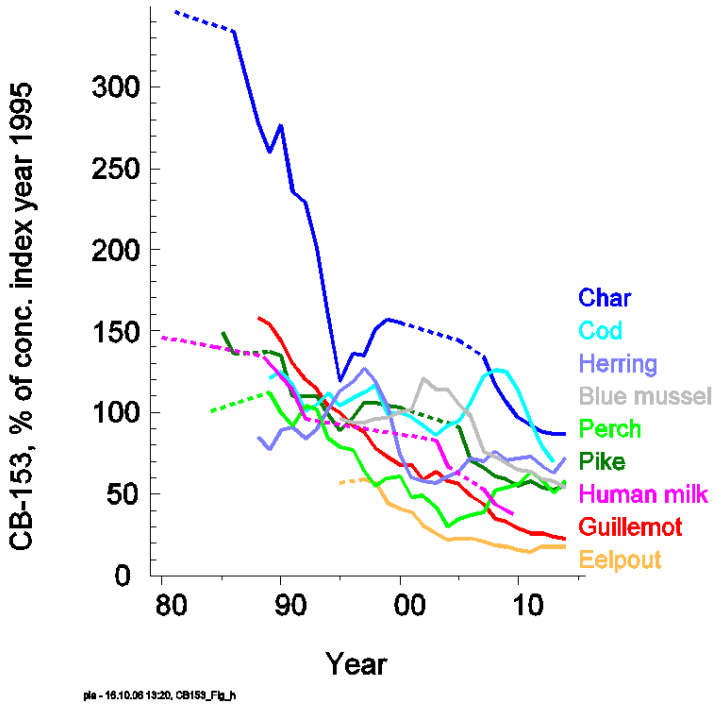

Figure 1. Temporal running mean smoother (5 years) of PCB-153, expressed as % of the value recorded in 1995. Data from the Marine monitoring programme and the Health related environmental monitoring (Nyberg 2016)

Monitoring of POPs in food

Within the Swedish Environmental Protection Agency (EPA), the Environmental Assessment Department is involved in a number of projects aimed at collecting data on POP levels in matrices of relevance to human health. Among these projects are studies of POPs in food, intake estimates, and surveys of POP levels in human breast milk and serum, activities that are being conducted by the National Food Agency (NFA) with financial support from the Swedish EPA.

The presence of POPs in food is regulated by means of maximum levels (MLs), and human exposure is in some cases restricted by (national) dietary recommendations. For example, the NFA has issued national dietary advice on fatty fish from the Baltic region. Since consumption of large quantities of fatty Baltic fish may lead to an intake of dioxins and dioxin-like PCBs that are above tolerable limits. MLs are becoming increasingly harmonised within the EU, one example being the MLs for dioxins and PCBs. The EU has also maximum levels for a number of persistent pesticide residues, including DDT, in food products. NFA reports annually to the EU on levels of dioxins, PCBs and several other POPs in foods, as a part of the national control programmes.

In five-year intervals NFA samples foods and beverages, covering over 90% of the Swedish food market, in a market basket study with the aim to follow temporal

trends of human POP exposure from food and beverages. The market basket studies cover many inorganic and organic contaminants, including dioxins, PCBs, chlorinated pesticides, brominated flame retardants and PFASs, such as PFOS.

Pesticide residues in fresh and preserved fruits and vegetables (imported as well as domestically grown), and occasionally in drinking water, are monitored by the National Food Agency. Results are published annually. Residues in water are monitored by the National Food Agency and others.

Arctic Monitoring and Assessment Programme

The Arctic Monitoring and Assessment Programme (AMAP) is one of six Working Groups of the Arctic Council. AMAP is mandated to produce sound science-based, policy-relevant assessments and public outreach products to inform policy and decision-making processes with respect to i.a. POPs. The assessments are based on national environmental monitoring and research. Assessments on findings of POPs in the Arctic environment is seen as an important source of information on long range transported substances, and as a member of the Arctic Council, Sweden participates in this work.

4.3 Technical assistance

Obligations

Article 12 places an obligation on developed country Parties to provide assistances to developing Parties and Parties with economies in transition in order to develop and strengthen their capacity to implement the obligations under the Convention. It also mandates the establishment of regional and sub-regional centers for capacity-building and transfer of technology.

Implementation so far

The Swedish Chemicals Agency (KemI) and the Swedish EPA have agreements with the Swedish International Development Cooperation Agency (Sida). Several capacity-building activities related to institutional capacity and chemicals legislation have been initiated based on those agreements, and have been reported separately to the Secretariat of the Convention and in the previous NIPs

Sweden prioritizes to support coherent implementation of activities with the overall objective to develop national structures and legislation for chemicals management to reduce the overall risks associated with chemicals. Implementation of POPs related activities should as far as possible be done in connection to other related issues. The Swedish Chemicals Agency is involved in global, regional and bilateral development cooperation with the aim to contribute to providing the basis for countries to raise their capacity to reduce the risks associated with chemicals, by providing guidance on the development of legislation and sustainable institutions for chemicals control. Swedish EPA’s core areas of expertise in development cooperation involve the identification and disposal of POP wastes in different medias.

During 2014 and 2015, the two Swedish agencies organised workshops with concerned organisations under the Ministry of Environment of China on chemicals control, management of solid waste including e-waste and contaminated sites. In 2015, the Swedish EPA organised also a Chinese study visit to Sweden for a GEF-project in China targeting e-waste.

As a measure to share experiences from the work on inventory and remediation actions of PCB in buildings the Swedish EPA hosted a side event during the 2017 Stockholm convention COP 8 meeting in Géneva. The Swedish EPA is a member of the intersessional working group to the Stockholm convention with the purpose to prepare a report on progress towards the elimination of PCB to be considered at the Stockholm convention COP 9 meeting in 2019.

The Swedish EPA manages since 2013 a governmental bilateral cooperation programme with strategic countries in the areas of environment and climate. Within this framework, funds have been allocated to the Swedish Chemicals Agency, for cooperation with a number of countries (China, Vietnam, Indonesia, Uruguay, Brasilia and South Africa) on activities related to the development of legal framework and institutional set-up for chemicals management. Within the same programme, the Swedish EPA runs bilateral activities with a number of countries (China, India and Russia etc.) focusing on capacity building of the public environmental management, pollution prevention and control of industries and waste management.

The Swedish EPA is engaged in a number of Arctic projects within AMAP, incl. Expert Group on Hazardous waste and has lead for the Expert Group on POPs. The Expert Group plans further activities on inventories of other dioxin emission objects in North Russia as well as promotion of the Stockholm Convention on POPs. A plan for a pilot project on reduction of mercury emissions from a coal combustion plan in Chelyabinsk has been drafted and start-up is being prepared for.

With relevance also to POPs, the International Training Programme (ITP) arranged by KemI in “Strategies for chemicals management” has supported the development of chemicals management capacities and therefore also the aims of the Stockholm Convention in so far 45 countries, (15 in Africa, 13 in Asia, 14 in Eastern Europe/Central Asia, and two in South America). The total number of participants is 395. The first set of eight programmes was organized 2006-2012, the second set of nine programmes 2013-2017. KemI has submitted an application to Sida for a new programme 2017-2021. The programme is designed for relevant governmental officials, in order to assist their administration in developing national strategies for chemicals management and sustainable development.

KemI has supported UNEP in the development of the LIRA-Guidance on legal and institutional infrastructures for the sound management of chemicals and measures for recovering costs of national administration (published 2015), including POPs. Testing of two test versions of the LIRA was supported in two countries (Nigeria,

Uruguay). As a follow up to the LIRA-Guidance, KemI since 2016 supports UNEP in developing four additional documents on chemicals control. This project involves both the development of an information document to give a collection of arguments about what chemicals control legislation can bring to countries and the development of three guidance documents. The three guidance documents will offer suggestions related to institutional functions and its funding risk reduction tools and enforcement of chemicals legislation. KemI has also supported the development of the report on Cost of inaction in the management of chemicals, published in February 2013 and the UNDP Case Studies in Partnership Initiative (testing in Cambodia and Zambia): Mainstreaming SMC Issues into MDG-based National Development Planning, published in 2012.

KemI continues to support in cooperation with FAO, PAN-AP and the Field Alliance a regional programme in South East Asia; Towards a Non-Toxic South-East Asia.. The main objective is to support sound management of pesticides, industrial and consumer chemicals by strengthening institutional capacity, legislation and enforcement as well as by developing and introducing farmers to sustainable of farming methods. Furthermore, bilateral cooperation with authorities in Serbia on chemicals risk management has been supported.

KemI further continues to support a Master course on Pesticide Risk Management, initiated in 2011 and organized by the University of Cape town, South Africa (UCT) in collaboration with FAO. The course is aimed at pesticide regulators, inspectors (health, labour, customs and environment), disposal and waste management managers from African countries, but is also suited for a range of researchers, academics, NGO staff and pesticide laboratory staff who are working in the field of pesticide management. The pesticide registrar's e-list Server and the Vula web platform at UCT are also supported, with the objective to provide and develop means for exchange of information and networking. To expand the course to cover chemicals in general and to establish at network also for chemicals in general is currently discussed. Work is also ongoing to support regional cooperation on pesticide management with the SADC region.

