Detection of good practices for

Persistent Organic Pollutants (POPs) Eradication

Regional Activity Centre for Cleaner Production (RAC/CP)
Mediterranean Action Plan

Regional Activity Centre for Cleaner Production

UNEP

MAP

STOCKHOLM CONVENTION

GOBIERNO DE ESPAÑA | MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE

Generalitat de Catalunya
Departament de Territori i Sostenibilitat

If there is any study point which can be improved or if there is any inaccuracy, please let us know.

The CP/RAC, based in Barcelona-Spain, was established in 1996. Its mission is to promote sustainable consumption and production in Mediterranean countries. The CP/RAC activities are approved by the Contracting Parties to the Barcelona Convention and by the Bilateral Monitoring Commission made up of representatives from the Spanish and Catalan Governments.

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This work was commissioned by CP/RAC to INEDIT:
Ramon Farreny, Environmental Sciences and Technology, PhD(UAB)
Jordi Oliver, Environmental Sciences, PhD (UAB)
Lara González, Environmental Sciences, Trainee (UAB)

Regional Activity Centre for Cleaner Production (CP/RAC)
C/ Dr. Roux, 80
08017 Barcelona (Spain)
Tel +34 93 553 8790 Fax +34 93 553 8795
www.cprac.org

1. INTRODUCTION

Persistent organic pollutants (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. Because of this, they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulate in human and animal tissue, biomagnify in food chains, and to have potential significant impacts on human health and the environment (Ritter et al., n.a.). Exposure to POPs can lead serious health effects including certain cancers, birth defects, dysfunctional immune and reproductive systems, greater susceptibility to disease and even diminished intelligence (UNEP, 2011a).

Many POPs are currently or were in the past used as pesticides. Others are used in industrial processes and in the production of a range of goods such as solvents, polyvinyl chloride (PVC), and pharmaceuticals. There are a few natural sources of POPs, but most POPs are created by humans in industrial processes, either intentionally or as byproducts (Ritter et al., n.a.).

There have been several institutional and cooperative efforts to protect humans and the environment from the effects of substances that are toxic, persistent and liable to bioaccumulate.

The **Mediterranean Action Plan** (MAP) is a regional cooperative effort involving 21 countries bordering the Mediterranean Sea, as well as the European Union. Through the MAP, the Contracting Parties to the Barcelona Convention and its Protocols are determined to meet the challenges of protecting the marine and coastal environment while boosting regional and national plans to achieve sustainable development. Thus, they shall take all appropriate measures to prevent, abate, combat and eliminate to the fullest possible extent pollution of the Mediterranean Sea Area caused by discharges from rivers, coastal establishments or outfalls, or emanating from any other land-based sources and activities within their territories, giving priority to the phasing out of inputs of substances that are toxic, persistent and liable to bioaccumulate (UNEP 2007). The Protocol for the Protection of the Mediterranean Sea against Pollution form Land-Based Sources and Activities (LBS Protocol), deriving from the Barcelona Convention and entered into force in May 2008, establishes in Annex 1 that the Parties will give priority to POPs when preparing action plans, programmes and measures (UNEP, 1996).

The Stockholm Convention on Persistent Organic Pollutants (UNEP, 2009a) is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have adverse effects to human health or to the environment (UNEP 2011). The Stockholm Convention on persistent organic pollutants forms a framework, based on the precautionary principle, which seeks to guarantee the safe elimination of these substances, which are harmful to human health and the environment, as well as reductions in their production and use (EU 2008). Given their long range transport, no one government acting alone can protect is citizens or its environment from POPs. In response to this global problem, the Stockholm Convention, which was adopted in 2001 and entered into force in 2004, requires Parties to take measures to eliminate or reduce the release of

POPs into the environment. Currently the number of parties and signatories reaches 176 and 151, respectively (UNEP, 2011a). The text of the Stockholm Convention on Persistent Organic Pollutants was adopted 22 May 2001 and entered into force 17 May 2004. Initially, twelve POPs have been recognized as causing adverse effects on humans and the ecosystem and these can be placed in 3 categories:

- *Pesticides*: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene;
- *Industrial chemicals*: hexachlorobenzene, polychlorinated biphenyls (PCBs); and
- *By-products*: hexachlorobenzene; polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/PCDF), and PCBs.

The Convention was amended in 2009 to include nine new POPs added to its Annexes A, B and C (UNEP 2011). These new POPS are the following:

- *Pesticides*: chlordecone, alpha hexachlorocyclohexane, beta hexachlorocyclohexane, lindane, pentachlorobenzene;
- *Industrial chemicals*: hexabromobiphenyl, hexabromodiphenyl ether and heptabromodiphenyl ether, pentachlorobenzene, perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride, tetrabromodiphenyl ether and pentabromodiphenyl ether; and
- *By-products*: alpha hexachlorocyclohexane, beta hexachlorocyclohexane and pentachlorobenzene.

Later, in 2011, another POP (endosulfan*)* has been incorporated in the Stockholm Convention by means of Decision SC-5/3 (UNEP, 2011b).

The chemicals targeted by the Stockholm Convention are listed in the annexes of the convention text (UNEP 2011):

- **Annex A (Elimination)**: Parties must take measures to **eliminate** the production and use of the chemicals listed under Annex A. Specific exemptions for use or production are listed in the Annex and apply only to Parties that register for them.
- **Annex B (Restriction)**: Parties must take measures to **restrict** the production and use of the chemicals listed under Annex B in light of any applicable acceptable purposes and/or specific exemptions listed in the Annex.
- **Annex C (Unintentional production)**: Parties must take measures to reduce the **unintentional releases** of chemicals listed under Annex C with the goal of continuing minimization and, where feasible, ultimate elimination.

Tables 1, 2 and 3 show the list of substances included in the Stockholm Convention, grouped according to the annexes:

Annex A: Elimination			
Chemical *(Use)*	**CAS Nº**	**Activity**	**Specific exemption**[1]
Aldrin ***(Pesticide)***	309-00-2	Production	None
		Use	Local ectoparasiticide / Insecticide
Chlordane ***(Pesticide)***	57-74-9	Production	As allowed for the Parties listed in the Register
		Use	Local ectoparasiticide / Insecticide Termiticide / Termiticide in buildings and dams / Termiticide in roads Additive in plywood adhesives
Dieldrin ***(Pesticide)***	60-57-1	Production	None
		Use	In agricultural operations
Endosulfan	115-29-7 959-98-8 33213-65-9	Production	As allowed for the parties listen in the Register
		Use	Crop-pest complexes
Endrin ***(Pesticide)***	72-20-8	Production	None
		Use	None
Heptachlor ***(Pesticide)***	76-44-8	Production	None
		Use	Termiticide, Termiticide in structures of houses and Termiticide (subterranean) Wood treatment In use in underground cable boxes
Hexachlorobenzene ***(Pesticide/industrial chemical)***	118-74-1	Production	As allowed for the Parties listed in the Register
		Use	Intermediate Solvent in pesticide Closed system site limited intermediate
Mirex ***(Pesticide)***	2385-85-5	Production	As allowed for the Parties listed in the Register
		Use	Termiticide
Toxaphene ***(Pesticide)***	8001-35-2	Production	None
		Use	None
Polychlorinated biphenyls (PCB) ***(Industrial chemical)***	1336-36-3	Production	None
		Use	Articles in use in accordance with the provisions of Part II of this Annex
Alpha hexachlorocyclohexane ***(Pesticide/Derivative)***	319-84-6	Production	None
		Use	None
Beta hexachlorocyclohexane ***(Pesticide/Derivative)***	319-85-7	Production	None
		Use	None
Chlordecone ***(Plaguicida)***	143-50-0	Production	None
		Use	None
Hexabromobiphenyl ***(Industrial chemical)***	35694-06-5	Production	None
		Use	None
Hexabromodiphenyl ether and heptabromodiphenyl ether ***(Industrial chemical)***	36483-60-0 32536-52-0	Production	None
		Use	Articles in accordance with the provisions of Part IV of this Annex.
Lindane ***(Pesticide)***	58-89-9	Production	None
		Use	Human health pharmaceutical for control of head lice and scabies as second line treatment
Pentachlorobenzene ***(Pesticide/Industrial chemical/Derivative)***	608-93-5	Production	None
		Use	None
Tetrabromodiphenyl ether pentabromodiphenyl ether ***(Industrial chemical)***	40088-47-9 32534-81-9	Production	None
		Use	Articles in accordance with the provisions of Part V of this Annex

Table 1: Stockholm Convention substances listed in Annex A.

[1]Please note that, as at 17 May 2009, there were no Parties registered for the specific exemptions listed in Annex A pertaining to aldrin, chlordane, dieldrin, heptachlor, hexachlorobenzene, and mirex. Therefore, in accordance with paragraph 9 of Article 4 of the Convention, no new registrations may be made with respect to such exemptions, which appear in grey text in the table.

Annex B: Restriction			
Chemical ***(Use)***	**CAS №**	**Activity**	**Acceptable purpose** **or specific exemption**[1]
DDT **(1,1,1-trichloro-2,2-bis** **(4-chlorophenyl)ethane)** ***(Pesticide)***	50-29-3	Production	Acceptable purpose: Disease vector control use in accordance with Part II of this Annex Specific exemption: Intermediate in production of dicofol
		Use	Acceptable purpose: Disease vector control in accordance with Part II of this Annex Specific exemption: Production of dicofol
Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride ***(Industrial chemicals)***	1763-23-1 and 307-35-7	Production	Acceptable purpose: In accordance with Part III of this Annex, production of other chemicals to be used solely for the uses below. Production for uses listed below. Specific exemption: As allowed for Parties listed in the Register.
		Use	Acceptable purpose: In accordance with Part III of this Annex for the following acceptable purposes, or as an intermediate in the production of chemicals with the following acceptable purposes: • Photo-imaging • Photo-resist and anti-reflective coatings for semi-conductors • Etching agent for compound semiconductors and ceramic filters • Aviation hydraulic fluids • Metal plating (hard metal plating) only in closed-loop systems • Certain medical devices (such as ethylene tetrafluoroethylene copolymer (ETFE) layers and radio-opaque ETFE production, in-vitro diagnostic medical devices, and CCD colour filters) • Fire-fighting foam • Insect baits for control of leaf-cutting ants from *Atta spp.* and *Acromyrmex spp.* Specific exemption: For the following specific uses, or as an intermediate in the production of chemicals with the following specific uses: • Photo masks in the semiconductor and liquid crystal display (LCD) industries • Metal plating (hard metal plating) • Metal plating (decorative plating) • Electric and electronic parts for some colour printers and colour copy machines • Insecticides for control of red imported fire ants and termites • Chemically driven oil production • Carpets • Leather and apparel • Textiles and upholstery • Paper and packaging • Coatings and coating additives • Rubber and plastics

Table 2: Stockholm Convention substances listed in Annex B.

[1]Please note that, as at 17 May 2009, there were no Parties registered for the specific exemptions listed in Annex A pertaining to aldrin, chlordane, dieldrin, heptachlor, hexachlorobenzene, and mirex. Therefore, in accordance with paragraph 9 of Article 4 of the Convention, no new registrations may be made with respect to such exemptions, which appear in grey text in the table.

Annex C: Unintentional production			
Chemical ***(Use)***	**CAS Nº**	**Activity**	**Specific exemption**
Polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/PCDF) ***(Derivative)***		Production	None
		Use	None
Hexachlorobenzene (HCB) ***(Derivative)***	118-74-1	Production	None
		Use	None
Polychlorinated biphenyls (PCB) ***(Derivative)***	1336-36-3	Production	None
		Use	None
Pentachlorobenzene (PCB) ***(Pesticide/Industrial chemical/Derivative)***	608-93-5	Production	None
		Use	None

Table 3: Stockholm Convention substances listed in Annex C.

