UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

REPORT for
Technical Annex and Guidance Documents to the Existing PCB Regulation related to "POPs Legacy Elimination and POPs Release Reduction Project"- Turkey

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1. INTRODUCTION

One of the aims of the POPs Legacy Elimination and POPs Release Reduction Project is, sound management and safe disposal of PCBs considering environmentally safe management of chemicals, in regards to the requirements of the country for the Stockholm Convention. The aim of the second component of the Project is planning and capacity building for environmentally sound management of future PCB stockpiles. In this respect, this report aims to identify formal requirements and technical aspects for the management of PCBs and PCB containing equipment, regulatory requirements, enforcement needs, measures, modalities, monitoring and reporting in order to support Turkey's objectives under the Stockholm Convention.

The first chapter of the report covers the framework for sound management of PCBs, while a detailed evaluation of regulatory requirements pertaining to the existing and relevant draft national legislation as well as the main regulatory requirements of international legislation are presented in the third chapter. The fourth chapter covers the current situation of PCBs management in Turkey and in the fifth chapter, examples and good practices in PCBs management from around the world are given. The sixth chapter covers current situation in terms of implementation of the formal requirements and technical aspects of management of PCBs and PCB containing equipment. In the last chapter of the report, aspects of enforcement needs, measures, modalities, monitoring and reporting to support Turkey's objectives under the Stockholm Convention are evaluated and recommendations are set forth.

2. FRAMEWORK FOR SOUND MANAGEMENT OF PCBs

Main components of sound management of PCBs are presented in the panel below (IFCS, 2001). Management of PCBs should be made sustainable with support from various legal instruments and trainings. Fort his reason, it is imperative that management plans are considered as living documents.

MAIN COMPONENTS OF A PCB MANAGEMENT PLAN
Timelines
PCB Inventory and Information
Reporting
Threshold concentrations
Treatment of PCBs/disposal of equipment containing PCBs, remediation of contaminated sites
Analysis, labeling and monitoring
Handling
Decontamination of equipment containing PCBs and replacement for PCBs
Metal recovery from equipment containing PCBs
Education and training

Timelines. Components of the PCB management plan works best with timelines, except for certain activities such as inventory and monitoring – which should be regarded as ongoing activities. Clear deadlines for disposal of equipment containing PCBs and a defined tracking mechanism are the only sure method to apply for progress. The first priority should be storage/use of PCB containing equipment that poses an exposure risk for humans and the environment. The financial aspect will be the key to meet deadlines and for progress in general.

PCB Inventory and Information. An inventory is necessary to identify the scale and variety of PCB holdings (equipment/oil/waste) in the country. Although establishment of an inventory may be mandatory according to legislation, it may not be enough for completion of the inventory. It should not be forgotten that the inventory list would change by the year, where some wastes are sent for disposal and taken off the list, while others are being added. Uncertainty at the initial stage should be considered normal. As the process continues, reduction of uncertainty via analysis of oils and materials should be targeted. The country should make sure there are no import or illegal entry of equipment or material containing PCBs into the country. It is common to observe many transformers containing relatively lower concentration of PCBs after their decontamination. Inventory should also include equipment that is taken off service or in storage waiting for disposal. There are guidelines prepared by UNEP and the Ministry that help inventory preparations (UNEP, 1999 and Ministry of Environment and Forestry, 2009).

Preparation of information sources via technical and other documentation, awareness rising activities, trainings and workshops greatly helps dissemination of information. Success can be achieved when both upper administration and public care about these issues.

Disposal. If the total quantities and volume/mass of equipment/waste containing PCBs is not large, then it many not be economically feasible to justify the establishment of a local disposal facility. Then, these equipment/wastes may be exported to other countries within the requirements of the Basel Convention. Cost is naturally an important factor in this decision. It may be possible to take advantage of mobile disposal or decontamination facilities – but this should be permitted by the relevant legislation. It should be remembered that while incineration is a viable disposal option, there are other non-combustion disposal technologies. There are many guidelines for disposal of equipment containing PCBs: (i) UNEP, 2002, (Destruction and Decontamination Technologies for PCBs and Other POPs Wastes under the Basel Convention Volume A, B, C), (ii) USEPA, 2010 (iii) UNEP, 2004.

Decontamination and replacing PCBs. The costs associated with a transformer containing PCBs may be very high, such that:

- Purchasing a new equipment and its assembly
- Storage of the equipment under suitable conditions prior to disposal
- Transportation to the disposal facility
- Disposal

For this reason, decontamination may be feasible for equipment such as transformers that are difficult to replace both in terms of physical and financial constraints. Conditions and rules of decontamination should be specified by legal and technical documentation. Care should be taken to establish the legal basis for decontamination of in-line transformers. PCB content after decontamination should be established clearly for, for example:

- oil
- surface
- porous surfaces
- non-porous surfaces

Information should be disseminated for alternatives of PCB containing oils. The most frequently used alternatives are mineral oils/paraffins. However, there is an increased fire risk because of the flammability of mineral oils. A number of methods can be used at facilities for prevention. Apart from mineral oils:

- other organo-chlorine materials (trichloroethylene, tetrachloroethylene, etc)
- natural vegetable oils
- silicone oils

can be used. Alternatives differ from each other in terms of cost and physicochemical properties.

