HELSINKI COMMISSION
Baltic Marine Environment Protection Commission

POLYCHLORINATED BIPHENYLS

(PCBs)

A compilation and evaluation of the information given by the Contracting Parties with the focus on legislative situation, current uses, stockpiles and releases.

Working Document
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submitted by the Co-ordinator of the Project Team on Hazardous Substances
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POLYCHLORINATED BIPHENYLS (PCB)

Chemical name: Polychlorinated Biphenyls

Trade Names/Synonyms: Aroclor, Chlorextol, chlorinated biphenyl, chlorinated diphenyl, Clophen, chlorobiphenyl, Dykanol, Fenclor, Inerteen, Kanechlor, Noflamol, Phenoclor, polychlorobiphenyl, Pyralene, Pyranol, Santotherm, Sovol, Therminol.

CAS-NO. 133-63-63[1]

Formula: $C_{12}H_{10-(x+y)}Cl_{(x+y)}$

INTRODUCTION

Technological polychlorinated biphenyls consist of a mixture of homologous and/or isomeric chlorinated biphenyls. Theoretically 209 congeners/ compounds are possible with various degrees of chlorination between 21 % and 68 %. PCBs with an average content of 42 to 54 % chlorine play the largest role in production and use. Of special ecological interest are the congeners: 28, 52, 101, 118, 138, 153, 180, non-ortho 77, 126, 169 and mono-ortho 105, 118 (Münch et al., 1999).

From the beginning of their commercial use in 1929 until the beginning of the 1970s PCBs were utilized in open as well as closed systems.

Use in closed systems:

- insulation liquid in capacitors
- insulation and cooling liquid in transformers
- hydraulic oil at mines
- liquid in heat exchangers

Use in open application:

- lubricants
- softener for plastics and glues
- laminating agents in paper production
- impregnating agent
- fire retardant (e.g. in printing inks, oil, paints, self-copying paper and plastics)
- additive in cement plaster and casting agents
- additive for insecticides
- sealing liquid in measuring instruments
- heavy oil in ring scales

Main emission sources:

- Evaporation of PCBs used in the past in open systems, from products, from buildings
- Evaporation of spilled or leaked PCBs from equipment containing PCBs still in use
- Evaporation from landfills or incinerators
- Evaporation of PCBs from improper disposal of PCB containing products
- Emissions of PCBs from engines and furnaces burning liquid or gaseous fuels containing PCBs or contaminated with them
- Emissions of PCBs from open burning or incomplete incineration of waste
- Emissions of PCBs from small capacitors in household appliances
- Evaporation of PCBs from waste oil recycling

[1] There are many CAS numbers for PCBs and there are other classifications numbers, like index no (according to directive 67/548/EEC) and EG number (according to EINECS). In some cases the monochloro- and dichloro-biphenyls are excluded from the definition of PCBs. Some substances that from a chemical point of view not at all are PCBs, are included in the directive on disposal of PCB/PCT.

PCBs are mainly emitted from their application in open systems in the past and in electrical equipment partly used until today (more than 90 % of total PCB emissions). Because of the long lifetimes of the products containing PCBs (10 - 30 years) and e.g. its use in small capacitors/condensers, which are usually disposed with garbage, as well as unavoidable accidental and illegal release of PCB it is very difficult to stop PCB emissions in a short time by legal or technical measures (Münch et al. 1999).

Polychlorinated Biphenyls (PCBs) are now out of production worldwide, but since 1929, the beginning of their commercial use, until 1989, world production, excluding the Soviet Union, totalled 1.5 million tons (UNEP 1999 report).

For Eastern Europe IEIA supposed to use 0.0427 g PCB/capita as an emission factor for 1990 and 1993/95. In the past, IEIA reported there was no PCB use in electrical equipment in Eastern Europe; they used another technology/agents therefore no PCB emission from electrical equipment was estimated for Eastern European countries in the 1970s and 1980s (Münch et al., 1999).

Because of the mobility and persistence of PCBs, environmental concentrations of PCBs tend to be uniform throughout the globe (Tanabe et al., 1994). But based on monitoring data, the polar regions appear to be an environmental sink for PCBs (Muir et al., 1992) (all in Holoubek et al., 2000).

A mass balance of PCBs in UK and other countries (Harrad et al., 1994) showed that soil retained a larger amount of PCBs than other compartments did (air, freshwater, sediment, or biota) and is today the greatest source (90 %) of it for the atmosphere through re-circulation. The major input of PCBs to freshwater ecosystems is by the atmosphere (Bremle, 1997).