4.4 Financial assistance

Obligations

Article 13: All parties undertake to provide financial support and incentives in respect of those national activities that are intended to achieve the objective of the Stockholm Convention in accordance with their National Plans, priorities and programmes. Developed countries are required to provide new and additional financial resources throughout the financial mechanism to enable developing country Parties and Parties with economies in transition to meet the agreed full incremental costs of implementing measures which fulfil their obligations under the Stockholm Convention.

Implementation so far

Swedish financial assistance for POP-related activities will continue to mainly be channelled through the Global Environment Facility (GEF) as it is the financial mechanism of the Stockholm Convention. Sweden's total funding for GEF6 for the period 2014-2018 is 1,335 million SEK. In the period, 8-9 % of the GEFs funds are allocated for Persistent Organic Pollutants (POPs) projects. In addition Sweden has contributed to the Quick Start Programme Trust fund and the SAICM/QSP-secretariat to support capacity building and enabling activities, including POPs-related activities, under SAICM (Strategic Approach to International Chemicals Management). Sweden's total contribution to QSP during the period 2006-2015 amounts to 75 million SEK. Sweden has since 2015 supported the Operational Special Programme for Institutional Strengthening and is member of its executive board. The contribution 2015 was 1.5 million SEK and for 2016/2017 25 million SEK. Sweden has continued to support developing country participation in Stockholm Convention meetings during 2013, 2015 and 2017.

4.5 Reporting

Obligations

In accordance with article 15 each Party must report to the Conference of the Parties on the measures the Party has taken to implement the provisions of the Stockholm Convention and on the effectiveness of such measures in meeting the objectives of the Stockholm Convention. The reporting shall include data on the total quantity of production, import and export in Annexes A and B and a list of countries from which it has imported and exported substances.

Implementation so far

Sweden reported to the COP according to the timetable laid down by the COP. Sweden submitted its third National Report to the Stockholm Convention 29 August 2014 and will submit its fourth National Report by 31 August 2018 in accordance with Decision SC-7/23: Reporting pursuant to Article 15 of the Stockholm Convention. Furthermore, according to requirements in the POPs-regulation, statistics on production and placing on the market is reported annually to the European Commission. Every third year an extensive report on the implementation of the POPs-regulation is submitted.

4.6 Effectiveness evaluation

Obligations

Article 16: Conference of the Parties to periodically evaluate the effectiveness of the Stockholm Convention, starting four years after entry into force. The evaluation will be conducted on the basis of available scientific, environmental, technical and economic information.

Implementation so far

Article 9 of Regulation (EC) No 850/2004 stipulates that the Commission and the Member States, including Sweden, shall establish in close cooperation, appropriate programmes and mechanisms, consistent with the state of the art, for regular provisions of comparable monitoring data on the presence of dioxins, furans and PCBs as identified in Annex III in the environment.

Harmonized monitoring at EU-level exists for emissions of all byproduct POPs through the release register E-PRTR. There is also harmonized monitoring in the area of feed and food where it is recommended that a number of defined food and feed samples are analysed yearly. Common methods for sampling and analysis ensure comparability of the results that will be complied by the Commission in a database with the aim of having a clear picture of the time trends in background presence of these substances in feed and food.

Under the Water Framework Directive (Directive 2000/60/EC), Member States are obliged to monitor substances placed on the priority list (many of which have POP characteristics), if they are charged into the river basin or sub-basin. In addition, Member States/Sweden has to monitor also other pollutants if they are discharged in significant quantities in the river basin or sub-basin.

Analysis

The EU, including Sweden, will continue to play an active role in the international work regarding the effectiveness evaluation and will continue to generate exposure data for its territory.

Sweden plays an active role within the work of Western Europe and other Groups - WEOG-ROG, which contributes to the effectiveness evaluation of the Stockholm Convention. Sweden will continue to contribute to this important work.

4.7 Addition of future chemicals

Sweden is of the view that the presently listed substances in the Convention are not the only ones that fulfil the criteria in Annex D (Information requirements and screening criteria). There are other substances and groups of substances that are very persistent, bio-accumulate, are transported over long distances and have adverse effects on organisms, including humans. Swedish authorities will continue to monitor the environment and evaluate chemicals for emerging POP candidates, prepare technical reports and, where appropriate, notify the government about substances that warrant further attention.

The Stockholm Convention does not lay down any particular obligation concerning addition of chemicals to it, but allows any Party to propose amendments of the Stockholm Convention by nominating further substances for listing. Within the EU a nomination is to be done by the European Commission, and Sweden will continue to work with the EU Commission to nominate further candidates. A discussion among Member states on more substances to nominate by the European Commission is ongoing.

At the eighth Conference of the Parties in May 2017 two more substances were added to the Convention; deca-bromdifenyleter, deca-BDE and short-chain chlorinated paraffins, SCCP

Currently under review by the POPs Review Committee are perfluorooctanoic acid, PFOA and perfluorohexane sulfonate, PFHxS, both nominated by Norway, and dicofol nominated by the EU. Sweden will continue to actively participate in and support the POPs Review Committee in its work with nominated substances.

Substances nominated for listing in the Stockholm Convention such as PFOA are showing increasing levels at some places in the Baltic Sea, for example in Guillemot eggs the trend for the last years seems to increase (Bignert el al 2016). . The POP Review Committee under the Stockholm Convention considered at its meeting in 23 October 2017 the draft risk management evaluation on PFOA, its salts and PFOA-related compounds and decided that it should be recommended for consideration by the Conference of the Parties in 2019.

References

Apler and Josefsson 2016. Swedish status and trend monitoring programme. Chemical contamination in offshore sediments 2003– 2014. SGU-rapport 2016:04

Bergman 2010. Insamling och kemisk analys av miljöföroreningar i svensk modersmjölk - Resultat från 2008-2010. Report to the Swedish EPA.

Bignert et al 2015. Övervakning av metaller och organiska miljögifter i marin biota. Naturhistoriska riksmuseet, NRM. Rapport 2:2015.

Bignert et al 2016. Comments Concerning the National Swedish Contaminant Monitoring Programme in Marine Biota, 2016. Swedish Museum of Natural History. Report nr:5:2016.

BiPro 2005. Study to facilitate the implementation of certain waste related provisions of the Regulation on Persistent Organic Pollutants (POPs). Report to the EU Commission

Bjermo et al 2013. Fish intake and breastfeeding time are associated with serum concentrations of organochlorines in a Swedish population. Environment International 51 (2013) 88–96.

Boström 2015. Data av växtskyddsmedel i ytvatten 1983-2014. Underlagsrapport till Naturvårdsverkets regeringsuppdrag Screening av förekomsten av miljögifter.

Commission Regulation (EC) 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs.

Cousins et al 2005. Results from the National Screening programme 2004. Subreport 5: Mirex and Endoslufan. IVL report B 1641.

Danielsson et al 2014. Contaminants in fish from potentially polluted sites along the Swedish coast with the national monitoring programme as reference. Swedish Museum of Natural History. Report nr:8:2014.

EBH-stödet 2017. Swedish national database for contaminated land. Administrated by the county administrative boards. 2017-10-11

Ericson et al 2008. Screening of persistent halogenated compounds in human adipose tissue and blood from Sweden. Report to the Swedish EPA.

European Commission 2014. Common implementation strategy for the Water Framework Directive (2000/60/EC). Guidance Document No. 32 on biota monitoring (the implementation of EQSbiota) under the Water Framework Directive. Technical report 2014 – 83. 4

Glynn et al 2011. Regional differences in levels of chlorinated and brominated pollutants in mother's milk from primiparous women in Sweden Environment International 37 (2011) 71–79.

Glynn et al 2017a. Concentrations of polyfluorinated alkyl substances in the Swedish Market Basket 2015. Report to the Swedish EPA´s Health-Related Environmental Monitoring Programme, contract 2215-15-007.

Glynn et al 2017b. Temporal trends of perfluoroalkyl substances (PFAS) in individual serum samples from first-time mothers in Uppsala 1997-2016. Report to the Swedish EPA.

Gyllenhammar et al 2016a. Concentrations of four new brominated flame retardants (HBB, PBEB, BTBPE, DBDPE), PBDEs and HBCD in blood serum from first-time mothers in Uppsala 1996-2015. Report to the Swedish EPA.

Gyllenhammar et al 2016b. Temporal trends of poly- and perfluoroalkyl substances (PFASs) in serum from children at 4, 8, and 12 years of age, in Uppsala 2008-2015. Report to the Swedish EPA.

Gyllenhammar et al 2017a. Levels of persistent halogenated organic pollutants (POP) in mother´s milk from first-time mother´s in Uppsala, Sweden: results from year 2015 and 2016, an temporal trends of the time period 1996-2016. Report to the Swedish EPA.

Gyllenhammar et al 2017b. Temporal trends of poly- and perfluoroalkyl substances (PFASs) in pooled serum samples from first-time mother´s in Uppsala 1997-2016. Report to the Swedish EPA.

Haglund 2011. Results from the Swedish National Screening Programme 2010 Subreport 1. Polychlorinated naphthalenes (PCNs). IVL report B2002.

Haglund 2014. Screening av dioxiner och dioxinlika ämnen i bröstmjölk, fet fisk och annan mat. Halter av polyklorerade naftalener (PCN), bromerade dioxiner och furaner (PBDD/F), klorerade dibensotiofener samt klorerade dioxiner och dioxinlika PCB. Report for the Swedish EPA.