Recovery. The main issue is recovery of metal parts from equipment containing PCBs. It is imperative that extent, permission and prohibitions are clearly stated regarding recovery operations. For example, recycling of PCB containing oils above a certain concentration is prohibited. Oils to be sent for disposal should be monitored closely, and their illegal use for domestic heating and/or as additive to fuels (diesel fuel called No.10 lube, NTL) should be prohibited. There is a study in our country in regards to this issue, by Gedik and Yurdakul (2014); a total of 25 NTL samples collected from around Turkey was shown to contain high Zn, Mo and Cl. Findings suggest inclusion of waste oils, transformer oils or chlorinated solvents as additives to NTL. On the other hand, recovery of metal parts from PCB transformers is advantageous due to economic as well as environmental considerations. The important issue is identification of technical specifications and threshold concentrations, before and after decontamination of equipment. Lastly, health and safety precautions should be clearly specified for locations where such recovery operations are undertaken.

Handling. Prior to disposal, equipment known to contain PCBs should be stored under appropriate conditions. They should be treated as hazardous wastes. Any operation on the equipment should be performed by trained personnel. Transportation should only be carried out by licensed firms. Storage should be in premises away from sensitive areas (e.g. specially protected zones, food preparation sites) and under conditions that prevent off-site migration (e.g. impervious floor, bunding to contain spills).

Threshold concentrations. While deciding on management strategies for PCBs, thresholds need to be established for quantities and concentrations of PCB containing material. For example, a single ballast capacitor from a florescent light fitting contain approx. 100g of PCBs, which can be deemed unimportant/small, yet a building containing hundreds of such light fittings would transform the issue to a new level.

The concentration of PCBs in oils is important as it has implications on the disposal method selection. For example, in many countries, thresholds such as “low PCB content” lower than 10 mg/kg, “high PCB content” higher than 50 mg/kg, and “PCB free” for those having PCBs less than 2 mg/kg are accepted.

Analysis, Labeling and Monitoring. A monitoring activity should be consistent and continuous. Monitoring spanning over many years, yielding comparable data should be the norm. Monitoring activities should be carried out in industrial, urban, rural areas as well as in a variety of matrices (e.g. air, soil, plants). A proper organization of financial and human resources is a must for such long-term endeavors.

PCB analyses should be carried out with a systematic. It is not possible to analyze all transformers and/or capacitors in use. Statistical sampling methods should be employed. Considering history of PCB production, depending on the date of production, certain equipment (e.g. those produced after 1985 in the US/Germany or after 1995 for Russia) may have no possibility of contaminated with PCBs according to records, then they may not need to be analyzed.

Equipment known to contain PCBs should be labeled properly and relevant personnel should be trained. When a facility is known to possess PCB containing equipment/materials, then all other relevant equipment should be carefully investigated for presence of PCBs. Any facility that is/was used for

repair/maintenance of PCB containing transformers/equipment has a high probability of having a PCB contaminated site, hence, analysis should be planned accordingly. Equipment stored under unsuitable conditions for purposes of metal recovery has a high potential to cause contamination. Analysis of leachate for PCBs can give information about potential illegal storage of PCB containing equipment in sanitary landfills or wild dumping sites.

Reporting. Reporting is as important as the other components of PCB management discussed above. In terms of the requirements of the Stockholm Convention, periodical progress reports are prepared. Apart from being a legal necessity, in terms of the conditions of our country where the rate of change of human resources is very high, it is imperative to keep a record of progress for new coming personnel.

3. REGULATORY FRAMEWORK

3.1. National Legislation

3.1.1. Existing National Legislation Pertaining to PCBs

Environmental Law: The implementing institution of this law dated 10.08.1983 and numbered 2872 is the Ministry of Environment and Urbanization. The law defines hazardous waste in Article 2 and sets principles of hazardous waste management and production, use, storage, transportation, import-export of hazardous wastes. In case of violation of articles of this law, administrative fine is imposed.

Law on the Approval of Ratification of the Stockholm Convention on Persistent Organic Pollutants: This law is brought into force by the Council of Ministers (Ministry of Environment and Urbanization) dated 02.04.2009 and numbered 5871 and it declares the approval of ratification of the Stockholm Convention.

Law on the Approval of Ratification of the Basel Convention Controlling Transboundary Movements of Hazardous Wastes and their Disposal: This law is brought into force by the Council of Ministers (Ministry of Environment and Urbanization) dated 28.12.1993 and numbered 3957 and it declares the approval of ratification of the Basel Convention.

By-law on Control of Polychlorinated Biphenyls and Polychlorinated Terphenyls: The implementing institution of this by-law which is published at the Official Gazette dated 27.12.2007 and numbered 26739 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Waste Management). The Objective of the by-law is to regulate administrative and technical principles and procedures towards completely disposing used materials and equipment containing PCBs and PCTs. Relevant EU legislation: 96/59/EC (Directive on Disposal of PCBs and PCTs).