Tab. 1: Historic PCB emissions in Europe [kg/a]

Country	**1970**	**1975**	**1980**	**1985**	**1990**	**93-95**
Denmark	24971	20546	10522	10387	1011	1026
Estonia	86	118	127	113	175	135
Finland	23451	19283	9852	9983	2670	2721
Germany East	90896	70205	36858	35449	10085	0
Germany West	311264	253604	127368	124736	33171	42462
Latvia	28	25	23	21	135	126
Lithuania	24	26	43	42	200	178
Poland	637	791	978	1007	2488	2374
Russia	2094	2437	2504	2548	8871	8072
Sweden	41163	33743	17029	16960	1991	2022
Europe	**1727699**	**1427520**	**756731**	**757906**	**115581**	**113115**

(in: Münch & Axenfeld, 1999)

REGULATORY STATUS

EU, HELCOM, PARCOM/OSPAR, UN/ECE and UNEP have all established instruments with regard to PCBs and PCTs. A detailed overview on main legislation and regulations with relevance for the PCB problematic can be found in "PCBs. A compilation of information, derived from HELCOM Recommendations, EU-Directives, UN-ECE-LRTAP, UNEP and OSPAR, and analysis of appropriate measures aiming at safe handling and reduction of releases of PCB from PCB-containing equipment in use" (June 2001).

The use of PCBs as a raw material or chemical intermediate has been banned in the EU since 1985 (85/467/EEC, 6th amendment to Directive 76/769/EEC).

The most important regulations – Council Directive 96/59/EC and HELCOM Recommendation 6/1 have been fully implemented only by the EU-Countries. But PCBs/PCTs are not produced in any of the Baltic Sea States.

With regard to the national PCB legislation at least the Nordic countries have more stringent requirements than what EU legislation is stipulating (e.g. lower volume levels, more stringent timetables).

HELCOM RECOMMENDATION 6/1

Recommendation regarding the elimination of the use of PCBs and PCTs (adopted 13 March 1985, having regard to Article 13, Paragraph b) of the Helsinki Convention). The Contracting Parties should stop the production of PCBs and PCTs and the marketing of articles and equipment containing PCBs/PCTs from 1987 on. National programmes should be established to identify and/or label, collect, dispose and destruct PCB-containing articles. Equipment containing PCBs/PCTs should be disposed of or destructed in an environmentally safe manner: hydraulic fluids in underground mining equipment, closed system electrical equipment (transformers, resistors, inductor, capacitors > 1 kg total weight) as soon as possible, small capacitors at the latest when they reach the end of their service life. This Recommendation is fully implemented only by the EU-countries.

HELCOM RECOMMENDATION 16/10

Recommendation regarding the reduction of discharges and emissions from production of textiles (adopted 15 March 1995 having regard to Article 13, Paragraph b) of the Helsinki Convention).
Within the production of textiles the Contracting Parties should apply best available technology and should not use (among other hazardous substances) PCB. These measures should be implemented by 1 January 1998 for new plants and by 1 January 2000 for existing plants.

HELCOM RECOMMENDATION 19/5

HELCOM objective with regard to hazardous substances (adopted 26 March 1998, having regard to Article 13, Paragraph b) of the Helsinki Convention)
The objective is to prevent pollution of the Convention Area by continuously reducing discharges, emissions and losses of hazardous substances towards the target of their cessation by the year 2020, with the ultimate aim of achieving concentrations in the environment near background values for naturally occurring substances and close to zero for man-made synthetic substances. The corresponding substances selected for immediate priority action are listed in Attachment, Appendix 3. PCB is one of them.

HELSINKI CONVENTION

Annex 1, Part 2.2: In order to protect the Baltic Sea Area PCBs shall be banned for all uses, except in existing closed system equipment until the end of service life or for research, development and analytical purposes in the Baltic Sea Area and its catchment area.

COUNCIL DIRECTIVE 76/769/EEC

of 27 July 1976 relating to restrictions on the marketing and use of certain dangerous substances and preparations (e.g. TBT, PCBs). This Directive has been also amended several times, e.g. by Council Directive 85/467/EEC of 1 October 1985 on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (PCBs/PCTs). The objective is to restrict the marketing and use of PCBs and PCTs. Thus, the use of PCBs and PCTs is prohibited in closed-system electrical equipment transformers, resistors and inductors, in large capacitors (> 1 kg total weight), in certain small capacitors, in heat-transmitting fluids in closed-circuit heat-transfer installations, in hydraulic fluids for underground mining equipment from July 1986 on. Council Directive 89/677/EEC of 21 December 1989 on the approximation of the laws, regulations and administrative provisions of the member states relating to restrictions on the marketing and use of certain dangerous substances and preparations amended this Directive for the 8th time. The Directive prohibits the use and reuse of PCBs and PCTs and any mixture containing them in more than 0.005 % by weight.

COUNCIL DIRECTIVE 96/59/EC

of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCBs/PCTs), replacing Council Directive 76/403/EEC (ban of use of PCBs in EC in open applications, 1976). According to Council Directive 96/59/EC Member States must submit an inventory and detailed plans for the disposal of the relevant PCB wastes and the decontamination/disposal of relevant equipment containing more than 5 litres (> 5 dm^3) of PCB until September 1999. The year 2010 has been set as a deadline for complete disposal or decontamination of equipment containing PCBs. Any equipment, which is subject to inventory, must be labelled. Transformers containing between 500 and 50 ppm of PCB are allowed to remain in service indefinitely. Furthermore the Member States must prohibit the separation of PCBs from other substances for the purpose of reusing the PCBs and the topping-up of transformers with PCBs. Member States have also to establish plans for the collection and disposal of equipment not subject to the inventory.