Haglund 2017. Miljöövervakning av utgående vatten & slam från svenska avloppsreningsverk. Resultat från år 2015 och en sammanfattning av slamresultaten för åren 2004-2015. Report to Swedish EPA.

Hardell et al 2010. Time trends of persistent organic pollutants in Sweden during 1993–2007 and relation to age, gender, body mass index, breast-feeding and parity. Science of the Total Environment 408 (2010) 4412–4419

Helander 2008. Swedish Museum of Natural History. Havet 2008, s 93.

Jogsten et al 2010. Analysis of POPs in human samples reveal a contribution of brominated dioxin of up to 15% of the total dioxin TEQ. Chemosphere 78 (2010) 113–120.

Jönsson et al 2014. Tidstrender för och halter av perfluorerade alkylsyror (PFAAs) i serum samt ftalatmetaboliter och alkylfenoler i urin hos unga svenska män och kvinnor– Resultat från den fjärde uppföljningsundersökningen år 2013. Report for the Swedish EPA

Kaj and Palm 2004. Screening av hexaklorbutadien (HCBD) i miljön. IVL report B 1543.

Kemiinformation 2013. Uses of PFOS in Sweden 2012/13 in the areas exempted from the ban.

KEMI 2012. Kemikalieinspektionen. Tillsyn 8/12 Kemikalier i inomhusmiljön – Golv.

KEMI 2015. Kemikalieinspektionen. Rapport 6/15. Förekomst och användning av högfluorerade ämnen och alternativ. Rapport från ett regeringsuppdrag.

KEMI 2016. Kemikalieinspektionen. Tillsyn 3/16. Textil och läder, Ett tillsynsprojekt om skor och fritidskläder.

KEMI 2017. Kemikalieinspektionen, rapport 6/17. Handlingsplan för en giftfri vardag. Slutredovisning. Rapport från ett regeringsuppdrag

Larsdotter et al 2005. Serumnivåer av pentaklorfenol, polyklorerade bifenyler och hydroxylerade metaboliter av PCB under graviditet och amning. Report to Swedish EPA.

Liu et al 2014. Sources of unintentionally produced polychlorinated naphthalenes, Chemosphere 2014.

Livsmedelsverket 2012. Cantillana, T. och Aune, M. Dioxin- och PCB-halter i fisk och andra livsmedel 2000-2011. Livsmedelsverket Rapport 21 – 2012.

Livsmedelsverket 2013. Rapport 4-2013. Kontroll av bekämpningsmedel i livsmedel 2010.

Livsmedelsverket 2014. Rapport 5-2014. Kontroll av bekämpningsmedel i livsmedel 2011 och 2012.

Lundin L., Jansson S. (2017) A desktop study on destruction of persistent organic compounds in combustion systems. Umeå University

Mark- och Miljööverdomstolen Svea Hovrätt, 2014; M 7429-13

Norström, K., Viktor T., Palm Cousins A., Rahmberg, M. (2015) Risks and Effects of the dispersion of PFAS on Aquatic, Terrestrial and Human populations in the vicinity of International Airports Final report of the RE-PATH project 2009-2014. IVL rapport B 2232

Nyberg 2016. Elisabeth Nyberg. Impoved assessment in environmental monitoring of POPs. Using monitoring data from the aquatic ecosystem and human milk. Thesis, Stockholm University 2016.

Nyberg et al 2017. Monitoring of POPs in human milk from Stockholm and Gothenburg, 1972-2015. Swedish Museum of Natural History. Report nr:9:2017.

Salihovic et al 2016. The metabolic fingerprint of p,p′-DDE and HCB exposure in humans. Environment International 88 (2016) 60–66.

SGI 2015. Statens geotekniska institut. Preliminära riktvärden för högfluorerade ämnen (PFAS) i mark och grundvatten. Rapport från ett regeringsuppdrag. SGI publikation 21.

SGI 2017. Föroreningsproblematik vid gamla handelsträdgårdar – råd vid miljötekniska undersökningar. SGI Publikation 34

SGU 2016. Erfarenhetsåterföring dioxinförorenade sågverksområden - kan fördjupad riskbedömning leda till effektivare åtgärder? Erfarenhets-PM. 10 juni 2016.

Sjöberg et al 2016. Sakrapport med data från övervakningen inom Programområde Luft t.o.m. 2015. IVL report C224.

Swedish Chemicals Agency 2014. Update to include Endosulfan in the Swedish National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants. Report nr 462a-H14-03500.

Swedish EPA 2005. Höga halter av miljöfarliga ämnen i miljön? Resultat från Miljöövervakningens Screeningprogram 1996 – 2003. Rapport 5449, februari 2005.

Swedish EPA 2007. Oavsiktligt bildade ämnens hälso- och miljörisker - en kunskapsöversikt. Rapport 5736, oktober 2007.

Swedish EPA 2009. Naturvårdsverket Rapport 5911. Betydelse av pentaklorfenolbehandlat trä för spridning av dioxiner i miljön, ISBN 978-91-620-5911-8.

Swedish EPA 2013. Karin Wiberg et al. Orsaker till dioxinproblemet i Östersjöregionen och förslag till åtgärder

Swedish EPA 2014a. Naturvårdsverket Rapport 6634. Biociders spridning i miljön och deras hälso- och miljörisker - Screening år 2000-2013. En kunskapsöversikt, ISBN 978-91-620-6634-5.

Swedish EPA 2014b. Översyn av nationell akvatisk miljögiftsövervakning 2014. Programområden Sötvatten och Kust och hav. Rapport 6627, december 2014.

Swedish EPA 2016. Högfluorerade ämnen (PFAS) och bekämpningsmedel. En sammantagen bild av förekomsten i miljön Redovisning av ett regeringsuppdrag. Rapport 6709, mars 2016.

www.ivl.se. Hosts data from screening studies ordered by the Swedish EPA.

Woldegiorgis, A., Andersson, J., Remberger, M., Kaj, L., Ekheden, Y., Blom, L. and Brorström-Lundén, E. (2006) Results from the National screening program 2005. Subreport 3: Perfluorinated alkylated substances. IVL Svenska Miljöinstitutet, IVL rapport B1698.

Annex I Roles and responsibilities

Ministries in Sweden generally have relatively small staffs and their work is largely devoted to policy-making. The responsibilities for supervision are given to a number of semiautonomous government agencies under but outside the ministries. The responsibilities of central, regional and local authorities with regard to supervision (inspections, etc.) under the Environmental Code are listed in the next sections. The central agencies for enforcement of the Environmental Code are also listed. For information purposes, authorities responsible for other legislation of relevance in connection with POPs have been included in the tables.

Responsibilities of ministries and central government agencies

Swedish agencies are heavily engaged in the preparation of positions in EU negotiations and in the implementation of Community legislation. This requires smooth co-operation and effective exchange of information with the Government, which is the body that makes decisions on the national positions when new EU law is developed.

Public administration in Sweden is both self-governing and subordinated to political decision-makers. There has traditionally been a sharp division between politics and administration. The split between Government and Agencies is a manifestation of this. The Government or the Riksdag (Swedish Parliament) may not dictate how an Agency shall decide on an individual issue relating to the application of national law. The Government has, through the authority vested in an Agency or through established practice, given the administrative agency the right to act on its own on the basis of more or less precise instructions from the Government.

In the case of implementing Community legislation, the Agencies can often decide within their existing mandates what Swedish legislation is required for the implementation of Community law. Agencies may issue regulations, while ordinances are issued by the Government and laws by the Riksdag. The distribution of power between the Government and the Agencies in the issuing of regulations makes great demands on co-ordination. The Agencies have to inform the Government how Community legislation has been implemented by them in Swedish regulations.

The Swedish Environmental Protection Agency is the central administrative authority with responsibility, alongside regional and local authorities, for protection of the natural environment under the provisions of the Environmental Code. This responsibility encompasses environmental protection in a wide sense, including the use of land, chemicals and waste and the conservation of biological diversity. The Agency issues a range of regulations designed to safeguard the environment, including regulations on pesticide use in agriculture, and gives guidance. The

Agency may intervene before the Land and Environment Courts on behalf of the environment. The Agency also reports to the EU and is competent authority according to article 7.4 and 7.5 of the POPs Regulation. The Agency is responsible for the coordination of the follow-up for seven of Sweden's sixteen national environmental quality objectives.

The Swedish Chemicals Agency (KemI) is the main responsible agency for supervising chemicals that are placed on the market. It is a driving force in efforts to achieve the environmental quality objective of 'A non-toxic environment'. The Agency is a supervisory authority under the Ministry of the Environment and Energy and works at the national, EU and global levels to limit the health and environmental risks associated with chemicals. KemI keeps a product register and maintains a number of databases to support its work and that of other agencies. Pesticides must be approved before they may be placed on the market. KemI controls that health and environmental requirements are met. In the Pesticides Register it is possible to search on approved pesticides, companies and exemptions, on the website: http://webapps.kemi.se/BkmRegistret/Kemi.Spider.Web.External/ KemI checks companies' compliance with applicable regulations, provides support to local authorities, provides support to other countries and issues reports and publications. KemI makes its expert knowledge available through several duty officers and its website www.kemi.se, with a large number of databases and up-to-date information on chemicals, plant protection products and biocides.