By-law on Control of Waste Oils: The implementing institution of this by-law which is published at the Official Gazette dated 30.08.2008 and numbered 26952 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Waste Management). The by-law determines limit PCB values in waste oils, avoids combustion of PCB containing waste oils and ensures their environmentally sound management. Relevant EU legislation: 2008/98/EC (Waste Framework Directive) and 75/439/EC (Directive on Disposal of Waste Oils).

By-law on Control of Waste Electrical and Electronic Equipment: The implementing institution of this by-law which is published at the Official Gazette dated 22.05.2012 and numbered 28300 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Waste Management). The by-law prohibits production and export of equipment containing certain

hazardous substances including PCBs and sets principles for the disposal of electrical and electronic equipment containing PCBs and other hazardous substances. The publication of this by-law repeals By-Law on Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment which is published at the Official Gazette dated 30/5/2008 and numbered 26891. Relevant EU legislation: 2002/95/EC (Directive on Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), 2002/96/EC (Directive on Waste Electrical and Electronic Equipment (WEEE)).

By-law on the General Principles of Waste Management: The implementing institution of this by-law which is published at the Official Gazette dated 02.04.2015 and numbered 29314 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Waste Management). The objective of this by-law is to determine the general principles and procedures on waste management from cradle to grave without posing any harm on environment and human health. The publication of this by-law repeals By-Law on Control of Solid Wastes, By-Law on Control of Hazardous Wastes, By-Law on General Principles of Waste Management. Relevant EU legislation: 2008/98/EC (Waste Framework Directive).

By-law on Landfill of Wastes: The implementing institution of this by-law which is published at the Official Gazette dated 26.03.2010 and numbered 27533 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Waste Management). The objective of this by-law is to set technical and administrative issues and general rules regarding construction of appropriate facilities during the disposal of wastes through landfilling, proper admission of wastes, pollution prevention during and after operation. Relevant EU legislation: 1999/31/EC (Landfill of Wastes Directive).

By-law on the Incineration of Wastes: The implementing institution of this by-law which is published at the Official Gazette dated 06.10.2010 and numbered 27721 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Waste Management). The objective of the by-law is to prevent and restrict the adverse effects of incineration of hazardous and special wastes on environment, especially the pollution and risks on human health via the emissions in air, soil, surface and groundwater, through applicable methods. Relevant EU legislation: 2000/76/EC (Incineration of Wastes Directive).

Notification on Certain Non-hazardous Waste Recovery: The implementing institution of this notification which is published at the Official Gazette dated 2011 and numbered 27967 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Waste Management). The objective of this notification, is to regulate the administrative and technical principles of minimization of the adverse effects of certain non-hazardous waste emerging as a result of an activity, minimization of waste, temporary storage, establishment of recovery facilities and ensuring environmentally sound management of these facilities. The publication of this notification repeals By-Law on Recovery of Non-Hazardous and Inert Wastes.

Notification on Auditing of Import of Chemicals that are Controlled for Environmental Protection (Product Safety and Audit: 2016/6): The implementing institution of this notification which is published at the Official Gazette dated 2015 and numbered 29579 is Ministry of Economy. The objective of this notification is to regulate the procedures and principles on auditing towards compatibility of Annex I chemicals and products with the environmental protection perspective.

Regulation on Use of Domestic and Urban Wastewater Treatment Sludge in Soil: The implementing institution of this regulation which is published at the Official Gazette dated 2010 and numbered 27661

is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Water and Soil Management). The objective of this regulation, is to determine the principles on taking necessary measures for use of treatment sludge in soil, in accordance with the sustainable development targets.

By-law on Test Methods Applied for Determining the Physicochemical Toxicological and Eco-toxicological Properties of the Substances and Mixtures: The implementing institution of this by-law which is published at the Official Gazette dated 2013 and numbered 28848 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Chemicals Management). The objective of this by-law is to regulate the administrative and technical procedures and principles of tests on substances and mixtures to determine their physico-chemical, toxicological and eco-toxicological characteristics that are stemmed from their inherent properties.

By-law on Classification, Packaging and Labelling of Dangerous Substances and Preparations: The implementing institution of this by-law which is published at the Official Gazette-duplicate dated 2013 and numbered 28848 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Chemicals Management). The Ministry of Environment and Urbanization implements this by-law together with the Ministry of Food, Agriculture and Livestock. The objective of this by-law is to regulate the administrative and technical procedures and principles of classification, packaging and labelling of substances, preparations and certain goods in order to provide high-level protection against adverse effects on human health and environment and to ensure their free movement. The publication of this by-law repeals Regulation on Classification, Packaging and Labelling of Dangerous Substances and Preparations. Relevant EU legislation: 1272/2008.

Notification on Storage, Treatment, Dismantling and Processing of End of Life Vehicles: The implementing institution of this notification which is published at the Official Gazette dated 2011 and numbered 27986 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Waste Management). The objective of this notification is to determine the criteria that will be valid for delivery points of end-of-life vehicles, temporary storage areas, individual stores and operation facilities.

Regulation on End of Life Vehicles: The implementing institution of this regulation which is published at the Official Gazette dated 2009 and numbered 27448 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Waste Management). The objective of this regulation is to avoid waste generation from vehicles in order to protect environment and human health, to decrease the waste to be disposed of through reuse, recycle and recovery of end-of-life vehicles and their pieces, to determine standards and accountabilities of economic operators and temporary storage areas.