Denmark

Production has never taken place. Restricted use since mid 1970ies. 1977 open applications were banned. With the first **Statutory Order on PCB containing equipment from 1986** a total ban of the sale and use with few exemptions was stated: Small electrical installations (total weight < 1 kg) can be used until end of technical lifetime. Apparatus in use before June 1994 containing monomethyl-tetrachlordiphenylmethan (CAS No 76253-60-6) can be used until end of technical lifetime. Ban on sales and import. Use of large capacitors prohibited by 1 Jan. 1995, the equipment has to be disposed of by 1 Jan. 2000. Other products containing PCB should be disposed properly at end of technical lifetime. Regulations are effective but PCB is still of concern in small units. Council Directive (96/56 EC) on the disposal of PCB/PCT was transposed with **Statutory Order on PCB from 1998.** In **1998 Statutory Order on treatment of waste of electric and electronic products** coming into force by 1 Dec. **1999** was adopted. Thus all waste of electronic and electric equipment has to be separately collected. Substance covered by **Statutory Order 921 of 8. Oct. 1996** regarding quality criteria for aquatic

compartments for certain hazardous substances in relation to emission from point sources.

Estonia

The Chemicals Act providing the framework for this sector was adopted on May 6, 1998 and amended on April 28, 1999. The use of PCB is banned by **Governmental Regulation No. 99, March 1999** on adoption of the listing of products posing threat to environment as waste for which production, import and export, sale and use is prohibited, and **Regulation of Minister of Environment No. 71, July 1999** on the treatment of wastes containing PCB and PCT. So the requirements of Council Directive 96/59/EC on elimination of PCB and PCT are transposed into two Estonian legal acts. Each owner must inform Estonian Environmental Information Centre about all installations that contain more than 5 dm^3 PCB by July 1, 2001.

Finland

According to **Government Decision 1071/1989** the manufacture, import, placing on the market and supply of PCB's and of products containing PCB is prohibited. According to **Government Decision 711/1998** on phasing out of PCB's and PCB containing equipment and on handling PCB containing waste (into force 15.10.1998; implements Council Directive 96/59/EC) the use of equipment containing more than 5 dm^3 of PCB's is prohibited as from 31.12.1999. No permits allowing emissions of PCB exist. Voluntary cessation during the 70ies, prohibition of any new uses since 1989 and obligation to take out of use and destruct the remaining PCB equipment. The Finnish Environment Institute has prepared in accordance with Government Decision 711/1998 an action programme aiming at ensuring the environmentally sound collection and destruction of PCB equipment not yet destructed.

Germany

The use of PCBs is banned in Germany (since 1972 in open systems, since 1978 also in closed systems, prohibition of any new use since 1989). The production of PCB was terminated completely already in 1983 and the import of PCB containing hydraulic fluids for use in coal mining was terminated in 1988. The **Executive Order of May 2000** requires that PCB containing appliances containing 1 litre or with concentrations above 50 ppm must be disposed safely. With this Executive order, Council Directive 96/59/EC is implemented more stringently in Germany (1 litre instead of 5 litre). Further national regulations:

*10. BImschV of 1978: Executive order to the Federal Emission Control Act of 1978: Restriction of PCB, PCT and VC.

*1987 Executive Order to the Federal Waste Act of 1987: Restriction of PCBs in waste oils with a limit of 20 ppm.

*Executive Order of 1989 (18th July 1989): Ban of PCB with rules on limited use of PCB containing appliances until end of 1999 (Amendment to the 10th Executive Order to the Federal Emission control Act).

*Federal Communication of a uniform analytical method for PCB and PCT detection (6th December 1989).

*Executive Order of 1993 (14th October 1993) amending the Executive Order of 1989.

*Executive Order of 1993: Hazardous Substances (labelling duty for PCB containing materials).

Latvia

PCB is not registered/licensed for uses as plant protection product, wood preservative, disinfectant, antifouling and biocide. Concerning use as chemical substance no information is available. PCB is banned for marketing and use since 17.01.2000 according to HELCOM Convention. PCBs, PCTs and preparations, including waste oils, with a PCB or PCT content higher than 0.005 % by weight may not be used in chemical industry. **Regulations of Cabinet of Ministers No. 158 (25.04.2000):** "Restrictions and bans on use and marketing of some dangerous chemical substances and dangerous chemical products".

However, the following categories may be used until 2002:

1. closed-system electrical equipment transformers, resistors and inductors;

2. large condensers (1 kg total weight)
3. small condensers (provided that the PCB has a maximum chlorine content of 43 % and does not contain more than 3.5 % of penta- and higher chlorinated biphenyls);
4. heat-transmitting fluids in closed-circuit heat-transfer installations;
5. hydraulic fluids for underground mining equipment;

The use of equipment, plant and fluids referred to in points 1 to 5, which are in service, shall continue to be authorised until they reach the end of their service life.
The placing on the second-hand market of such equipment, plant and fluids, which are not intended for disposal, is prohibited from 2003.
If, for technical reasons, it is not possible to use substitute products, competent State Institution may permit the use of PCBs, PCTs and preparations thereof where the latter are solely intended, in the normal conditions of maintenance of equipment and to supplement the level of liquids containing PCBs in properly functioning existing plant purchased before the entry into force of regulation.
Until 2003 primary and intermediate products for further processing into other products are not prohibited.
Equipment, plants and fluids, which contain PCBs and PCTs, have to be provided with using instructions before placing on the market.
The use in closed-loop systems is allowed until the end of the exploitation, or for research, development and analytical purposes.