The Swedish Agency for Marine and Water Management (SwAM) was started in July 2011 and has the responsibility to manage the use and prevent overuse of Sweden's sea and freshwater environments. SwAM has the overarching responsibility for the enforcement of national and international legislation pertaining to waters. The work is largely steered by European legislation such as the Water Framework Directive and its daughter directive on priority substances and the Marine Strategy Framework Directives, regional conventions such as OSPAR and HELCOM as well as Swedish law and relevant national Environmental Quality Objectives. The authority is responsible for the monitoring of the aquatic environment, although this responsibility is shared with the Environmental Protection Agency when it comes to hazardous substances. An important tool is marine spatial planning to solve issues that arise from conflicting interests between protection and usage. The authority also has a special responsibility to regulate commercial fishing in Swedish waters. The authority may intervene before the Land and Environment Courts on behalf of the environment.

The National Food Agency is the central administrative authority for matters relating to food, with the role of actively promoting safe foods of high quality. It is responsible for the food control including pesticide, veterinary drug and contamination control. Foods are also monitored for contaminants for which maximum limits are lacking in the food legislation.

The Swedish international development cooperation agency (Sida) is a government organization under the Swedish Foreign Ministry that administers approximately half of Sweden's budget for development cooperation. The overall target of Sweden's development assistance is to ensure that those in poverty have the ability to improve their living conditions. Sida supports interventions that encompass several areas, such as environment and climate and agriculture and food security, two areas that include the sound management of chemicals.

The Swedish Work Environment Authority is responsible for monitoring chemical risks in the workplace and ensuring that employers comply with the requirements of the Work Environment Act. Through inspections and by other means, the authority checks that limit values are not exceeded.

The Swedish Board of Agriculture is the Government's expert authority in the field of agricultural and food policy, and the agency is responsible for the agriculture, horticulture and reindeer husbandry sectors. It also has a responsibility for feedstuffs.

The Swedish Forest Agency is the Government's expert authority on forests and forest policy. It has a responsibility for the protection of woodland natural habitats.

The Medical Products Agency is responsible for chemicals in pharmaceuticals and cosmetics.

Regional (State) and local (municipal) supervision

The County Administrative Board exercises supervision of hazardous activities such as chemicals management, where KemI is not responsible, and waste management within the county. Municipal authorities engaged in work within the environmental or health protection area exercise supervision within each municipality. These authorities are often referred to as Environmental Boards. Regional and local supervision of the occupational environment is exercised by the Swedish Work Environment Authority. The County Administrative Boards also give guidance on enforcement and supervision to the municipal authorities.

Chemical emergency information centres for accident prevention and response

There are two chemical emergency information centres in Sweden*; the Swedish Poisons Information Centre and the Swedish Civil Contingencies Agency (MSB). The Swedish Poisons Information Centre* monitors and gives information on acute poisonings and accidents related to human exposure to chemicals in all situations i.e. on an individual basis and in mass exposure situations. The Centre also acts as the Chemical Emergency Response Centre for the Swedish Chemical Industry.

This means that the Centre gives information on environmental aspects of chemical release, provided that the chemical industry has supplied this information to the Centre. This activity is run in close collaboration with the Swedish Civil Contingencies Agency (MSB)

The Swedish Civil Contingencies Agency (MSB) is responsible for chemical emergency information dealing with activities related to rescue actions and environmental aspects. When an accident happens where chemicals are involved e.g. when transporting dangerous goods, the rescue leader seeks relevant information on how to deal with the chemical(s) first of all in his own files. Pertinent information can also be found in the transport documents. Information is also available from the Rescue Services Information Bank at the Swedish Civil Contingencies Agency (MSB) This Agency has a stand-by person ready (within half an hour) to assist municipal rescue services in all types of accidents.

Annex II Institutional, policy and regulatory framework

In April 1999 the Swedish Parliament adopted national environmental quality objectives, describing what quality and state of the environment and the natural and cultural resources of Sweden which are environmentally sustainable in the long term. In a series of decisions, the Parliament subsequently has adopted interim targets, indicating the direction and timescale of the action to be taken to move towards these objectives. The overall goal of environmental policy is to hand over to the next generation a society in which the major environmental problems have been solved, without increasing environmental and health problems outside Sweden's borders.

As we work towards the goal of sustainable development, Sweden's environmental quality objectives, of which there are now sixteen, are being used to lend visibility to the ecological dimension of the process.

One of the sixteen objectives adopted by the Swedish Parliament is 'A Non-Toxic Environment'. The Stockholm Convention's aim of protecting human health and the environment from persistent organic pollutants is a component part of the endeavour to achieve this objective. As the agency with overall responsibility for the environmental quality objective, the Swedish Chemicals Agency co-ordinates work on the objective. Enterprises, operators and consumers can make important contributions along with municipalities, county administrative boards and responsible central agencies. An in-depth evaluation of the environmental goals is performed regularly. The aim of the in-depth evaluation is to establish whether the policy instruments used or the objectives themselves need to be revised. The evaluation report describes the progress made towards the objectives and includes proposals on such matters as appropriate measures, instruments, resources, organisational arrangements and, where relevant, changes to interim targets or monitoring systems (www.miljomal.nu).

In December 2010 the Swedish Government instructed the Swedish Chemicals Agency to produce a national action plan for a toxic-free everyday environment. This plan included the measures needed in the period 2011–2014 to reduce the risk faced by people of being exposed to hazardous chemicals in their everyday lives. The Swedish Chemicals Agency has been assigned by the government to continue work on the action plan during 2015–2020. Chemical hazards in the working environment are not part of this assignment. Implementation of the plan will involve collaboration with other government agencies, industry, the scientific community, environmental groups and consumer organisations. See further information at http://www.kemi.se/en/about-us/our-work/action-plan-for-a-toxic-free-everyday-environment. With HELCOM's Baltic Sea Action Plan (BSAP) the Baltic Sea

countries have committed themselves to achieve a "Baltic Sea with life undisturbed by hazardous substances".

A Non-Toxic Environment

The environmental quality objective 'A non-toxic environment' states as follows: *The occurrence of man-made or extracted substances in the environment must not represent a threat to human health or biological diversity. Concentrations of non-naturally occurring substances will be close to zero and their impacts on human health and on ecosystems will be negligible. Concentrations of naturally occurring substances will be close to background levels.*

The environmental quality objective 'A Non-Toxic Environment' aims to ensure that:
– total exposure to chemical substances via all sources of exposure is not harmful to people or biodiversity,
– as far as possible, severely hazardous substances are no longer used,
– there is very little spread of unintentionally produced substances with hazardous properties, and information is available concerning the formation, sources, emissions, and spread of the most significant of these substances and their degradation products,
– contaminated sites are remediated to such an extent that they do not represent a threat to human health or the environment,
– knowledge about the environmental and health properties of chemical substances is available and sufficient for the purposes of risk assessment, and
– information is available about substances hazardous to the environment and health that are present in materials, chemical products, and articles.

Further information including milestone targets can be found at http://www.miljomal.se/sv/Environmental-Objectives-Portal/

The co-ordinating mechanisms at the ministerial level, at agency level as well as between the levels are well established and work effectively. The necessary co-ordination is assured by e.g. regulations in Government Ordinances or in other government decisions. The roles of existing government agencies are well defined through relevant legal acts. Chapter 26 of the Environmental Code states that, when warranted, the supervisory agencies shall cooperate in the work of supervision.

The Swedish Chemicals Agency, the Swedish Environmental Protection Agency and the Swedish Work Environment Authority have agreed on common strategies for chemicals control nationally and internationally. The ministries as well as the agencies, when preparing legislation and other decisions concerning chemicals, as a rule invite other ministries and agencies involved to take part or submit comments. All interested stakeholders, e.g. industry, trade unions and public interest groups are frequently brought into the process.

The objectives and scope of the Environmental Code

The Environmental Code is to be applied so that the health of humans and the environment is protected against damage and nuisance, irrespective of whether these are caused by pollution or other influences. Furthermore, valuable natural and cultural environments shall be protected and conserved and biological diversity shall be preserved. Land, water and the physical environment generally shall be used so that, from an ecological, social, cultural and socio-economic viewpoint, the long-term good management of resources is assured. Finally, reuse and recycling together with other management of material, raw materials and energy shall be promoted so that an ecological cycle (‘eco-cycle’) is attained.

The fundamental rules of the Environmental Code apply, in principle, to all human activity that may harm the environment. The general rules of consideration are the most central provisions. These indicate that operations must be conducted and measures taken so that harm to the health of humans and the environment is averted. Simultaneously, the efficient management of land, water and other resources is promoted. Unless otherwise provided, the rules of the Environmental Code apply to all operations and measures that affect the environment. It is immaterial whether the operation or measure takes place as part of a commercial operation or if it is conducted by a private individual. Thus, the Environmental Code applies to everything from major projects, such as building and operating hydroelectricity plants or motorways, to small individual measures, such as washing a car with detergents or composting household waste.

Precautionary measures

The fundamental rule for consideration in the Environmental Code means that everybody who is to conduct an operation or take a measure must perform those protective measures, observe the limitations and take the precautionary measures that are required in order that the operation or measure will not harm health or the environment. The rule is a natural consequence of the Polluter Pays Principle prepared by the OECD in the early 1970s. The obligation to take precautionary measures is also closely linked to internationally recognised principles, e.g. Principle 15 of the Rio Declaration and subsequent developments in the Cartagena Protocol, the Stockholm Convention and other international instruments. According to the precautionary principle, precautionary measures must be taken as soon as there is reason to assume that an operation or a measure may injure human health or the environment. The person conducting the operation or taking the measure cannot excuse himself by the absence of complete scientific evidence that harm arises.

