UNITED NATIONS

SC

UNEP/POPS/POPRC.12/11/Add.3

Distr.: General
7 October 2016

Original: English

Stockholm Convention on Persistent Organic Pollutants

Persistent Organic Pollutants Review Committee
Twelfth meeting
Rome, 19–23 September 2016

Report of the Persistent Organic Pollutants Review Committee on the work of its twelfth meeting

Addendum

Risk management evaluation on short-chain chlorinated paraffins

At its twelfth meeting, by its decision POPRC-12/3, the Persistent Organic Pollutants Review Committee adopted a risk management evaluation on short-chain chlorinated paraffins on the basis of the draft contained in the note by the secretariat (UNEP/POPS/POPRC.12/4), as revised during the meeting. The text of the risk management evaluation as adopted is set out in the annex to the present addendum. It has not been formally edited.

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Annex

Short-Chain Chlorinated Paraffins

(SCCPs)

RISK MANAGEMENT EVALUATION

September 2016

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Executive Summary

1. In 2006, the European Union and its Member States submitted a proposal to list short-chain chlorinated paraffins (SCCPs) to Annex A, B and/or C of the Stockholm Convention pursuant to paragraph 1 of Article 8 of the Convention. At its second meeting, the Persistent Organic Pollutants Review Committee concluded that SCCPs meet all of the screening criteria specified in Annex D. The risk profile for SCCPs was adopted at the eleventh meeting, in October 2015, where the Committee decided:

(a) That SCCPs are likely, as a result of their long-range environmental transport, to lead to significant adverse human health and environmental effects such that global action is warranted;

(b) To prepare a risk management evaluation that includes an analysis of possible control measures for SCCPs; and

(c) To invite parties and observers to submit to the Secretariat the information specified in Annex F of the Convention.

2. SCCPs are chlorinated paraffin mixtures that are viscous, colourless or yellowish dense oils (Environment Canada 2008). Consistent with the risk profile, the risk management evaluation focuses on SCCPs (Alkanes, C_{10-13}, chloro) with greater than 48% chlorination by weight. Chlorinated paraffins (CPs) are produced by the chlorination of a hydrocarbon feedstock consisting of n-alkanes. The feedstock used determines the carbon chain lengths that are contained in the product. Traditionally, three different carbon chain length feedstocks are used to manufacture CPs: short-chain (C_{10-13}), medium-chain (C_{14-17}), and long-chain (C_{18+}). More recently in North America, manufacturers have further divided long-chain feedstocks (C_{18+}) into those used to produce LCCPs (C_{18-20}) and those used to produce very long-chain CPs (C_{20+}) (United States submission May 2016). In other regions, the chain length composition of feedstocks can vary significantly, for example, China produces a CP mixture with chain lengths ranging from C_{10} to C_{20} (World Chlorine Council submission February 2016). As such, the feedstocks used to manufacture CP mixtures may contain other carbon chain lengths outside the defined ranges, which affect the composition of the CP mixture that is produced (UNEP/POPS/POPRC.6/INF/15). A wide ranging feedstock (i.e., C_{10} to C_{20}) or a feedstock that contains trace amounts of short-chain lengths may result in CP mixtures that contain SCCPs.

3. SCCPs were, and continue to be, used primarily in metalworking applications and in polyvinyl chloride (PVC) plastics. Other uses described in the risk profile include using SCCPs in paints, adhesives and sealants, leather fat liquors, plastics, and as flame retardants in rubber, textiles and polymeric materials (UNEP/POPS/POPRC.11/10/Add.2). SCCPs may be released into the environment at all life cycle stages: during production, storage, transportation, use, and disposal of SCCPs and products that contain SCCPs. Although data are limited, major sources of release of SCCPs are likely the formulation and manufacturing of products containing SCCPs, such as PVC plastics, and use in metalworking fluids (UNEP/POPS/POPRC.11/10/Add.2).

4. The production of SCCPs has decreased globally as jurisdictions have established control measures (UNEP/POPS/POPRC.11/10/Add.2). According to information provided in Annex E, Annex F, comment submissions and the risk profile, SCCPs were reported to be produced in Brazil, and were reported to be imported by Albania, Argentina, Australia, Republic of Korea, Croatia, Argentina, Dominican Republic, Ecuador and Mexico. No other production information was obtained from Annex F submissions or during the literature search. While historical use of SCCPs was high, reductions have been noted in recent years in some countries. More recently, production volumes of CP mixtures that may include SCCPs increased. Control actions for SCCPs have been proposed and implemented in Albania, Canada, EU member states, Norway and the United States. Inspection and enforcement activities carried out in Austria, Germany, Norway and Sweden where SCCPs are banned have found the continued presence of SCCPs in articles.

5. It has been demonstrated that technically feasible alternatives are commercially available for all known uses of SCCPs. Information on the economic feasibility and accessibility of these alternatives in developing countries is not available. All uses of SCCPs have been phased out in Canada, EU member states, Norway and the United States, for years. More recently, the remaining uses of SCCPs in rubber conveyor belts and dam sealants have been replaced with viable alternatives in the EU (EC 2015). In addition, a decrease in SCCP consumption for conveyor belts, as well as dam sealants, has been observed which indicates that technically feasible alternatives exist, are accessible and available (Denmark 2014).

6. Two information sources note that the technical feasibility of some alternatives in paint and coating applications is unclear. Both studies also note the possible increased cost of manufacturing and using chemical alternatives to SCCPs. The exact impact of switching to alternative chemicals and

processes are expected to be unique to each situation, and can be difficult to predict when market and cost information is insufficient. Given that no adverse economic effects have been reported by parties that have successfully enacted prohibitions on SCCPs (Canada, EU member states and Norway), or from jurisdictions where SCCPs are no longer in use (United States of America), it can be concluded that alternatives are widely available for all applications.

7. Information provided by most parties and observers does not indicate that negative economic impacts are anticipated if SCCPs are listed to the Convention, excluding China and the Russian Federation. China and the Russian Federation indicate that listing SCCPs is expected to increase costs and result in negative impacts to the chlorinated paraffin industry, as well as to the manufacturers of the raw materials and the downstream products industry (China Annex F 2015 submission; Russian Federation submission April 2016).

8. Listing SCCPs to the Convention in Annex A or B to eliminate or restrict the production and use of SCCPs is expected to result in benefits to human health, the environment, agriculture and biota. It is not possible to quantify the benefits of eliminating or restricting SCCPs; however, they are considered to be significant given the costs associated with the significant adverse effects on human health and the environment that are likely to result from the continued production and use of SCCPs.

9. No party or observer submitted information to propose or justify the need for a specific exemption or acceptable purpose in the listing of SCCPs to the Convention. Consideration could be given to including a specific exemption to assist parties with their transition to alternative substances; however, no party has identified a specific use where flexibility in the recommended control measure is required.

10. SCCPs maybe unintentionally produced during the manufacture of other CP mixtures. To provide additional protection of human health and the environment from exposure to SCCPs, a listing to the Convention could include controls for SCCP impurities in other CP mixtures. The purpose of the controls would be to minimize the amount of SCCPs contained in other CP mixtures, which would reduce both human and environmental exposures. Canada and EU member states have taken measures to limit the content of SCCPs in other CP mixtures, which demonstrates that this control measure is technically feasible. In addition, MCCPs and other CP mixtures are often used as alternatives to SCCPs in many applications; therefore, as the use of SCCPs is phased out the production and use of MCCPs and other CP mixtures could increase. This further emphasizes the need to develop other alternatives or methods, and promote best available techniques to limit the presence of SCCPs in other CP mixtures.

11. Having prepared a risk management evaluation and considered the management options, the Persistent Organic Pollutants Review Committee recommends, in accordance with paragraph 9 of Article 8 of the Convention, that the Conference of the Parties to the Stockholm Convention consider listing and specifying the related control measures for SCCPs in Annex A including controls to limit the presence of SCCPs in other CP mixtures, with or without specific exemptions.

1. Introduction

12. The European Union and its Member States submitted a proposal to list short-chain chlorinated paraffins (SCCPs)[1] in Annex A, B and/or C of the Convention (UNEP/POPS/POPRC.2/14), together with a detailed dossier to support the proposal (UNEP/POPS/POPRC.2/INF/6). The Persistent Organic Pollutant Review Committee (POPRC) decided, at its second meeting held in November 2006, that SCCPs meet all screening criteria specified in Annex D, and that the variability of the environmental fate properties of SCCPs should be addressed in the preparation of the risk profile (Decision POPRC-2/8).

13. At its third meeting, the POPRC considered the draft risk profile and agreed to defer its decision and requested that parties and observers submit additional toxicity and ecotoxicity information (Decision POPRC-3/8). No decision was made on the draft risk profile at the fourth meeting of the Committee. During the fifth meeting, the Committee agreed to an intersessional workplan to revise the draft risk profile and gather updated production, use and inventory data, and further information on toxicity and ecotoxicity (POPRC.5/10/AnnexIV). In addition, the Committee decided to examine toxicological interactions between chemicals and used SCCPs as a case study

[1] The original proposal referred to SCCPs as “short-chained chlorinated paraffins”. For the purpose of review by the POPs Review Committee, the present document refers to SCCPs as “short-chain chlorinated paraffins”, which is a more commonly used name for the same chemicals.

(POPRC-5/3). At the sixth meeting, the Committee agreed to defer its decision. At the eighth meeting, the Persistent Organic Pollutants Review Committee agreed to establish an intersessional working group to prepare a revised draft risk profile on SCCPs and present it to the Committee at its eleventh meeting for its consideration (UNEP/POPS/POPRC.8/16/AnnexIV).

14. The risk profile on SCCPs was adopted at the eleventh meeting of the Committee in October 2015 (Decision POPRC-11/3).

1.1 Chemical identity of Short-Chain Chlorinated Paraffins[2]

15. SCCPs are chlorinated paraffin mixtures that are viscous, colourless or yellowish dense oils (Environment Canada 2008). Consistent with the risk profile, the risk management evaluation focuses on SCCPs (Alkanes, C_{10-13}, chloro) with greater than 48% chlorination by weight. Chlorinated paraffins (CPs) are straight-chain chlorinated hydrocarbons. CPs are classified according to their carbon-chain length: SCCPs have carbon-chain lengths from 10 to 13, medium-chain chlorinated paraffins (MCCPs) have carbon-chain lengths from 14 to 17 and long-chain chlorinated paraffins (LCCPs) have carbon-chain lengths of 18 or greater.

16. CPs are produced by the chlorination of a hydrocarbon feedstock consisting of n-alkanes. The feedstock used determines the carbon chain lengths that are contained in the product. In general, there are three different carbon-chain length feedstocks that are used to manufacture CPs: short-chain (C_{10-13}), medium-chain (C_{14-17}), and long-chain (C_{18+}). More recently in North America, manufacturers have further divided long-chain feedstocks (C_{18+}) into those used to produce LCCPs (C_{18-20}) and those used to produce very long-chain CPs (C_{20+}) (United States submission May 2016). In other regions, the chain length of feedstocks can vary significantly, for example, China produces a CP mixture with chain lengths ranging from C_{10} to C_{20} (World Chlorine Council submission February 2016). As such, the feedstocks used to manufacture CP mixtures may contain other carbon chain lengths outside the defined ranges, which affect the composition of the CP mixture that is produced (UNEP/POPS/POPRC.6/INF/15). In addition, as the feedstock can contain other chemicals such as olefins (alkenes) and aromatic compounds (UNEP/POPS/POPRC.6/INF/15). A wide ranging feedstock (i.e., C_{10} to C_{20}) or a feedstock that contains trace amounts of short-chain lengths, may result in CP mixtures that contain SCCPs. In addition, depending on the manufacturing process, CP production can be a source of several unintentional persistent organic pollutants (POPs), such as polychlorinated biphenyls, hexachlorobenzene and polychlorinated naphthalenes (Takasuga et al. 2012).

17. The nomination proposal identified the substance as Chemical Abstract Service (CAS) number 85535-84-8 and European Inventory of Existing Commercial Chemical Substances (EINECS) number 287-476-5 (Alkanes, C_{10-13}, chloro). This CAS number represents the commercial SCCP product that is produced by the chlorination of a single hydrocarbon fraction consisting of n-alkanes that have a carbon chain length distribution consisting of 10, 11, 12 and 13 carbon atoms. The nomination also cited several synonyms, listed in Table 1. The synonyms are general in nature, and encompass much more than the substance represented by either the CAS number given, or C_{10-13} chlorinated alkanes in general. A supporting document for the draft risk profile on short-chain chlorinated paraffins (UNEP/POPS/POPRC.6/INF/15) contains further information, including a non-exhaustive list of additional CAS numbers that may be used to identify SCCPs.

Table 1: **Name and registry number**

Common name	Short-chain chlorinated paraffins
IUPAC name	Alkanes, C_{10-13}, chloro
Synonym	Alkanes, chlorinated; alkanes (C_{10-13}), chloro-(50%-70%); alkanes (C_{10-13}), chloro-(60%); chlorinated alkanes, chlorinated paraffins; chloroalkanes; chlorocarbons; polychlorinated alkanes; paraffins chlorinated.
Chemical Abstract Service (CAS) Number	85535-84-8[3]
European Inventory of Existing Commercial Chemical Substances (EINECS)	287-476-5

[2] Additional information regarding the chemical identity of SCCPs can be found in UNEP/POPS/POPRC.6/INF/15 available at: http://chm.pops.int/desktopmodules/MFilesDocs/images/doc.png

[3] This CAS number represents the commercial SCCP product that is produced by the chlorination of a single hydrocarbon fraction consisting of n-alkanes that have a carbon chain length distribution consisting of 10, 11, 12 and 13 carbon atoms; however, this CAS number does not specify the degree of chlorination of the SCCP. Please note that there are other CAS numbers which may represent or contain SCCPs. Please refer to Table 3 of UNEP/POPS/POPRC.6/INF/15 for more CAS numbers that may be relevant.