Turkish Food Codex By-law on Contaminants: The implementing institution of this by-law that is published at the Official Gazette dated 29.12.2011 and numbered 28157 is Ministry of Food, Agriculture and Livestock (Directorate General of Food and Control). Codex determines the limit values of PCBs and other dangerous substances in food. Relevant EU legislation: 1881/2006/EC (Directive on Setting Maximum Levels for Certain Contaminants in Foodstuffs).

By-law on Control of Soil Pollution and Sites Contaminated by Point Sources (Polluted Site Risk Evaluation Technical Guide): The implementing institution of this by-law which is published at the Official Gazette dated 08.06.2010 and numbered 27605 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Water and Soil Management). The

objective of the by-law is to determine principles of identification, cleaning and monitoring of areas affected from pollutants including PCBs, in accordance with the sustainable development targets. The publication of this by-law repeals Regulation on Soil Pollution. Currently, there are no relevant EU legislation. There had been a proposal towards establishment of a Council through European Parliament Regulation to prepare a framework to change 2004/35/EC (Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage) for protection of soil. However, that proposal was withdrawn in 2015.

By-law on Surface Water Quality Management: The implementing institution of this by-law that is published at the Official Gazette dated 30.11.2012 and numbered 28483 is Ministry of Forestry and Water Affairs (Directorate General of Water Management, Department of Water Quality Management). The objective of the by-law is to determine the biological, chemical, physico-chemical and hydro-geomorphological quality of surface, coastal and transitional waters, monitoring water quantity and quality, to identify the purposes of use of these waters through ensuring the protection and use balance, in accordance with the sustainable development targets, to determine procedures and principles towards protecting and reaching "good status" in waters. PCBs are listed among "specific substances" in the by-law, as well as in the "priority substances" list for dioxin-like PCBs. January 2016 draft includes 13 sectors as NACE (The Statistical Classification of Economic Activities in the European Community) codes, which could use PCBs. The by-law also includes monitoring of these substances in water and in sediments. The by-law is published at the Official Gazette dated 15.04.2015 and numbered 29327 and certain changes were made on this by-law. The publication of this by-law repeals Regulation on Water Pollution Control. Relevant EU legislation: 2000/60/EC (Water Framework Directive), 2008/105/EC (Environmental Quality Standards Directive).

By-law on Control of Air Pollution Arising from Industrial Facilities: The implementing institution of this by-law, which is published at the Official Gazette dated 03.07.2009 and numbered 27277, is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Air Management). The objective of the by-law is to control POPs emissions emerging from industrial facilities and to protect humans and environment from pollution in air. Within this scope, it restricts PCBs and other hazardous substances and determines emission limit values. The by-law is published at the Official Gazette dated 20.12.2014 and numbered 29211, and certain changes were made on this by-law. The publication of this by-law repeals Regulation Controlling Air Pollution due to Industrial Facilities and Regulation on Large Combustion Plants. Relevant EU legislation: 2010/75/EU (Integrated Pollution Prevention and Control Directive).

By-Law on Restriction and Prohibition of Dangerous Substances and Preparations: The implementing institution of this by-law which is published at the Official Gazette dated 2008 and numbered 27092 is Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Chemicals Management). The objective of this by-law is to regulate the administrative and technical procedures and principles towards production, use, use in preparations or in goods and their supply to market in order to ensure the protection of human health and environment. The by-law was prepared considering the Annex XVII of Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH).

Notification on Refuse Derived Fuel, Substitute Fuel and Alternative Raw Material: The implementing institution of this by-law which is published at the Official Gazette dated 2014 and numbered 29036 is

Ministry of Environment and Urbanization (Directorate General of Environmental Management, Department of Waste Management). The objective of the by-law is the use of wastes as alternative raw material, preparation of refuse derived fuel, and the technical, administrative procedures and principles and minimum standards that should be ensured within these preparation facilities and principles for general rules, on refuse derived fuel and as additional fuel in co-incineration plants.

3.1.2. Draft Regulation that could affect the management of PCBs/substances or equipment containing PCBs

Management of PCBs and PCB containing substances and equipment is expected to be affected from the draft regulation, which is not in force yet, but planned to be so in the near future. This regulation is the Draft Regulation on Persistent Organic Pollutants.

The objective of the Draft Regulation on Persistent Organic Pollutants is to be compatible with the EU legislation and two internationally binding document on POPs which are POPs Protocol of the United Nations Economic Commission for Europe (UNECE) Long Range Transboundary Air Pollution Convention (CLRTAP) and Stockholm Convention. Owners of PCB containing substances and equipment as well as industries that have a potential to be unintentionally emitting PCBs are expected to be under stricter control via this new regulation. This new regulation requires a detailed inventory to be prepared for PCBs and for it to be a continuous activity. It is stated that owners of substances containing PCBs should make sure to avoid cross contamination of any generated waste with PCBs. These users should destroy/dispose of waste containing PCBs according to per best environmental practices or best available techniques. Although other alternative waste management strategies other than BAT/BEP can be possible, they are subjected to strict controls.