Lithuania

According to **Hygienic standards 36:1999:** "Banned and restricted substances"; PCB, except mono- and dichlorinated biphenyls, as well as preparations, including waste oils, with a PCB content higher than 0.005 % by weight, may not be used and placed on the market. Components, installations, apparatus and systems, which contain those substances and preparations, which had been in use before the Hygienic standards entered into force, can be used till the time of the use expires. PCBs and their preparations can be used for replenish of above mentioned components, installations, apparatus and systems' liquids. According to **Hygienic standards 63:2000:** "Banned and restricted pesticides"; import, production and use of PCB as pesticide is banned in the Republic of Lithuania. PCBs as pesticides are not registered in the Republic of Lithuania. According to **Order of Environmental Ministry No. 351 of 28.08.2001:** "Regulations of Issuing Permits for Import and Export from and into the Republic of Lithuania of Dangerous Chemical Substances", to import and export PCB it is necessary to receive permit issued by the Ministry of Environment. According to **Governmental Resolution No. 452 of 21.04.1999:** "On licensing of dangerous chemicals"; enterprises involved in production, trade and storage of PCB, except mono and dichlorinated biphenyls, as well as of preparations, including waste oils, with a PCB content higher than 0.005 % by weight, from 01.10.1999 shall have a licence issued by the Regional Environmental Departments under the Ministry of Environment. The Prior Informed Consent (PIC) procedures and regulations will be implemented in 2003.

Poland

Executive Order of the Council of Ministers of 17 Dec. 1996 on Fees for Economic Use of the Environment; **Executive Order of the Minister of Economy of 19 Feb 1999** on Chemical Substances Dangerous for Health and Life. Production or use is not legally banned. But according to the new Environmental Protection Law, PCBs are classified as substances particularly dangerous to the environment and should be step-wise eliminated. All uses should be controlled and registered. PCBs cannot be marketed and reused, except for cases specified in law acts. This Law has been adopted on 27 April 2001. PCBs are not produced nor imported; in some cases they are still in use in long-life equipment, till its "natural death". The provisions of Council Directive 96/59/EEC have been transposed into Polish law by July 2001 by means of enforcement of the Act on the Environmental Law and the Act on Waste, and on the amendments in certain Acts and their related

administrative regulations. It is expected that the related inventories (waste and equipment with PCB volumes of more than 5 dm^3, and with concentration of up-to 0.05% by weight of PCBs) will be carried out until 31 December 2002. The complete elimination of equipment containing PCB is planned until 31 December 2010.

Russia

Production, import, marketing and use are not legally banned, although production of PCB ended between 1987 and 1993.

Limit of application of PCB confirmed by the law. Norms of dioxins and dioxin similar substances in the different nature areas. Khudoley V.V., Livanov G.A. "The dioxins dangerous in the city" St.Petersburg.2000, p. 117 -130. Federal programme "The nature conservation and preservation of the environment and population from the dioxins and dioxin similar substances during the 1996-1997 (the Resolution of the Russian Government 5.11.1995 N1102).

Sweden

PCB is not allowed to import, manufacture or use. Since 1986, a PCB chemical product and a PCB commodity may not be manufactured, processed, offered for sale, transferred for use or reused (**The PCB Ordinance SFS 1985:837**). The EC directive (96/56 EC) on the disposal of PCB/PCT applies. In EU, imports from and exports to third countries of PCB is regulated by the Council Regulation (EEC 2455/92) concerning the export and import of certain dangerous chemicals. The regulation does not apply to substances or preparations imported or exported for the purpose of analysis or scientific research and development.

The open use was banned in 1973, for closed systems in 1978 (Münch et al., 1999).

CURRENT USES

Denmark

No production. Total ban on sales and import since 1986.
Remaining uses in paints, sealants etc. unclear (total consumption between 1950 – 1983: appr. 600 – 1100 tons)
PCB-containing equipment is no longer in use in the power distribution network
PCB may still be in use in capacitors in ballasts of fluorescent lamps and in white goods older than 20 years
Only a small amount of PCB-containing large capacitors are still in use.
Scarce info concerning the content of PCB in electronics however indicates, that PCB is out of the turnover of electronics today.

Estimated added up consumption of PCB with electrical and electronic products in Denmark 1950-1983.