Structures

18. The Stockholm Convention nomination for listing is directed at SCCP products that contain more than 48% by weight chlorination. Examples of two molecules that can be found within an SCCP product are presented in Figure 1.

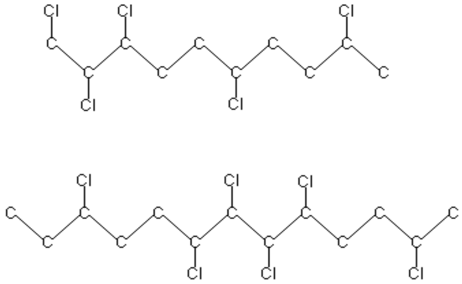

Figure 1: Structure of two SCCP compounds ($C_{10}H_{17}Cl_5$ and $C_{13}H_{22}Cl_6$)

Physical-chemical properties

19. The range in chlorine content of SCCPs is primarily responsible for the large differences that are evident in measurements and estimates of physical/chemical properties, as shown in Table 2 below. The approximate range of molecular weights for SCCPs is 320–500 grams per mole (EC 2000).

20. Due to the acknowledged complexity of the mixtures, the chemical analysis of SCCPs is challenging. In the absence of more complete characterizations of the mixtures and suitable individual standards, quantification is usually based on a technical product, introducing major uncertainties if compositions of the sample and the standard do not match (Bayen et al. 2006; Reth et al. 2006 cited in Vorkamp & Riget 2014). Also Sverko et al. (2012) stated that there is a need for a globally concerted effort to standardize methods for SCCP analysis.

21. Recently three International Standards Organization (ISO) methods have been published that enhance the standardized analyses of SCCPs in water, sediment, sewage sludge, suspended matter and leather. (Methods are available from http://www.iso.org/iso/home.html). Method ISO 12010:2012 is applicable to the determination of the sum of SCCPs in unfiltered surface water, ground water, drinking water and wastewater using gas chromatography-mass spectrometry with electron capture negative ionization (GC-ECNI-MS) (ISO 2012). Method 18635:2016 2016 specifies a method for the quantitative determination of SCCPs in sediment and suspended (particulate) matter, sewage sludge, and soil using GC-ECNI-MS (ISO 2016). Method ISO 18219:2015 specifies a chromatographic method to determine the amount of SCCPs in processed and un-processed leathers (ISO 2015).

22. The most advanced technique, which is not currently a routine method, in CPs detection is 2-dimensional gas chromatography combined with electron capture detection. The method is able to qualitatively identify groups of CP isomers by carbon chain length and chlorination level. Currently, the most commonly used method of detection and quantification used in the literature is gas chromatography followed by either high or low resolution electron capture negative ion mass spectrometry (GC-ECNI-MS) (UNEP/POPS/POPRC.11/10/Add.2).

23. A recent study by van Mourik et al. (2015) reports that while GC/ECNI-MS remains the most commonly applied technique, novel and promising use of high resolution time of flight Mass Spectrometry (TOF-MS) has also been reported (van Mourik et al. 2015). In addition, improved cleanup procedures have been found to remove interfering compounds, and new instrumental techniques, which distinguish between MCCPs and SCCPs, have been developed. The study also states that new CP quantification methods have emerged, including the use of mathematical algorithms, multiple linear regression and principal component analysis. A study by Gao et al. (2016) developed a novel analytical method, deuterodechlorination combined with high resolution gas chromatography – high resolution mass spectrometry (HRGC-HRMS), to determine the congener compositions of SCCPs in commercial chlorinated paraffins and environmental and biota samples. Internal standard quantification of individual SCCP congeners was achieved, and the relative standard deviations for quantification of total SCCPs were within 10% (Gao et al. 2016).

Table 2: **Overview of relevant physical-chemical properties**

Property	Value	Reference
Vapour pressure (Pa)	Range from 2.8 to 0.028 x 10^{-7} Pa	Drouillard et al. 1998, BUA 1992
	SCCP with 50% chlorine by weight is 0.021 Pa at 40 ºC	EC 2000
	SCCP products with 50-60% chlorine are predicted to have subcooled liquid VPs ranging from 1.4 x 10^{-5} to 0.066 Pa at 25ºC	Tomy et al. 1998
Henry's Law Constant (Pa·m^3/mol)	0.7 - 18 Pa x m^3/mol	Drouillard et al. 1998
Water solubility (µg/L)	C_{10-12} chlorinated alkanes ranged from 400 - 960 µg/L	Drouillard et al. 1998
	C_{10} and C_{13} chlorinated alkane mixtures ranged from 6.4 – 2370 µg/L	BUA 1992
	SCCPs containing 59% chlorine content at 20ºC range from 150 to 470 µg/L	EC 2000
log K_{OW}	4.48 – 8.69	UNEP/POPS/POPRC.11/10/ Add.2
	SCCPs with chlorine content ranging from 49-71% ranges from 4.39-5.37	EC 2000
log K_{OA}	4.07 to 12.55 for a chlorination content of 30-70% (modelled values)	Gawor&Wania 2013

1.2 Conclusions of the Review Committee regarding Annex E information

24. At its eleventh meeting (Rome, 19-23 October 2015), the Committee evaluated the risk profile for SCCPs in accordance with Annex E. The Committee, by its decision POPRC-11/3, adopted the risk profile for SCCPs (UNEP/POPS/POPRC.11/10/Add.2) and:

(a) Decided, in accordance with paragraph 7 of Article 8 of the Convention and on the basis of the risk profile, that short-chained chlorinated paraffins are likely, as a result of their long-range environmental transport, to lead to significant adverse human health and/or environmental effects, such that global action is warranted;

(b) Also decided, in accordance with paragraph 7 (a) of Article 8 of the Convention and paragraph SC-1/7 of the Conference of the Parties, to establish an ad hoc working group to prepare a risk management evaluation that includes an analysis of possible control measures for short-chained chlorinated alkanes in accordance with Annex F to the Convention;

(c) Invited in accordance with paragraph 7 (a) of Article 8 of the Convention, parties and observers to submit to the Secretariat the information specified in Annex F before December 11, 2015, as well as additional information relevant to Annex E.

1.3 Data sources

25. The risk management evaluation builds on the risk profile for SCCPs (UNEP/POPS/POPRC.11/10/Add.2), and is primarily based on information that was provided by parties and observers through responses to the request for the information specified in Annex F of the Stockholm Convention. The following parties and observers made submissions[4]:

(a) Parties: Albania, Canada, China, Germany, Hungary, Monaco, Netherlands, Norway, Romania, Sweden;

(b) Observers: International POPs Elimination Network (IPEN) / Alaska Community Action on Toxics (ACAT), researcher.

26. In addition to the above-mentioned sources, information has been gathered from open information sources and scientific literature. Key reports include:

[4] Annex F information provided by parties and observers is available at the Convention website (http://chm.pops.int/TheConvention/POPsReviewCommittee/Meetings/POPRC11/POPRC11Followup/SCCPInfoRequest/tabid/4794/Default.aspx).

(a) Evaluation of Possible Restrictions on Short Chain Chlorinated Paraffins (SCCPs). Report prepared by Risk & Policy Analysis (RPA) for the National Institute for Public Health and the Environment of the Netherlands (2010);

(b) Guidance Document No. 8: Measures for Emission Reduction of Short Chain Chlorinated Paraffins (SCCP) and Medium Chain Chlorinated Paraffins (MCCP) in the Baltic Sea Region. Prepared by the Control of Hazardous Substances in the Baltic Sea Region (COHIBA) Project Consortium (2011);

(c) Data on Manufacture, Import, Export, Uses and Releases of Alkanes, C10-13, Chloro (SCCPs) as well as Information on Potential Alternatives to its Use. Report prepared by BRE, IOM Consulting and Entec for the European Chemicals Agency (2008); and

(d) UNECE POPs Protocol Management Option Dossier for Short Chain Chlorinated Paraffins (SCCPs). Report prepared by BeratungsgesellschaftfürintegrierteProblemlösungen (BiPRO) under study contract on support related to the international work on Persistent Organic Pollutants (POPs) (2007).

The above mentioned reports and all other information sources are listed in the Reference section.

1.4 Status of Short-Chain Chlorinated Paraffins under International Conventions

27. SCCPs are subject to a number of international treaties and regulations.

28. In August, 2005, the European Community proposed that SCCPs be added to the UNECE Convention on Long Range Transboundary Air Pollution (LRTAP), Aarhus Protocol on Persistent Organic Pollutants. SCCPs met the criteria of decision 1998/2 of the Executive Body for persistence, potential to cause adverse effects, bioaccumulation and potential for long range transport. Thus, SCCPs were added to Annexes I and II of the 1998 Aarhus Protocol in December 2009 at the 27^{th} session of the Executive Body (Decision 2009/2). Annex II prohibits the use of SCCPs with exemptions for use as fire retardants in rubber in conveyor belts in the mining industry and in dam sealants, and states that action to eliminate these uses should occur once suitable alternatives are available. The listing of SCCPs to Annex II includes a requirement for any party that uses these substances to report on progress made to eliminate them and to submit information on such progress no later than 2015 and every four years thereafter. When two-thirds of the parties have adopted the amendment it will enter into force (UNECE 2009). To date four of thirty-two parties have ratified the amendments, including Luxembourg, Netherlands, Norway and Romania (UN 2016).

29. In 1995, OSPAR (Oslo/Paris) Commission for the Protection of Marine Environment of the North-East Atlantic adopted a decision on SCCPs (Decision 95/1). OSPAR Decision 95/1 and subsequent EU measures regulate the main uses of SCCPs and sources. In 2006, OSPAR prepared an overview assessment of the implementation of PARCOM (Paris Commission) Decision 95/1 on SCCPs (OSPAR 2006). The assessment was based on national implementation reports received from nine of 15 Contracting Parties which have been requested to submit, in the 2005/2006 meeting cycle, reports on those national measures taken. All reporting Contracting Parties have taken measures to implement PARCOM Decision 95/1. Some Contracting Parties reported a full ban of all or certain uses of SCCPs and reductions of other uses. In general, Contracting Party measures have addressed those uses covered by the European POP Regulation EU 850/2004.

30. Similar to OSPAR, the Baltic Marine Environment Protection Commission (HELCOM) has included SCCPs on their list of harmful substances. On November 15, 2007, HELCOM included SCCPs in the HELCOM Baltic Sea Action Plan. Contracting Parties to HELCOM have agreed, starting in 2008, to work for strict restriction on the use in the whole Baltic Sea catchment area of the Contracting States of several hazardous substances, including SCCPs. Hazardous substances are those found to be PBT or vPvB (Annex E 2010 submission from Lithuania).

31. In October 2015, the Chemical Review Committee (CRC) of the Rotterdam Convention adopted decision CRC-10/4, and recommended that SCCPs be listed in Annex III to the Convention as industrial chemicals and that a decision guidance document be prepared for the recommended listing.

1.5 Any national or regional control actions taken

32. SCCPs have been under scrutiny for their health and environmental impacts, and in response control actions for SCCPs have been proposed and implemented in Albania, Canada, EU member states, Norway and the United States.

33. Albania proposed control measures on 29 April 2015 to prohibit the production, placing on the market and use of SCCPs. The National Environmental Agency will maintain a database and report every four years on the progress made to eliminate SCCPs (Albania Annex F 2015 submission).

34. In Canada, the manufacture, use, sale, offer for sale and import of SCCPs and products that contain SCCPs is prohibited under the *Prohibition of Certain Toxic Substances Regulations, 2012* which came into force on March 14, 2013 (Canada 2013). These regulations allow the on-going use, sale and offer for sale of SCCPs and products that contain SCCPs which were manufactured in Canada or imported into Canada before the regulations entered into force. Regarding incidental presence of SCCPs, the regulations require annual reporting if the total annual quantity of SCCPs contained in a product, such as MCCPs, that is manufactured in Canada or imported into Canada exceeds 1 kg, and its annual weighted average concentration in the product is equal to or greater than 0.5% (w/w).

35. The United States Environmental Protection Agency (US EPA) added the category of polychlorinated alkanes to its list of toxic chemicals subject to Toxics Release Inventory reporting under Emergency Planning and Community Right-to-know Act (EPCRA) section 313 (see 40 CFR 372.65) based on available carcinogenicity and ecotoxicity data for short chain species (59 Federal Register 61432, November 30, 1994). In December 2009, the US EPA published its *Short-Chain Chlorinated Paraffins (SCCPs) and Other Chlorinated Paraffins Action Plan*, stating that "EPA intends to initiate action to address the manufacturing, processing, distribution in commerce and use of SCCPs". Furthermore in December 2014 the US EPA published a Significant New Use Rule for certain SCCPs, specifically Alkanes C_{12-13}, Chloro (CAS number 71011-12-6), that requires companies to notify the EPA of plans to manufacture, import or process these chemicals and provides the EPA an opportunity to review new uses and take action needed to protect human health or the environment (United States 2014).