Examples of appropriate precautionary measures include:

- the minimisation of emissions by the use of a particular filter or careful purification of waste water;
- that garden waste is not burned during unfavourable wind conditions;

- the erection of noise barriers;
- that chemicals are dealt with on a hard surface so that spills do not penetrate the ground;
- that dams are built in accordance with safety requirements and without constituting migration obstacles to fish; that the number of animals in agriculture is limited; or
- that a person arranging outdoor recreation for others informs the participants about the meaning of the right of public access.

Best available technology

Commercial operations must apply the best possible technology to avoid damage. The technology must, from the technical and financial viewpoint, be industrially feasible to apply within the type of business in question. This means that it must be available and not only exist at an experimental stage. However, the technology does not have to be located within Sweden. In the case of existing activities, a certain transitional period is sometimes required for the introduction of equipment corresponding to what is considered to represent the best possible technology.

Knowledge

Anyone intending to commence an operation must first acquire the knowledge required to determine the environmental effects that may arise. There is, of course, a difference in the requirements that may be imposed concerning a private individual's knowledge of the effect of various everyday measures on the environment and the requirements that may be imposed on someone responsible for operating industrial activities when choosing, for example, various chemical products required for the activity. However, it is always the possible effect of a measure, which determines the required knowledge.

The Product Choice (Substitution) Principle

Everybody who is to take a measure must avoid using or selling chemical products or bio-technical organisms that can harm human health or the environment, if these may be replaced with such products or organisms that may be assumed to be less hazardous. Corresponding requirements apply as regards goods containing or which have been treated with a chemical product or bio-technical organism. The provisions express the product choice principle, or the substitution principle.

An assessment must be made in every individual case. Prohibition of the use or sales can never be imposed generally for a product, an organism or goods. Instead, general prohibitions of chemical products that are so hazardous that they cannot be permitted under any circumstances, and also prohibitions of such products where equally effective substitutes involve a manifest advantage from the environmental viewpoint, may be imposed under the provisions of the chapter of the Environmental Code dealing with chemical products.

It should be observed that the product choice principle does not only apply to commercial sale or use. The rule applies also to a private individual who takes a measure. When a car owner washes his/her car and is to purchase detergents for this at a garage, he/she must choose the substance that is the least hazardous to the environment as possible yet nevertheless cleans the car. A correct choice presupposes that the goods are labelled in such a manner that the consumer obtains correct information about the properties of the product.

In the POPs area, the Swedish Chemicals Agency promoted the idea of substitution by preparing and publishing a report entitled Alternatives to Persistent Organic Pollutants (KemI Report 4/96). This report, which was submitted to the IFCS/UNEP ad hoc Working Group on Persistent Organic Pollutants at its final meeting in Manila, Philippines, in June 1996 was instrumental in creating the consensus that global action against POPs was warranted.

PRIO is a web-based tool (in Swedish and English, www.kemi.se) developed and maintained by the Swedish Chemicals Agency, intended to be used to preventively reduce risks to human health and the environment from chemicals. The aim of PRIO is to facilitate in the risk assessment so that people who work as environmental managers, purchasers and product developers can identify the need for risk reduction. To achieve this PRIO provides a guide for decision-making that can be used in setting risk reduction priorities. The target groups for PRIO are primarily Swedish actors but also include chemical suppliers to Sweden in other countries. PRIO also provides a source of knowledge for environmental and health inspectors, environmental auditors, risk analysts and those who in some other way can influence the use and handling of chemicals. Linked to PRIO are a number of environmental and health criteria, including PBT for the substances to be prioritised. The recommendations on which chemicals are prioritised for risk reduction measures are based on the environmental quality objective “A non-toxic environment” adopted by the Swedish parliament, work towards sustainable development and are in line with the objectives in the EU chemicals legislation, REACH. Throughout PRIO reference is made to Swedish legislation and other Swedish considerations.

In 2010 the Swedish Chemicals Agency developed a statistical database “The Commodity Guide“, giving examples on what materials approximately 1,000 groups of products can be made of and what chemicals can be part of these materials. The Commodity Guide is an attempt at placing commodities in a system, providing an overview of commodities and material used in Sweden. The aim of The Commodity Guide is to provide a guide to product developers and purchasers in decision-making and find alternatives. The idea is that those who possess knowledge about individual groups of commodities or materials should be able to contribute with data to develop the Commodity Guide.

Producer responsibility

Regulations about producer responsibility may be issued under the Environmental Code. Producer responsibility means that the producer must ensure that the waste is collected, transported away, recycled, reused or disposed of in such a manner as may be necessary from the viewpoint of health and environmentally acceptable waste handling. Such regulations may be issued as regards waste from the goods and packages that producers manufacture, import or sell and the waste from the operations they conduct. The expression 'producer', in this context, also comprises a party who imports or sells goods or packages.

To date, the Government has made rules on extended producer responsibility in many areas, e.g. recycled paper, tyres, packages, vehicles and electric and electronic products.

Environmental quality standards

An important provision in the Environmental Code permits the introduction of environmental quality standards. Under this provision, the Government may issue regulations for certain geographical areas or the whole of Sweden. These may concern the quality of land, water, air or the environment generally, if this is necessary to ensure long-term protection of, or remedy adverse effects on human health or the environment. Such regulations are referred to as environmental quality standards. Standards, which Sweden is required to introduce under EU rules, may also be issued by authorities other than the Government.

Under the definition used in Sweden, environmental quality standards are statutory, different categories of limits values, regarding some aspects of environmental status. The most stringent standards are those which may not be exceeded. Another category of quality standards represents values which should be strived for and possibly be attained, associated with a time frame or time limit. A third category of standards represents maximum or minimum occurrence of organisms in a water body, that can serve as indicators of the state of the environment. There are also environmental quality standards which are directly linked to EU law, with the subsequent legal implications. Environmental quality standards specify the levels of pollution or disturbance which humans, the environment or natural ecosystems may be exposed to without risk of significant detriment. Environmental quality standards for priority substances fall into the category of standards that must not be exceeded, according to Directive 2008/105/EC of the European Parliament and of the Council of the 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council, amended by Directive 2013/39/EU.

To date, several ordinances setting out environmental quality standards have been adopted under the provisions of chapter 5 of the Environmental Code. The great majority of the environmental quality standards are based on EU Directives.
The Ordinance (2010:477) on environmental quality standards for ambient air contains standards relating to nitrogen dioxide, oxides of nitrogen, sulphur dioxide, carbon monoxide, lead, benzene, particulate matter PM10 and PM 2,5, ozone benzo(a)pyrene, arsenic, cadmium, mercury and nickel in ambient air.
The Ordinance (2001:554) on environmental quality standards for fish and bivalve waters contains standards and guide levels for parameters such as zinc, dissolved copper, temperature, dissolved oxygen, pH, phenol compounds, ammonia, ammonium, nitrites and salinity.

The Ordinance (2004:675) on environmental quality standards for noise requires strategic noise mapping and the establishment of action programmes to limit, for example, road traffic, aircraft and railway noise.

There is also an Ordinance (2004:660) on Water Quality Management that sets environmental quality standards for bodies of surface water and which implements the Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water police and its daughter directive (Directive 2008/105/EC) as well as the Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration. According to this ordinance, environmental quality standards for surface and ground water bodies shall be set by the relevant authorities and the standards generally need to be fulfilled at specific points of time. Priority substances and their EU wide Environmental Quality Standards for surface waters are specified in the Directive (2008/105/EC). Sweden has implemented these and additional national standards in HVMFS 2013:19. These standards include a biota standard for non dioxinlike PCBs and pentachlorbensene. As regards the marine environment the Ordinance (2010:1341) on marine environment sets environmental quality standards for marine waters. The ordinance implements the Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy.

Public agencies and local authorities are required to ensure that environmental quality standards are met when reaching decisions on permits and similar approvals. This applies to determinations under both the Environmental Code and other legislation, for example the Planning and Building Act, the Roads Act and the Nuclear Technology Act. Permits may not be issued for operations that entail an infringement of an environmental quality standard. Furthermore, an existing permit may be reconsidered if the operation in question significantly contributes to an environmental quality standard not being achieved.

When public agencies and local authorities exercise supervision or issue regulations, too, environmental quality standards have to be met. They must also be observed in in the urban planning process. Municipal plans under the Planning and Building Act may not be adopted in contravention of the standards. An action programme is required to be prepared if this is necessary to comply with an environmental quality standard or if such a programme is called for under EU law. The programme will be prepared by the Government or by a government agency or local authority. Programmes of measures are developed by the five river basin district authorities.

The action programme must state what measures are to be taken to ensure compliance with the relevant environmental quality standard, which authorities and municipalities are to ensure that these measures are taken, and when they are to be implemented.

The principle of appropriate localisation

The choice of location for an operation has a major impact on what environmental disturbances that may arise. In the case of operations and measures that involve the use of areas of land or water, other than on a purely temporary basis, sites must be chosen that are appropriate with regard to the objectives and resource management provisions of the Environmental Code.

Sometimes, several locations may be suitable for an activity. When choosing between them, it is necessary to select a site which enables the purpose to be attained with the least possible damage or detriment to human health and the environment. In other words, the most appropriate site must be chosen. Factors that may be relevant to a localisation decision include sensitivity to discharges to water bodies, nature conservation at the location where the operation is to be conducted, and distance from housing areas.