1.1. Implementation of the Stockholm Convention in the Mediterranean area

Paragraph 4 of Article 12 of the Stockholm Convention, calls for the establishment, as appropriate, of arrangements for the purpose of providing technical assistance and promoting the transfer of technology to developing country Parties and Parties with economies in transition relating to the implementation of the Convention. These arrangements are to include regional and subregional centres for capacity-building and transfer of technology to assist developing country Parties and Parties with economies in transition to fulfil their obligations under the Convention (UNEP 2011).

One of such regional and subregional centres for capacity building and the transfer of technology within the Stockholm convention is the Regional Activity Centre for Cleaner Production (RAC/CP) settled in Barcelona, Spain. RAC/CP became a part of the Mediterranean Action Plan (MAP) in 1996 and, as a unit for promoting pollution prevention within the MAP, it is involved in dissemination, promotion, assessment, training and exchange of experiences and knowledge between Mediterranean countries.

The centre has been advising and providing consultancy services in wide areas of industrial operations. RAC/CP was nominated by the Western Europe and others region to serve as a regional centre under the Stockholm Convention for the Mediterranean region since October 2007 and has been endorsed in 2009 as the regional centre for capacity building and technology transfer by COP 4 for four years.

Currently 21 states plus the European Union take part of the MAP. Table 4 shows how the different signatories of the MAP that incorporate the Stockholm Convention (UNEP 2011).

Contracting parties	Signed	Ratification (X), Accepted (A), Approval (AA), Adhesion (a)
Albania	X	X
Algeria	X	X
Bosnia and Herzegovina	X	X
Croatia	X	X
Cyprus	X	a
European Union	X	AA
Egypt	X	X
France	X	AA
Greece	X	X
Israel	X	-
Italy	X	-
Lebanon	X	X
Libya	X	A
Malta	X	-
Monaco	X	X
Montenegro	X	X
Morocco	X	X
Slovenia	X	X
Spain	X	X
Syria	X	X
Tunisia	X	X
Turkey	X	X

Table 4: Incorporation of the Stockholm Convention by MAP parties.

2. OBJECTIVES

The aim of this project is to detect currently existing sources of information about good practices in POPs eradication, considering both companies that are adopting specific measures and also more general sources of information that define general best practices.

The identification of information sources is expected to be the first step towards a detailed definition of good practices for POPs eradication and their diffusion in the Mediterranean area.

3. METHODOLOGY

This phase consists of the following actions:

- **Definition of the legal framework** (directives, regulations, norms…) that includes the partial or total compliance with the Stockholm Convention on POPs.
- **Identification of different sources of information** regarding practical case studies and examples of good practices for POP eradication. The geographic scope of these sources is global. Therefore, experiences coming from all over the world will be of interest. The sectors that will focus the interest will those with a potential role in POPs eradication and, in particular, the textile industry and electronics due to their importance.

4. LEGAL FRAMEWORK

This section presents a review of the legal framework that includes a partial/total compliance with the Stockholm convention. The information is grouped into three levels: international, European and national. After this, a summary of the findings is presented in a synthetic table.

4.1. International level

The **Stockholm Convention on Persistent Organic Pollutants** (figure 1) was adopted at a Conference of Plenipotentiaries on 22 May 2001 in Stockholm, Sweden, and entered into force on 17 May 2004.

Figure 1. *Logo for the Stockholm convention.*

The Stockholm convention is the most important tool for protecting human health and the environment from persistent organic pollutants.

Additionally, the **Barcelona Convention under the MAP** aim to meet the challenges of protecting the marine and coastal environment while boosting regional and national plans to achieve sustainable development. These plans shall give priority to substances that are toxic, persistent and liable to bioaccumulate, in particular to persistent organic pollutants (POPs),

4.2. European Level

The most relevant legal figures regarding the elimination and minimisation of production, use and release of POPs at European level are the following:

- The **Regulation (EC) No 850/2004** of the European Parliament and of the Council of 29 April 2004 on POPs implements in the law of the Union the commitments set out in the Stockholm Convention on Persistent Organic Pollutants. This 2004 Regulation seeks to supplement the EU's already substantial legislation on the substances on the lists and shows a willingness to go beyond international obligations, especially in the field of chemical substances and waste management (EU 2008). The Regulation specifically concerns the production, placing on the market, use, discharge and elimination of substances which are banned or restricted under the Stockholm Convention on POPs, or the UN ECE (United Nations Economic Commission for Europe) Protocol on POPs[a]. It seeks to establish, at Community level, requirements for effective implementation of these two international agreements. It also seeks to prevent any legislative inconsistencies between Community and national texts and to encourage more consistent practical application. This approach should also contribute to the efficient functioning of the internal market. This Regulation has been amended by **Regulations 756/2010** and **757/2010** in order to update the list of substances involved.

- Additionally, the Stockholm Convention is approved on behalf of the European Community by means of the **Council Decision 2006/507/EC** of 14 October 2004 concerning the conclusion, on behalf of the European Community, of the Stockholm Convention on Persistent Organic Pollutants.

- **OSPAR convention** is the mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the European Community, cooperate to protect the marine environment of the North-East Atlantic. It started in 1972 with the **Oslo Convention** against dumping (Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft). It was broadened to cover land-based sources and the offshore industry by the **Paris Convention** of 1974. These two conventions were unified, up-dated and extended by the **1992 OSPAR Convention**. The new annex on biodiversity and ecosystems was adopted in 1998 to cover non-polluting human activities that can adversely affect the sea (OSPAR, 2011).

  The fifteen Governments are Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom. Finland is not on the western coasts of Europe, but some of its rivers flow to the Barents Sea, and historically it was involved in the efforts to control the dumping of hazardous waste in the Atlantic and the North Sea. Luxembourg and Switzerland are Contracting Parties due to their location within the catchments of the River Rhine (OSPAR, 2011).

  The Convention establishes a list of potentially hazardous substances that include persistent, bioaccumulative and toxic (PBT) substances, or of equivalent concern. The OSPAR Hazardous Substances Strategy sets the objective of preventing pollution of the maritime area. The OSPAR Commission is pursuing this strategy progressively by making every effort to move towards the goal of cessation of discharges, emissions and losses of hazardous substances by the year 2020. The work related to hazardous substances is carried out by the HASEC Committee (Hazardous Substances and Eutrophication Committee). The OSPAR list of substances potentially troubling was adopted in 2002. It is a dynamic list of work that is reviewed periodically when new information is obtained. The aim is to identify those substances that are of concern to the marine environment,

[a] More info at http://www.unece.org/env/lrtap/pops_h1.html

and are not adequately covered by the framework of the EC or any other international forum (Oslo Convention, 1972).

Besides this, there are **other legal figures** that affect some of the POPs listed in the Stockholm Convention.

- The **Water Framework Directive, WFD** (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy) establishes a framework for the protection of inland surface waters, groundwater, transitional waters and coastal waters. This Framework-Directive has a number of objectives, such as preventing and reducing pollution, promoting sustainable water usage, environmental protection, improving aquatic ecosystems and mitigating the effects of floods and droughts. Thus, the directive urges for the adoption of specific measures against pollution of water by individual pollutants or groups of pollutants presenting a significant risk to or via the aquatic environment, among which several POPs included in the Stockholm convention (EU, 2010).

- The **Directive 2002/95/EC** of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (directive **RoHS, Restriction of Hazardous Substances**). This directive restricts the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment. The POPs from the Stockholm convention that are included within RoHS are the following ethers: Hexabromodiphenyl ether, heptabromodiphenyl ether, Tetrabromodiphenyl ether and pentabromodiphenyl ether

- The **Regulation (EC) No 1907/2006** of the European Parliament and of the Council of 18 December 2006 concerning the **Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)**, establishing a European Chemicals Agency, amending Directive **1999/45/EC** and repealing Council Regulation (EEC) No **793/93** and Commission Regulation (EC) No **1488/94** as well as Council Directive **76/769/EEC** and Commission Directives **91/155/EEC, 93/67/EEC, 93/105/EC** and **2000/21/EC** (EU, 2011a), establishes the bases for an integrated system for the registration, evaluation, authorisation and restriction of chemicals. Its objective is to improve the protection of human health and the environment whilst maintaining competitiveness and strengthening the spirit of innovation in Europe's chemicals industry. REACH requires firms which manufacture and import chemicals to evaluate the risks resulting from the use of those chemicals and to take the necessary steps to manage any identified risk. Industry has the burden of proving that chemicals produced and placed on the market are safe. Among these chemicals one can find several POPs included in the Stockholm Convention.

4.3. National level: National Implementation Plans (NIP)

Parties to the Stockholm Convention are required to prepare a plan on how they are going to implement the obligations under the Convention and make efforts to put such plan into operation. The National Implementation Plan (NIP) is not a standalone plan for the management of POPs but is a part of a national sustainable development strategy of the Party preparing and implementing such plan. Also, the national implementation plan is a dynamic document as it is to be reviewed periodically and updated to address new obligations under the Convention (UNEP, 2011A). As an example, the case of Spain is presented next.

In the case of Spain, the NIP entered into force in 2007 (UNEP, 2011A). Table 5 shows the substances that are included in the NIP, in addition to the ones covered by the Stockholm Convention (CNRCOP 2011; MMA 2007). Each of these additional substances is considered because it is already regulated by other legal instruments, such as the Water Framework Directive (2000/60/CE) or other Decisions adopted by the European Council.

Chemical	CAS Nº	Phytosanitary/ Biocide	Industrial use	Unintentional production
Dicofol	115-32-2	X		
Trifluralin	1582-09-8	X		
Creosote	8021-39-4 8001-58-9 8007-45-2		X	
Pentachlorophenol	87-86-5	X	X	
Hexachlorobutadiene	87-68-3		X	
Polychlorinated naphthalene	2234-13-1		X	
Short chain Chloro-alkanes	85535-85-9		X	
Polycyclic aromatic hydrocarbon (PAHs)	50-32-8			

Table 5: Substances regulated by the Spanish NIP, in addition to the Stockholm Convention.

4.4. Summary

Table 6 shows the 21 POPs included in the Convention and identifies what legal figures affect each of them.

Chemicals	CAS Nº	International			EU							Spain
		Stockholm Convention			OSPAR	REACH	WFD	RoHS	850/2004/CE			NIP
		Elimination	Restriction	Reduction	Restriction	Reduction	Restriction	Restriction	Prohibition	Restriction	Reduction	Restriction
Aldrin	309-00-2	x			x	n.i.	n.i.	n.i.	x			x
Chlordane	57-74-9	x			x	n.i.	n.i.	n.i.	x			x
Dieldrin	60-57-1	x			x	n.i.	n.i.	n.i.	x			x
Endrin	72-20-8	x			x	n.i.	n.i.	n.i.	x			x
Endosulfan	115-29-7	x			n.i.	n.i.	n.i.	n.i.				x
Heptachlor	76-44-8	x			x	n.i.	n.i.	n.i.	x			x
Hexachlorobenzene	118-74-1	x		x	n.i.	x	x	n.i.	x		x	x
Mirex	2385-85-5	x			x	n.i.	n.i.	n.i.	x			x
Toxaphene	8001-35-2	x			x	n.i.	n.i.	n.i.	x			x
Polychlorinated biphenyls (PCB)	1336-36-3	x		x	x	n.i.	n.i.	n.i.	x		x	x
Alpha hexachlorocyclohexane	319-84-6	x			n.i.	n.i.	n.i.	n.i.				x
Beta hexachlorocyclohexane	319-85-7	x			x	n.i.	n.i.	n.i.				x
Chlordecone	143-50-0	x			x	n.i.	n.i.	n.i.	x			x
Hexabromobiphenyl	35694-06-5	x			n.i.	n.i.	n.i.	n.i.				x
Hexabromodiphenyl ether and heptabromodiphenyl ether	36483-60-0 68928-80-3 32536-52-0	x			x (octa)	x	x	x	x			x
Lindane	58-89-9	x			x	n.i.	n.i.	n.i.	x			x
Pentachlorobenzene	608-93-5	x			n.i.	n.i.	x	n.i.				x
Tetrabromodiphenyl ether and pentabromodiphenyl ether	40088-47-9 32534-81-9	x			x (penta)	n.i.	x	x				x
DDT	50-29-3		x		x	n.i.	n.i.	n.i.	x			x
Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride	1763-23-1		x		n.i.	n.i.	n.i.	n.i.				x
Polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/PCDF)	1746-01-6a 51207-31-9b			x	n.i.	x	n.i.	n.i.			x	x

Table 6: Summary of the POPs legal framework.