36. Initially, SCCPs were on the original list of 16 substances identified as substances of very high concern under REACH (Registration, Evaluation, Authorization and Restriction of Chemical substances). The European Union adopted restrictions on the formulation and use of short-chain chlorinated alkanes in metalworking fluids and leather finishing products under the European Union Existing Substances Regulations (EEC 793/93). These regulations prohibited placing short-chain chlorinated alkanes on the European Union market beginning January 6, 2004, in concentrations greater than 1% for use in metalworking fluids or fat liquoring of leather.

37. Subsequently, SCCPs were added to Annex I of the EU POP Regulation (EC Regulation No. 850/2004 of the European Parliament and of the Council of 29 April 2004 on persistent organic pollutants and amending Directive 79/117/EEC), extending the scope of the original regulations to prohibit the production, placing on the market and use of SCCPs or preparations containing SCCPs in concentrations greater than 1% by weight or articles containing SCCPs in concentrations greater than 0.15% by weight. These restrictions place concentration limits on the presence of SCCPs in products (1.0%) and articles (0.15%). The regulations specifically state that articles that contain SCCPs in concentrations lower than 0.15% by weight are allowed to be placed on the market and used, as this is the amount of SCCPs that may be present as an impurity in an article produced with MCCPs. The regulation allows the use of conveyor belts in the mining industry and dam sealants containing SCCPs already in use on or before 4 December 2015, and articles containing SCCPs already in use on or before 10 July 2012. The initial regulation allowed the use of SCCPs in conveyor belts and dam sealants; however, on 13 November 2015 Regulation (EC) No 850/2004 was amended by Commission Regulation (EU) 2015/2030 to remove these exemptions and list SCCPs solely in Annex I of the Regulation. This change entered into force on 4 December 2015 and subsequently all uses of SCCPs are prohibited above the previously mentioned limit values.

38. SCCPs were banned in Norway in 2001, and the Norwegian regulation has been amended to replicate the recently updated EU POP Regulation.

2. Summary information relevant to the risk management evaluation

Production, Uses and Releases

39. As discussed in the risk profile, the production of commercial SCCP products has decreased globally as jurisdictions have established control measures (UNEP/POPS/POPRC.11/10/Add.2). According to information provided in Annex E, Annex F, comment submissions and the risk profile, SCCPs were reported to be produced in Brazil, and were reported to be imported by Albania, Australia, Republic of Korea, Croatia, Argentina, Dominican Republic, Ecuador and Mexico. No other production information was obtained during the literature search. While historical use of SCCPs was high globally, reductions have been noted in recent years in some countries. More recently, production volumes of CP mixtures that may contain SCCPs have increased (UNEP/POPS/POPRC.11/10/Add.2).

40. CPs (of various chain lengths) are known to be produced in Brazil, China, India, Japan and the Russian Federation. Global production of CPs has increased significantly since the 1930s. The production volume of SCCPs in Europe, Canada, and the United States was estimated to be in the range 7.5 to 11.3 kt/y (metric kilo tonnes) in 2007 (Hilger et al. 2011). The total consumption of SCCPs in the European Union in 2010 was estimated to be around 530 tonnes. China is the largest volume producer of CPs, with an increasing estimated annual production from 600 kt in 2007 (Fiedler 2010) to 1000 kt/year in 2009 (Chen et al. 2011). It is also possible that India has increased CP production (Potrykus et al. 2015). According to Annex E (2014) information from China, no specific SCCP production data are available since production is related to several CP products that are not identified by carbon chain-length, rather the CP mixtures are identified by percent chlorination by weight. The Chinese submission stated that CP-42, CP-52 and CP-70 have the highest production volumes (others are CP-13, CP-30, CP-40, CP-45, CP55 and CP-60). Tang et al. found that CP-42 and CP-52 account for over 80% of the total production volume of CPs in China (Tang et al. 2005). According to Gao et al. the SCCP mass fractions in CP-42, CP-52 and CP-70 were determined to be 3.7%, 24.9% and 0.5%, respectively (Gao et al. 2012). Very limited information is available on SCCP production in some countries.

41. SCCPs were, and continue to be, used primarily as extreme pressure additives (i.e., lubricants and coolants) in metalworking applications and in polyvinyl chloride (PVC) plastics. Other uses described in the risk profile include using SCCPs in paints, adhesives and sealants, leather fat liquors, plastics, and as a flame retardant in rubber, textiles and polymeric materials (UNEP/POPS/POPRC.11/10/Add.2). Prior to EU regulation, in Germany, approximately 74% of SCCP consumption was in the metalworking industry and for fat liquoring of leather. As discussed in detail in the risk profile, the use of SCCPs varies between different countries and regions.

42. One study cited by Potrykus et al. in their 2015 report titled, *The Identification of Potentially POP-containing Wastes and Recyclates – Derivation of Limit Values*, considers that SCCPs are used in everyday products such as microwave dishes, lamps, electronic items such as cables, adapters, keyboards, memory media, photo frames, headphones, and also in detergent. Inspection and enforcement activities carried out in Austria, Germany, Norway and Sweden where SCCPs are banned have found the continued presence of SCCPs in articles. In Norway, SCCPs were found above permitted levels in various products for children such as jackets, stickers, pencil cases and running shoes. Concentrations in articles were found to contain SCCPs above permitted levels ranging from 0.16 to 10.7 % (Norway Annex F 2015 submission). In 2014, to enforce the prohibition on SCCPs, the City of Hamburg found that 19 of 84 plastic products sampled contained SCCPs, including electronics, toys, household articles, tools, swimming gadgets, bicycle pants and sports articles (Germany Annex F 2015 submission). SCCP concentrations exceeding permitted levels in mats, ranging from 0.4% to 6.9%, were detected in Austria (Austria submission May 2016). The Swedish Chemicals Agency has also carried out tests on 62 articles and found that 16 contained SCCPs in high concentrations; furthermore, 11 other articles had low concentrations of SCCPs that could have resulted from contamination during manufacturing or delivery (Sweden Annex F 2015 submission). SCCPs were detected in electrical products, toys, childcare articles, exercise gloves, plastic bags, bathroom articles, sports equipment, garden equipment and office articles (Sweden Annex F 2015 submission). These findings demonstrate that new products continue to be a source of SCCPs and contribute to human and environmental exposure. In Europe, it was estimated that releases during the service life of products and articles contributed 0.6 – 1.7 t/year to air, 7.4 – 19.6 t/year to wastewater, 4.7-9.5 t/year to surface water and 8.7-13.9 t/year to industrial soil (BRE 2008).

43. Furthermore the risk profile states that releases of SCCPs to the environment may occur at all life cycle stages: during production, storage, transportation, use, and disposal of SCCPs and products that contain SCCPs. Although data are limited, the major sources of release of SCCPs are likely the formulation and manufacturing of products containing SCCPs, such as PVC plastics, and use in

metalworking fluids (UNEP/POPS/POPRC.11/10/Add.2). The possible sources of releases to water from manufacturing facilities include spills, facility wash-down and storm water runoff. SCCPs in metalworking/metal cutting fluids may also be released into aquatic environments from drum disposal, carry-off and spent bath use (Canada 1993). Ecuador notes that the cleaning of metallurgical facilities results in releases to aquatic ecosystems (Ecuador Annex E 2010 submission). These releases are collected in sewer systems and ultimately end up in the effluents of sewage treatment plants. Information on percentage releases to sewage treatment plants or on removal efficiency is limited. However, application of sewage sludge to soil or irrigation of wastewater may be a source of SCCP loadings to soil (Zeng et al. 2011, 2012). In 2013, it is estimated that 300 kg of SCCPs was released to sewage sludge in Norway (Norway Annex F 2015 submission). Other releases could result from gear oil packages, fluids used in hard rock mining and equipment used in other types of mining, fluids and equipment used in oil and gas exploration, manufacture of seamless pipe, metalworking and operation of turbines on ships (CPIA 2002; Environment Canada 2003).

44. Information on waste streams that contain SCCPs, and their associated concentrations, are not widely available. However, a study found that in Germany the main waste streams that contain SCCPs are rubber waste from conveyor belts used in underground mining operations and sealants from construction and demolition waste (Potrykus et al. 2015). The report also noted that SCCPs have replaced polychlorinated biphenyls (PCBs) in certain open applications, such as sealants and adhesives (Potrykus et al. 2015). While the report focuses on waste streams in Germany, the findings demonstrate the potential for releases of SCCPs from disposal and recycling operations which would be applicable to jurisdictions with similar characteristics.

45. In Germany, it is likely that the rubber containing SCCPs from conveyor belts is treated and/or disposed of together with other rubber waste, and approximately 62% of rubber waste is directed to material recovery, and the remainder is incinerated (Potrykus et al. 2015). Since SCCPs are thermally decomposed at 200ºC (BiPRO 2011), and higher incineration temperatures are used in energy recovery/incineration (~800ºC), it can be assumed that the SCCP content in rubber from conveyor belts is destroyed through incineration and poses no concern (Potrykus et al. 2015). However, recycling operations do not remove or destroy SCCPs, therefore SCCPs from rubber waste may be released into recyclates. In Germany, rubber recyclates are used to manufacture rubber flooring for indoor use and outdoor use, such as playgrounds (Potrykus et al. 2015). This finding indicates that SCCPs could be introduced into recyclates and incorporated into products made from recycled rubber, possibly resulting in uncontrolled global distribution of SCCPs (Potrykus et al. 2015). To address this concern, the report recommends the separation of rubber waste from SCCP containing conveyor belts be separated from the waste stream and be treated appropriately. The study highlighted that information is not available regarding the processing methods and disposal options for used conveyor belts from underground mining operations. In addition, difficulties were encountered in obtaining samples of rubber waste from SCCP containing conveyor belts for the project. Therefore, it was not possible to quantify the amount of SCCPs contained in waste rubber from conveyor belts (Potrykus et al. 2015).

46. The same study reported that in Germany SCCPs were found at concentrations above 1,000 ppm in three of four joint sealant samples from construction and demolition waste (Potrykus et al. 2015). Due to their nature, a considerable share of sealants and adhesives adhere to the surface of construction materials (especially on concrete, tiles, bricks and ceramics) and are treated together with those types of wastes. Therefore, in practice, it is not expected that sealants and adhesives can be separated completely from construction materials and treated separately. It is estimated that in 2011 about 54 million tonnes of concrete, tiles, bricks and ceramic wastes were treated/disposed of in Germany, with 51 million tonnes being directed to material recovery (Potrykus et al. 2015). Since the removal of sealants and adhesives from construction materials is highly impractical, the SCCP content may be released into recyclates and incorporated into products made from recycled materials, possibly resulting in uncontrolled global distribution (Potrykus et al. 2015). To address this concern, separation of sealants and adhesives that contain SCCPs would be preferred; however, this is not considered feasible. Regarding the portion of the construction waste stream that is incinerated, it is expected that the SCCP content would be destroyed by the high temperatures exceeding 200ºC (BiPro 2011).

47. Petersen (2012) reported that in the EU approximately 25 kt of SCCPs are contained in building materials as a “stock” of SCCPs within building and construction applications. The estimates revealed that sealants and coatings clearly constitute the largest part of the stock, while SCCPs in rubber is negligible. It was calculated that on a yearly basis 1.2 kt of building and construction waste contained SCCPs. The potential for loss during production and transport is expected to be less than that during product use and disposal for chlorinated paraffins (Fiedler 2010).

48. Disposal of products that contain SCCPs in landfills is not expected to be a major release as CPs would remain stabilized in products (i.e., polymers), with minor losses to washoff from percolating water (UNEP/POPS/POPRC.11/10/Add.2). In addition, leaching from landfill sites is likely to be negligible owing to strong binding of CPs to soils (UNEP/POPS/POPRC.11/10/Add.2). However, certain landfills have been found to be ongoing sources of CPs in the Canadian Arctic (Dick et al. 2010).

49. Releases of SCCPs could occur from the creation of dust during the recycling of plastics and construction and demolition waste, or in the mechanical treatment of rubber prior to incineration (Potrykus et al. 2015), which may involve processes such as chopping, grinding and washing. If released as dust from these operations, the SCCPs would be adsorbed to particles because of high sorption and octanol–air partition coefficients. The emission rate would depend on the extent of dust control at the facility (De Boer et al. 2010). Recently it was shown that intense e-waste recycling activities may be a source of CPs in the environment (Chen et al. 2011, Luo et al. 2015). Quantitative information on this potential source of SCCPs is not currently available. Release of SCCPs is also associated with ship breaking activities (Nost et al. 2015).

50. The risk profile indicates that the major human exposure pathway to SCCPs is through food consumption and that inhalation and dermal contact can also contribute to SCCP body burden. SCCPs have been detected in cooking oil in China, including in fried confectionary products and raw seeds used to produce the oils (Cao et al. 2015); however, the study notes that further investigation is required to determine the mechanism of contamination during the production and processing of the oil. In addition, a study conducted by Strid et al. identified the presence of CPs in household appliances that contaminate food during preparation is an unexpected exposure pathway and needs to be addressed (Strid et al. 2014). A study conducted by Gao et al. (2015) demonstrated that concentrations of SCCPs within urban buildings were higher than outdoor concentrations, which suggests that the general public can be exposed to SCCPs in the indoor environment. Furthermore, Hilger et al. (2013) found concentrations of SCCPs in dust samples taken from private residences and public buildings located in Bavaria. One sample from a public building contained 2050 µg/g of SCCPs, whereas concentrations in residences were significantly lower (Hilger et al. 2013).