Application	**Estimated added up consumption of PCB in Denmark [tonnes] [1)]**
Large capacitors for power factor correction	450 - 750
Small capacitors in fluorescent light ballasts, refrigerators, microwave ovens etc.	175 - 325
High voltage transformers	30 - 100
Capacitors etc. in electronics	?? 3)
Sum	**655 - 1175**

Notes: [1)] The total consumption of PCB with the application, summed up for the whole period of use in Denmark.
(in: COWI, 2000 a)

Estonia

The use of PCB is banned. Equipment and products marketed until 1990. Owners of equipment containing PCBs must remove them from use and eliminate PCBs from equipment as soon as possible but not later than December 31, 2010. It is estimated that in total 250 – 500 tons PCB-containing capacitors are in use, which corresponds to approximately 100 – 150 tons of PCB-containing oil. Further roughly 20000 transformers are in use, which corresponds to approximately 10000 tons of PCB-containing oil. Assuming an average content of 1.5 mg PCB/kg the transformers would in total contain approximately 15 kg PCB (COWI, 2000 b). Unknown amounts of small capacitors in fluorescent lamps, electric appliances etc., and applied varnish, paint and lubricants might be still in use.

Finland

All transformers and capacitors with a capacity over 1 kVAr containing over 0.005 % PCB had to be taken out of use by the end of 1994. The use of equipment containing more than 5 dm^3 of PCBs is prohibited as from 31.12.1999. The separation of PCB from PCB-containing waste for reuse is forbidden. No production, export or import of PCBs or PCB containing equipment for use.

Germany

Production termination times: PCB (1983), PCT (1971), highest chlorinated PCB (1977), higher and medium chlorinated PCBs (1980). The import of PCB containing hydraulic fluids for use in coal mining, which in 1983 still amounted to 1000 t/a, was terminated in 1988. The relevant modes of applications are the following: closed system (transformers, condensers) 25000 t; circulatory systems (hydraulic, thermal and lubricating oils), open systems (plasticiser for rubber and synthetic resins, carbonless copy paper, adhesives, paints, printing inks) 62000 t *(year unclear).* The total estimated amount of PCB-containing materials/products in Germany (1998) in closed and open applications was approximately 4000 tons, with small capacitors and building products having the main contribution. According to Lorenz et al. (1983) 4118 t PCB for condensers, 5967 t for transformers and 7692 t for mining facilities were used in former West-Germany between 1974 and 1980.

Tab. 2: Production rate of PCBs [t/y] in Germany

1973	1974	1975	1976	1977	1978	1979	1980
6 949	8 374	7 328	6 610	5 680	7 640	7 280	7 309

(Lorenz et al. 1983 in: Münch & Axenfeld, 1999)

Latvia

The following categories may be used until 2002:

1. closed-system electrical equipment transformers, resistors and inductors;
2. large condensers (1 kg total weight)
3. small condensers (provided that the PCB has a maximum chlorine content of 43 % and does not contain more than 3.5 % of penta- and higher chlorinated biphenyls);
4. heat-transmitting fluids in closed-circuit heat-transfer installations;
5. hydraulic fluids for underground mining equipment;

The use of equipment, plant and fluids referred to in points 1 to 5, which are in service, shall continue to be authorised until they reach the end of their service life.

Lithuania

The amount of import/export, production [t] for the year 1998 for coal was 273105 / 46915 and for heavy fuel oil, gasoline, diesel fuel 1188157.5 / 3826713.5.

Tab. 3: Industrial and consumer uses of combustion material [t] for the years 1997 and 1998.

combustion of…	Uses [t/y 1997]	Uses [t/y 1998]
❑ coal	254900	219200
❑ wood	1765200	1975200
❑ crude oil	8800	3500
❑ heavy fuel oil	1309100	1664100
❑ light heating oil	33000	11900
❑ diesel oil	139700	124200
total	**3510700**	**3998100**

Poland

All uses should be controlled and registered. PCBs cannot be marketed and reused, except for cases specified in law acts.

Poland had its two own technical PCB formulations - Chlorofen, which is similar in appearance and composition to Aroclor 1262, and Tarnol, which is similar to Aroclor 1254 (Falandysz, 1998). Tarnol, which was also called "Chlorowany bifenyl", was a low chlorinated technical PCB formulation manufactured between the years 1971 and 1976 by the company Zak³ady Azotowe in Moœcice near the city of Tarnów in southern-east Poland (Falandysz et al., 1993; Falandysz, 2000). The total quantity of manufactured Tarnol in 679 tons. No official data on the kinds of use of the Tarnol were released - it seems that it was used exclusively as a dielectric fluid mainly for the transformers but use as dielectric in capacitors could be also possible. Chlorofen was a highly chlorinated (63.6 % Cl) PCBs formulation manufactured in the town of Z¹bkowice Œl¹skie in southern Poland. Since 1993, in Poland the waste oils containing PCBs were included on the list of hazardous substances, but to the present days the flux of these pollutants was not a subject of any regulation (Lulek, 1996). Recently available data (Gurgacz, 1994) have indicated that in national power plant installations about 1400 tons of transformers and capacitors oils are used. However, unknown is even estimated amount of the waste industrial oils (transformers, capacitors, motors etc.) occurred in the trade. An assessed percentage of PCB contaminated equipment is as follows: transformers (0.38 %), capacitors (35 - 50 %), other electromagnetic equipment (25 - 50 %). An assessed amount of PCB contaminated oil/capacitors/other electromagnetic equipment is up to 10000 tons (Falandysz, 2000). Determination of the levels of PCBs in random samples of waste motor and transformer oils collected from

different regions of Poland showed that the concentrations in most of the samples did not exceed the limit value of 50 µg.g-1 (Lulek, 1996).