Note: n.i.: not included

5. STATE OF THE ART ON POPs ERADICATION: SOURCES OF INFORMATION AND SECTORIAL ANALYSIS

This section presents the information obtained by means of an extensive review of worldwide experiences and case studies of eradication of POPs. In order to organize the information, the concept of product life cycle has been taken in mind. As shown in Figure 2, the life cycle of any product would start with the extraction of raw materials (e.g. cotton production), followed by design and production (e.g. manufacturing a cotton T-shirt), packaging and distribution (e.g. selling the clothes in a store), use stage and finally the end-of-life stage (e.g. incineration of the shirt once placed in the municipal container waste).

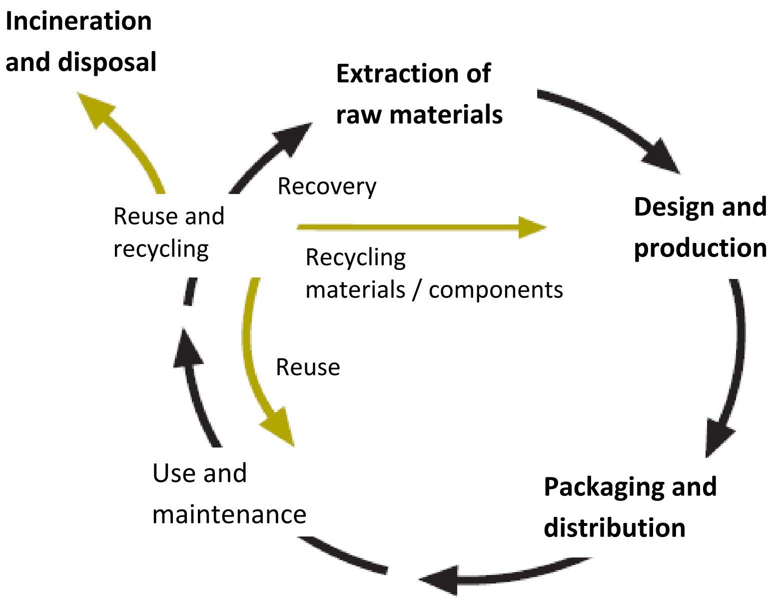

Figure 2. *Life cycle of a product. Stages in bold are the most relevant for POPs management.*

The availability of **public information on best practices** in the eradication of POPs is highly variable depending on the sector, and it depends largely on the exposure of the sector to the public. Thus, the available information of companies engaged in the sale of products (distribution channels and retail) is more abundant than the information referring to companies engaged in the extraction of resources (e.g. raw material producers) or in the end-of-life of products (e.g. incinerators).

In the search of good practices of POP eradication, it is especially important to take into account the POPs included in Annex C (**unintentional production**). These compounds appear in processes such as incineration of municipal waste (incineration sector), casting (metallurgy) and industrial processes that involve chlorinated compounds (paper industry), and currently represent **one of the main challenges to Stockholm convention** (UNEP, 2011A). In this sense, the *Guidelines on best available techniques and provisional guidance on best environmental practices relative to Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants* (UNEP, 2008) are of particular interest in order to obtain guidance on best available techniques and best environmental practices for the relevant sectors.

Table 7 shows a **synthesis of the several sectors potentially involved in the eradication of POPs**. The definition of sectors is made taking into account activities that are potential consumers of POPs (such as agriculture, that consumes pesticides) and also considering the sources of POPs stated in Annex C of the Stockholm convention (UNEP, 2008), which shows industrial source categories that have the potential for comparatively high formation and release of unintentional POPs to the environment. Additionally, most of these sectors are also included in Annex 1, part A, of the LBS Protocol (UNEP 1996), as sectors to be considered when setting priorities for the preparation of action plans, programmes and measures for the elimination of the pollution from land-based sources and activities.

The list of sectors is:

1. Agrifood sector
2. Textile sector
3. Metallurgy
4. Automotive industry
5. Electronics
6. Paper industry
7. Construction industry
8. Energy industries
9. Waste management and incineration

The sectors analyzed in this report can be classified according to whether they are producers of raw materials for other sectors (e.g. agrifood, metallurgy and paper industry), if they are processing industries that consume raw materials but are also third-party providers (e.g. textile or electronics sectors), or if they are assemblers of previously manufactured items (e.g. automotive and transport sector). Finally there are sectors that are transversal to all other sectors as waste management and incineration and energy generation.

Table 7 presents a matrix that contains the several sectors (in each row) and a simplification of the possible life cycle stages of any product, considering supply of raw materials, production process and sales and distribution (in each column). A general set of good practices, which is explained in more detail in the following sections, is presented in the corresponding matrix cell in Table 7. Good practices have been grouped into two main types:

- **Integration of technological changes**, which also includes changes in the production model. Some examples are: optimization of combustion processes, flue abatement systems, change of pesticides, etc.

- **Incorporation of management changes, including quality controls, ecolabels and tools such as Restricted Substances Lists (RSL).** Some examples are the implementation of tests and trials to the input materials to the process or to the products provided, the use of ecolabels to select input materials or the development and implementation of RSL that could be used as a manageable list of substances that manufacturers, distributors, retailers and consumers can refer to when searching for better alternatives.

The sources of information for these good practices are also shown in table 7, and are divided into the following categories:

1. Public bodies and institutions
    - 1.1. UNEP
    - 1.2. Other sources

2. Sectorial sources
    - 2.1. Sectorial clusters
    - 2.2. Individual companies

3. Labelling
    - 3.1. Environmental labels

	Supply of raw materials	Production	Sales and distribution
AGRIFOOD SECTOR	Change to other POP-free chemicals **(1.1)**	Change from conventional to organic farming **(1.2)** Quality control of food **(1.2)**	Agrifood product eco,labels **(3.1)**
TEXTILE SECTOR	Selection of raw materials coming from agriculture **(1.1)** RSL **(2.1, 2.2)**	Use of pigments without chlorinated substances **(1.1)**	Textile ecolabels **(3.1)**
METALLURGY		Presorting and cleaning of materials **(1.1)** Temperature control **(1.1)** Effluent treatment: filters, activated carbon… **(1.1)** Alternative technologies for certain processes **(1.1)**	
AUTOMOTIVE INDUSTRY	RSL **(2.1, 2.2)** Textile ecolabels **(3.1)**		
ELECTRONICS	RSL **(2.2)**	Use of alternative substances as flame retardants **(1.2)**	Materials ecolabels **(3.1)** Quality controls **(2.2)**
PAPER INDUSTRY		Elementary or totally chlorine free processes **(1.1)**	
CONSTRUCTION INDUSTRY	RSL **(2.2)**		
ENERGY INDUSTRIES	Fuel controls (1.1)	Optimize combustion conditions **(1.1)** Gas cleaning methods and ash disposal **(1.1)**	
WASTE MANAGEMENT AND INCINERATION	Waste input control **(1.1, 2.2)**	Process optimization **(1.1)** Flue gas, solid residue and effluent treatment **(1.1)** Alternatives to combustion for POPs disposal **(1.2)**	

Table 7. General good practices according to the sector and the life cycle stage.
Red colour corresponds to technological changes, and yellow colour correspond to changes to the management. The number in parentheses indicates the type of information source that provides such good practice (1.1. UNEP, 1.2. Other international institutions, 2.1. Sectorial clusters, 2.2. Individual companies, 3.1. Ecolabels).

In the case of sectorial sources of information, it worth highlighting the case of the elaboration and implementation of Restricted Substances Lists (RSL). In the case of labelling, the good practice consists on a voluntary regulation. The main features of both approaches/tools are described below**.**

Restricted Substances List (RSL)

Chemical manufacturers are at the farthest upstream end of supply chains. Manufacturers either produce chemicals or chemical compounds or extract them in their natural state. Downstream users of these substances are businesses located downstream of the chemical manufacturers in the supply chain (excluding distributors and retailers) that use substances in the products or services they provide. It can be challenging for downstream users to obtain the information they need about the substances they use in their products; the desired information usually includes basic substance identity and/or the hazard or risk properties of a substance.

A well-functioning chemicals management system requires a manageable list of substances that manufacturers, distributors, retailers and consumers can refer to when searching for better alternatives.

Restricted Substances Lists (RSL) specify the chemical substances that are banned or restricted for the use in certain circumstances in the company signing the RSL. According to this, the company's suppliers have to comply with the requirements laid down in the RSL, with regard to those components and products supplied to the company.

An example of a RSL can be found in the company REI, a US outdoor retail cooperative that produces outdoor gear and apparel (REI 2004). Their RSL consists of three parts:

- *Primary restricted substances list* (for that substances that are have been used in textile processing and have been found in finished products). Substances listed should be restricted in products according to the limits and tests methods provided in the RSL
- *Supplementary List*. These substances should be restricted, although they are not commonly found in finished products of the company.
- *Of Concern.* This list includes those substances that are not restricted in apparel products by global legislation (in contrast with the previous two parts of the RSL), but are a voluntary restriction of the company.

It has to be stated that it is one thing to determine what should be phased out, and another to find a substitute that is acceptable from environmental, health and performance perspectives. Choosing an environmentally sound and commercially viable alternative can be a formidable challenge. In general, the companies that have a RSL have to work with their suppliers in order to eliminate such substances in procured material and find adequate alternatives, in an effort to minimize hazardous substances in their products and supply chains. It is also important to remark that new solutions do not always have to involve replacing one substance with a safer substance. Perhaps the desired function or service can be achieved by applying alternative techniques, making changes in the manufacturing process or redesigning the product.

For example, brominated flame-retardants (BFR) are usually added to the plastic cases of laptops to make them fireproof. Emerging evidence is however proving that an exposure to BFR has a severe impact on human health. A major global computer manufacturer decided to deal with the potential problem not by replacing the flame-retardant with another chemical with the same specific function, but by making the cases in aluminium instead of plastic. The resulting product eliminated the problem by eliminating the need (to prevent the plastic case from bursting into flames). Not to mention the additional benefit of offering a product that stood out from the competition in terms of both safety and design (Rosander, 2008).

Once a decision has been taken to replace a substance with a better alternative, a new challenge appears, particularly for companies with a wide product range and numerous suppliers spread out over the globe. A supply chain management is needed in order to make sure the change is implemented throughout the company product cycle.

ChemSec (2009) provides a study that analyzes the processes by which RSL are developed within progressive companies in different business sectors. The study includes three case studies of interest: Sony Ericsson (electronics), Sara Lee (textile) and Skanska (construction). More details on some of these case studies will be provided later in the document.

Another example of the management and use of RSL can be found in the automotive sector. Ford has recently released the '2011 Restricted Substance Management Standard' (Ford, 2011) in which detailed information on how the RSL is managed can be obtained.

Ecolabelling (Type 1 Ecolabels)[2]

Ecolabels type 1 are voluntary, multiple-criteria based, third party programs that award a license that authorizes the use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle. Ecolabel schemes encourage businesses to market products and services that are kinder to the environment.

In some cases and for some product categories the environmental criteria required in order to fulfil with the Ecolabel requirements include the eradication or minimization of the use of POPs. This is the case for Oeko-tex Standard 100, the Nordic Swan, Blue Angel, TCO or the EU organic farming logo (figure 3), amongst others.

Figure 3. *TCO, Blue Angel, Nordic Swan, Oeko-tex Standard 100 and the EU organic farming logo.*

Ecolabel schemes are a good source of information concerning companies and brands that comply with the defined environmental standards. Therefore, future research on specific good practices of companies concerning POPs will have on Ecolabel listings a good starting point.