The provision on appropriate localisation is of most significance when a location is to be chosen for an operation that has not yet commenced. However, it also applies to extensions to existing installations. In addition, it is to be taken into account when permits are reconsidered. In such a situation, relocation may be required. However, such a requirement must not be unreasonable.

The resource management and eco-cycle principles

Everyone undertaking an operation or measure is required to conserve raw materials and energy and to reuse and recycle them wherever possible. In the first instance, renewable sources of energy are to be used. This provision of the Environmental Code represents the resource management and ‘eco-cycle’ (or ‘closed loop’) principles.

As regards both these principles, the best effects can be achieved at the design and manufacturing stages. The principles are to be applied, inter alia, in the consideration of permit applications for environmentally hazardous activities. This extends the scope of permit decisions compared with earlier legislation.

Environmentally hazardous activities and health protection

The general provisions of the Environmental Code, for example the general rules of consideration, naturally apply to environmental hazardous activities and to other measures that may affect human health. In addition, chapter 9 of the Code contains special provisions on environmentally hazardous activities and health protection.

The concept of 'environmentally hazardous activity'

An environmentally hazardous activity is defined as any use of land, buildings or structures that involves an emission to land, air or water. The same applies to uses that entail other forms of detriment to human health or the environment, for example caused by noise, vibration or radiation. Ionising radiation, for example gamma, X-ray and particle radiation, is also included.

To be regarded as environmentally hazardous, an activity does not need to be hazardous to the environment in the individual case. Nor need too much be read into the word 'activity'. The concept of 'use' is to be viewed in a long-term perspective, which means, for example, that a landfill site where waste is no longer deposited will be covered as long as there is a possibility of it resulting in pollution. The decisive factor is the effect of the activity, and not the actual running of the operation.

General rules on environmentally hazardous activities

The Swedish Government is empowered to issue general regulations concerning environmentally hazardous activities. The Government may issue regulations, applicable to particular parts of Sweden, prohibiting the emission of wastewater, solid matter or gas or the disposal of solid matter. This applies if the activity in question may result in surface water, land or groundwater being polluted or affected in some other way. The mandate may be used, for example, to prohibit emissions to a lake that is an important source of drinking water, or which supports rare or particularly valuable species of fauna and flora.

In other cases, too, the Government may issue rules laying down prohibitions, protective measures, restrictions and other precautions. The intention is that the powers granted will in part be used to transpose EC legislation into Swedish law and to comply with other international obligations, and also to introduce regulations of a general nature for a particular sector. Such regulations may be used instead of individual permit decisions.

Under the Environmental Code, the Government may require that permits be obtained for or notification given of an environmentally hazardous activity. Such activities may be assigned to one of three lists, A, B or C. Environmentally hazardous activities included on the A list require a permit from the Land and Environment Court. The B list comprises activities for which permit applications are instead considered by county administrative boards or municipal committees. Finally, the C list includes environmentally hazardous activities that are subject to a requirement to notify the county administrative board or the local authority.

Even if an activity is not subject to a permit requirement, the supervisory authority may in a particular case require an operator to apply for a permit if there is a risk of significant pollution or other substantial detriment. Where changes are made to existing activities, too, it may be necessary to apply for a permit. In such cases the law requires an overall assessment to be made of the entire operation. This will avoid several permit decisions being in force for a single operation; otherwise each individual permit would apply only to the part that has been altered. However, an overall assessment is not required in the case of minor alterations. Existing activities which have not actually been altered, but which were started before the permit requirement was introduced, are also subject to this requirement. It also applies to activities which under the earlier rules obtained an exemption from the requirement to hold a permit.

Under earlier legislation, the permit system in principle only applied to emissions from environmentally hazardous activities. The Environmental Code requires a broader assessment, also taking into account questions concerning the management of natural resources and use of chemicals. Furthermore, it is now possible to make a combined assessment of permit applications for both an environmentally hazardous activity and a water operation, if they are submitted by the same applicant and relate to the same activity or to activities that are connected with each other.

Health protection

The Environmental Code contains special provisions designed to prevent any detriment to human health, i.e. any disturbance which, from a medical or public health point of view, may have adverse effects on health. Disturbances that are trivial or purely temporary are not covered. The definition is somewhat wider than the expression ‘sanitary nuisance’ used in earlier legislation.

Under the Code, housing and public premises are required to be used in such a way as to prevent detriment to health. They must be kept free of vermin and other pests. Installations for the supply of groundwater must likewise be established and used in such a manner that no detriment to human health arises. Municipalities may introduce a permit or notification requirement for new groundwater supplies in areas

subject to water shortages. A permit may also be required for the keeping of animals in an area subject to a detailed development plan or area regulations, provided such a requirement is necessary to prevent detriment to human health.

Contaminated sites

Remediation of contaminated sites is also governed by the Environmental Code, which clarifies the question of responsibility for the remediation of contaminated areas of land and water. The rules are based on the Polluter Pays Principle (PPP). The Code states, for example, that persons who pursue or have pursued an activity or taken a measure that causes damage or detriment to the environment are responsible, until such time as the damage or detriment ceases, for remedying it to the extent deemed reasonable. Where the Code so provides, the person may instead be liable to pay compensation for the damage or detriment.

Liability for remediation rests primarily on the present or previous operator. In the second hand it is the landowner that is responsible. For a site that is owned for private housing, it is a precondition for liability that the purchaser knew about the pollution. If several operators or landowners are responsible, they will normally be jointly and severally liable. Remediation liability means that the party responsible must, to the extent that is reasonable, perform or pay for remediation. Under the transitional provisions of the Environmental Code, this liability applies to activities undertaken after 30 June 1969.

An owner or user of a property must immediately notify the supervisory authority if contamination is discovered. This requirement applies even if the site was previously considered to be contaminated. If a land or water area is severely contaminated and it is necessary to restrict the use of the land, then the county administrative board must declare it an environmental hazard zone.

Chemical products and biotechnical organisms

The general rules of consideration in chapter 2 of the Environmental Code also apply with regard to chemical products and biotechnical organisms. The knowledge requirement and the product choice principle are of particular importance. In addition, chapter 14 contains special provisions concerning chemical products and biotechnical organisms. The Environmental Code is complemented by an Ordinance on pesticides which supplements the Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC and the Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products. Additionally, there are Ordinances regulating the (placing on the market and) use of nematodes, insects and spiders for plant protection and biocidal purposes.

In the Code chemical product is defined as a chemical substance or preparation of chemical substances. Bio-technical organism is defined as a product that has been specially produced to function as a pesticide or for some other technological purpose or which completely or partially consists of or contains living micro-organisms, nematodes, insects or spiders. In this context, micro-organisms also include viruses.

Chemical Products Register

Chemical products that are commercially manufactured in Sweden or imported to Sweden must be registered in a products register. A corresponding register may be prepared for bio-technical organisms. The provisions on chemical products also apply to articles which contain or are treated with chemicals. The definition of article is the same as in the REACH Regulation and the CLP Regulation.

Prohibition

If it is of particular importance from the health or environmental viewpoint, a chemical product or bio-technical organism may be generally prohibited, provided that such prohibitions are consistent with applicable EU-law. Such prohibitions are set out in the Ordinance (1998:944) on prohibition on the handling, import and export of chemical products. This may be appropriate in the case of, for example, carcinogenic products. It may also be relevant in the case of products whose feared injurious effects in the individual case, though not of a serious kind, can through widespread use result in injurious effects, such as for example cosmetics, hygienic products and pesticides.

Environmental penalty charges and sanctions

The Environmental Code contains rules on enforcement, criminal sanctions and environmental penalty fees. The rules of enforcement through administrative measures are generally applicable to all legislations which fall under the environmental code. The enforcement authorities can use issue injunctions and bans with or without a fine in order to force a person or a company to comply with the legislation. Core provisions in the Environmental Code and the legislation which fall under the Code, as well as EU regulations, are specifically criminalised in the Code. Breaches of the POPs Regulation prohibiting production and use of the regulated POPs and violations of the waste management rules have been criminalised in May 2012.

The applicable sanctions for private individuals include fines (set on the basis of the personal income) or imprisonment up to six years. Companies can be required to pay a company charge. An environmental penalty charge must be paid by business operators who in the conduct of commercial operations neglect specific requirements that follow from regulations issued under the Environmental Code and which are specified in the Ordinance (2012:259) on Environmental Penalty Charge. The charge is founded on strict liability. The charge varies from SEK 1,000 to SEK

50,000. The supervisory authority decides on the environmental penalty charge. The decision may be appealed against to the Land and Environment Court.

Pesticide regulations

The legal basis for Swedish pesticide control is to be found in four categories of documents:

- the European Community legislation
- the Environmental Code and other acts promulgated by the Swedish Parliament
- ordinances promulgated by the Swedish Government
- regulations issued by competent Swedish authorities.

The Environmental Code is a framework statute covering inter alia the control of pesticides. It contains several basic provisions governing the manufacture, import, export, sale and other handling of chemical products. The Code is accompanied by an Ordinance on pesticides, an Ordinance on Biocidal Products and an Ordinance on Chemical Products and Biotechnical Organisms. The purpose of the legislation is to prevent injury to human health and the environment being caused by the inherent properties of pesticides. The framework structure of the Code means that the Government or a designated government agency (such as the Swedish Chemicals Agency) can promulgate ordinances and regulations, respectively, in order to implement the provisions of the Code (and Ordinance). After the entry into force of the Regulation (EC) No 1107/2009 concerning the placing of plant protection products on the market, the requirements in the Environmental Code and regulations under it apply mainly to biocidal products and the use of nematodes, insects or spiders for pesticide purposes. Since the authorisation procedure for plant protection products is governed by the Regulation (EC) No 1107/2009 and not by the Environmental Code it will not be described in the account below.