Russia — From 1939 to 1993 the total PCB production was about 180000 tons. The production ended between 1987 and 1993 but PCB is still in use. The total amount of PCB in PCB-containing equipment is approximately 27000 – 35000 tons.

Sweden — PCB is not allowed to import, manufacture or use. Companies have accepted an obligation to investigate agreements etc. and substitute PCB (sealant, small capacitors, fluorescent light fittings) in buildings before 2004.

STOCKPILES AND RELEASES/EMISSIONS TO THE ENVIRONMENT

Denmark PCB was not detected/under detection limit in waste water outlet, examined in 1993. No systematic information on stockpiling of PCB containing products (e.g. construction material, PVC cables etc.). In 1983 the total accumulated use of PCB in DK was estimated to 1100 to 2000 tons, of which approx. 50 % was used in electrical equipment. The rest was among others used in paint, joint filler and self-copying paper. A substance flow analyses of PCB in electronic equipment indicates that only very small amounts of PCB is present in electrical equipment now (few tons) and there exist regulations for the disposal of such equipment. A report on degree of use and amount of PCB used in existing buildings will be available in 2001. Anyhow, the emission, discharges and losses of PCBs are assumed to be reduced compared to the late eighties.

Estonia Ongoing and proposed PCB inventories, covering 500 – 1000 enterprises and efforts to further implement the PCB Directive will probably lead to a reduction of PCB emission.

Finland In an inventory performed in accordance with Government Decision 711/1998 the Regional Environmental Centres received about 100 notifications of PCB equipment containing more than 5 dm^3 of PCBs. It was estimated that these equipments contained about 1 ton PCB in total. Most of these equipments were not in use but stored by the possessors. The Regional Environmental Centres were obliged to ensure by the end of April 2000 that the remaining PCB equipment were send for destruction by the owners. According to the information received the obligations have been fulfilled. Small capacitors (< 1 kVAr) were not covered by the Government Decision (1071/89) obligation to be taken out of use by the end of 1994. Between 1950 and late 1970's PCB-capacitors were used in small electrical appliances such as in fluorescent lamps of big storehouses and industrial buildings, in street lightning, industrial electronics, oil burners, domestic appliances (washing machines, mangles, deep-freezers etc.). According to the study made in 1983 it was estimated that about 3 million small capacitors had been produced and imported to Finland until 1979 (when the use of PCB-capacitors ceased) with a total amount of PCB estimated to 300 tons. The lifetime of these electric appliances is about 20 years. Hence, most of these capacitors have been taken out of use by now. However, there is no reliable inventory or estimation of the situation or the final handling of these small capacitors. PCB was used until the late 1960's also in open applications like copying papers, ship paints, insulating glues. During the renovation of concrete buildings built in 1960's removing old insulating glues have to be analysed and PCB containing construction waste has to be handled as hazardous waste. A study on the amounts of PCB containing insulation glues used and still in buildings is at the moment under work.
An estimated PCB emission to the air was 550 kg in 1995. According to this estimation the most important sources of PCB emissions in Finland are coal-fired power plants, metal industry and diverse diffuse sources. It should be noted that the bulk deposition of PCBs is an order of magnitude higher than could be expected on the basis of the estimated emissions. Partly this is explained by long-range transport of PCBs.

Germany The disposal depends on the PCB content (incineration, hydrogenation, deposition in underground facilities). Not all amounts of PCB produced and used were/are disposed properly. PCB from open applications has already reached the environment via various disposal routes. PCB waste quantities, which will arise in Germany between 1996 and 2000: liquid waste for incineration (132000 t), solid

waste 120000 t). In a recent study (UBA 1999) it has been shown that of PCB containing equipment (1988 in former West-Germany 286000 t; 1991 in former GDR 25000 t) approx. 274000 t (88 %) have been disposed of by the year 2000. This means that 37000 t PCB containing material and equipment remain in Germany still to be disposed of safely.
No studies have been conducted on the (probably low) emissions arising during the production of PCBs. The quantification of releases of PCB still in use is extremely difficult.

Tab. 5: PCB emission inventory Germany estimated for the period 1994/95

Source	**PCB [kg]**
open applications*	max. 16000
closed applications	max. 10989
diffuse land fill gas release	max. 5,9
landfill gas incineration	0,02
domestic waste incineration	0,32
transport -diesel powered vehicles	0,26
sinter plants	92
secondary steel production	206
fire places	789
total	**28082.5**

* only for PCB containing sealants
Source: Ifeu estimates (Ifeu, 1998)
(UBA Texte 75/98)

In the POPCYCLING-Baltic Project the historic emission of PCBs in Germany are estimated to be 42462 kg/a for the period 1993-1995. In a TNO study of 1998, emissions in Germany are estimated to amount to 43000 kg/a and decrease to 19000 kg/a in the year 2000.
The emissions have been reduced from 160.1 t/a in 1985 to 42.4 t/a in 1996. However, there are still significant quantities of PCB present in uncontrolled, closed and open applications. The quantification of releases of PCB still in use is extremely difficult.