3.1.3. Articles of National Regulation that includes PCBs

Main components of effective PCB management are explained in the first section of the report. Accordingly, Turkish regulation is analyzed in detail one by one whether it contains any article regarding PCBs or not. Articles of national legislation, which are determined as per the scope of main components of PCB management, are summarized in Table 1.

Table 1. Detailed analysis of national legislation within the scope of the main components of PCB management.

Management Component	Legislation*	Detailed Information
Timing	1	Annex-A Part II: It is aimed that all equipment will be ceased by 2025.
	2	Annex-1 Substances and Substance Groups that are subject to Restriction and their Restriction Terms: supply to market for sales and use is prohibited. PCB containing equipment could be used until the end of service life or disposal.
Inventory	3	Article 12. Preparation of the Inventory, Annex-3 PCB Inventory Form
	4	Article 15. Registration responsibility is given for PCB/PCT equipment holders under Notification and Registration Responsibility, waste transporters and waste operation facilities Annex-4 Codes are present for PCB including substances under Waste List.
	5	Article 8. Unintentionally produced PCBs are listed under Annex – 3 List of substances subject to Reduction of Emissions List within the scope of emission reduction, minimization and disposal. It is indicated that inventories for air, water and soil emissions should be prepared, saved and these inventories' continuation should be ensured. Article 14. Inventory Preparation and Reporting
	6	Article 3. Import Operations. Annex-1 PCBs are present in Chemicals under Control for Environmental Protection and their import are prohibited.
Reporting	1	Article 15. Report Submission. Annex-A Prohibition Part II It is indicated that reporting is needed every 5 years for PCBs.
	7	Article 13. Information Exchange. The report for the previous calendar year should be prepared.
	4	Article 15. Notification and Registration Responsibility.
	8	Article 5. General Rules. PCB content should be indicated in waste incineration.
	5	Article 10. Implementation Plans. It is stated that inter-institutional information exchange will be realized during the review and updated studies.
Limit Values	3	Article 4. Definitions. PCB containing preparations are defined to contain more than 50 ppm PCB.
	8	Article 4. Definitions. PCB containing wastes are defined as wastes other than these of containing PCBs less than 0,005% by weight. They are defined as substances containing Annex 4 listed compounds and substances under the Annex 3-B limits. They are defined as substances containing Annex 4 listed compounds and substances other than the ones under the Annex 3-B limits.

Management Component	Legislation*	Detailed Information
	9	Article 25. Provisions for the sales of recovery products. Annex-1 Waste Oil Categories and Allowable Pollutant Parameter Limit Values Category I. maximum 10 ppm, Category II: maximum 50 ppm (appropriate for recovery), Category III: > 50 ppm (shall be disposed of).
	4	Article 4. Definitions. PCBs are described as wastes containing over 50 ppm PCB.
	10	Annex-2 Waste Acceptance Criteria. Class III Storage Facility (for Inert Wastes): 7-alike PCBs– 1 ppm. (Increase amount: 3 times)
	11	Article 5. Maximum limits. Annex-1 Maximum Limits Section 5. Dioxins and PCBs.
	12	Annex-1. Generic Pollutant Limit Values. Aroclor 1016 and for the ones other than 1016 are referred with different references. Technical Guidance on Polluted Field Risk Evaluation. Annex-2 Generic Pollutant Limit Values and Annex-3 Toxicological Values
	13	Annex-5 - Table 4: Priority Substances for Surface Waters and Environmental Quality Standards Annex-5 – Table 5: Priority Substances for Surface Waters and Environmental Quality Standards Annual Average Environmental Quality Standard and Maximum Allowable Limit Environmental Quality Standard is defined for PCBs and dioxin like PCBs.
	5	Article 9. Waste Management for Persistent Organic Pollutants. Annex-2 List of Substances subject to Restriction Annex -3 List of Substances subject to Emission Reduction provisions Annex -4 Substances List – PCBs are present. Annex -5 Waste Management
	14	Annex-1 Air Emission Base and Limit Values for Facilities. 0,1 ng/Nm^3 is indicated as a limit value for PCBs.
	15	Annex-3 Refuse Derived Fuel characteristics indicate 50 ppm limit value for PCBs.
	16	Annex 1, Annex II, Annex IV Certain Characteristics of Acceptable Dilution Water: Total PCBs should be less than 50 ng/L.
	17	Annex 1-C PCB limit value is determined as 0,80 mg/kg dry material.
	18	Annex-3, Annex-5, Annex-6
Monitoring	1	Article 16. Effectiveness Evaluation. Annex-C Part II and Part III Resource Categories
	5	Article 11. Monitoring