Biocidal products are used for different purposes to counteract harmful organisms. In accordance with the Regulation (EU) No 528/2012, biocidal products are divided into 23 product types.

Regulation (EU) No 528/2012 is implemented into Swedish law through:

- Chapter 14 of the Swedish Environmental Code ;
- The Ordinance (2008:245) on Chemical Products and Biotechnical Organisms;
- The Pesticides Ordinance (2014:425) and
- The Swedish Chemicals Agency's Regulations (KIFS 2008:3) Chemical Products and Biotechnical Organisms.

The main rule in Sweden is that all biocidal products must be authorised to be placed and used on the Swedish market. However, today some products are cur-

rently exempted from the requirement for authorisation, as long as the active substance-product type is being evaluated within the EU. These products may be sold and used without valid authorisations during the transitional period, with some exemptions. Products containing active substances that are still under review may be authorised in accordance with national rules in each Member State. After a decision has been made in the EU review programme for a combination of active substance and product type, the rules according to the Regulation (EU) No 528/2012 apply.

Training requirements

Pesticides assigned to Class 1 and those pesticides in Class 2 used mainly in agriculture, forestry, horticulture or as wood preservatives may be used only by persons meeting certain competence requirements, and, in some cases, having attained a certain age.

Sustainable use of pesticides

Chemical or biological pesticides must be used in such a manner that human health is not harmed or humans caused other nuisance and so that the environmental impact is as little as possible. Pesticides may not be spread from aircraft. Nor may pesticides be used over forestland to combat brushwood. Use of pesticides in areas protected for abstraction of drinking water is prohibited without a permit from the local authorities.

Banned or severely restricted pesticides

The European Union has issued a list of substances which may be included as active substances in approved plant protection products in the European Union (Commission Implementing Regulation (EU) No 540/2011 of May 2011 implementing Regulation (EC) No 1107/2010 of the European Parliament and of the Council as regards the list of approved active substances). There is also a number of substances included in the international Prior Informed Consent Procedure (Regulation (EC) No 689/2008 of the European Parliament and of the Council of 17 June 2008 concerning the export and import of dangerous chemicals), which are either banned or severely restricted within the European Union. As from 1 September 2015, a biocidal product cannot be made available on the EU market unless either the substance supplier or the product supplier is included in the so called Article 95 list for the product type to which the product belongs. If there is a decision that the substance is not allowed to be used in biocidal products, the biocidal product is not allowed to be placed on the Swedish market.

To avoid stockpiling and other waste management problems of a pesticide following a decision to discontinue the approval, the retailer is usually allowed to keep on marketing the product for a year. After that period, the pesticide may be used yet another year.

Pesticide fees

The Swedish Chemical Agency's pesticide related activities are funded by fees paid by the pesticide industry. The fee for an application for approval varies from approximately EUR 12,000 to EUR 35,000 depending on if it is an application for a mutual recognition of a pesticide approved in another member state or if it is a new application. Additional fees are applicable if the product contains more than one active substance, if residues in commodities need to be evaluated by the National Food Agency, and if efficacy needs to be evaluated by the Swedish Board of Agriculture. The fees for application for products of low risk, and for minor uses are lower. The annual fee is 5,5 % of the product's sales value the previous year, or 1,3 % of the combined sales value for one or more biological products. The minimum fee is approximately EUR 200 (SEK 2,000) and a maximum fee of approximately EUR 40,000 (SEK 400,000).

The application fee, when Sweden is the evaluating Rapporteur, for approval or renewal of approval of an active chemical substance for use in a plant protection product is EUR 675,000 for a dossier submitted by a task force, otherwise EUR 450,000. In the case the active substance is a micro-organism, the fee is EUR 300,000 if there is more than one applicant submitting the dossier, and 200,000 for a single applicant.

For biocides the corresponding fees are EUR 570,000 (more than one applicant) or EUR 430,000 (a single applicant) for a chemical active substance for one product type, and EUR 300,000 (more than one applicant) or EUR 200,000 (a single applicant) if the active substance is a micro-organism.

Sales statistics and feedback

The Swedish Chemicals Agency keeps a restricted database (Pesticides Register) covering all approved pesticide products, their composition and quantities sold the previous year. A list of approved pesticide products as well as annual sales statistics is available on the website www.kemi.se. Swedish manufacturers and agents to foreign manufacturers who have had a pesticide product filed in the Pesticides Register on some occasion during a calendar year must provide information to the Swedish Chemicals Agency concerning the quantity of the product transferred, and estimated distribution of the quantity between agriculture, forestry, commercial fruit growing and gardening, industry, and household consumption.

In 2016 a total of 8,721metric tonnes of pesticides (active substances) was sold in Sweden, which is a reduction with 345 tonnes compared to 2015. The main part (76.8 %) was sold to industry, mainly for wood treatment using pressure and vacuum technology. The annual amount of sold quantities is strongly affected by the demand for creosote impregnated wood, particularly for export purposes. A total of 1,619 tonnes was sold to agriculture, accounting for 19 % of the total sold quantities. Compared with the average during 1981–1985 (the base years for the national

risk reduction programme), a reduction in volume has been achieved. However, although the volume of applied pesticides has decreased the intensity in the form of number of doses per hectare has increased. This is explained by a shift towards low-dose products. A total of 342 tonnes of pesticides for plant protection purpose were sold as consumer products. Sales of wood preservatives, antifouling products and mosquito repellents for consumer use were 4, 34 and 10.2 tonnes, respectively. Consumer products always belong to the lowest hazard class. The Swedish Poisons Information Centre collects and publishes statistics on incidents and accidents concerning pesticides (and other chemicals).

Enforcement

A number of government agencies make sure that the manufacturers and importers of pesticides take their responsibility under the pesticides control legislation. The Swedish Chemicals Agency (an agency under the Ministry of Environment) is responsible for the entire approval procedure covering both health and environmental aspects and agricultural and non-agricultural pesticides (plant protection products and biocides). The Agency has a right to issue regulations and restrict or prohibit the use of a pesticide.

Other government agencies supervise occupational use and environmental effects of pesticides, respectively. The National Food Agency (a general-directorate under Ministry of Enterprise and Innovation) establishes maximum pesticide residue limits and monitors imported and domestically produced foods, and drinking water. Results are published the year after the monitoring took place. The Swedish Environmental Protection Agency is the competent authority for hazardous waste management. The Swedish Board of Agriculture (in co-operation with the County Administrations) evaluates efficacy and phytotoxicity and is also responsible for the training of spray operators.

Residue monitoring

Pesticide residues in fresh and preserved fruits and vegetables (imported as well as domestic), and occasionally drinking water are monitored by the National Food Agency. Results are published annually. Residues of pesticides have also been monitored in ground water (Swedish Agency for Marine and Water Management Report 2014:15, and CKB Report 2014:1).

Other legislation related to chemicals management

In addition to the Environmental Code, there are several product-related or activity-related national acts and ordinances. The chemicals control legislation of the European Union has been implemented into the national chemicals control system with only a few and basically temporary exceptions.

The use of chemicals is also regulated by the Work Environment Act, administered by the Swedish Work Environment Authority. Government agencies such as this one have the power to establish binding regulations under the law. Several agencies use standard setting procedures, for example the National Food Agency, the Swedish Work Environment Authority and others. A report (in Swedish) issued by the Swedish Toxicological Council describes how and why standards are set.

The Work Environment Act (1977:1160) and the Work Environment Ordinance (1977:1166) lay down provisions to ensure a working environment which will not expose employees to ill health or accidents and which is satisfactory having regard to the nature of work and social and technical developments in the community. They also promote partnership between employers and employees in pursuit of a good working environment.

Several areas where problems related to chemicals may occur are regulated separately, e.g.:

- The Food Act (2006:804) and the Food Ordinance (2006:813) which apply to the offering for sale, selling and serving or other delivery of food for consumption.
- The Act (2006:805) on feeding-stuffs and animal by-products.
- Regulations are also issued governing the import of foodstuffs, permitted food additives, residues of xenobiotics and on drinking water.
- The Medicinal Products Act (2015:315) and Medicinal Products Ordinance (2015:458) apply to pharmaceuticals. The Environmental Code, however, is applicable to chemical products that are marketed as hygienic or cosmetic products.
- The Act (2010:1011) on flammable and explosive products.
- The Ordinance (2010:1075) on flammable and explosive products.
- The Act (2006:263) on transportation of dangerous goods.
- The Ordinance (2006:311) on transportation of dangerous goods.

The Public Access and Secrecy Act (2009:400) contains provisions on secrecy applicable to inter alia supervisory agencies under the Ordinance on Chemical Products and Biotechnical Organisms. Secrecy shall apply to information about the business or management conditions, inventions or research results of a private person, if it can be assumed that the person concerned should suffer economically if the information was to be disclosed.