[2] According to ISO standards, there are three types of ecolabels:

a) Type 1 (ISO 14024): certified eco-labels by an independent body (for instance, EU ecolabel, Blue Angel, Nordic Swan…)
b) Type 2 (ISO 14021): product self-declarations made by manufacturers (for instance: 100% recyclable; free of CFC…)
c) Type 3 (ISO 14025): Environmental Product Declarations (EPD) which give very detailed information based on quantitative indicators deriving from a Life Cycle Assessment. They are used business to business.

5.1. Agrifood sector

Agriculture for food or raw material production is on the basis of many industrial processes. As shown in Tables 1, 2 and 3, many of the POPs have uses as pesticides in agriculture. Therefore, POPs that are used by this sector are included in the agricultural products and will accompany the product and its derivatives throughout its whole lifecycle.

Generally speaking, **best practices** in this sector imply the substitution or elimination of pesticides. Therefore the proposed strategies are:

- a change to other POP-free chemicals, or
- a shift toward organic farming.

In order to make possible the reduction, substitution or elimination of pesticides, several research groups and institutions have conducted scientific studies. For example, for finding alternatives to lindane for the preservation of seeds (RAP-AL, 2006; IPEN, 2009), alternatives to DDT for disease vector control (UNEP, 2009b; WHO, 2007) or alternatives to endosulphan (Bejarano et al. 2008).

At a European level the EU organic farming logo (EU, 2011b) certifies that the food has been grown following certain regulations that, amongst other chemicals, avoid the use of pesticides and POPs. The goal of the EU organic farming label is to set a new course for the continued development of organic farming. Sustainable cultivation systems and a variety of high-quality products are the aim. In this process, even greater emphasis is to be placed in future on environmental protection, biodiversity and high standards of animal protection.

In order for a product to be certified with the organic farming logo, at least 95% of its agricultural ingredients must be organic.

Additionally, it is also recognized as a **good practice** to:

- establish quality controls to the produced goods.
- use of ecolabels to certify the goods properties and raise consumers' awareness.

Although the potential cancer risk of persistent organic pollutants remains undefined, the implementation of actions to reduce the exposure to these substances, which mainly occurs through the diet, is important, in particular to protect the most vulnerable subjects (for example, pregnant women, nursing infants, subjects living near local sources, and others), if and where these can be identified (Fattore et al., 2002).

The potential implications of POPs on cancer risk are unclear and substantially different between different POPs. Two POPs have been classified by the International Agency for Research on Cancer (IARC) as known human carcinogens. These are the PCDD (the most toxic congener of the dioxin group), and the 2,3,4,7,8-pentachloro-dibenzofuran, the most toxic congener of the furan group. PCDD is well known as a multiorgan carcinogen in animals; the target organs include liver, thyroid, lung, skin, and soft tissues (Fattore et al., 2002).

Concerning food, the elimination or the regulation of the amount of POPs that can be contained in food is regulated by law in each region or state. For instance, in Catalonia the ***Public Health Agency of Barcelona***, publishes annually a report analyzing various types of pollutants (including POPs) that are present in different food families (ASPB, 2011). The conclusion of the study is that in general, the concentrations of POPs are below the legal limits. However, some families of food such as vegetables may contain levels above the recommended or regulated by law.

Concerning **companies** that are already implementing programs for eliminating the use of pesticides, which gives them the chance of marketing a more sustainable product, an illustrative case is the one of ***Egedeniz textile company*** in Turkey which produces its own organic cotton. The company claims that *our agricultural programs are certified by Control Union (ex- Skal International) of Netherlands who inspect that all agricultural practices are in accordance with European Union Regulation (EEC) No. 2092/91 on production of agricultural products. All processes from cotton to the end product are followed in accordance with the rules of Sustainable Textile Standards of Global Organic Textile Standards (GOTS)* (Egedeniz, 2011).

The **Global Organic Textile Standard** (GOTS) is the worldwide leading textile processing standard for organic fibres, including ecological and social criteria, backed up by independent certification of the entire textile supply chain. The aim of the GOTS is to define requirements to ensure organic status of textiles, from harvesting of the raw materials, through environmentally and socially responsible manufacturing up to labelling in order to provide a credible assurance to the end consumer. This standard for organic textiles covers the production, processing, manufacturing, packaging, labelling, exportation, importation and distribution of all natural fibres (GOTS, 2011).

The GOTS standards focus on compulsory criteria only. First of all, the fibres should be natural and have to be grown in an organic way. Second, the entire production process should be taken into account. This means that every processing step must meet certain criteria. They encompass every process-step of textile production (spinning, weaving, washing, etc) and for every step it is laid down which processing aids may (not) be used, in order to gain as much environmental profit as possible (GOTS, 2011).

5.2. Textile sector

The textile industry exhibits one of the most complicated manufacturing chains. It is a fragmented and heterogeneous sector dominated by small and medium-sized enterprises. Textile products may contain POPs coming from the phytosanitary products used in the agricultural stages of natural fibres, or they may appear in some production processes of the product (for example, in the dyeing process if POP-containing dyes and pigments are used, in the treatment of cotton with certain fungicides and in the finishing process (UNEP, 2008)).

According to this, the first good practice would be:

- establish quality controls to raw materials.

And once in the production process, good practices should focus on:

- control the use of chlorinated chemicals.

The UNEP *Guidelines on best available techniques and provisional guidance on best environmental practices, in textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)* (UNEP, 2008) explain that contamination with PCDD and PCDF has been found in both textile and leather products. The occurrence of PCDD/PCDF in the textile and leather industries is due to use of chlorinated chemicals, especially pentachlorophenol and chloronitrofen, to protect the raw material (e.g. cotton, wool or other fibres, leather); and use of dioxin contaminated dyestuffs (e.g. dioxazines or phthalocyanines). Smaller quantities of PCDD/PCDF may be formed during finishing, and during incineration of process generated sludges.

There exist several alternatives to the above-listed dye pigments exist. Possible alternatives to pentachlorophenol and chloronitrofen include 2-(thiocyanomethylthio) benzothiazole (TCMTB); o-phenylphenol (oPP); 4-chloro-3-methylphenol (CMK); and 2-n-octyl-4-isothiazolin-3-one (OIT).

Additionally, polybrominated flame retardants, such as polybrominated diphenyl ethers and chlorinated paraffins (C10-13 chloroparaffins) are used in the textile industry. All halogenated flame retardants are involved in the formation of PCDD/PCDF when incinerated (UNEP, 2008).

Besides this, Perfluorooctanesulfonic acid or perfluorooctane sulfonate (PFOS) compounds can be also found in some impregnation agents for textiles. Their unique properties have led to their widespread uses as water, grease and stain-repellent finishes for textiles. The Detox Campaign from Greenpeace highlighted that perflurorinated chemicals (such as PFOS) were present in the wastewater from certain textile factories that were supplying several major brands (Greenpeace, n.d.).

As regards best available techniques, the most efficient primary measure to prevent contamination of textiles and leather goods with PCDD/PCDF would be not to use dioxin-contaminated biocides and dyestuffs in the production chains. Also, if any of the above-mentioned chemicals are being used, preference should be given to batches containing low concentration (e.g. distilled or otherwise purified chemicals). To the extent possible, burning of textile, upholstery, leather products and carpet should be avoided to prevent PCDD/PCDF formation. Instead, they should be re-used or recycled when possible and, eventually, they could be landfilled instead of incinerated. Other alternatives to incineration are presented in section 5.9.

In order to prevent or minimize formation and release of PCDD/PCDF when burning sludge from wastewater treatment and flotation, the previously mentioned best available techniques should be applied. However, other environmentally sound techniques should also be explored (UNEP 2008).

Once being produced, clothes are sold. Despite shops receive the final product, companies and brands have the power to regulate the upstream suppliers, making sure that the product complies with certain characteristics. Good practices at this sale stage are:

- application of tests for textile and RSL.
- use of textile ecolabels.

In this sector, many companies interested in the eradication of POPs tend to cluster together. These groups are a good source of information from which to locate companies with common concerns to then retrieve information for individuals.

The two most relevant clusters are AFIRM and Textile Exchange:

- **AFIRM Group** (Apparel & Footwear International RSL Management Group): is a recognized global centre of excellence, providing resources for sustainable, self-governing RSL implementation across the apparel and footwear supply chain. The supply chain has knowledge about RSL and chemical safety, assuring that consumers and workers are safer from the impact of harmful substances and the environment is cleaner. This improves customer confidence and the public's perception of apparel and footwear companies. The purpose of AFIRM is to provide a forum to advance the global management of restricted substances in apparel and footwear, communicate information about RSL to the supply chain, discuss concerns, and exchange ideas for improving RSL management, to ultimately elevate consumer satisfaction.

- **Textile Exchange**: focuses on minimizing the harmful impacts of the global textile industry and maximizing its positive effects by building capacity, interpreting and disseminating information, and sharing best practices across the entire value chain – from farmers and raw material providers to brands, retailers, and consumers.

Another source from which to locate companies that work towards the eradication of POPs are textile eco-labels, which usually have databases and lists of products, such as the database of eco-label Oeko-Tex Standard 100, which regulates the amounts of toxic substances (including POPs) that may be present in textiles.

Table 8 contains the POPs regulated by Oeko-Tex Standard 100 and are classified in categories. The limits fixed by Oeko-Tex Standard 100 include more substances not present in table 8.

Product Class	***I***	***II***	***III***	***IV***
	Baby	**in direct contact with skin**	**with no direct contact with skin**	**decoration material**
Pesticides [mg/kg], including the following POPs: Aldrine, Chlordane, DDT, Dieldrine, Endrine, Heptachlor, Hexachlorobenzene, Hexachlorcyclohexane α-, Hexachlorcyclohexane β-, Lindane, Mirex, Toxaphene.				
Sum (incl. PCP)	0.5	1.0	1.0	1.0
Chlorinated phenols [mg/kg], including the following POPs: Pentachlorobenzenes, Hexachlorobenzene.				
Sum	0.05	0.5	0.5	0.5
Other chemical residues [g/m^2], including the following POPs: Perfluorooctane sulfonates PFOS.				
Sum	1.0	1.0	1.0	1.0
Flame retardant products, including the following POPs: Pentabromodiphenylether, Octabromodiphenylether.				
Not used				

Table 8: Categories of substances and POPs regulated by Oeko-Tex Standard 100.

Another source of information is the website for the Life Project Subsport (http://www.subsport.eu). In there, it is possible to find listings of regulated pollutants by different companies. In this site there are companies of all sectors, including textiles.

The most widespread best practices are:

- RSL (restricted substances list).
- Tests to verify RSL are respected.
- Ecolabels.
- Change from raw fibres (such as cotton) to organic fibres or crops grown with alternative pesticides.

Some examples of companies that have implemented Restricted Substance Lists (according to REACH or with substances that they consider relevant) are: *Adidas, Gap, Hugo Boss, H&M, Levis Strauss & Co., Nike, Puma,* and *VF Corporation*. Other companies have textile ecolabels: *Anvil Knitwear, C&A* and *Sanko Tekstil Inc*. Some of the reasons why these companies implement RSL are, according to one of the leading companies (Nike, 2012) :

- To protect workers, consumers and the environment
- To prevent negative press, brand damage, lost sales and loss of public trust
- There is a demand for safe products from consumers, the government, NGOs and brands
- Compliance with legal requirements for certain substances

Annex I provides more details on these companies and the substances that are regulated by the respective restricted substances lists.

5.3. Metallurgy

The metallurgical industry is concerned with the production of metallic components for use in consumer or engineering products. This involves the production of alloys, the shaping, the heat treatment and the surface treatment of the product.