Management Component	Legislation*	Detailed Information
	13	Article 13. Evaluation of Monitoring Values
Analysis/Labelling	3	Article 10. PCB Analysis. Article 5. Labelling requirement is indicated in General Principles Annex-4 Substances and Equipment
	10	Annex-1 International Standards for Determination of Wastes
	11	Article 11. Sampling and Analysis Methods
	9	Article 9. Responsibilities of waste oil producers Article 11. Responsibilities of operators of waste oil refinery and regeneration facilities
Handling	1	Annex-A Part II: Article b) and c)
Handling - Mixing	9	Article 5. It is stated in General Principles that waste oils should not be mixed with each other and they should not be diluted.
Handling – Transportation	3	Article 13. Transportation.
	7	Article 2. Definition. Annex-1 Waste Categories to be Controlled
Handling - Separation	19	Article 14. Operation Facilities' Technical Characteristics
	20	Annex-1 Minimum Technical Characteristics in Temporary Storage and Process Facilities for End-of-Life Vehicles and Operations that should be applied in these facilities
	21	Article 11. Waste stores and their qualifications
Handling – Temporary Storage	3	Article 14. Temporary storage
Handling – Health and Safety Measures	3	Article 20. Measures in working environments. Article 21. Measures in leakage and pollution. Article 22. Measures against fire.
Treatment	3	Article 15. Treatment. Article 17. Environmental License.
Recovery	1	Annex-A Part II: Article d)
	3	Article 5. General Principles.

Management Component	Legislation*	Detailed Information
		Article 15. Treatment.
	9	Article 5. It is stated in General Principles that waste oil could be regenerated for recovery purposes and the appropriate categories are indicated. Article 21. Use of waste oil for energy generation.
Recovery - Analysis	22	Article 11. Conditions in recovery facilities. Article 22. (2) Recovery, Recycle, recovery of energy and disposal.
Recovery - Disposal	9	Article 22. Disposal of waste oil. Article 25. Provisions on sales of recovery products.
Recovery – Facilities	20	Annex-4 Reuse-Recovery and Reuse-Recycling Ratio Tracking Forms
Labelling - Disposal	1	Annex-A Part II: Article a), e), f)
Disposal	3	Article 5. General principles. Article 15. Treatment. Article 16. Disposal. Article 17. Environmental license.
	1	Annex-A Part II: Article g), h)
	5	Article 9. Waste Management for Persistent Organic Pollutants Ek-4 Annex List includes PCBs Ek-5 Waste Management

*Regulation numbering in the table is as below:

1. Environmental Law
2. Law on the Approval of Ratification of the Stockholm Convention
3. Law on the Approval of Ratification of the Basel Convention Controlling Transboundary Movements of Hazardous Wastes and their Disposal
4. By-law on Control of PCB and PCTs
5. By-law on Control of Waste Oils
6. By-law on Control of Waste Electrical and Electronic Equipment
7. By-law on the General Principles of Waste Management
8. By-law on Landfill of Wastes

9. By-law on the Incineration of Wastes
10. Notification on Refuse Derived Fuel, Substitute Fuel and Alternative Raw Material
11. Notification on Certain Non-hazardous Waste Recovery
12. Notification on Auditing of Import of Chemicals that are Controlled for Environmental Protection (Product Safety and Audit: 2016/6)
13. Regulation on Use of Domestic and Urban Treatment Sludge in Soil
14. Draft Regulation on Persistent Organic Pollutants
15. By-law on Test Methods Applied for Determining the Physicochemical Toxicological and Eco-toxicological Properties of the Substances and Mixtures
16. By-law on Classification, Packaging and Labelling of Dangerous Substances and Preparations
17. Notification on Storage, Treatment, Dismantling and Processing of End of Life Vehicles
18. Regulation on End of Life Vehicles
19. By-law on Control of Air Pollution Arising from Industrial Facilities
20. Turkish Food Codex By-law on Contaminants
21. By-law on Control of Soil Pollution and Sites Contaminated by Point Sources (Polluted Site Risk Evaluation Technical Guide)
22. By-law on Surface Water Quality Management

3.2. International Legislation

3.2.1. Stockholm Convention on Persistent Organic Pollutants

The Stockholm Convention on Persistent Organic Pollutants 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 harmful impacts on human health or on the environment. The Stockholm Convention on POPs was adopted by the Conference of Plenipotentiaries on 22.05.2001 in Stockholm, Sweden. The Convention entered into force on 17 May 2004. Turkey signed the convention in 2001, and approved it in 2009. Starting from January 2010, the Convention has entered into force in Turkey. As of the last current count, there are 152 signatories and 180 parties to the Convention worldwide (URL 1).

Chemicals are listed under three annexes of the Convention. Annex A – includes prohibited chemicals, where also special provisions for PCBs are stated. Annex B includes chemicals for which use is restricted. And Annex C lists chemicals to be reduced. PCBs are listed under Annex A and C.

All provisions of the Convention apply to PCBs. A detailed evaluation of provisions of the Stockholm Convention is covered in Sections 3.1.1 and in Table 1 in Section 3.1.3 via evaluation of the Law on the Approval of Ratification of the Stockholm Convention on Persistent Organic Pollutants. Apart from that, Convention articles are listed in the below panel.