51. The increasing regulation of SCCPs has resulted in a decrease in SCCPs currently used. However, evidence suggests that significant amounts are still in use and are being released. The release and distribution of SCCPs to the environment is confirmed by monitoring data (UNEP/POPS/POPRC.11/10/Add.2), and are likely to occur over a long time-frame. Control measures should be considered for all the above described sources of exposure and releases including production, use and in the waste management phase. A diagram that summarizes the lifecycle of SCCPs and associated releases is provided in the additional information document that accompanies this risk management evaluation.

2.1 Identification of possible control measures

52. The objective of the Stockholm Convention (Article 1) is to protect human health and the environment from POPs. This may be achieved by listing SCCPs in:

(a) Annex A to eliminate releases from intentional production and use (specific exemptions allowed); or,

(b) Annex B to reduce releases from intentional production and use (specific exemptions and acceptable purposes allowed); and/ or

(c) Annex C to reduce or eliminate releases from unintentional production.

53. Control measures that result from a listing to the Convention can include actions that eliminate or restrict intentional production and use of the substance as well as import and export. These control measures may allow for time-limited or on-going production or use when appropriate justification has been demonstrated. Possible measures also include actions that control import and export. Measures may also include actions to minimize and eliminate unintentional production. Upon listing to the Convention, parties are required to take appropriate actions to manage stockpiles and wastes in an environmentally sound manner. Being mindful of the precautionary approach referred to in Article 1 of the Convention, the aim of any risk reduction strategy for SCCPs should be to, as far as possible, reduce and eliminate emissions and releases of SCCPs. This risk management evaluation considers socio-economic information submitted by parties and observers to enable a decision to be made by the Conference of the Parties regarding possible control measures. This document reflects the available information on the differing capabilities and conditions among parties.

54. There is no evidence that SCCPs are unintentionally formed through thermal process since, due to their thermal instability, SCCPs are expected to be degraded by incineration (IPCS 1996). As previously mentioned SCCPs may be produced during the manufacture of other CP mixtures due to short-chain lengths contained in the hydrocarbon feedstock that is used in the process (UNEP/POPS/POPRC.6/INF/15). No information is available on existing stockpiles, and releases from appropriately engineered landfills are considered to be unlikely; however, wastewater treatment effluent and sewage sludge may be a potential source which can be applied to land, including agricultural land. There are multiple industrial uses and release mechanisms of SCCPs that contribute to environmental and human exposure, for that reason, the control measures will focus on intentional production and consider unintentional formation.

Control measures for releases from intentional production

55. SCCPs are intentionally produced, although global production is decreasing as national and regional regulatory controls are established (UNEP/POPS/POPRC.11/10/Add.2). Current quantitative information on intentional production and use is lacking; however, recent studies have demonstrated several SCCP homologues are persistent in the environment and investigations on food webs and food chains confirm several SCCPs accumulate in invertebrates, freshwater and marine fish at high levels (Zeng et al. 2013; Yin et al. 2015; UNEP/POPS/POPRC.11/10/Add.2). Information on alternatives provided in Annex F submissions to the Committee and gathered through a literature review demonstrates that alternatives are available for all known uses of SCCPs. The decrease in production and use volumes further substantiates that substitution has taken place and demonstrates that technically feasible, economically viable alternatives to SCCPs are available.

56. Given that Canada, EU member states, Norway and the United States, have regulated production and use of SCCPs and that parties have not identified uses where alternatives are not available or any technical challenges associated with the transition to alternative chemicals and processes[5], the listing of SCCPs in Annex A, without any specific exemptions, could be the primary control measure to eliminate remaining uses at the global scale and to prevent the re-introduction of other uses. This listing would subject SCCPs to the provisions of Article 3 of the Convention, requiring parties to take the legal and administrative measures necessary to eliminate production and use and to only import and export SCCPs in accordance with the Convention. In addition, this listing would restrict the production and use of new articles that contain SCCPs.

Control measures for releases from unintentional production

57. Although unintentional production of SCCPs is limited to one source category: the manufacture of other CP mixtures using hydrocarbon feedstocks, control measures for this source of release could be considered. A listing of SCCPs to the Convention could reduce releases of SCCPs into the environment as a result of the unintentional production of SCCPs during the manufacture of other CP mixtures.

58. In the EU, CPs are manufactured using paraffin feedstocks with specification-controlled chain lengths (RPA 2010). Manufacturers in the EU indicate that distinct feedstocks are purchased to manufacture SCCPs (C_{10-13}) and MCCPs (C_{14-17}). The feedstocks and products remain separate throughout the manufacturing process and are not mixed to produce distinct commercial grades of SCCPs and MCCPs (the same is true for LCCPs) (RPA 2010). The paraffin feedstocks are prepared using molecular filters, which does not give 100% certainty that the final product will only contain 100% of the prescribed carbon chain lengths. It is generally accepted that up to 1% of the paraffins in the final product could fall outside of the requested chain length range (RPA 2010). However, SCCPs have been found in some CP products at concentrations ranging from 3.7% to 24.9%, which points to the ongoing inclusion of SCCPs in CP mixtures (Gao et al. 2012). In Europe, it was estimated that <33.4 t/year of SCCPs are released to the environment as a result of their presence in MCCPs (BRE 2008).

59. According to Euro Chlor, a European manufacturer of CPs, producers of MCCPs in the EU have used paraffin feedstocks in the production process with a C_{10-13} content of less than 1%; however,

[5] Section 2.3 of this document provides a summary of chemical and non-chemical alternatives to SCCPs. Additional detailed information and references regarding alternatives, including available health and environmental hazard profiles, loading details, price estimates, and information on their technical feasibility, availability and accessibility, are provided in the additional information document that accompanies this risk management evaluation. Where available, information on the health and environmental hazard profiles and regulatory status for the alternatives has been provided.

the actual levels are often much lower (UK 2008). Given that it is feasible to manufacture MCCPs and other CP mixtures containing less than 1% of SCCPs, and that alternative feedstocks such as olefins which do not contain SCCPs are available, a listing to Convention that includes control measures for SCCPs as an impurity could be appropriate. This could be achieved by an Annex A listing that includes controls for the occurrence of SCCPs as an impurity in other CP mixtures above a specified concentration limit. Annex A would require parties to implement Article 3 provisions to prohibit and/or take legal and administrative measures necessary to limit the presence of SCCPs in other CP mixtures, and to import and export in accordance with the provisions of paragraph 2 of the Convention. SCCPs could also be listed to Annex C of the Convention to reduce releases of SCCPs as a result of unintentional production during the manufacture of other CP mixtures. Listing SCCPs to Annex C would require parties to, among other requirements, establish guidance on best available technologies (BAT) and best environmental practices (BEP) to minimize the unintended production of SCCPs during the manufacture of other CP mixtures from hydrocarbon feedstocks. Listing SCCPs to the Convention with controls to limit the presence of SCCPs as impurities in CP mixtures, would reduce SCCPs contamination in products and articles as a result of the production and use of other CP mixtures.

60. In the case of SCCPs, where their presence in other CP mixtures results from the presence of short-chain lengths in the feedstocks used to manufacture various CP mixtures, BAT and BEP options are available (EC 2006). BAT could include an additional process step prior to production to purify the feedstock and remove hydrocarbon chain lengths less than 14 using a molecular filter (RPA 2010). BEP could include taking steps to establish quality control and quality assurance procedures to purchase and use feedstocks that do not contain short-chain lengths (RPA 2010).

61. Control measures for the unintentional formation of SCCPs from thermal process are not required as this is not a source of release to the environment.

Control measures for releases from stockpiles and wastes

62. Introducing waste management measures, including controls for products and articles upon becoming waste, in accordance with Article 6 of the Convention, would ensure that wastes containing SCCPs at concentrations above the low persistent organic pollutant (POP) content are disposed of in such a way that the POP content is destroyed or otherwise disposed of in an environmentally sound manner. Following a listing of SCCPs to the Convention, a concentration level for low POP content could be established in cooperation with the Basel Convention, which is typically also tasked with determining the methods that constitute environmentally sound disposal. These measures would also address proper waste handling, collection, transportation and storage to eliminate or reduce emissions and the resulting exposure to SCCPs. Establishing the low POP content value and developing the guidelines under the work of the Basel Convention will help parties to dispose of waste containing SCCPs in an environmentally sound manner (UNEP/CHW.12/INF/9).

63. As described above, SCCPs are contained in rubber waste from conveyor belts and in sealants and adhesives in construction and demolition waste (Potrykus et al. 2015). While listing SCCPs to the Convention would eliminate or reduce the SCCP content in new products, thereby reducing releases from the waste stream in the longer term, control measures could be implemented to address rubber waste and construction and demolition waste wherein SCCPs may be found. The German study highlighted challenges related to separating these materials that contain SCCPs from the waste stream for appropriate treatment (Potrykus et al. 2015). However, Article 6(1)(d)(ii), requires that these wastes are disposed of in such a way that the POP content is destroyed or irreversibly transformed so that they do not exhibit the characteristics of POPs. Alternatively, waste that contains POPs may be disposed of in an environmentally sound manner when destruction or irreversible transformation does not represent the environmentally preferable option, or the POP content is low. Waste containing SCCPs below the low POP content level shall be disposed of in an environmentally sound manner in accordance with pertinent national legislation and international rules, standards and guidelines.

64. As stated above, it is not expected that SCCPs and products that contain SCCPs which are disposed of in appropriately engineered landfills will be a significant source of release to the environment. However, there is evidence that wastewater may contain SCCPs which when treated at a wastewater treatment plant will sequester in sludge (Canada 1993, Ecuador Annex E submission 2010). The land application of sewage sludge that contains SCCPs may be a source of release to the environment (Zeng et al. 2011, 2012). Land application of sewage sludge should be carried out in accordance with applicable regional and local requirements.

65. Waste management activities should take into account international rules, standards, and guidelines, including those that may be developed under, or in cooperation with, the Basel Convention

on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, and relevant global and regional regimes governing the management of hazardous wastes. Parties should also consider emission reduction measures and the development of guidance and use of best available techniques and best environmental practices (BAT/BEP) in the waste management phase. In addition, parties shall endeavour to develop appropriate strategies for identifying sites contaminated with SCCPs. If contaminated sites are identified and remediation is undertaken, it shall be performed in an environmentally sound manner.

2.2 Efficacy and efficiency of possible control measures in meeting risk reduction goals

Intentional Production

66. Information on chemical substitutes and alternative techniques is available for all known uses of SCCPs (refer to section 2.3 and the additional information document that accompanies this risk management evaluation). Canada, Norway, the United States and the European Union have completely transitioned away from SCCPs. In addition, parties have not identified uses where alternatives are not available, or any technical challenges associated with the transition to alternative chemicals and processes. This indicates that alternatives are available; therefore, the elimination of intentional production is considered to be achievable. These alternatives and alternative techniques may not necessarily be economically feasible or accessible for developing countries.

67. Canada reported that costs for eliminating the production and use of SCCPs are not expected, as chemical substitutes and alternative techniques are readily available and in use. Cost increases for consumers in Canada are not expected, since industry has largely transitioned to substitutes (Canada 2013). Alternatively, China and the Russian Federation indicated that eliminating intentional production is expected to have an impact on the paraffin and chlorinated paraffin industries, including the manufacture of the raw materials, by increasing the raw material cost, monitoring costs, legal cost and administrative cost, etc. (China Annex F 2015 submission; Russian Federation submission April 2016).No quantitative data are available to estimate the expected costs for developing countries that may result from eliminating the production and use of SCCPs, and including controls to limit the presence of SCCPs in other CP mixtures. No information is available regarding the economic benefits expected for those manufacturing alternatives to SCCPs.

68. A 2011 study published by the Environment Agency in the United Kingdom estimated the effectiveness of abatement measures to reduce emissions of SCCPs within the European Union (Corden et al. 2011). The study assumed that less than 1,100 tonnes of SCCPs were used in the European Union in 2004, and that approximately 35.4 tonnes were released into the environment. Using this baseline, the incremental costs and corresponding reduction in emissions were determined for chemical substitution and emissions abatement technologies, such as additional wastewater treatment and air pollution control measures. The findings from this report for the European Union are summarized in Table 3, which reports the total cost (combined one-time costs and on-going operating costs) in the European Union (Corden et al. 2011). Generally, it can be concluded from this analysis that chemical substitution of SCCPs with alternatives is the most effective method for reducing releases into the environment, and that emissions abatement technologies are less effective. Regarding costs, the findings reveal that chemical substitution in rubber applications would provide the greatest reduction in releases of SCCPs at the lowest cost. While certain alternatives in textile applications and sealant and adhesive applications are more costly.