Several processes in this sector may generate unintentional POPs of different characteristics. Although there are no alternative measures to the smelting process, there are some primary and secondary measures that can avoid or reduce pollution (UNEP, 2008). According to the '*Guidelines on best available techniques and provisional guidance on the best environmental practice: thermal processes in the metallurgical industry*' (UNEP, 2008), the general good practice in the metallurgical industry consists of applying corrective measures.

The work done by the Institute of Environmental Protection in Warsaw on the document '*Opportunities for reduction of dioxin emissions from the metallurgical sector in Poland'* (Institute of Environmental Protection, 2005) presents recommendations for the reduction of generation or emission of dioxins from the metallurgical industry (in particular, for iron ore sintering plants, electric arc furnace steel production processes, hot-blast furnace operations, secondary aluminium smelting in induction heaters and primary zinc production from zinc cathodes).

As a particular **example** from the metallurgy sector, the case of the **secondary production of copper** is presented here (UNEP, 2008). Secondary copper smelting involves copper production from sources that may include copper scrap, sludge, computer and electronic scrap, and drosses from refineries. Processes involved in copper production are feed pretreatment, smelting, alloying and casting. Factors that may give rise to chemicals listed in Annex C of the Stockholm Convention include the presence of catalytic metals (of which copper is a highly effective example); organic materials in feed such as oils, plastics and coatings; incomplete combustion of fuel; and temperatures between 250°C and 500°C.

Best available techniques in the case of secondary production of copper include (UNEP, 2008):

- pre-sorting,
- cleaning feed materials,
- maintaining temperatures above 850°C,
- utilizing afterburners with rapid quenching,
- activated carbon adsorption, and
- fabric filter dedusting.

Figure 4 shows a diagram of the copper production process. It can be seen that there is an unintentional emission of POPs from the process.

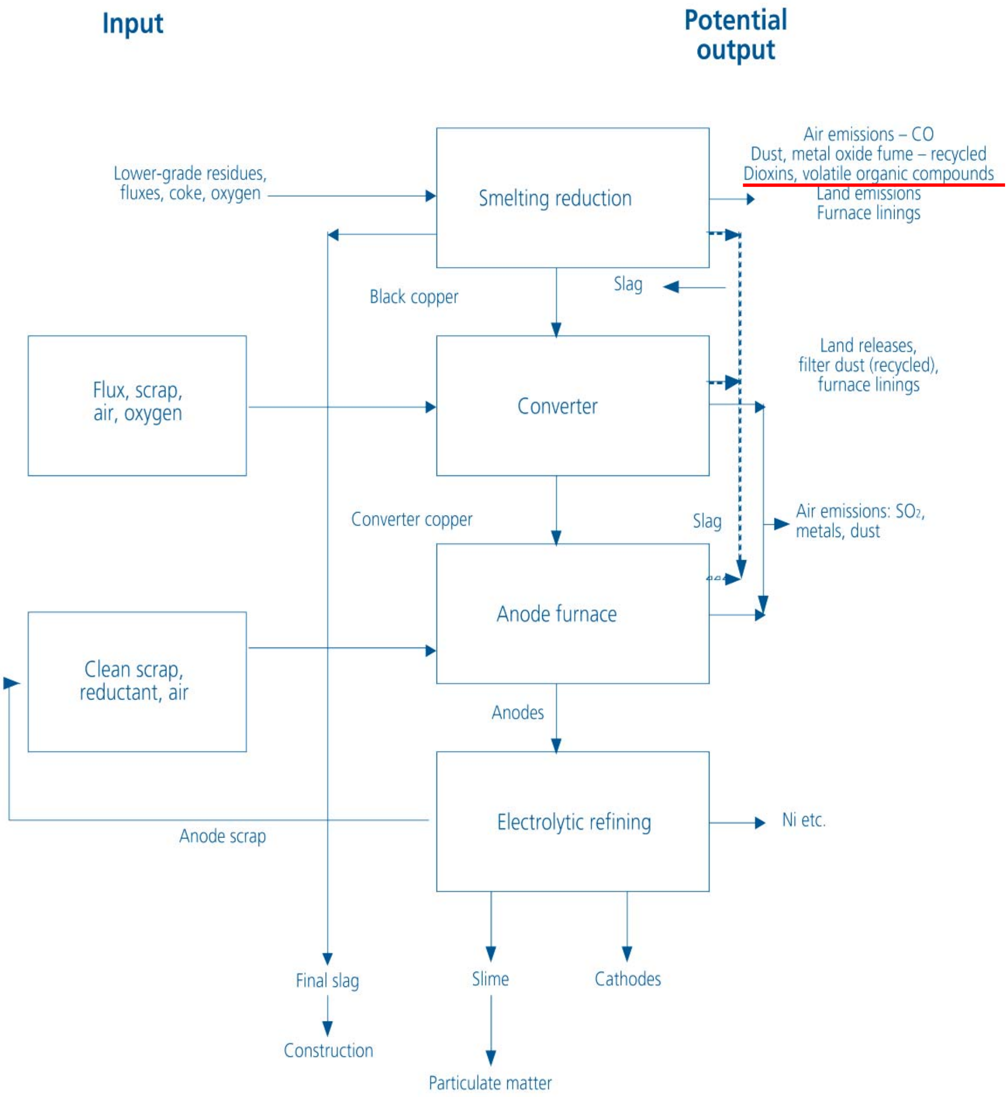

Figure 4. *Copper secondary production (UNEP, 2008)*

It has not been possible to identify a particular company that states that is implementing good practices towards POPs eradication. However, the guidelines on best available techniques and best environmental practice in the metallurgical industry (UNEP, 2008) are a good starting point to identify best practices in the sector.

5.4. Automotive industry

The automotive industry designs, develops, manufactures, markets, and sells motor vehicles. Since motor vehicles are made of, among others, textile materials (e.g. upholstery) and electric and electronic components (containing flame retardants), the automotive industry also has a role in POPs eradication.

Good practices in this sector may be obtained from the ***European Automotive Manufacturers Association*** **(ACEA)**, which was founded in 1991 and represents the interests of the sixteen European car, truck and bus manufacturers at EU level. Among its objectives, ACEA aims at producing more efficient, secure and environmentally friendly products. At the chemical substances level, its members have to comply not only with REACH specifications but also with the ***Global Automotive Declarable Substance List*** **(GADSL)** (ACEA, 2011).

The GADSL is the result of a year-long global effort of representatives from the automotive, automotive parts supplier (tier supplier) and chemical/plastics industries who have organized the Global Automotive Stakeholders Group (GASG). The GASG's purpose is to facilitate communication and exchange of information regarding the use of certain substances in automotive products throughout the supply chain. The GADSL only covers substances that are expected to be present in a material or part that remains in a vehicle at point of sale. In recent years many individual declarable substance lists were developed to exchange information regarding the material and substance composition of automotive parts. The experience gained by the above industries in using these multiple lists has shown that the declaration process could be improved upon and this was a key reason for developing a single, globally harmonized list with clear criteria and a transparent process to manage future versions of the GADSL. (American Chemistry Council, 2011).

Therefore, all members from ACEA apply the GADSL as a Restricted Substances List, which may be useful to eradicate some of the POPs included in the Stockholm convention. The substances included in GADSL that are part of the Stockholm convention are dioxins, furans, lindane, hexachlorobenzene, pentachlorobenzene, PFOS and PCBs (American Chemistry Council, 2011). Information exchange along the vehicle supply chain helps manage those potential risks while also meeting customer requirements. The GADSL is used to enhance further dialogue and cooperation along the supply chain on the benefits and potential risks of certain substances or groups of substances in a specified use within vehicle parts/materials.

In addition to Restricted Substances Lists, another source of information are **textile ecolabels** such as Oeko-Tex 100 (in the same way as it was previously explained in the textile industry section). Besides this, companies can introduce quality controls on the products they buy to the suppliers.

Therefore, **general good practice** in the automotive sector can be grouped into:

- Restricted Substances Lists (GADSL)
- Ecolabelling

Some examples of companies from ACEA are *BMW Group, DAF Trucks NV, Daimler AG, Porsche AG, Fiat, General Motors Europe, Jaguar Land Rover, Man Truck & Bus AG, PSA Peugeot Citroën, Renault SA, Scania AB, Toyota Motor Europe, Volkswagen AG, Ford of Europe GmbH* and *Volvo Car Corporation* (ACEA, 2011). The two former companies, additionally, are also committed to the 'Ford's Restricted Substance Management Standard', which goes beyond the GADSL. Finally, Volvo Car Corporation also uses the Oeko-Tex 100 ecolabel in some of its products.

Annex I provides more details on these companies and the substances that are regulated by the respective restricted substances lists.

5.5. Electronics

Many of the electronic products we all use every day contain hazardous chemicals. Traditionally **brominated flame retardants (BFR)** have often been used in electronic products to slow down the spread of fire. Today, there exist more than 175 different types of flame retardants (RAC-CP, 2009). These polymers are not only used in electronics but also in a great variety of products (although 56% of them are used in the electronics industry).

Flame retardants have faced renewed attention in recent years, since the use of BFR in electronics is highly problematic from both an environmental and a human health perspective. The earliest flame retardants, polychlorinated biphenyls (PCBs) were banned in 1977 when it was discovered that they are toxic (ATSDR, 2001). Industries shifted to using BFR instead, since they currently are the most economical and efficient (BSEF, 2001). However, BFR are now receiving closer scrutiny, since some of them have been demonstrated as harmful and its production has been banned, as is the case for hexabromodiphenil, which is included in Annex A of the Stockholm Convention (DiGangi et al., 2010).

According to the International Chemical Secretariat (ChemSec, 2010), **less hazardous alternatives** are available on the market, meeting the same technical and safety requirements. Thus, good practice in the electronics sector is **the substitution of BFRs for other substances** with similar properties but different chemical characteristics. Nimpuno et al. (2009) state that many suppliers are producing products that are bromine- and chlorine-free. To get to this point, both electronic manufacturers and suppliers have employed a range of green design strategies that include product redesign, increased use of inherently fire-resistant materials, such as metal enclosures, and the substitution of brominated and chlorined chemicals with safer alternatives. This has led to the development of new materials and chemicals that have a lower impact on human health and the environment. Some examples of the alternatives are the new resin formulations carried out by plastic manufacturers (less hazardous resins, such as thermoplastic copolyester, can now be used for wires and cables and new polyamide can be used to produce connectors and sockets). An example of an alternative to BFR is the use of certain metal hydroxides, an ingredient found in antacids. However, for all companies making a material conversion, thorough hazard assessments of the alternatives is critical to ensuring that safer alternatives are being used to replace bromine and chlorine compounds (Nimpuno et al., 2009).

Another good practice is the use of RSL, accompanied by quality controls to verify that the lists are correctly implemented.

Additionally, a number of **ecolabels** restrict or ban BFR in their product criteria, e.g. the Blue Angel in Germany, the Swan in the Nordic countries and TCO[3] which is of particular interest for

[3] Flame retardants must be added to displays and computers for reasons of safety but a TCO-labeled product should not contain bromine and chlorine-based flame retardants. In addition, the use of non-halogenated flame retardants is restricted in order to limit the impact on health and the environment. TCO-labeling requirements go beyond RoHS, the EU directive that regulates the use of chemicals in electronic products (TCO Development, 2011).

electronics. IT Eco-declarations of manufacturers, which provide environmental information for a specific product or product family in an industry standard format developed by IT organizations in Sweden, Norway and Demark, require the declaration of certain halogenated flame retardants (Walz and Schmitt, 2004).

ChemSec carried out a Market Overview to assess and demonstrate how large parts of the electronics industry are moving away from BFR and PVC. The Market Overview was based on a web-based research of official corporate information from a wide range of electronics companies during March and April 2010. It lists products on the market today free from BFR and/or PVC, as well as companies that have adopted strategies and policies to replace these by 2014. The Market Overview covers 28 electronic companies; many of them market leaders in their sector. Among these, 23 of them have at least one product on the market free or almost free from BFR. Additionally, three out of four companies officially state that by 2014 they will have products totally free from BFR and/or PVC on the market. Some examples of these products free from BFR already available on the market are the Hewlett Packard Compaq 8000f Elite personal computer, the G2410 LED Flat Panel display from Dell, the Apple iPod and the HFA6364 fluorescent ceiling lamps from Panasonic (ChemSec, 2010).