MAIN ARTICLES OF THE STOCKHOLM CONVENTION

ARTICLE 3: Measures to reduce or eliminate releases from intentional production and use
ARTICLE 4: Register of specific exemptions (none for PCBs)
ARTICLE 5: Measures to reduce or eliminate releases from unintentional production
ARTICLE 6: Measures to reduce or eliminate releases from stockpiles and wastes (in close cooperation with the Basel Convention)
ARTICLE 7: Implementation Plans
ARTICLE 8: Listing of chemicals in Annexes A, B and C
ARTICLE 9: Information exchange
ARTICLE 10: Public information, awareness and education
ARTICLE 11: Research, development and monitoring
ARTICLE 12: Technical assistance
ARTICLE 13: Financial resources and mechanisms
ARTICLE 14: Interim financial arrangements
ARTICLE 15: Reporting
ARTICLE 16: Effectiveness evaluation
ARTICLE 17: Non-Compliance
ARTICLE 18: Settlement of disputes
ARTICLE 19: Conference of the parties
ARTICLE 20: Secretariat
ARTICLE 21: Amendments to the Convention
ARTICLE 22: Adoption and amendment of annexes
ARTICLE 23: Right to vote
ARTICLE 24: Signature
ARTICLE 25: Ratification, acceptance, approval or accession
ARTICLE 26: Entry into force

Annex-A Part II of the Convention is reserved solely for PCBs. Main issues addressed in this part are summarized below:

Part II – Polychlorinated Biphenyls:

- With regard to the elimination of the use of PCBs in equipment by 2025:

(a) make determined efforts to identify, label and remove from use equipment containing > 10% and > 5L PCBs as well as equipment containing > 0.05% and >5L PCBs. Also endeavor to identify and remove from use equipment containing > 0.005% and > 0.05L PCBs,

(b) measures to be promoted to reduce exposures and risk to control the use of PCBs,

(c) ensure that equipment containing PCBs shall not be exported or imported except for the purpose of environmentally sound waste management,

(d) not allow recovery fort he purpose of reuse in other equipment of liquids with PCBs content > 0.005% (except for maintenance and servicing operations),

(e) make determined efforts designed to lead to environmentally sound waste management of liquids containing PCBs and equipment contaminated with PCBs having > 0.005% as soon as possible but no later than 2028,

(f) endeavor to find other articles containing > 0.005% and manage them in accordance with paragraph 1 of Article 6,

(g) and (h): provide a report every 5 yrs on progress in eliminating PCBs and submit to the Conference of the Parties, and review of reports.

Lastly in the Convention, Annex-C is devoted to Unintentional Production. Titles under this annex are summarized below:

- Part I. POPs subject to the requirements of Article 5 (PCDD/F, HCB, PCBs)
- Part II. Source Categories: Sources that have a comparatively high potential to unintentionally release Annex-C chemicals
- Part III. Source Categories: Sources that have a potential to unintentionally release Annex-C chemicals
- Part IV. Definitions
- Part V. General guidance on best available techniques and best environmental practices

3.2.2. Law on the Approval of Ratification of the Basel Convention Controlling Transboundary Movements of Hazardous Wastes and Their Disposal

Basel Convention on Transboundary Movements of Hazardous Wastes and their Disposal was adopted in 1989 and put into force in 1992. The Convention regulates the industrial wastes posing a threat against environment and public health. All transboundary movements of hazardous wastes for final disposal, their reuse or recycling operations is legalized by this Convention.

There are technical guidance documents developed by the Basel Convention. The collaboration between the relevant authorities of Stockholm Convention and Basel Convention is needed for the following actions:

- Disposal efficiency and identification of irreversible changes,
- Decision making on components of environmentally sound disposal methods,
- Decision on the concentration level of various chemicals in order to define low POP content.

3.2.3. POPs Protocol of the United Nations Economic Commission for Europe (UNECE) – Convention on Long Range Transboundary Air Pollution (CLRTAP)

Convention on Long Range Transboundary Air Pollution (CLRTAP) was approved by our country by the law dated 28/4/1982 and numbered 2667 and has entered into force through publication in the Official Gazette dated 23/3/1983. "Protocol on Long-term Financing of the Cooperative Program for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe" (EMEP) was approved on 3/6/1985 and it was published on the Official Gazette dated 23/7/1985. Protocol has been internationally in force since 28/1/1988.

Total emission of 4 parameters (SO_2, NO_x, NMVOC, NH_3) should be reported to United Nations, European Environment Agency and European Union and European Economic Commission Secretariat as per Long Range Transboundary Air Pollution Convention and EMEP Protocol. There are 8 protocols within the scope of CLRTAP and the Persistent Organic Pollutants Protocol (CLRTAP/POPs Protocol), which contain regulations on PCBs, has not yet been ratified by our country.

PCB limit values and definition/phasing out and environmentally sound disposal deadlines are determined according to the POPs Protocol as:

- PCB containing equipment: > 500 mg/kg and 5L → by 3 December 2010 and 31 December 2015
- Liquids (non-equipment): > 50 mg/kg → by 31 December 2015 and 31 December 2020
- Equipment: > 50 mg/kg and for 0,05 L → by 31 December 2025

Annex III – Until a year to be selected between 1995 and 2010, countries are expected to commit for decreased emissions (through determination of a reference year). Moreover, limit values for dioxins and furans are provided in Annex IV – Large Combustion Plants.