Table 3
Summary of Emission Reductions and the Corresponding Substitution and Abatement Costs for Eliminating SCCPs

Application	Measure	Cost (£)*	Emission Reduction (tonne)	Percent Reduction (%)
Rubber	Chemical substitution with MCCPs	87,400	15.42	43.6
	Chemical substitution with LCCPs	16,900	1.93	5.5
	Chemical substitution with organophosphates	56,900	1.93	5.5
	Additional wastewater treatment for rubber formulation and processing	Not reported	0.00	0.0

Application	Measure	Cost (£)*	Emission Reduction (tonne)	Percent Reduction (%)
	Thermal oxidation of emissions to air for rubber formulation and processing	Not reported	0.00	0.0
Paints and Coatings	Chemical substitution with MCCPs	175,700	2.49	7.0
	Chemical substitution with LCCPs	23,000	0.31	0.9
	Chemical substitution with phthalates	23,800	0.31	0.9
Textiles	Chemical substitution with MCCPs/decaBDE	273,800	4.01	11.3
	Wastewater treatment for textiles (alternate to chemical substitution)	55,100	0.90	2.5
Sealants and Adhesives	Chemical substitution with MCCPs	171,400	6.33	17.9
	Chemical substitution with LCCPs	27,500	0.90	2.5
	Chemical substitution with phthalates	30,000	0.90	2.5
	Chemical substitution with terphenyls	85,000	0.90	2.5

* Denotes total cost for implementing the measure in the European Union, based on the assumption that less than 1,100 tonnes of SCCPs were used in 2004.

Source: Corden, C., Grebot, B., Kirhensteine, I., Shialis, T., Warwick, O. 2011. Evidence. Abatement cost curves for chemicals of concern. The Environment Agency.Horizon House. Bristol, United Kingdom. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/290505/scho0811bucc-e-e.pdf

69. As demonstrated above, costs are expected to arise from a listing of SCCPs to the Convention that would require chemical substitution. However, it is expected that the benefits to those companies that produce alternatives to SCCPs would outweigh this increased cost (BiPro 2007). Costs could also arise from the requirements included in Article 6 of the Convention which require parties to develop appropriate strategies for identifying stockpiles, products and articles in use and wastes consisting of, containing or contaminated with SCCPs.

70. The listing of SCCPs to Annex A without specific exemptions would be the most efficient control measure to eliminate intentional production thereby reducing human and environmental exposure. A listing to Annex A with specific exemptions would allow continued production and use, for five years unless otherwise specified, thereby possibly continuing the release of SCCPs into the environment. Listing SCCPs in Annex B to restrict their production and use, with acceptable purposes and/or specific exemptions, could reduce human and environmental exposure, but would not eliminate it. If specific exemptions or acceptable purposes are included in the listing of SCCPs to the Convention, then parties shall take appropriate measures to ensure that any production or use under such exemption or purpose is carried out in a manner that prevents or minimizes human exposure and release into the environment. The study completed by Corden et al. demonstrates that using emissions abatement technologies may be more costly to achieve the same emissions reduction as substitution (Corden et al. 2011). For exempted uses or acceptable purposes that involve the intentional release of SCCPs into the environment under conditions of normal use, such release shall be to the minimum extent necessary, taking into account any acceptable standards and guidelines.

71. Critical uses for SCCPs were not identified by parties and observers through Annex F submissions. Additional research was carried out, and no uses were identified where a suitable alternative was not commercially available for developed countries. In addition, no use was identified for which social and economic factors could inhibit a parties' ability to transition to alternative chemicals and processes for developed countries. Information is not available regarding the accessibility of alternatives in developing countries.

72. No party or observer submitted information to propose or justify the need for a specific exemption or acceptable purpose in the listing of SCCPs to the Convention. Consideration could be given to including a specific exemption to assist parties with their transition to alternative substances; however, no party has identified a specific use where flexibility in the recommended control measure is required. Considering the unknown cost, availability and accessibility of alternatives and alternative techniques for developing countries exemptions may be needed to afford parties, who have not yet

begun to phase out, the necessary flexibility to identify and implement appropriate substitutes and complete their phase out of SCCPs.

Unintentional Production

73. As stated above, SCCPs may be produced during the production of other CP mixtures, resulting in SCCP contamination in products and articles as a result of the production and use of other CP mixtures. Parties have implemented risk management controls to restrict the concentration of SCCPs. In Norway and in the EU, regulations were enacted to prohibit the production or placing on the market and use of substances or preparations containing SCCPs at concentrations equal to or greater than 1%. This restriction limits the amount of SCCPs that may be contained in preparations, such as other CP mixtures. Similarly, in Canada regulatory action was taken to limit the concentration of SCCPs in any product that is manufactured in Canada or imported into Canada. Mandatory annual reporting is required by any company that produces more than 1 kg of SCCPs total per year, or the concentration of SCCPs exceeds 0.5% in a product (including unintended or incidental presence in products) (Canada 2013).

74. Listing SCCPs to the Convention would be the most effective method to reduce releases of SCCPs into the environment as a result of the unintentional production of SCCPs during the manufacture of other CP mixtures. This could be achieved by an Annex A listing that includes controls for the occurrence of SCCPs as an unintentional trace contaminant in other CP mixtures above a specified concentration limit. Alternatively, the listing could allow the production and use of substances or preparations containing SCCPs in concentrations lower than 1% by weight and articles containing SCCPs in concentrations lower that 0.15% by weight. This would require parties to implement Article 3 provisions to prohibit and/or take legal and administrative measures necessary to limit the presence of SCCPs in other CP mixtures, and to import and export in accordance with the provisions of paragraph 2 of the Convention. SCCPs could also be listed to Annex C of the Convention to reduce releases of SCCPs as a result of unintentional production during the manufacture of other CP mixtures. This listing would subject SCCPs to the provisions of Article 5 that require parties to develop action plans; promote the application of available, feasible and practical measures to reduce releases and eliminate sources; promote the development and use of substitute or modified materials, products and processes to prevent unintentional formation; and, promote the use of best available techniques and best environmental practices.

75. It is expected that resources will be expended by parties if control measures for unintentional production of SCCPs during the manufacture of other CP mixtures are put in place. In addition, costs may be incurred by parties to promote the development and application of feasible and practical measures, such as best available techniques and best environmental practices, to achieve a realistic and meaningful level of release reduction or source elimination.

76. Detailed information on the quantity of SCCPs released as a result of unintentional production during the manufacture of other CP mixtures is not available. However, it is estimated that a maximum of 33.4 tonnes of SCCPs were released in 2004 from unintentional formation of SCCPs in MCCPs used within the European Union (ECHA 2008). In addition, the production and use of MCCPs and other CP mixtures is expected to increase as SCCPs are phased out which could increase the unintended production and subsequent release of SCCPs during the manufacture of alternative chemicals. At this time, considering current information, it cannot be determined if a listing to the Convention would be an efficient control measure, in terms of costs and benefits, to reduce unintentional releases as both the economic impacts and environmental and health benefits cannot be characterized.

77. It should be noted that there are other initiatives under the United Nations Environment Program (UNEP) Chemicals Branch, who developed the Standardized Toolkit to assist countries in the identification and quantification of POP releases as per Annex C of the Convention. Consideration could be given to conducting research to better understand how the unintentional production of SCCPs during the manufacture of other CP mixtures contributes to releases to the environment. The outcome of this work may support a listing to the Convention, or could be the foundation for the development of guidance materials to assist parties in reducing releases of SCCPs resulting from unintentional production.

Stockpiles and Wastes

78. As a consequence of listing SCCPs to the Convention, the provisions of Article 6 would apply and parties to the Convention would be required to manage stockpiles and waste in a manner that is protective of human health and the environment. A listing to Annex A, B and/or C would be the most effective control measure to reduce releases of SCCPs into the environment from stockpiles and wastes. In addition, a listing to the Convention would eliminate or reduce the content of SCCPs in new products; therefore, reducing SCCPs in the waste stream in the long term. This is especially important where it may not be feasible to separate wastes that contain SCCPs from the recycling stream (e.g. rubber, sealants and adhesives).

79. SCCPs are expected to be present in rubber waste from conveyor belts and in sealants and adhesives in construction and demolition waste (Potrykus et al. 2015). As noted previously, information on the concentration of SCCPs in these waste streams is limited to the one German study (Potrykus et al. 2015). A listing to the Convention would lead to a low POP content value being established for SCCPs in waste, and the development of guidelines by the Basel Convention to assist parties with the environmentally sound management of waste containing SCCPs (UNEP/CHW.12/INF/9). For these control measures to be efficient, proper waste management could require the identification of materials that contain SCCPs to facilitate separation and subsequent destruction of the POP content in the waste (UNEP.CHW.12/INF/9). Currently, sorting and separation techniques specific to SCCPs are not available.

80. Destruction of wastes that contain SCCPs in accordance with Article 6.1d(ii) and 6.2 of the Convention would contribute to the elimination of emissions and exposure to SCCPs from waste. Different methods for the disposal of POPs-containing waste in an environmentally sound manner are available (Basel Convention 2015). While there are many options, incineration at high temperatures is generally considered the effective way to destroy POP substances or products that contain POPs, such as in hazardous waste incinerators and by cement kiln co-incineration (Basel Convention 2015). Incineration of POPs-containing waste may result in the formation of harmful incineration products. Available information on emissions from incineration of waste containing SCCPs is limited. Many countries and regions globally have the capacity to incinerate POPs, such as in hazardous waste incinerators or by co-processing in cement kilns. However, a general overview of the global capacity or the capacity for incineration in specific regions is not available (UNEP/POPS/POPRC.11/2). Where neither destruction nor irreversible transformation is the environmentally preferable option or the POP content is low, other environmentally sound disposal techniques may be used. One option is disposal in specially engineered landfills that are designed to prevent leaching and spreading of hazardous chemicals, as described by the Basel Convention guidance (Basel Convention, 1995).

81. There is no information available regarding the existence of stockpiles consisting of or containing SCCPs, or any costs that could be associated with the management of these stockpiles. In addition, there is no cost information available related to the environmentally sound disposal of wastes that contain SCCPs. The Convention does not oblige parties to undertake remediation measures for contaminated sites. If such measures are undertaken they shall be performed in an environmentally sound manner and it is expected that costs could arise.

2.3 Information on alternative products and processes

2.3.1 Introduction

82. The responses to the Annex F request for information identified that SCCPs are primarily used in metalworking applications and in polyvinyl chloride (PVC) processing. SCCPs are also used as plasticizers and flame retardants in a variety of applications, including in paints, adhesives and sealants, leather fat liquors, plastics, rubber, textiles and polymeric materials.

83. A synopsis of known and potential alternatives to SCCPs is provided below. Additional detailed information and references regarding alternatives, including available health and environmental hazard profiles, loading details, cost implications, price estimates, and information on their technical feasibility, availability and accessibility, are provided in the additional information document that accompanies this risk management evaluation (UNEP/POPS/POPRC12/INF/7). Where available, information on the health and environmental hazard profiles and regulatory status for the alternatives has been provided.

84. It is important to note most of the alternatives identified in this risk management evaluation have not been assessed under the Convention. As such, it is presently unknown if some of these would exhibit POPs characteristics or other hazardous properties that should be assessed by parties before considering such substances as suitable alternatives. In the case of alternatives to SCCPs in textile applications many are POPs or exhibit POPs characteristics.

85. Any transition to alternative substances must be mindful of the health and environmental hazard profiles of the alternatives under consideration. Simply replacing persistent organic pollutants with other hazardous chemicals should therefore be avoided and safer alternatives should be pursued. To ensure that a potential alternative leads to the protection of human health and the environment, the chemical being considered should be assessed to determine whether it is safer than persistent organic pollutants. Although a comprehensive risk assessment may be impossible if there is a lack of information on its hazardous properties or exposure data, a simple analysis of risk should be performed, taking into account the weight of available evidence. General guidance is available on considerations related to alternatives and substitutes for listed POPs and candidate chemicals and can be accessed here: http://chm.pops.int/TheConvention/POPsReviewCommittee/Meetings/POPRC5/POPRC5Documents/tabid/592/Default.aspx (UNEP/POPS/POPRC.5/10/Add.1).

86. When transitioning to alternative chemical substances, consideration must be given to national and regional assessment outcomes and control measures for alternative chemical substances. Where available, information on regional and national regulatory requirements has been included in the additional information document that accompanies this risk management evaluation.

2.3.2 Alternatives and alternate processes in metalworking fluids

87. Historically, SCCPs have been used as lubricants and coolants in metalworking fluids (MWF). In general, lubricants that are chlorinated paraffins or contain chlorinated paraffin additives are designed to lubricate parts that experience extreme pressures, and are used in deep drawing, tube bending and cold heading (US EPA 2004). The transition away from using SCCPs, and chlorinated paraffins in general, in metalworking applications has included the development of alternatives as well as alternative processes.

88. In an effort to implement sustainable MWF systems, significant progress has been made by industry through the development of environmentally adapted lubricants (EALs). EALs are highly biodegradable, have low toxicity and their performance is equal to or better than conventional alternatives (Skerlos et al. 2008). There are numerous classes of EALs, including vegetable oil-based (oleochemical) ingredients which can be used in traditional water-based and straight-oil formulations in place of conventional fluids (Skerlos et al. 2008). Furthermore, bio-based formulations have the potential to reduce the waste treatment costs for MWF effluents and the occupational health risks associated with petroleum oil-based MWFs (Raynor et al. 2005). The United States military has substituted non-chlorinated canola, sunflower and soybean oils in place of petroleum or petroleum-derived compounds, which often contain CP additives, and it was found that the vegetable-based alternatives provide better heat dissipation and produced less smoke during machining (US Navy 2006). To facilitate the transition to renewable bio-based MWFs, guidance is available from the US EPA regarding the development of 100% petroleum-free formulations (US EPA 2006).