Some examples of the companies identified in the Market Overview from ChemSec (ChemSec, 2010) are: *Acer, Apple, Cisco, Dell, Electrolux, Fujitsu, HP, Lenovo, LG Electronics, Microsoft, Nintendo, Nokia, Panasonic, Philips, Samsung, Sharp, Sony Ericsson, and Toshiba*.

Additionally, it has been found that *BSH* (Bosch und Siemens Hausgeräte GmbH), *Dell, Nokia and Siemens* have implemented a RSL, according to the companies' web pages and also the website *Subsport.eu.*

Besides this, ChemSec and the consultancy company CPA (Clean Production Action) have compiled case studies that provide examples of seven companies that have removed most forms of bromine and chlorine from their product lines. The purpose of their works to allow parties outside the industry to see the level of conformance that can be met today, as well as provide a tool for engineers designing the next generation of greener electronic devices (Nimpuno et al., 2009). The case studies come from *Apple* (Restriction of Elemental Bromine and Chlorine to Achieve Elimination of BFRs and PVC in Consumer Electronic Products), *Sony Ericsson* (Bromine- and Chlorine-Free Mobile Phones), *DSM EP* (Bromine- and Chlorine-Free Plastic Components), *NanYa/Indium* (Bromine- and Chlorine-Free Printed Circuit Boards), *Seagate* (Bromine- and Chlorine-Free Hard Disk Drives) and *Silicon Storage Technology, SST* (Bromine-Free Semiconductor Chips).

Annex I provides more details on some of these companies and the substances that are regulated by the respective restricted substances lists.

5.6. Paper industry

The main processes involved in making pulp and paper products are raw material handling and preparation, storage (and preservation for non-woods), wood debarking, chipping and agricultural residue cleaning, deknotting, pulping, pulp processing and bleaching if required and, finally, paper or paperboard manufacturing.

Of the chemicals listed in Annex C of the Stockholm Convention, only PCDD and PCDF have been identified as being produced during the production of pulp using elemental chlorine. Of the 17 PCDD/PCDF congeners with chlorine in the 2,3,7 and 8 positions, only two congeners – namely 2,3,7,8-TCDD and 2,3,7,8-TCDF – have been identified as potentially being produced during chemical pulp bleaching using chlorine. Most of the formation of the 2,3,7,8-TCDD and 2,3,7,8-TCDF is generated during bleaching via the reaction of chlorine with precursors of TCDD and TCDF (UNEP 2008). This problem was detected in the late 90s, and today, thanks to the best available techniques, it is becoming less relevant.

The good practices in the sector, according to the *Guidelines on Best Available Techniques and Provisional Guidance on Best Environmental Practice relevant to Article 5 and the Annex C of the Stockholm Convention on Persistent Organic Pollutants: Production of pulp using elemental chlorine or chemicals generating elemental chlorine* (UNEP 2008), consist of **primary measures applied to reduce or eliminate the formation of POPs in the bleaching process**. These measures are:

- eliminate elemental chlorine by replacing it with chlorine dioxide (elemental chlorine-free bleaching) or in some cases with totally chlorine-free processes;
- reduce application of elemental chlorine by decreasing chlorine multiple or increasing the substitution of chlorine dioxide for molecular chlorine;
- minimize precursors such as dibenzo-p-dioxin and dibenzofuran entering the bleach plant by using precursor-free additives and thorough washing;
- maximize knot removal; and
- eliminate pulping of furnish contaminated with polychlorinated phenols

An example of a company that is already applying some of these good practices is ***Xerox***, a leading company in document technology and services, which produces many printing and office supplies such as paper in many forms (Xerox, 2011).

5.7. Construction industry

The construction industry is large, complex and diverse and covers a wide range of business interests and activities. The construction industry is comprised of clients (including house-builders and commercial property developers who determine what should be built and where); designers (who decide on the detail of what should be built); materials and components suppliers (who extract and/or manufacture materials and components) and contractors (who carry out the building).

The accent on the eradication of POPs related to this industry is on the use of materials and components that contain POPs (such as in some electronic goods or textile materials)

In order to avoid the use of materials and components that may contain POPs (for example, the presence of BFR in plastics, textiles, electric switches, relays, insulation and fuses), it is considered a good practice in the construction sector to use a RSL.

An example of this practice can be found in **Skanska** (2011a), a Czech construction company. Several Skanska business units have developed their own chemicals management systems or restricted substance lists, which they use within their individual territories. Skanska's global restricted substance list basically represents the overlap in all the Skanska business units' lists, including chemicals that are either already covered by existing legislation or ones that will likely be regulated soon, and should therefore be restricted on all Skanska projects. According to the RSL, the central purchasing units also perform the relevant screening of purchased materials before each purchase.

Table 9 shows the list of restricted substances of Skanska in Sweden, which includes some POPs. Please note that the figure also includes some examples of usage of each substance.

SKANSKA IN SWEDEN'S LIST OF RESTRICTED SUBSTANCES		
Substance	**Conc. (%)**	**Examples of usage.**
Acrylamides monomers	0,5	Laboratory analysis, glues, paints, plastic, vamish, grouting/injection agent and water purification.
Arsenic As wood preservative (the restriction is also valid for usage in contact with ground and water and for usage in marine environment. Exceptions exist.)	0	Wood-preservative.
Asbestos	0,5	Ventilation ducts, chip board, insulation and filling and reinforcing material. May be found in older constructions and products.
Brominated flame retardants PBB (polybrominated biphenyls), pentaBDE (pentabromodiphenylether) and octaBDE (octabromodiphenylether).	0,1	May occur in plastic, textile, electric switches, relays, insulation and fuses.
Cadmium As surface treatments, stabilizer and pigment.	0,5	Surface treatments, stabilizer and pigment.
CFC	0	Cooling/refrigeration agent, propellant agent in insulation, jointing, sealing materials and aerosol cans.
Chlorinated solvents Exemptions exist, for example, dichloromethane used in analysis work	0,5	Cleaning products.
Chloromethyl methyl ether Exceptions for use in research, development and analysis in professional use.	0,1	Cleaning products.
Chrome As wood preservative adobe ground. Exceptions exist.	0,5	Wood-preservative used in pressure impregnation.
Chromium VI Soluble chromium VI in cement and cement-containing preparations	0,000 2	Chromium VI occurs naturally in cement, but should be actively reduced by the producer.
Coal tar/Creosote	0	Treated wood for use inside buildings, in playgrounds, parks and outdoor recreational and leisure facilities.
1,4-dichlorobenxene	0,1	Solvents and biocide.
Erionite	1	Potential impurity in natural materials used as catalytic converters and ion exchangers.
Halons	0	Cooling/refrigeration agent and used in fire-extinguishing equipment.
HCFC Restrictions in/at new installments and filling up in existing systems	0	Cooling/refrigeration agent.
Mercury	0,025	Batteries, thermometers, detonators, measuring instruments and electrical installations, such as, for example, switches, relays, and fluorescent tubes and bulbs.
Nonylphenol and nonylphenol ethoxylate For cleaning, metal working or as components in pesticides and biocides	0,1	Surfactant in e.g. cleaning agents.
PCB	0	Softener used in sealants agents, capacitors, and transformer oils.
Tin compounds (organostanic compounds)	0	Boat and anti-fouling paints and in any totally or partly submerged appliance or equipment.

Table 9: Restricted Substances List from Skanska for Sweden (Skanska, 2011b).

5.8. Energy industries

The energy industry is the totality of all of the industries involved in the production and sale of energy, including fuel extraction, manufacturing, refining and distribution. Modern society consumes large amounts of fuel, and the energy industry is a crucial part of the infrastructure and maintenance of society in almost all countries. Among the activities involved, it worth highlighting the role of the following ones in the eradication of POPs:

- fossil fuel-fired utility and industrial boilers
- firing installations for wood and other biomass fuels,
- motor vehicles (particularly those burning leaded gasoline)

Fossil fuel-fired utility and industrial boilers

Utility and industrial boilers are facilities designed to burn fuel to heat water or to produce steam for use in electricity generation or in industrial processes. The volumetric concentrations of chemicals listed in Annex C of the Stockholm Convention in the emissions from fossil fuel-fired boilers are generally very low. However, the total mass emissions from the boiler sector may be significant because of the scale of fossil fuel combustion, in terms of both tonnage and distribution, for electricity generation and heat or steam production.

According to the *Guidelines on Best Available Techniques and Provisional Guidance on Best Environmental Practice relevant to Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants. Fossil fuel-fired utility and industrial boilers* (UNEP, 2008), measures that can be taken to decrease the formation and release of chemicals listed in Annex C include:

- maintenance of efficient combustion conditions within the boiler and ensuring sufficient time is available to allow complete combustion to occur;
- undertaking measures to ensure fuel is not contaminated with PCB, HCB or chlorine, and is low in other components known to act as catalysts in the formation of PCDD and PCDF;
- use of appropriate gas-cleaning methods to lower emissions that may contain entrained pollutants; and
- Appropriate strategies for disposal, storage or ongoing use of collected ash.

Firing installations for wood and other biomass fuels

The main purpose of firing installations for wood and other biomass fuels is energy conversion. Large-scale installations for firing wood and other biomass fuels mainly use fluidized bed combustion and grate furnaces. Technologies for small-scale plants include underfeed furnaces and cyclone suspension furnaces. Technology selection is related to fuel properties and required thermal capacity (UNEP, 2008).

Chemicals listed in Annex C of the Stockholm Convention can result from the firing of wood and other biomass fuels, particularly in the case of fuel contamination. According to the *Guidelines on Best Available Techniques and Provisional Guidance on Best Environmental Practice relevant to Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants: Firing installations for wood and other biomass fuels* (UNEP, 2008), there exist several measure to avoid unintentional emission of POPs.

Among the primary measures, control of fuel quality is a key issue (including exclusion of treated wood). Additionally, control measures for non-contaminated biomass include optimized combustion techniques and dust removal. (UNEP 2008)

Combustion of contaminated biomass, such as wood waste, should be avoided in these installations. Fly ash (especially the finest fraction) from biomass combustion has to be landfilled due to its high heavy metal content. In many countries (including in the European Union), wood treated with chlorinated compounds or heavy metals is regarded as waste and falls within the scope of waste incineration directives or regulations.

<u>Motor vehicles, particularly those burning leaded gasoline</u>

The major fuels used in motor vehicle transportation are gasoline and diesel. PCDD and PCDF have been found in the emissions from motor vehicles fuelled with gasoline or diesel (the presence of dioxins in car exhaust was first reported in 1978). The higher concentrations identified in emissions from vehicles run on leaded gasoline are due to the presence of chlorinated and brominated scavengers in the fuel.

Therefore, a good practice is to set controls on the fuel consumed. The United States Environment Protection Agency (US EPA) has recently created several programmes that establish progressively stricter rules for gasoline and diesel fuel quality in order to reduce emissions and enable the use of sensitive emission control technology. Some of the applied strategies are (US EPA, 2010):

- Removing lead from gasoline, for example, ensures that cars no longer release hazardous lead emissions and allows cars to use catalytic converters (which do not work with leaded gasoline). Catalytic converters greatly reduce carbon monoxide, hydrocarbon, and nitrogen oxide emissions.
- Efforts are in progress to reduce the amount of sulphur allowed in both gasoline and diesel fuel. Other fuel improvements include limits on gasoline benzene levels and fuel volatility (the tendency of gasoline to evaporate).
- Programs to encourage the use of electric vehicles and non-petroleum fuels such as alcohols and natural gas are helping to introduce these cleaner-burning alternatives and reduce air toxic emissions from a wide variety of mobile sources.