Regulations on PCBs

The Swedish Ordinance (2007:19) on PCBs etc. replaces and extends the two previous Swedish ordinances regulating PCBs. The ordinance is partly harmonised within the European Union through the POPs Regulation, and implements the Council Directive 96/59/EC of 16 September 1996 on the disposal of PCB and PCT. Some of the most important sections of the ordinance are summarised below.

The ordinance contains definitions of a PCB and a PCT preparation and a PCB and a PCT product. The limit values are 50 ppm (mg/kg) for e.g. sealants and flooring material and 2 ppm (mg/kg) for insulation liquids. It also includes a ban on the manufacture, processing, marketing and transfer of such preparations and products, for use or reuse.

A transformer or the type of capacitor with a power higher than two kilovolt-amperes (reactive) must not be used if it contains a PCB product. Anyone who holds equipment which contains or which can be assumed to contain more than five cubic decimetres of a PCB product shall notify the Swedish Environmental Protection Agency of this fact immediately. The holder of such equipment shall also ensure that the equipment is decontaminated immediately.

Anyone who owns a building or other installation in which joint-sealing compounds or flooring compounds may have been used during erection or renovation in the period from 1956 to 1973 shall before 30 June 2008 investigate whether the joint-sealing compound or flooring compound is a PCB product. The owner shall ensure that sealants and flooring containing more than 500 ppm (500 mg/kg) PCB product is removed according to the timelines given in the ordinance i.e. 2016 at the latest. The rules do not apply to a natural person who owns a single-family or two-family-house.

Anyone who holds a PCB product or equipment that contains or may be assumed to contain a PCB product shall ensure that the product or equipment is clearly marked with the information that it contains a PCB product.

The management of PCB in waste from electrical and electronic products is regulated by the Swedish Environmental Protection Agency’s Regulations on Professional Pre-treatment of Waste Electrical and Electronic Products (NFS 2005:10). The management of PCB capacitors is also mentioned in Directive (2000/53/EC) on end-of-life vehicles and in the Ordinance (2007:186) on vehicle disposal.

Regulations on stockpiles and wastes

The Swedish Waste Ordinance (2011:927) forms part of Sweden’s implementation of the Waste Framework Directive. The Waste Ordinance includes among other things rules on the procedures to be followed in the handling, transport, recovery and disposal of waste.

Due to the early phase-out of most POPs in Sweden, there are no known stockpiles of POPs substances. Some of the POPs substances, typically those which have been used in products with a long life-span, may still however remain in products and articles in use in Sweden. These are for example PBDEs in electrical and electronic equipment or vehicles and PCBs in sealants and flooring material.

The waste ordinance along with chapter 15 of the Swedish Environmental Code and the EU POPs Regulation regulate the safe handling and disposal of waste containing POPs. Sweden has a good capacity for incineration of waste, for example waste containing PCBs is subject to high temperature incineration. The classification of waste as hazardous follows the Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste (2000/532/EC) (the European List of Waste), which has been revised to adapt to the EU CLP classification system. This revision along with the setting of limit values for the new POPs under the EU POPs Regulation are expected to further clarify the requirements for classifying waste containing POPs as hazardous waste and the subsequent treatment and destruction.

Professional storage and treatment of hazardous waste may only be undertaken with a permit from the competent authority (a Land and Environment Court or county administrative board).

Regulations on releases of unintentionally formed POPs

National regulation on chlorinated dioxins and furans exist in relation to the incineration of waste, under the Directive 2010/75/EU if the European Parliament and of the Council of the 24 November 2010 on industrial emissions Directive (integrated pollution prevention and control) (IED Directive). In Sweden this Directive is implemented as general binding rules setting minimum standards for the whole waste incineration (and co-incineration) sector. Since the regulation not only includes emission limit values but also construction and management obligations, it is also expected to promote the reduction of other POPs than dioxins and furans. According to the Directive, continuous measurements of emissions into the air of heavy metals and dioxins and furans are to be carried out. As regards other POPs, and other sectors, conditions regarding emissions of POPs are set individually, e.g. for industrial installations.

Regulations on waste containing POPs

Unintentionally formed POPs in waste, such as fly ash from waste incinerators, are regarded as hazardous waste if it meets the criteria for classification as such waste. The provisions on hazardous waste mentioned above also apply to waste containing unintentionally formed POPs, if the waste is classified as hazardous waste. Even if concentrations of POPs are below the level to be classified as hazardous waste, fly ash may not be allowed to be landfilled. The reason for this is that the ash will normally not meet the criteria for the acceptance of waste at landfills (Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC (2003/33/EC)).

Regulations on food and feed

There is a Commission Regulation (EC) No 1881/2006 of December 2006 setting maximum levels for certain contaminants in foodstuffs. There is also a Commission Recommendation of 3 December 2013 on the reduction of the presence of dioxins, furans and PCBs in feed and food (2013/711/EU) and a Commission recommendation 2016/688 of 2 May 2016 on the monitoring and management of the presence of dioxins and PCBs in fish and fishery products from the Baltic region.

The EU has established maximum levels for dioxins, dioxin-like PCBs and non-dioxin-like PCBs in food and feed, at strict but feasible levels. It is intended that these levels should gradually be lowered, in order to eliminate products with unacceptably high levels of contamination. In order to stimulate a proactive approach to reduce the presence of dioxin and dioxin-like PCBs in food, action levels for levels in food have been set. Action levels are a tool for competent authorities and operators to highlight cases where it is appropriate to identify a source of contamination and to take measures for its reduction or elimination.

Annex III List of POPs

Table 5. List of POPs in Annex A, B and C 2017.

Annex A – Elimination	**Annex B – Restriction**	**Annex C – Unintentional production**
Aldrin	DDT	Polychlorinated dibenzo-p-dioxins (PCDD)
Chlordane	Perfluorooctane sulfonic acid (PFOS)	Polychlorinated dibenzo-furans(PCDF)
Dieldrin		Hexachlorobenzene (HCB)
Endrin		Polychlorinated Biphenyls (PCB)
Heptachlor		Pentachlorobenzene (PeCB)
Hexachlorobenzene (HCB)		Hexachlorobutadiene (HCBD)
Mirex		Polychlorinated napthalenes (PCNs)
Toxaphene		
Polychlorinated Biphenyls (PCB)		
Chlordecone		
Hexabromobiphenyl		
Pentabromodiphenyl ether		
Lindane		
Alpha-hexachlorocyklohexane		
Beta-hexachlorcyclohexane		
Octabromodiphenyl ether		
Pentachlorobenzene (PeCB)		
Endosulfan		
Hexabromocyclododecane (HBCDD)		
Pentachlorophenol (PCP)		
Hexachlorobutadiene (HCBD)		
Polychlorinated napthalenes (PCNs)		
Deca-bromdifenyleter, (Deca-BDE)		
Short-chain chlorinated paraf-fins (SCCP)		

Table 6. Chemicals currently under review by the POPRC.

Step 1. Screening criteria, Annex D	Step 2. Develop a risk profile Annex E	Step 3. Develop a risk management evaluation, Annex F	To be considered at COP 9 in 2019
Perfluorohexane sulfonate, PFHxS			Dicofol Perfluorooctanoic acid, PFOA

Amendments to the Convention

The initial clusters of twelve POP substances have been significantly increased since 2001. At present 28 substances, or groups of substances, are covered by the Convention.

At the forth Conference of Parties, COP4 in May 2009, it was agreed for the first time to add nine substances to the Convention. The amendments entered into force on 26 August 2010. Two of these POPs are pesticides (chlordecone and lindane) three occur in pesticides (alfa- and beta- hexachlorocyclohexane, α,β-HCH and pentachlorobenzene, PeCB) and four are industrial chemicals (hexabromobiphenyl, HBB, perflourooctane sulfonic acid/sulfonyl fluoride PFOS/PFOSF, and commercial penta- and octa-bromodiphenyl ether, BDEs. Pentachloro-benzene may also be formed unintentionally in thermal processes.

At COP5 in 2011 it was agreed to add endosulfan (SC5/3) to Annex A of the Convention with specific exemptions. The amendment for endosulfan entered into force on 27 October 2012. A voluntary work programme with recommendations on how to ensure the elimination of the in 2009 regulated polybrominated diphenyl ethers (PBDEs) and PFOS, from the waste stream was agreed, and the Parties are due to report on their experiences in implementing the work programme. COP5 was also promoting the synergies or closer ties between the Stockholm Convention and the related policy instruments covered by the Rotterdam Convention and Basel Convention.

At the sixth COP in 2013 the decision was made to add the flame retardant hexabromocyclododecane (HBCDD) to Annex A of the Convention with specific exemptions for production and use in expanded polystyrene and extruded polystyrene in buildings. The amendment for HBCDD entered into force on 26 November 2014 internationally, while in the EU not until April 2016. The reason for this was that the process within the EU to regulate HBCDD was having a later time plan than the one of the Stockholm Convention. Therefore the EU requested an Opt-out as possible by Article 22(3)(b) of the Convention.

During the Conference of the Parties held in 2013 and 2015, it was agreed to add four additional substances to the Annexes of the Convention. The three industrial chemicals hexabromocyclododecane (HBCDD), hexachlorobutadiene (HCBD) and polychlorinated napthalenes (PCNs), and the pesticide pentachlorophenol (PCP). HBCDD, HCBD and PCP were added to Annex A, and PCN was added to both Annex A and Annex C. These additions entered into force in 27 November 2014 for HBCDD and in 16 December 2016 for the others.