89. In addition to the development of EALs, alternative techniques have been developed including the use of gas-based system such as supercritical CO_2. Under supercritical conditions, CO_2 has the density and solvency of a liquid while maintaining the compressibility and viscosity of a gas (Skerlos et al. 2008). Although gas-based systems may have a lower emissions performance in terms of global warming potential, overall the environmental impact of these systems has been evaluated to be lower than the liquid-based lubrication systems (Skerlos et al. 2008). Supercritical CO_2 can be combined with soybean oil to obtain improved performance above employing either alternative on its own (Clarens et al. 2006). Other alternative processes include dry machining, where no cutting fluid is required, and cryogenic machining, where liquefied gases are used (Shokrani et al. 2014).

90. Chemical alternatives to SCCPs in metalworking fluids also include MCCPs, LCCPs, sulphur-based compounds (e.g., zinc dialkyldithiophosphate, sulfonated fatty esters, overbased calcium sulphonates), phosphorus-based compounds (e.g,., tributyl phosphate, alkyl phosphate esters, phosphate acid esters, hydrogen phosphites), nitrogen-based compounds, chlorinated fatty esters and acids, boundary acid esters, complex esters (Canada 2009; EC 2002; US EPA 2004; Dover n.d.; COHIBA 2011). Other potential substitutes include alkanolamides and diisopropyloleate (Canada 2009).

91. The technical suitability of alternative chemicals and processes depends upon the individual requirements of the specific process being undertaken. Evidence suggests that there are ample alternatives to SCCPs for use as MWFs; however, they may not be suitable for all applications (Canada 2009). There is also limited information available on pricing, but globally, MWFs was one of the first applications to be targeted by regulation and necessitating a transition to substitutes (RPA 2010). Therefore, it can be concluded that alternatives are commercially available, accessible and in use in many regions.

92. Synthetic and semi-synthetic lubricants, are often diluted with water rather than VOC solvents, may also serve as alternatives (US EPA 2004).

93. Based on information from Europe, that was collected prior to the phase out of SCCPs in metalworking applications in 2003, it is expected that transitional costs due to the need for reformulation (e.g. laboratory testing) will be in the order of 50,000 Euros per formulator (BiPRO 2007). Cost increases of around 20% have been expected for moving to chlorine-free alternatives as implementation requires re-formulation of the base-oil (BiPRO 2007). In addition, substitution costs for metalworking applications depend on the type of substitute and can range from 100 Euros per tonne for MCCPs to 2,500 Euros per ton for non-CP alternatives (RPA 2001). Since the transition to alternatives has taken place in Canada, EU member states, Norway and the United States, transitional costs for reformulation of metalworking fluids are expected to be significantly lower due to the existing experiences of formulators supplying these markets.

2.3.3 Alternatives to SCCPs for polyvinyl chloride

94. In the manufacturing of PVC, SCCPs are used primarily in applications where moderate plasticizing and flame retarding properties are required at low cost (Canada 2009). Analysis of alternatives to SCCPs suggests that, in many cases, the overall technical characteristics of the PVC product (e.g., flexibility and stability) would improve with the use of alternatives. Flame retardancy can be achieved through the use of alternate techniques, such as using inherently flame-resistant materials, flammability barriers and product re-design (New York 2013). Although technically feasible, the use of alternatives to SCCPs may increase the raw materials costs for PVC manufacturers. Identified chemical alternatives include: tricresyl phosphate, MCCPs, LCCPs, antimony trioxide, zinc borate, diisononyl phthalate, diisodecyl phthalate, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, diisoundecyl phthalate (Canada 2009). According to a statement from the European Council of Vinyl Manufacturers, SCCPs are no longer used in PVC; however, the group does not indicate what alternatives have replaced SCCPs in this application (ECVM 2008).

95. According to a Dutch study (Van der Gon et al. 2006), it was estimated that the total cost for substitution of SCCPs in PVC in the United Kingdom would be approximately 1,000 Euros per tonne replaced (includes one-off costs and operational costs for the entire sector). As a result of using alternatives to SCCPs, cost implications may arise for reformulation, re-approval and on the price of the finished product (BiPRO 2007).

2.3.4 Alternatives to SCCPs in other applications

96. Historically SCCPs were mostly used in metalworking fluids and in PVC, but as controls were implemented the use profile of SCCPs changed to include other applications, such as rubber products (other than PVC), sealants, adhesives, paints, coatings, leather fat liquors, plastics, textiles and polymeric materials (RPA 2010; Canada 2009).

Rubber applications

97. Due to the inherent flammability of rubber, SCCPs are used as flame retardants in a variety of rubber products including natural rubber, styrene and butadiene rubber, polybutadiene rubber, acrylonitrile and butadiene rubber, butadiene or isoprene rubber and ethylene propylene diene monomerelastomer (RPA 2010). In applications where a non-flammable plasticizer is needed, phosphate esters are viable alternatives to SCCPs (Dick 2001). Other possible alternatives include alicyclic chlorinated compounds, c- decaBDE, bis-tetrabromophthalimide as halogen sources in combination with diantimony trioxide, and possibly borate and phosphate esters to reduce afterglow combustion (Dick 2001). While c-decaBDE is a technically viable alternative to SCCPs, it is not an acceptable alternative since POPRC has decided to recommend that c-decaBDE be considered for listing to the Convention. As previously mentioned, relevant regional and national assessment conclusions and control actions must be considered when selecting alternative substances to SCCPs.

98. It is suggested that inorganic flame retardants, brominated flame retardants and organophosphorus compounds can replace SCCPs in rubber formulations (RPA 2010). Other studies identify alternative flame retardants to SCCPs in rubber applications as diantimony trioxide, aluminium hydroxide, acrylic polymers and phosphate containing compounds, synthetic and natural esters, calcium sulphonates, alkyl phosphate esters, sulphonated fatty esters, MCCPs, LCCPs, cresyl diphenyl phosphate, tertbutylphenyl diphenyl phosphate and isopropylphenyl diphenyl phosphate (OSPAR 2006; BiPRO 2007; ECHA 2008).

99. SCCPs can be used as flame retardants in rubber used in conveyor belts. In 2011, it was estimated that 80% of SCCPs used in rubber applications were as flame retardants in conveyor belts (COHIBA 2011), for use in underground mines where specific safety requirements must be met

(RPA 2010). SCCPs have been confirmed in mono-ply (solid woven) conveyor belts, also referred to as PVG solid woven conveyor belts, where a textile core is impregnated with PVC and is then covered with a rubber cover (RPA 2010). Flame retardancy can be achieved through the use of alternate techniques, such as using inherently flame-resistant materials, flammability barriers and product re-design (New York 2013). Alternative conveyor types, such as PVC solid woven and chloroprene (CR) multi-ply, are available that do not contain SCCPs; however, the performance characteristics of these alternate types are not as high as the PVC solid woven conveyor belt (RPA 2010). In comparison to the PVC solid woven conveyor belt, the other types do not perform as well in terms of wear resistance, robustness, impact and rip resistance, edge stability, etc. (RPA 2010). Additional information on the comparison of these three types of conveyor belts is contained in the additional information document that accompanies this risk management evaluation. Chemical alternatives to SCCPs are available for use in conveyor belts and include MCCPs and LCCPs. Information gathered in a 2010 study is limited, but indicates that manufacturers have switched to alternatives and no negative impacts were reported in terms of cost or technical feasibility (RPA 2010).

100. According to a Dutch study (Van der Gon et al. 2006), it was estimated that the total cost for substitution of SCCPs as a flame retardant in rubber applications in the United Kingdom would be approximately 1,000 Euros per tonne replaced (includes one-off costs and operational costs for the entire sector). As a result of using alternatives to SCCPs, cost implications may arise as a result of reformulation and re-approval, which may affect the price of the finished product (BiPRO 2007). Transitional costs could be high for flame retarded conveyor belts given that the research needs and testing requirements could be more arduous than in other applications given the safety requirements surrounding underground mining (BiPRO 2007).

Sealant and adhesive applications

101. Regarding sealants and adhesives, SCCPs are used as plasticizers and in some cases as flame retardants, in polysulphide and polyurethane formulations, and in acrylic and butyl sealants (RPA 2010). Generally, alternatives to SCCPs in sealants are various phosphate esters (EC 2002). Phthalic esters and phosphoric esters have been used as plasticizers for sealants (Takahashi et al. 1974). Specifically in polysulphide sealants, phthalate esters (e.g., isooctyl benzyl phthalate, benzyl butyl phthalate, 1-isobutyrate benzyl phthalate, diisoundecyl phthalate, di-2-ethylhexyl phthalate), phosphate esters, glycolate esters, 2,2,4-trimethyl-1,3-pentaniediol, di-2-ethylhexyl adipate, hydrogenated terphenyls, and alkyl sulphonic acid esters of phenol and/or cresol can be used as plasticizers (Special Chem 2003; Wypych 2004; BiPro 2007; Mittal &Pizzi 2009)). Several studies have identified MCCPs and LCCPs as alternatives to SCCPs in sealants and adhesive products (BiPro 2007, ECHA 2008; Canada 2009; McBride 2010). While the previously mentioned alternatives are suitable plasticizers for polysulphides, dipropylene glycol dibenzoate is suitable for polyurethane formulations (McBride 2010).

102. Alternate types of sealants and adhesives are available that are not formulated using SCCPs as the plasticizer. Silicone sealants do not contain SCCPs, as polydimethylsiloxanes are used as the plasticizer, and are technically feasible alternatives to polysulphide-based products. According to the Swiss Federal Office for the Environment, Substances, Soil and Biotechnology Division silicone-based products have the largest share of the sealant and adhesive market (Swiss Federal Office 2008). Silicones perform better than polysulphide options in terms of recovery from stress, UV resistance, cure rate and low temperature gunability but may not perform as well in terms of paintability, colour availability, resistance to hydrolysis (Special Chem 2003). Urethane sealants that do not contain SCCPs are also viable alternatives to polysulphide products and generally perform better, with the exception of their propensity for bubbling (Special Chem 2003). Information gathered in a 2010 study indicates that manufacturers have switched to alternative plasticizers, such as MCCPs, or to sealants that do not normally contain SCCPs (i.e., silicone sealants) (RPA 2010).

103. Regarding SCCPs contained in dam sealants, it may be argued that a fire retardant is not required and SCCPs may not play a critical role in the performance of the product; however, if the SCCPs act as a plasticizer in this application it can be replaced with high molecular weight plasticizers which are less prone to leakage from the cured polymer (Denmark 2014).

104. According to a Dutch study (Van der Gon et al. 2006), it was estimated that the total cost for substitution of SCCPs in sealant and adhesive applications in the United Kingdom would be approximately 1,000 Euros per tonne replaced (includes one-off costs and operational costs for the entire sector). It is reported that some producers would require up to two years to identify and test alternatives and that the cost to end users may increase by 5%; however, other companies have reported no apparent loss in performance or increase in cost (BiPRO 2007).

Paint and coating applications

105. SCCPs are used in chlor-rubber and acrylic protective coatings and in intumescent paints. Typical applications include road marking paints, anti-corrosive coatings for metal surfaces, swimming pool coatings, decorative paints for internal and external surfaces, and primers for polysulphide expansion joint sealants (RPA 2010). In coatings and paints, MCCPs and LCCPs are identified as potential alternatives to SCCPs (BiPro 2007; ECHA 2008; RPA 2010). In these applications, alternate plasticizers include phthalate esters, polyacrylic esters and diisobutyrate and alternate flame retardants include phosphate and boron containing compounds (RPA 2010; ECHA 2008; COHIBA 2011). It should be noted that the technical and economic feasibility of some of these suggested alternatives is unclear (ECHA 2008). For road marking paints, thermoplastic products (which do not contain SCCPs) are used rather than paint products since they provide improved durability. These alternate products are widely available and are used in Northern Europe, United Kingdom and most Scandinavian countries (RPA 2010). Information gathered in a 2010 study indicates that companies may continue to use coating and paint products that contain SCCPs, but that alternatives are available (RPA 2010). In the same study, concern was expressed by companies over the availability, cost and technical feasibility.

106. According to a Dutch study (Van der Gon et al. 2006), it was estimated that the total cost for substitution of SCCPs in paint and coating applications in the United Kingdom would be approximately 1,000 Euros per tonnereplaced (includes one-off costs and operational costs for the entire sector). It is speculated (with a high degree of uncertainty) that this could result in a 7% increase in the cost of acrylic paint (BiPRO 2007).

Textile applications

107. The textiles industry uses SCCPs as a flame retardant and in one niche application to provide a flame-retardant, waterproof and rot-proof finish to heavy textiles, such as military tents (RPA 2010). Alternative flame retardant substances are available to be used in place of SCCPs. Antimony trioxide, in combination with halogenated flame retardants, can be used on textiles such as wool, cotton, polyester, polyamide fibres and blends (upholstery fabrics and roof insulating fabric) (PFA 2003). Brominated flame retardants, such as c-decaBDE, hexabromocylcododecane, and 1,2-bis (2,4,6-tribromophenoxy)ethane may be used with antimony trioxide on polyester and cellulosic fibers, modacrylic fibers, non-wovens for drapery, upholstery and textile coatings (PFA 2003). Organophosphorus compounds, such as tris(isopropylphenyl) phosphate, are suitable for cellulosic, nylon and polyester fibers (upholstery fabric, garments, flexible ducting) (PFA 2003). Information gathered in a 2010 study indicates that companies completed the transition to alternative flame retardants in textiles several years ago and no concerns were noted (RPA 2010).