As alternatives to leaded gasoline, the following fuels may be considered (UNEP 2008):

- unleaded gasoline (best when equipped with catalyst);
- diesel (best when equipped with diesel oxidation catalyst and particulate filter);
- liquefied petroleum gas;
- compressed natural gas;
- propane/butane gas;
- biofuels; and
- alcohol-oil mixtures.

These alternative fuels require the promotion of cleaner vehicles and equipment. Many governments are doing an effort to develop a market for new cleaner vehicle models in order to reduce fuel consumption, dependence on oil and also exhaust emissions (not only of POPs but also of greenhouse gas emissions). At the European level, Directive 2009/33/EC aims to contribute to the EU objectives of increasing energy efficiency in the transport sector and protecting the environment by reducing emissions of carbon dioxide and air pollution from vehicle.

According to the *Guidelines on Best Available Techniques and Provisional Guidance on Best Environmental Practice relevant to Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants. Motor vehicles, particularly those burning leaded gasoline,* best available techniques include (UNEP 2008):

- banning of halogenated scavengers, and
- fitting motor vehicles with an oxidation catalyst or particulate filter.

In many developed countries, leaded gasoline is not used any more, but in the case of developing countries it is still the main type of gasoline consumed (UNEP, n.a.).

5.9. Waste management and incineration

Waste incinerators are identified in the Stockholm Convention as having the potential for comparatively high formation and release of chemicals listed in Annex C to the environment (UNEP, 2009a).

This section is divided into two parts:

- Waste Incineration (monocombustion of wastes)
- Co-incineration of waste (combustion of wastes in cement kilns or similar plants)

Waste Incineration

The potential purposes of waste incineration include volume reduction, energy recovery, destruction or at least minimization of hazardous constituents, disinfection and the recovery of some residues.

The environmentally sound design and operation of waste incinerators requires the use of both best available techniques and best environmental practices (which are to some extent overlapping) to prevent or minimize the formation and release of chemicals listed in Annex C.

According to the *Guidelines on Best Available Techniques and Provisional Guidance on Best Environmental Practice relevant to Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants. Waste Incinerators* (UNEP, 2008) and according to the Basel Convention[4] Technical Guidelines on Incineration on Land (UNEP, 2002) , **best environmental practices** for waste incineration include:

- appropriate off site procedures (such as overall waste management and consideration of environmental impacts of siting) and
- appropriate on site procedures (such as waste inspection, proper waste handling, incinerator operation and management practices and handling of residues).

Best available techniques for waste incineration include (European Commission 2006; UNEP, 2008;):

- appropriate selection of site;
- waste input and control;
- techniques for combustion, flue gas, solid residue and effluent treatment.

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[4] The Basel Convention obliges its Parties to ensure that hazardous and other wastes are managed and disposed of in an environmentally sound manner. To this end, Parties are expected to minimize the quantities that are moved across borders, to treat and dispose of wastes as close as possible to their place of generation and to prevent or minimize the generation of wastes at source. Strong controls have to be applied from the moment of generation of a hazardous waste to its storage, transport, treatment, reuse, recycling, recovery and final disposal. All parties belonging to the Mediterranean Action Plan and Serbia have ratified the Basel. More information at http://www.basel.int /

More details on best available techniques and best environmental practices for the hazardous waste treatment sector (including incineration) can be found in the document 'Review of BATs and BEPs for the Hazardous Waste Treatment Sector in the Mediterranean Region' (RAC CP, 2006).

Releases of chemicals listed in Annex C from municipal solid waste incinerators designed and operated according to best available techniques and best environmental practices occur mainly via fly ash, bottom ash and filter cake from wastewater treatment. Therefore it is of major importance to provide for a safe sink of these waste types, for example by pretreatment and final disposal in dedicated landfills, which are designed and operated according to best available techniques (UNEP 2008).

In the specific **case of POPs disposal**, there exist alternative technologies that do not imply combustion processes. The alternative non-combustion technologies not only prevent the formation and release of un-intentional POPs, but the capital and operating costs are also considered to be far less compared to incinerators that are equipped with state of-the-art pollution control devices and monitoring. Generally, these technologies use physical and chemical means of converting POPs/POPs wastes to less harmful substances. Among these alternatives, the following should be noted: Gas Phase Chemical Reduction (GPCR), Base Catalyzed Decomposition (BCD), Sodium Reduction (SR) and SuperCritical Water Oxidation Reduction (SCWO) (IPEN, 2005).

Figure 5 shows a simplified flow scheme of an incinerator, indicating the output flows that may release POPs to the environment.

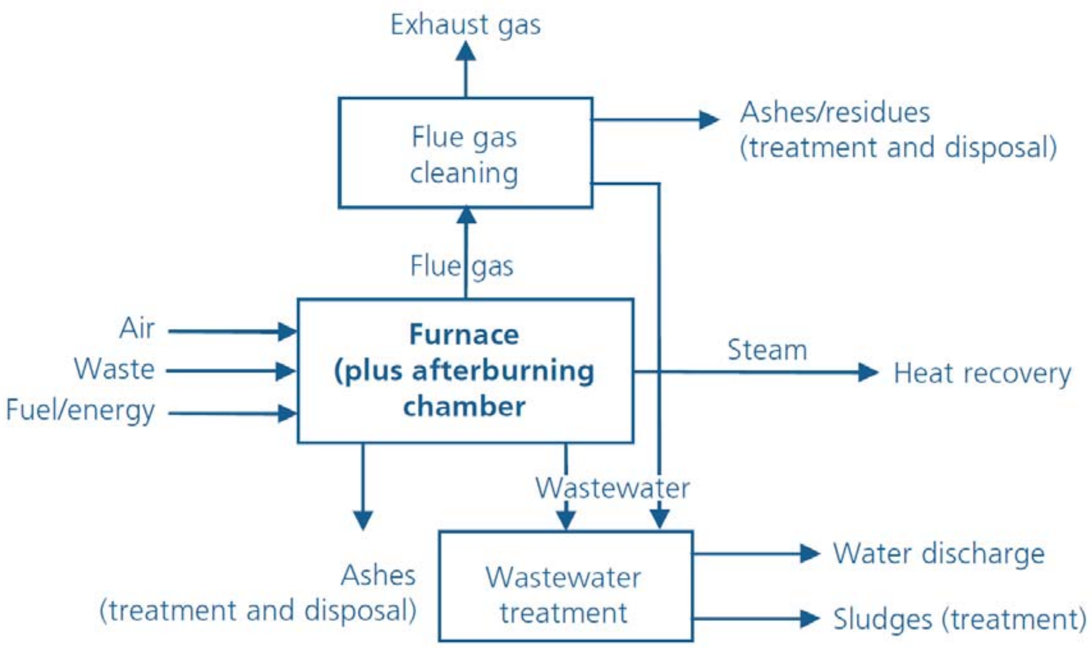

Figure 5. *Simplified flow scheme of an incinerator (UNEP, 2008)*

<u>Coincineration of waste in cement kilns</u>

Several industrial processes can provide temperatures and residence times similar to those required for hazardous waste incinerators. Examples include cement, lime, lime and aggregate kilns, industrial boilers and blast furnaces. However, the burning of hazardous waste in such

facilities generates air emissions of products of incomplete combustion, including PCDDs and PCDFs, as well as volatile heavy metals (UNEP, 2002).

The production of cement may give rise to the emission of unintentional POPs depending on the fuels used. The main purpose of cement kilns is clinker production. Firing wastes in cement kilns aims at energy recovery and substitution of fossil fuels or substitution of minerals. In some cases hazardous wastes are disposed of in these installations.

The manufacturing process includes the decomposition of calcium carbonate ($CaCO_3$) at about 900°C to calcium oxide (CaO, lime) (calcination) followed by the clinkering process at about 1450°C in a rotary kiln. The clinker is then ground together with gypsum and other additives to produce cement. The combustion process in the kiln, has the potential to result in the formation and subsequent release of chemicals listed in Annex C of the Stockholm Convention.

According to the *Guidelines on Best Available Techniques and Provisional Guidance on Best Environmental Practice relevant to Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants: Cement kilns firing hazardous waste* (UNEP, 2008), and according to the Basel Convention Technical Guidelines on Incineration on Land (UNEP, 2002) several **good practices** exist.

Well-designed process conditions, and the installation of appropriate primary measures, should enable cement kilns firing hazardous waste to be operated in such a manner that the formation and release of chemicals listed in Annex C can be minimized sufficiently, depending on such factors as the use of clean fuels, waste feeding, temperature and dust removal. Where necessary, additional secondary measures to reduce such emissions should be applied.

The specific measure that could be incorporated are (UNEP, 2002, 2008)[5]:

- Primary measures and process optimization
  - Process optimization and modification
  - Hazardous waste preparation and input controls
  - Stabilization of process parameters
- Secondary measures
  - Dust abatement and recirculation of dust
  - Activated carbon injection and filter
  - Selective catalytic reduction

An example of a company that is introducing some of these good practices is **Holcim**, one of the world's leading suppliers of cement and aggregates (crushed stone, sand and gravel). This company, for instance, is aware that before the start of the co-processing activity, it is important to study the chemical structure and the decomposition process of the waste under the conditions of cement kilns. Then, depending on the outcome of the evaluation, a trail should be carried out to evaluate the emissions in the stack gas of the cement plant as well as to calculate the risks for the environment. In this sense, Holcim is aware that test trails are an important tool to get information about the expected emissions and the behaviour of the waste during the destruction process. The decision to start co-processing waste and to carry out a test depends on the chemical composition as well as the quantity of the waste. Therefore, it is recommendable to perform frequent analysis of waste samples and to secure the traceability of the waste from its origin to the cement kiln (Holcim, 2011a, 2011b)

[5] More information can also be obtained from the Technical guidelines on the environmentally sound co-processing of hazardous wastes in cement kilns (UNEP/CHW.10/6/Add/3/Rev.1), deriving from the Tenth Meeting of the Conference of the Parties to the Basel Convention (available at http://www.basel.int/Portals/4/Basel%20Convention/docs/pub/techguid/cement/tg-cement-e.pdf)

6. CONCLUSIONS

Most Persistent Organic Pollutants (POPs) are created by humans in industrial processes, either intentionally or as byproducts. The activities and sectors that are potentially involved in the eradication of POPs are varied. This study has analysed the most important ones: agrifood sector, textile industry, metallurgy, automotive industry, electronics, paper industry, construction activities, energy industries and waste management and incineration. Since the nature of these activities is highly variable, so is the type of good practice that can be applied.

Good practices aiming to eradicate POPs could be divided into the integration of technological changes (e.g. changes in the production process, changes of the production model) and the incorporation of management changes (including quality controls, the use of ecolabels and tools such as Restricted Substances Lists). Technological changes are expected to be implemented in the core activity of each sector (i.e. the production stage of, for example, paper, textiles or electronic goods), while management strategies tend to be implemented in the selection of input materials to the processes (e.g. selecting raw materials) or when marketing a product (e.g. certifying it with an ecolabel).

The information on these good practices has been obtained from international institutions (UNEP, cleaner technology centres, research institutes, etc.), companies (either individual or clustered) and ecolabelling schemes.

The information available on companies and sectors implementing good practices strongly differs among sectors. In general, the more exposed to the public, the more information is available on the internet. Therefore, sectors such as textile, automotive and electronics offer rather abundant information on companies that are moving towards POPs eradication. Actually, some of these companies cluster together into professional sectorial clusters that, among other interests, aim to produce more environmentally friendly products and develop common strategies towards POPs eradication. In addition, the fact that some of these companies are large (multinational textile, automotive or electronics companies), makes possible to have more resources for POPs eradication and communication. Due to this set of facts, it has been possible to identify several companies that could be a source of information to further develop some case studies on good practices for POPs eradication.