Latvia No information concerning emissions.

Lithuania Tab. 6: Emissions [kg/y] of PCB for the years 1997 and 1998 arising from combustion and landfills.

	Emissions [kg/y 1997]	Emissions [kg/y 1998]
Coal combustion	0.918	0.789
Wood combustion	6.178	6.913
Oil combustion	5.366	6.493
Landfills	648068.7 m^3 (0.000194)	339055.8 m^3 (0.000102)
total	12.46	14.19

Emissions of PCB for the years 1990, 1993, 1994 and 1995 arising from combustion and landfills accordingly are: 15.45 kg/y, 11.22 kg/y, 11.31 kg/y and 7.06 kg/y. The emission data on PCB from transformer leaks and capacitor leaks are not available.

No measured data were available on emissions of PCB. For this reason an estimation using the emission factors presented in the “Technical Paper to the OSPARCOM-HELCOM-UNECE emission inventory of heavy metals and persistent organic pollutants - The TNO Institute of Environmental Sciences, 1995” has been made. Main emission source of all these PCB is stationary combustion (types of fuel: coal, wood, oil) and landfills.

Poland

Tab. 4: Estimated quantity of waste and equipment containing PCBs and envisaged directions for their management

Specification	Mass *[tonnes]*	Source of origin	Management method
PCB oil	3,000	♦ oil removed from transformers- 1,000 tonnes, ♦ oil removed from scrapped power capacitors and from other equipment (switches, rectifiers, etc.) – 1,000 tonnes, ♦ waste oils and liquids from decontamination process - 1,000 tonnes,	Incineration in the installation for destruction of liquid halogenated organic substances
Power capacitors and other equipment which require disposal	7,620	♦ 250,000 pcs. power capacitors, average mass 30 kg/piece, as installed and scrapped – 7,500 tonnes ♦ non-metallic materials for dismantling transformers (paper, timber) – 120 tonnes,	incineration in the installation for destruction of liquid halogenated organic substances
Transformers and other equipment which require decontamination	3,500	♦ 1,000 pcs. transformers after removal of oil and of non-metallic elements – 3,000 Tonnes ♦ metallic elements from power capacitors, switches, and others - 500 tonnes	decontamination

Russia No releases from PCB production or production of PCB-containing equipment anticipated.
The total amount of PCB in PCB-containing equipment is approximately 27000 – 35000 tons.
The total amount of PCB in PCB-contaminated waste is approximately 1240 tons.
Emissions from contaminated production sites, landfills, illegal disposal sites are most likely.
The total amount of PCB released from equipment and waste is 3160 tons; the quantity spilled during dismantling of equipment is 140 tons.

Sweden Requirements of reports on possession of equipment of substances banned or restricted in containing PCB apply. Due to restriction on use since 1973 very few numbers might remain. Exact amounts of discharges to water/emissions to air and losses (from production, use, storage, transport and waste treatment) within the catchment area of the Baltic Sea are not available for PCB.

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COUNCIL DIRECTIVE 67/548/EEC on the approximation of laws, regulations and administrative provisions in relation to the classification, packaging and labelling of dangerous substances (Dangerous Substances Directive), adopted in 1967.

COUNCIL DIRECTIVE 76/769/EEC of 27 July 1976 relating to restrictions on the marketing and use of certain dangerous substances and preparations (e.g. TBT, PCBs).

COUNCIL DIRECTIVE 85/467/EEC of 1 October 1985 amending for the sixth time Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (PCBs/PCTs).

COUNCIL DIRECTIVE 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCBs/PCTs). (replaces COUNCIL DIRECTIVE 76/403/EEC (ban of use of PCBs in EC in open applications, 1976).

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EG Richtlinie für die Beschränkung des Inverkehrbringens und der Verwendung gewisser gefährlicher Stoffe vom 27.9.1976. 76/767 EG-Abl: Nr .L 262 / 201). PCBs

HELCOM RECOMMENDATION 6/1
Recommendation regarding the elimination of the use of PCBs and PCTs
- adopted 13 March 1985, having regard to Article 13, Paragraph b) of the Helsinki Convention

HELCOM RECOMMENDATION 16/10
Reduction of discharges and emissions from production of textiles
- adopted 15 March 1995 having regard to Article 13, Paragraph b) of the Helsinki Convention

HELCOM RECOMMENDATION 19/5
HELCOM objective with regard to hazardous substances (adopted 26 March 1998, having regard to Article 13, Paragraph b) of the Helsinki Convention)

1992 HELSINKI CONVENTION, Annex 1, Part 2.2, Substances banned for all uses, except in existing closed system equipment until the end of service life or for research, development and analytical purposes.