108. While hexabromocyclododecane is a technically viable alternative to SCCPs, it is not an acceptable alternative since it is listed to Annex A of the Convention (without an exemption for use in textiles). Similarly c-decaBDE is a technically feasible alternative, but POPRC has decided to recommend that c-decaBDE be considered for listing to the Convention at the eighth Conference of the Parties. As previously mentioned, relevant regional and national assessment conclusions and control actions must be considered when selecting alternative substances to SCCPs.

109. According to a Dutch study (Van der Gon et al. 2006), it was estimated that thetotal cost for substitution of SCCPs in textile applications in the United Kingdom would be approximately 1,000 Euros per tonne replaced (includes one-off costs and operational costs for the entire sector).

Leather Applications

110. The leather industry has used SCCPs as inexpensive bulking agents in fat liquors, and they are not considered critical to leather processing (UK 1997). The Helsinki report states that the use of SCCPs in the leather industry has been replaced by natural animal and vegetable oils in the EU (EC 2002). Potential alternatives include nitroalkanes, alkyl phosphate and sulfonated fatty acid esters (US EPA 2009).

111. Given that SCCPs are not considered critical to leather processing and that Canada, EU member states, Norway and the United States have completed the phase-out of SCCPs in this application, no relevant cost implications are expected as a result of a phase out of SCCPs for this specific use (BiPRO 2007).

2.3.5 Summary of alternatives

112. The preceding sections have provided a summary of alternative chemicals and processes that have been identified as potential substitutes for SCCPs and products that contain SCCPs. Additional information on alternatives is available in the additional information document that accompanies this risk management evaluation (UNEP/POPS/POPRC12/INF/7).

113. It has been demonstrated that technically feasible alternatives are commercially available for all known uses of SCCPs. Information on the economic feasibility and accessibility of these alternatives in developing countries is not available. Many uses of SCCPs have been phased out in Canada, EU member states, Norway and the United States, for years. More recently, a decrease in SCCP consumption for conveyor belts, as well as dam sealants, has been observed which indicates that technically feasible alternatives exist, are accessible and available (Denmark 2014). In addition, remaining uses of SCCPs in rubber conveyor belts and dam sealants have been replaced with viable alternatives in the EU (EC 2015).

114. It is expected that producers of SCCPs and chlorinated substitutes will face losses that are difficult to quantify but could be to the order of 10 – 20 million Euros (BiPRO 2007). It is also expected that these losses will be outweighed by corresponding gains for producers of alternatives (e.g. MCCPs, LCCPs and other substitutes) (BiPRO 2007). These expected costs may not be representative of the experiences of developing countries as no information is available. Overall, it can be concluded that the impact on the chemical manufacturing industry is characterized by a shift away from SCCPs to substitutes, and that the gains for producers of substitutes will outweigh the losses for SCCPs (BiPRO 2007).

115. Two information sources (ECHA 2008; RPA 2010) note that the technical feasibility of some alternatives in paint and coating applications is unclear. Both studies also note the possible increased cost of manufacturing and using alternatives to SCCPs (ECHA 2008; RPA 2010). The exact impacts of switching to alternative chemicals and processes are expected to be unique to each situation, and can be difficult to predict when market and cost information is insufficient (BiPRO 2007). The available information demonstrates that substitution is underway and that alternatives are technically feasible and widely available for all applications (including in paints and coatings).

2.4 Summary of information on impacts on society of implementing possible control measures

2.4.1 Health, including public, environmental and occupational health

116. The risk profile documents human health and environmental concerns associated with SCCPs and reports that they are very toxic to aquatic organisms. SCCPs can cause toxicological effects in mammals and may affect the liver, the thyroid hormone system, and the kidneys, e.g., by causing hepatic enzyme induction and thyroid hyperactivity, which in the long-term can lead to carcinogenicity in these organs. SCCPs are also classified as suspected of causing cancer, and are listed as category 1endocrine disrupters for human health according to the former preliminary criteria for prioritisation of potential endocrine disrupting substances (UNEP/POPS/POPRC.11/10/Add.2). The majority of human exposure to SCCPs is from food consumption and there is likely some exposure resulting from inhalation and dermal contact.

117. Listing SCCPs to the Convention would provide benefits to human health and the environment by eliminating or reducing releases to the environment and thereby reducing human and environmental exposure. Listing SCCPs to Annex A of the Convention, without specific exemptions, would provide the largest benefit; however, the inclusion of specific exemptions or a listing in Annex B could be considered to accommodate any critical uses that are identified. For a use to be considered critical, it must be demonstrated that the specific application provides a societal benefit that warrants the ongoing use of a POP substance. Given that some jurisdictions have phased out their use of SCCPs, a listing in Annex B or that includes acceptable purposes and/specific exemptions could have a negative impact on human health and the environment by slowing or reversing the transition away from SCCPs. Such a listing would allow releases of SCCPs to continue over time, providing a lower level of protection for human health and the environment in comparison to an Annex A listing without specific exemptions.

118. Implementing control measures to limit the unintentional production of SCCPs during the manufacture of other CP mixtures would provide additional benefit to human health and the environment by reducing the presence of SCCPs contamination in products and articles as a result of the production and use of other CP mixtures. This would further reduce potential releases of SCCPs and subsequent human and environmental exposure. This could provide substantial benefit since MCCPs and other CP mixtures are known alternatives to SCCPs and their production is expected to increase as SCCPs are phased out globally.

2.4.2 Agriculture, aquaculture and forestry

119. Elimination of SCCPs would provide the greatest benefit to agriculture, as well as human and wildlife health, by ending further dispersal of a POP substance to soil. The inclusion of specific exemptions or acceptable purposes for SCCPs, is expected to result in some benefit as the use of SCCPs would be restricted. Contamination of agricultural soil with SCCPs may occur as a result of land application of sewage sludge. Applying sewage sludge to agricultural land is a way of managing sewage sludge while at the same time exploiting essential plant nutrients and organic matter in agriculture. As discussed above, this practice may contribute to environmental dispersion or redistribution of SCCPs. It may also contribute to human and environmental exposure due to the occurrence of organic contaminants, such as SCCPs in sludge. Control measures to eliminate or restrict the production, use and subsequent incorporation of SCCPs into articles are expected to reduce the levels of SCCPs in sewage sludge.

2.4.3 Biota

120. The risk profile documents that SCCPs have been detected in diverse environmental samples (air, sediment, water, wastewater, sewage sludge, fish, birds, terrestrial and marine mammals), and in remote areas such as the Arctic and Antarctic (UNEP/POPS/POPRC.11/10/Add.2). In addition, available empirical (laboratory and field) and modelled data all indicate that SCCPs can accumulate in biota. For some food webs, including in the Arctic, biomagnification and the trophic transfer potential of SCCPs is evidenced through high concentrations in upper trophic level organisms, notably in marine mammals and aquatic freshwater biota (e.g., beluga whales, ringed seals and various fish). The risk profile states that SCCPs are persistent in sediments, and are particularly toxic to aquatic invertebrates. Considering the key role that invertebrates play in aquatic ecosystems, there is concern regarding the measured SCCP concentrations and the potential for toxic effects on sediment-dwelling and other invertebrates. It was highlighted that the bioaccumulation of SCCPs by freshwater and marine fish is also of high concern given the effects identified in fish at low concentrations.

121. The implementation of control measures to eliminate or restrict the production and use of SCCPs would have a positive effect on biota by the eventual removal of a persistent toxic substance that bioaccumulates in the food chain and causes adverse effects. Control measures that are more restrictive, such as a listing to Annex A without specific exemptions, would provide the greatest benefit. Due to the long range environmental transport of SCCPs, control measures that allow their ongoing production and use may not be adequately protective of biota, including those residing in remote regions such as the Arctic.

2.4.4 Economic aspects and social costs

122. Information provided by most parties and observers does not indicate that negative economic impacts are anticipated if SCCPs are listed to the Convention, excluding China and the Russian Federation. China and the Russian Federation indicate that listing SCCPs is expected to increase costs and result in negative impacts to the chlorinated paraffin industry, as well as to the manufacturers of the raw materials and the downstream products industry (China Annex F 2015 submission; Russian Federation submission April 2016). Furthermore, China states that a listing may increase management and consumer costs, and may cause related business to stop production and lay off employees (China Annex F 2015 submission). However, no quantitative data are available. In addition, information was not provided regarding the economic benefits expected for those manufacturing alternatives to SCCPs.

123. Information provided by the Netherlands demonstrates that the price for SCCPs has been declining since the late 1990s (RPA 2010); however, the European Chemical Agency (ECHA) suggests that the cost of SCCPs has increased in recent years due to the shrinking market for these chemicals (ECHA 2008). In addition, it is important to consider the influence of the price of oil on the cost of the paraffin fractions (e.g., raw materials) required to produce SCCPs (Yan 2008).

124. As demonstrated above, technically feasible alternative chemicals and techniques are commercially available for all applications and are being used to phase out SCCPs. In addition, it is reasonable to assume that manufacturers of SCCPs have already converted, or will convert, their facilities to produce MCCPs and LCCPs (RPA 2010). As there is legislation in place in jurisdictions, such as Canada, EU member states and Norway it can be assumed that this has resulted in the conversion of SCCP production facilities and the costs have already been borne by the manufacturers. Negative economic effects of this transition have not been reported by these parties. As a result of the use of alternative substances (e.g., MCCPs and LCCPs), it is expected that some distributional effects would be experienced along the supply chain (RPA 2010).

125. Recent information on the cost implications for industry and consumers is not available. However, costs were estimated in 2007 to support the Management Option Dossier for SCCPs under LRTAP. It is expected that producers of SCCPs and chlorinated substitutes will face losses that are difficult to quantify but could be to the order of 10 – 20 million Euros (BiPRO 2007). It is also expected that these losses will be outweighed by corresponding gains for producers of MCCPs, LCCPs and other substitutes (BiPRO 2007). Overall, it can be concluded that the impact on the chemical manufacturing industry is characterized by a shift away from SCCPs to substitutes, and that the gains for producers of substitutes will outweigh the losses for SCCPs (BiPRO 2007). As substitution is expected to be the result of any listing to the Convention, information on the cost implications of switching to alternatives has been provided for each application of SCCPs in section 2.3.

126. A listing of SCCPs to Annex A or B would likely result in a shrinking market for SCCPs which could increase their price, and would create increased demand for alternatives to SCCPs thereby inducing economic benefit. It is not possible to quantify the economic effects of a prohibition or restriction on the production and use of SCCPs. In addition, unquantifiable societal benefits are anticipated from a listing to the Convention. The benefits to society are expected to include reduced human health effects and environmental contamination resulting from exposure to and releases of SCCPs (IPEN/ACAT Annex F 2015 submission).

127. There should be few social costs associated with the elimination of SCCPs because there is wide spread availability of safer products and practices (IPEN/ACAT Annex F 2015 submission). This is further supported by the number of parties that have implemented control measures and have not reported negative economic effects.

128. No information is available on the potential economic effects of listing SCCPs to the Convention with control measures to address the unintentional production of SCCPs during the manufacture of other CP mixtures. If additional costs were incurred, it is expected that they would be borne by the manufacturers of the paraffin feedstocks used to produce other CP mixtures, such as MCCPs. A listing could result in parties having to take measures to limit the concentration of SCCPs in other CP mixtures. To achieve consistent performance with this limit, manufacturers may need to develop and implement best available techniques and best environmental practices.

2.4.5 Movement towards sustainable development

129. According to IPEN/ACAT, elimination of SCCPs is consistent with the Strategic Approach to International Chemicals Management (SAICM), adopted in 2006, that emerged from the Johannesburg World Summit on Sustainable Development (2002). SAICM makes the essential link between chemical safety, sustainable development, and poverty reduction. The Global Plan of Action of SAICM contains specific measures to support risk reduction that include prioritizing safe and effective alternatives for persistent, bioaccumulative, and toxic substances (IPEN/ACAT Annex F 2015 submission).

2.5 Other considerations

2.5.1 Access to information and public education

130. In Australia, information is available on the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) website relating to the risk assessment, risk management strategy and risk control measures that have been recommended for SCCPs (https://www.nicnas.gov.au/).

131. In Romania, information on SCCPs is available on the website of the Ministry of Environment, Water and Forests (http://www.mmediu.ro/) and on the website of the National Environmental Protection Agency (http://www.anpm.ro/).

132. The United States Environmental Protection Agency (US EPA) maintains a webpage that contains information on the assessment and management of SCCPs (http://www.epa.gov/assessing-and-managing-chemicals-under-tsca/short-chain-chlorinated-paraffins).

133. In Canada, information is available on the risk assessment, risk management strategy and risk control measures that have been implemented for SCCPs (http://www.ec.gc.ca/toxiques-toxics/Default.asp?lang=En&n=148DE7B6-1).

134. In the EU, information on chemicals is available on the European Chemicals Agency (ECHA) website (http://echa.europa.eu/). Detailed information on SCCPs can be accessed at http://echa.europa.eu/documents/10162/2edcfedb-ec53-4754-8598-e787a8ff7a58.

2.5.2 Status of control and monitoring capacity

135. Environmental monitoring of SCCPs is carried out in Norway, including in coastal waters, air, precipitation, and biota. Annual monitoring reports are available for download at http://www.miljodirektoratet.no/no/Publikasjoner/. Inspection and enforcement activities carried out from 2011 to 2015 have identified SCCPs above permitted levels in products on the Norwegian market, including in various products for children such as jackets, stickers, pencil cases and running shoes. While the majority of the products tested were considered safe, products found to contain SCCPs above permitted levels ranged from 0.16 to 10.7 % (Norway Annex F 2015 submission).