However, other sectors have less information available, such as in the case of metallurgy, energy production, waste incineration, agrifood, paper industry and cement industries. In these sectors, it has been possible to identify general good practices, but further research would be necessary in order to detect more applied case studies. In the case of the agrifood, paper industry and cement industries, some companies have been detected as examples of implementation of good practices towards POPs eradication. However, it has not been possible to identify individual companies that are introducing some good practices in the metallurgy, energy production or waste incineration activities. This could be explained because these sectors are not exposed to the general public and, consequently, information may be only available from business to business

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8. ANNEX

This annex contains tables with companies of different sectors that have committed to reduce or eradicate the use or unintentional emission of POPs. If any of the companies presented next is based in the Mediterranean area, it will be highlighted with the symbol ◊ before the name.

Textile sector

Table 10 shows some companies that have a RSL to control the content of POPs of the materials they use.

Company	Good practice	Source	POP (annex)
Adidas	RSL	http://www.adidas-group.com/en/sustainability/welcome.aspx	Aldrin (A) Chlordane (A) Dieldrin (A) Endrin (A) Heptachlor (A) Lindane (A) Mirex (A) Toxaphene (A) Pentachlorobenzene (A/C) Hexachlorobenzene (A/C) PFOS (B) PCB (A/C)
Gap, Inc.	RSL	http://www.gapinc.com/content/gapinc/html.html	Dioxins and furans (C) Heptabromodifenile ether (A) Hexabromodifenile ether (A) Hexachlorobenzene (A/C)
Hugo Boss	RSL	http://group.hugoboss.com/en/sustainability.htm	Dioxins and furans (C) Heptabromodifenile ether (A) Hexabromodifenile ether (A) Hexachlorobenzene (A/C)
H&M	RSL	http://about.hm.com/es/csr http://www.subsport.eu/list-of-lists-database?lang=de	Aldrin (A) Alfa-hexachlorocyclohexane (A) Beta-hexachlorocyclohexane (A) Chlordane (A) Chlordecone (A) DDT (B) Dieldrin (A), Endrin (A) Heptaclor (A) Hexachlorobenzene (A/C) Lindane (A) Mirex (A) PCBs (A/B), PFOS (B) Toxaphene (A)
Levis Strauss & Co.	RSL	http://www.levistrauss.com/sustainability/planet/chemicals	Aldrin (A) Alfa-hexachlorocyclohexane (A) Beta-hexachlorocyclohexane (A) Chlordane (A) DDT (B) Dieldrin (A) Dioxins and furans (C) Endrin (A) Heptachlor (A) Hexachlorobenzene (A/C) Lindane (A) Mirex (A) Octabromodiphenyl ether (A) Pentabromodiphenyl ether (A) Pentachlorobenzene (A/C) PFOS (B) Toxaphene (A)

Table 10(a): Companies that implement a RSL in the textile sector

Company	Good practice	Source	POP (annex)
Nike	RSL	http://www.nikebiz.com/responsibility/considered_design/restricted_substances.html	Aldrin (A) Chlordane (A) Dieldrin (A) Dioxins and Furans (C) Endrin (A) Heptachlor (A) Hexachlorobenzene (A/C) Lindane (A) Mirex (A) Octabromodiphenyl ether (A) PCBs (A/C) PFOS (B) Toxaphene (A)
Puma	RSL	http://safe.puma.com/us/en/2009/03/puma%E2%80%99s-list-of-restricted-substances/ http://www.subsport.eu/list-of-lists-database?lang=de	Aldrin (A) Alfa-hexachlorocyclohexane (A) Beta-hexachlorocyclohexane (A) Dieldrin (A) Endrin (A) Heptachlor (A) Hexachlorobenzene (A/C) Lindane (A) Mirex (A) Octabromodiphenyl ether (A) Pentabromodiphenyl ether (A) Pentachlorobenzene (A/C) PFOS (B) Toxaphene (A)
VF Corporation	RSL	http://www.vfc.com/ http://www.vfc.com/brands http://www.vfc.com/corporate-responsibility/sustainability-at-vf	Aldrin (A) Alfa-hexachlorocyclohexane (A) Beta-hexachlorocyclohexane (A) Chlordane (A) Chlordecone (A) DDT (B) Dieldrin (A) Dioxins and furans (C) Endrin (A) Heptachlor (A) Hexachlorobenzene (A/C) Lindane (A) Mirex (A) Octabromodiphenyl ether (A) PCBs (A/C) Pentabromodiphenyl ether (A) Pentachlorobenzene (A/C) Toxaphene (A)

Table 10(b): Companies that implement a RSL in the textile sector

Table 11 includes some companies that have a textile ecolabel. The non-used substances are those regulated by each ecolabel.

Company	Good practice	Source	POP (annex)
Anvil Knitwear	Oeko-Tex standard 100 USDA's National Organic Program	http://www.anvilcsrexperience.com/2010/07/customer-health-and-safety-pr1-pr2/ http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=6f623e1de5457587ccdfec12bc34ed1c&rgn=div5&view=text&node=7:3.1.1.9.32&idno=7#7:3.1.1.9.32.7.354 http://www.apparelandfootwear.org/Resources/restrictedsubstances.asp	Aldrin (A) Alfa-hexachlorocyclohexane (A) Beta-hexachlorocyclohexane (A) Chlordane (A) DDT (B) Dieldrin (A) Dioxins and Furans (C) Endrin (A) Heptachlor (A) Hexachlorobenzene (A/C) Lindane (A) Mirex (A) Octabromodiphenyl ether (A) PCBs (A/C) Pentabromodiphenyl ether (A) Pentachlorobenzene (A/C) PFOS (B) Toxaphene (A)
C&A	Oeko-Tex standard 100	http://www.c-and-a.com/uk/en/corporate/fashion/	Aldrin (A) Alfa-hexachlorocyclohexane (A) Beta-hexachlorocyclohexane (A) Chlordane (A) DDT (B) Dieldrin (A) Endrin (A) Heptachlor (A) Hexachlorobenzene (A/C) Lindane (A) Mirex (A) Octabromodiphenyl ether (A) Pentabromodiphenyl ether (A) Pentachlorobenzene (A/C) PFOS (B) Toxaphene (A)
◊ Sanko Tekstil Inc.	Oeko-Tex standard 100 Global Organic Textile Standard	http://www.sankotextile.com http://www.sankotextile.com/urun2.asp?referans_id=128109627	Aldrin (A) Alfa-hexachlorocyclohexane (A) Beta-hexachlorocyclohexane (A) Chlordane (A) DDT (B) Dieldrin (A) Endrin (A) Heptachlor (A) Hexachlorobenzene (A/C) Lindane (A) Mirex (A) Octabromodiphenyl ether (A) Pentabromodiphenyl ether (A) Pentachlorobenzene (A/C) PFOS (B) Toxaphene (A)

Table 11: Companies that have an ecolabel in the textile sector

Automotive industry

Table 12 shows a list of companies belonging to ACEA Group, that implement the GADSL (Global Automotive Declarable Substance List).

Company	Good practice	Source	POP (annex)
BMW Group	Belong to ACEA Group	http://www.acea.be/ http://www.gadsl.org/	Heptabromodiphenyl ether (A) Hexabromodiphenyl ether (A) Hexachlorobenzene (A/C) Lindane (A) Mirex (A) Octabromodiphenyl ether (A) PCBs (A/C) PCDD i PCDF (C) Pentachlorobenzene (A/C) PFOS (B)
DAF Trucks NV			
DAIMLER AG			
Dr. Ing. h.c.F. PORSCHE AG			
◊ Fiat S.p.A			
Ford of Europe GmbH[1]			
General Motors Europe			
Jaguar Land Rover			
MAN Truck & Bus AG			
◊ PSA Peugeot Citroën			
◊ Renault SA			
Scania AB			
Toyota Motor Europe			
Volkswagen AG			
Volvo Car Corporation[1,2]			

Table 11: Companies implementing the GADSL (automotive sector)

[1]In addition to participating in ACEA, this company has implemented the Ford's Restricted Substance Management Standard (RSMS) (http://corporate.ford.com/microsites/sustainability-report-2010-11/issues-supply-environmental-materials)
[1]In addition to participating in ACEA, this company uses the Oeko-Tex standard 100 (http://www.mdsystem.com/html/data/RSMS_Package_2011.pdf)

Electronics

Table 12 shows some companies that use RSL in the electronics sector:

Company	Good practice	Source	POP (annex)
Acer	RSL	http://www.acer-group.com/public/Sustainability/sustainability_main04-2.htm	Alfa-hexachlorocyclohexane (A) Beta-hexachlorocyclohexane (A) Dioxins (C) Heptabromodiphenyl ether (A) Hexabromodiphenyl ether (A) Octabromodiphenyl ether (A) PCBs (A/C) Pentabromodiphenyl ether (A) PFOS (B)
Apple	RSL	http://www.apple.com/my/environment/materials/	Dioxins (C) Heptabromodiphenyl ether (A) Hexabromodiphenyl ether (A) Octabromodiphenyl ether (A) PCBs (A/C) Pentabromodiphenyl ether (A)
BSH Bosch und Siemens Hausgeräte GmbH	RSL	http://www.subsport.eu/list-of-lists-database?lang=de	Octabromodiphenyl ether (A) PCBs (A/C) Pentabromodiphenyl ether (A) PFOS (B) Tetrabromodiphenyl ether (A)
Dell	RSL	http://www.subsport.eu/list-of-lists-database?lang=de	Octabromodiphenyl ether (A) PCBs (A/C) Pentabromodiphenyl ether (A) PFOS (B) Tetrabromodiphenyl ether (A)
Hp	RSL	http://www.hp.com/hpinfo/globalcitizenship/environment/pdf/gse.pdf	Heptabromodiphenyl ether (A) Hexabromodiphenyl ether (A) Octabromodiphenyl ether (A) PCBs (A/C) Pentabromodiphenyl ether (A) PFOS (B)
Nokia	RSL	http://www.nokia.com/environment/strategy-and-reports/substance-and-material-management http://www.subsport.eu/list-of-lists-database?lang=de	Dioxins and furans (C) Octabromodiphenyl ether (A) Pentabromodiphenyl ether (A) Tetrabromodiphenyl ether (A) PCBs (A/C) Pentachlorobenzene (A/C)
Philips	RSL	http://www.philips.com/shared/global/assets/sustainability/rsl.pdf	Dioxins and furans (C) Heptabromodiphenyl ether (A) Hexabromodiphenyl ether (A) Octabromodiphenyl ether (A) PCBs (A/C) Pentabromodiphenyl ether (A) PFOS (B)

Table 12(a): Companies implementing a RSL in the electronics industry

Company	Good practice	Source	POP (annex)
Samsung	RSL	http://www.samsung.com/us/aboutsamsung/corpcitizenship/environmentsocialreport/downloads/SEC%20Standard_0QA-2049_%20Rev13_En.pdf	Heptabromodiphenyl ether (A) Hexabromodiphenyl ether (A) Octabromodiphenyl ether (A) PCBs (A/C) Pentabromodiphenyl ether (A) PFOS (B)
Siemens	RSL	http://www.siemens.com/sustainability/en/core-topics/product-responsibility/management-approach/siemens-standard.htm	Dioxins and furans (C) Heptabromodiphenyl ether (A) Hexabromodiphenyl ether (A) Hexachlorobenzene (A/C) Octabromodiphenyl ether (A) PBCs (A/C) Pentabromodiphenyl ether (A) PFOS (B)
Sony Ericsson	RSL	http://dl-www.sonyericsson.com/cws/download/1/904/313/1292585130/SEBannedandRestrictedSubstancelist.pdf	Heptabromodiphenyl ether (A) Hexabromodiphenyl ether (A) Hexachlorobenzene (A/C) Octabromodiphenyl ether (A) PCBs (A/C) Pentabromodiphenyl ether (A) PFOS (B)

Table 12(b): Companies implementing a RSL in the electronics industry

Regional Activity Centre
for Cleaner Production (CP/RAC)

Dr. Roux, 80 - 08017 Barcelona (Spain)
Tel.: + 34 93 553 87 90 - Fax: + 34 93 553 87 95

http://www.cprac.org

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