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HCH, HCB, DDE/DDT - Within the framework of the EU Environment and Climate project ENV4-CT96-0214 on Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING-BALTIC PROJECT). Funded by Umweltbundesamtes, Berlin (F.u.E. Vorhaben 104 02843), European Commission (DG XII), Environment and Climate project ENV4-CT96-0214 (1999).

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Tab. I: Overview on the situation concerning ban/prohibition, equipment, uses, releases and stockpiles in the Contracting Parties.

	ban/prohibition	equipment	uses	releases	stockpiles
Denmark	Production has never taken place. Restricted use since mid 1970ies. 1977 open applications were banned. 1986 total ban of the sale, use and import with few exemptions.	small electrical installations (total weight < 1 kg) until end of technical lifetime larger installations should be out of use by 1 Jan 2000 and disposed of	In 1983 the total accumulated use of PCB was estimated to 1100 - 2000 tons, approx. 50 % was used in electrical equipment. The rest was among others used in paint, joint filler and self-copying paper. PCB-containing equipment is no longer in use in the power distribution network. PCB may still be in use in capacitors in ballasts of fluorescent lamps and in white goods older than 20 years. Only a small amount of PCB-containing large capacitors are still in use. Scarce info concerning the content of PCB in electronics however indicates, that PCB is out of the turnover of electronics today	1993: not detected in wastewater outlet	no systematic info, substance flow analysis for electric equipment & report on amount in buildings available
Estonia	equipment and products marketed until 1990, since 1999 the use of PCB is banned	owners must inform Estonian Environmental Information Centre about all installations that contain more than 5 dm^3 PCB by July 1, 2001	It is estimated that in total 250 – 500 tons PCB-containing capacitors are in use, which corresponds to approximately 100 – 150 tons of PCB-containing oil. Further roughly 20000 transformers are in use, which corresponds to approximately 10000 tons of PCB-containing oil. Assuming an average content of 1.5 mg PCB/kg the transformers would in total contain approximately 15 kg PCB. Unknown amounts of small capacitors in fluorescent lamps, electric appliances etc., and applied varnish, paint and lubricants might be still in use.	Ongoing and proposed PCB inventories, covering 500 – 1000 enterprises and efforts to further implement the PCB Directive will probably lead to a reduction of PCB emission	
Finland	1989: manufacture, import, placing on market	since 31 Dec 1999 > 5 dm^3 prohibited	small capacitors, household appliances & building products	emission to air in 1995: 550 kg (estimated)	no reliable inventory of small capacitors, study about PCB in buildings under preparation
Germany	1972 open use, 1978 use in closed systems, prohibition of any new use since 1989, 1983 production, 1988 import of PCB containing	appliances containing 1 litre or concentrations above 50 ppm must be disposed safely (96/59/EC is	small capacitors, & building products (The total estimated amount of PCB-containing materials/products in 1998 in closed and open applications was approximately 4000 tons, with small	The quantification of releases of PCB still in use is extremely difficult. Emission ca. 160.1 t/a in 1985; 28.1 t in 1994/95;	37000 t still to be disposed

	ban/prohibition	equipment	uses	releases	stockpiles
	hydraulic fluids for use in coal mining was terminated	implemented more stringently)	capacitors and building products having the main contribution.)	42.4 t/a in 1996. Still significant quantities of PCB present in uncontrolled, closed and open applications.	
Latvia	as pesticide, 17.1.2000 marketing & use (Helsinki Convention) content higher than 0.005 % by weight may not be used in chemical industry	until 2002: large condensers (1 kg total weight) small condensers heat-transmitting fluids in closed-circuit heat-transfer installations; hydraulic fluids for underground mining equipment	used in closed-system electrical equipment transformers, resistors and inductors; mining	no info available	
Lithuania	import, produce & use as pesticide; since 1999 use & placing on the market; produce, trade, storage, im-/export only with permission	until use expires Components, installations, equipment and systems can be used until use expires.	combustion of contaminated coal, oil & wood PCB and their preparations can be used for replenish of equipment etc.	from landfills, from combustion of coal, wood, oil emissions from leaking transformers and capacitors are unknown	
Poland	production & use **not** legally banned but restricted provisions of 96/59/EEC have been transposed into Polish law by July 2001	use till “natural death”	Power capacitors, transformers and other equipment	no info available	3000 t PCB oil, 7620 t power capacitors and other equipment which require disposal, 3500 t transformers and other equipment which require decontamination
Russia	Production, import, marketing and use are not legally banned; production of PCB ended between 1987 and 1993.	the total amount of PCB in PCB-containing equipment is approximately 27000 – 35000 tons	production ended between 1987 and 1993 but PCB is still in use	the total amount of PCB released from equipment and waste is 3160 tons; the quantity spilled during dismantling of equipment is 140 tons emissions from contaminated production sites, landfills, illegal disposal sites are most likely	the total amount of PCB in PCB-contaminated waste is approximately 1240 tons
Sweden	1973 open use, 1978 in closed systems, 1986 manufacture, process, sale, use, reuse, import		substitution of PCB in small capacitors & buildings before 2004		few numbers