136. Since SCCPs are included in EU POP Regulation 850/2004, it is monitored regularly in Germany by regional and local authorities (Germany Annex F 2015 submission). In 2014, to enforce the prohibition on SCCPs, the City of Hamburg sampled 84 plastic products including electronics, toys, household articles, tools, swimming gadgets, bicycle pants and sports articles. SCCPs were found in 19 of the items and follow-up was initiated accordingly and detailed information is available at http://www.hamburg.de/projekte/4449872/marktueberwachung-sscp-in-kunststoffprodukten/.

137. SCCPs have been monitored in air and deposition in the Swedish monitoring program for air since 2009. SCCPs have been monitored on an annual basis in sludge from nine Swedish waste water treatment plants since 2004. SCCPs were measured in Perch and Arctic Char from Swedish lakes in 2007 and 2010. Information is available at http://www.nrm.se/download/18.551d33ba13a8a19ad04264a/13_2012+Limniska2012.pdf

138. The Swedish Chemicals Agency has carried out tests on 62 articles and found that 16 contained SCCPs in high concentrations; furthermore, 11 other articles had low concentrations of SCCPs that could have resulted from contamination during manufacturing or delivery (Sweden Annex F 2015 submission; http://www.kemi.se/en/news-from-the-swedish-chemicals-agency/2014/half-of-the-plastic-products-contained-hazardous-substances/). SCCPs were detected in electrical products, toys, childcare articles, exercise gloves, plastic bags, bathroom articles, sports equipment, garden equipment and office articles. As a result, implicated companies have withdrawn these products from the Swedish market. Additional information regarding articles found to contain SCCPs in the EU is available in the Rapex database (http://ec.europa.eu/consumers/archive/safety/rapex/)

139. In Canada, monitoring in environmental media and biota is used to evaluate the effectiveness of risk management controls and to measure progress towards eliminating SCCPs in the Canadian environment. In addition, environmental monitoring of SCCPs is carried out as part of the Northern Contaminants Program which was established in 1991 in response to concerns about human exposure to elevated levels of contaminants in wildlife species that are important to the traditional diets of northern Aboriginal people (NCP 2013). Synopsis reports are published on an annual basis and the most recent report is available at http://pubs.aina.ucalgary.ca/ncp/Synopsis20142015.pdf. Additional information on the program is available at https://www.aadnc-aandc.gc.ca/eng/1100100035611/1100100035612.

3. Synthesis of information

3.1 Summary of risk profile information

140. At its eleventh meeting in 2015, the POPs Review Committee adopted the risk profile and decided that short chain chlorinated paraffins are likely, as a result of long-range environmental transport, to lead to significant adverse human health and environmental effects, such that global action is warranted.

141. SCCPs are persistent in sediments, and have been measured in sediments in remote locations, such as Artic lakes. SCCPs are particularly toxic to aquatic invertebrates, which play a key role in aquatic ecosystems; therefore, there is concern regarding the measured concentrations of SCCPs and the potential for toxic effects to occur on sediment dwelling and other invertebrates. The bioaccumulation of SCCPs in freshwater and marine fish is also of high concern, given the effects identified in fish at low concentrations.

142. Although concentrations in water in remote areas are low, SCCPs are measured in Arctic biota at levels comparable to known POPs indicating widespread contamination, and have been shown to biomagnify in Arctic food chains. Notably, SCCPs are present in Arctic terrestrial and marine biota, which are in turn food for northern indigenous peoples. The majority of human exposure to SCCPs is from food consumption and there is likely some exposure resulting from inhalation and dermal contact. SCCPs are measured in human breast milk both in temperate and Arctic populations.

Additionally, simultaneous exposure to SCCPs, other chlorinated paraffins with similar modes of action and POPs may increase the risks due to toxic interactions.

3.2 Summary of risk management evaluation information

143. The production of SCCPs has decreased globally as jurisdictions have established control measures (UNEP/POPS/POPRC.11/10/Add.2). SCCPs were reported to be produced in Brazil, and were reported to be imported by Albania, Australia, Republic of Korea, Croatia, Argentina, Dominican Republic, Ecuador and Mexico. No other production information was obtained from Annex F submissions or from the literature search. While historical use of SCCPs was high, reductions have been noted in recent years in some countries. More recently, production volumes of CP mixtures containing SCCPs increased.

144. SCCPs were, and continue to be, used primarily in metalworking applications and in polyvinyl chloride (PVC) plastics. Other uses described include as plasticizers and flame retardants in paints, adhesives and sealants, leather fat liquors, plastics, rubber, textiles and polymeric materials (UNEP/POPS/POPRC.11/10/Add.2). The use of SCCPs varies between different countries and regions. Inspection and enforcement activities carried out in Austria, Germany, Norway and Sweden where SCCPs are banned have found the continued presence of SCCPs in articles.

145. SCCPs have been under scrutiny for their health and environmental impacts, and in response control actions for SCCPs have been proposed and implemented in Albania, Canada, EU member states, Norway and the United States. In these countries, alternative chemicals and processes have been used to replace SCCPs in all applications, which demonstrates that alternatives are technically feasible and widely available for all applications.

146. Available information indicates that technically feasible alternatives are commercially available for all known uses of SCCPs. Information on the economic feasibility and accessibility of these alternatives in developing countries is not available. Many uses of SCCPs have been phased out in Canada, EU member states, Norway and the United States, for years. More recently, the remaining uses of SCCPs in rubber conveyor belts and dam sealants have been replaced with viable alternatives in the EU (EC 2015). In addition, a decrease in SCCP consumption for conveyor belts, as well as dam sealants, has been observed which indicates that technically feasible alternatives exist, are accessible and available in the EU (Denmark 2014).

147. Two information sources (ECHA 2008; RPA 2010) note that the technical feasibility of alternatives in paint and coating applications is unclear. Both studies also note the possible increased cost of manufacturing and using alternatives to SCCPs. The exact impacts of switching to alternative chemicals and processes are expected to be unique to each situation, and can be difficult to predict when market and cost information is insufficient (BiPRO 2007). Given that no adverse economic effects have been reported by parties that have successfully enacted prohibitions on SCCPs (Canada, EU member states and Norway), or from jurisdictions where SCCPs are no longer in use (United States), it can be concluded that substitution is underway demonstrating that alternatives are technically feasible and widely available for all applications (including in paints and coatings).

148. Information provided by most parties and observers does not indicate that negative economic impacts are anticipated if SCCPs are listed to the Convention, excluding China and the Russian Federation. China and the Russian Federation indicate that listing SCCPs is expected to increase costs and result in negative impacts to the chlorinated paraffin industry, as well as to the manufacturers of the raw materials and the downstream products industry (China Annex F 2015 submission; Russian Federation submission April 2016). Furthermore, China states that a listing may increase management and consumer costs, and may cause related business to stop production and lay off employees (China Annex F 2015 submission). However, no quantitative data are available. In addition, information was not provided regarding the economic benefits expected for those manufacturing alternatives to SCCPs.

149. No party or observer submitted information to propose or justify the need for a specific exemption or acceptable purpose in the listing of SCCPs to the Convention. Consideration could be given to including a specific exemption to assist parties with their transition to alternative substances; however, no party has identified a specific use where flexibility in the recommended control measure is required.

150. Listing SCCPs to the Convention is expected to result in benefits to human health, the environment, agriculture and biota. It is not possible to quantify the benefits of eliminating or restricting SCCPs; however, they are considered to be significant given the costs associated with the significant adverse effects on human health and the environment that are likely to result from the continued production and use of SCCPs.

3.3 Possible risk management measures

151. Consistent with Decision POPRC-11/3, SCCPs warrant global action. Listing of SCCPs in Annex A would be considered the most effective control measure to take action on intentional production and use in consideration of SCCPs POPs properties and its international production and use. Regarding unintentional production of SCCPs during the manufacture of other CP mixtures, a listing to the Convention would also have an impact on reducing SCCPs. The suggested options for possible control measures are examined in Section 2.1.

Intentional production and use – preferred option

Annex A without specific exemptions

152. From a human health and environmental perspective, the preferred option is to list SCCPs in Annex A to send a clear signal that production and use of this POP substance must be phased out. This listing would eliminate production and use and result in significant emission reductions shortly following the entry into force of the control measure. Furthermore, this listing would eliminate SCCPs in new articles. Listing SCCPs to the Convention may have implications for parties that have not yet begun to phase out their use of SCCPs and transition to alternative substances. However, available evidence from countries that have already phased-out SCCPs, suggests that a transition away from SCCPs has had limited negative economic impacts on society as a whole, and that the effects to industry are mostly distributional.

153. The fact that some jurisdictions have already replaced SCCPs with alternative chemicals and processes in all applications indicates that the total prohibition of its production and use is technically feasible. Prohibition of the production and use of SCCPs would reduce and eventually eliminate releases of SCCPs to the environment (over a long period of time, given ongoing releases from existing articles in use).

Intentional production and use - alternative options for listing

Annex A with specific exemptions

154. Since no information specific to developing countries regarding the economic feasibility, the cost, and the availability and accessibility of alternatives and alternative techniques is available, specific exemptions to allow additional phase out time may be necessary to facilitate global elimination of SCCPs. Although this option will not result in the immediate elimination of SCCPs, it could provide a phase-out period to reduce the potential economic impacts that are associated with an immediate prohibition by allowing for *specific exemptions*. As required by Article 3 of the Convention, any party that has a specific exemption shall take appropriate measures to ensure that any production or use under such an exemption is carried out in a manner that prevents or minimizes human exposure and release into the environment. The inclusion of a specific exemption could allow replacement to be undertaken at a slower pace to reduce the associated costs in countries where the transition to alternatives has not yet begun. The inclusion of a specific exemption, as per Article 4, would allow the continued production and use of SCCPs in certain applications for an additional five years, unless otherwise specified, following the entry into force of the global control measure, thereby prolonging releases of, and exposure to, SCCPs.

155. Specific exemptions for certain uses, where there are no appropriate alternatives under local conditions, could be considered; however, currently no such uses have been identified. If the listing to Annex A were to include specific exemptions, this option could be exercised by all parties by registering the exemption.

Annex B with acceptable purposes

156. Listing SCCPs to Annex B would allow for acceptable purposes. However, parties and observers have not expressed concerns regarding the technical feasibility, availability and accessibility of alternatives to SCCPs in any application. Therefore, it is not expected that acceptable purposes are necessary to list SCCPs to the Convention.

157. Consistent with the requirements of Article 3 of the Convention, listing SCCPs in Annex B with acceptable purposes, or specific exemptions, would require parties to take appropriate measures to prevent or minimize human exposure and releases into the environment. Requirements for control of discharges and emissions could take various forms, and ideally would target all stages of the life-cycle where emissions may occur.

Unintentional production of SCCPs in other CP mixtures

158. SCCPs may be unintentionally produced during the manufacture of other CP mixtures, and thereby contained within other products and in articles. In addition, MCCPs and other CP mixtures are often used as alternatives to SCCPs in many applications; therefore, as the use of SCCPs is phased out the production and use of MCCPs and other CP mixtures could increase. This further emphasizes the need to implement controls to limit the presence of SCCPs in other CP mixtures. The purpose of the controls would be to minimize the amount of SCCPs contained in other CP mixtures, which would reduce both human and environmental exposures. Canada, Norway and EU member states have taken measures to limit the content of SCCPs in other CP mixtures, which demonstrates that controlling unintentional production is technically feasible.

Annex A with modifications

159. To address the unintentional production of SCCPs during the manufacture of other CP mixtures, an Annex A listing could include controls for the occurrence of SCCPs as an impurity in other CP mixtures above a certain threshold. Currently, a listing to Annex A excludes quantities of a chemical occurring as unintentional trace contaminants in products and articles. This exclusion would need to be modified to include controls to limit SCCPs in other CP mixtures. To achieve this, an additional remark is required to modify the application of note "i" in Annex A[6] to SCCPs. Such a listing would require parties to implement Article 3 provisions to prohibit and/or take legal and administrative measures necessary to limit the presence of SCCPs in other CP mixtures, and to import and export in accordance with the provisions of paragraph 2 of the Convention. Including controls to limit the presence of SCCPs in other CP mixtures within the Annex A listing would require parties to apply measures to the production of SCCPs in other CP mixtures, as well as the use, import and export of other CP mixtures and articles that contain SCCPs.

Annex C

160. Listing SCCPs to Annex C of the Convention could be considered to control the unintentional production of SCCPs during the manufacture of other CP mixtures. Listing SCCPs to Annex C would require parties to implement Article 5 provisions to take measures to reduce or eliminate releases from unintentional production. A listing of SCCPs to Annex C would only require parties to address releases of SCCPs during production of other CP mixtures.

4. Concluding statement

161. Having decided that SCCPs, are likely, as a result of long-range environmental transport, to lead to significant adverse effects on human health and the environment such that global action is warranted;

162. Having prepared a risk management evaluation and considered the management options;

163. The Persistent Organic Pollutants Review Committee recommends, in accordance with paragraph 9 of Article 8 of the Convention, that the Conference of the Parties to the Stockholm Convention consider listing and specifying the related control measures for SCCPs in Annex A, including controls to limit the presence of SCCPs in other CP mixtures, with or without specific exemptions.

[6] (i) Except as otherwise specified in this Convention, quantities of a chemical occurring as unintentional trace contaminants in products and articles shall not be considered to be listed in this Annex.

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