3.2.4. Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade

The objective of the Convention is (i) to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals, (ii) in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use by facilitating information exchange about their characteristics providing for a national decision-making process on their import and export and disseminating these decisions to Parties of the Convention.

The Convention forms legal requirements for the application of the Prior Informed Consent Procedures. It is based on voluntary PIC procedure. Voluntary PIC procedure is initiated in 1989 by United Nations Environment Programme (UNEP) and Food and Agriculture Organization (FAO) and ended on 24.02.2006. Turkey signed the Rotterdam Convention in 1998 by PIC Diplomatic Conference, which is prepared by co-ordination of UNEP and FAO. Rotterdam Convention is adopted in 1998, Turkey signed the Convention in 1998 and is in force since 2004. Even though it has been discussed in Parliament's Environment Commission in 2011, Turkey is not a party to the Convention since it is still waiting to be approved by the General Council.

Mutual objective of Stockholm-Basel-Rotterdam Conventions is to protect human health and the environment. Since they contain several different aspects for the management of chemicals from cradle to grave, a synergy is created between these three conventions. PCBs are covered by all three conventions.

3.2.5. UNECE Protocol on European Pollutant Release and Transfer Register (EC) No 166/2006

The objective of the Protocol, which is also known as the Kiev Protocol, is to form an integrated pollutant release and transfer register, which would cover the whole country. This way, public will participate to the environmental decision making processes, while environmental pollution is avoided or reduced.

European Union (EU) has accepted E-PRTR Directive in January 2006 for open notification to the public on industrial emissions (The previous system has lower limit values than EPER). Reporting limits were defined for ΣPCBs as: (i) Air: 0,1 kg/year, (ii) Water: 0,1 kg/year, (iii): 0,1 kg/year.

3.2.6. Relevant EU Legislation

EU legislation has been analyzed for components on management of PCBs and PCB containing substances and equipment:

- **EC Persistent Organic Pollutants (POPs) Regulation No. 850/2004:** It is the legal base for the implementation of Stockholm Convention, CLRTAP – POPs Protocol provisions in EU. While Stockholm Convention does not determine limit values, limit values for POPs emission/waste disposal etc. were determined as of 17.12.2014.
- **Council Directive 96/59/EC (16 September 1996) on the Disposal of Polychlorinated Biphenyls and Polychlorinated Terphenyls (PCB/PCT):** It contains parallel provisions to the Turkish regulation with the same name (By-law on PCBs and PCTs).
- **Regulation on Export and Import of Hazardous Chemicals - Prior Informed Consent Regulation (EU) (649/2012):** PCBs are included in the Chemicals to which PIC will be implemented. PCBs are also included in the Chemicals and Substances of which Export is prohibited.
- **Council Directive on Waste Electrical and Electronic Equipment (2012/19/EU):** It contains provisions on electronic parts (capacitor, etc.) of PCB containing equipment, to be separately treated/operated – recycle and reuse of these electronics could only be done within the scope of the relevant legislation.
- **European Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals (1907/2006) (REACH):** It aims for protection via avoidance.
- **Waste Framework Directive (2008/98/EC):** It contains parallel provisions to the Turkish regulation with the same name (By-Law on Waste Management).
- **Regulation on classification, labelling and packaging of substances and mixtures - CLP Regulation (1272/2008):** It contains parallel provisions to the Turkish regulation with the same name (By-law on Classification, Packaging and Labeling of Dangerous Substances and Preparations).

- **Council Directive on Incineration of Waste (2000/76/EC):** During granting permits to an incineration or co-incineration plant using hazardous waste, maximum PCB content should be reported.
- **Council Directive on Environmental Quality Standards in the Field of Water Policy (2008/105/EC):** PCBs were included in the 45 "priority substances" list under dioxin-like substances.
- **Industrial Emissions Directive (2010/75/EU):** Maximum PCB content of waste to be incinerated would be required besides other information, during the licensing of waste to be incinerated at incineration facilities.
- **Council Directive on End-of Life Vehicles (2000/53/EC):** During dismantling, any PCB containing part should be separately collected and stored in separate containers.
- **Commission Regulation Laying down Methods of Sampling and Analysis for the Control of Levels of Dioxins, Dioxin-like PCBs and Non-dioxin-like PCBs in Certain Foodstuffs (589/2014):** The dioxin-like and non-dioxin like PCBs should be controlled for their levels in food. Appropriate PCB analysis method(s) to be used during sample analysis are specified.
- **EC Communication on a Community Strategy for Dioxins, Furans and PCBs:** Effort should be made for the control of both industrial and domestic (traffic emissions and combustion for heating purposes, combustion in open places or wastes to be used as additional fuel) sources of these unintentionally released chemicals. In the BREF for iron and steel sector (Remus et al., 2013), it is stated that 9-10% of the toxicity from unintentionally released chemicals is due to dioxin-like PCBs. Measure to be taken here: Classification of scrap to decrease the risk of hazardous and non-metal compounds to be included such as PCBs, contaminated oil, machine oil. The scrap provider generally realizes this operation, but the operator audits all scrap in non-leaking containers. Hence, it is possible to control components of the container as applicable. It may be necessary to evaluate the rare amount of plastics (e.g. plastic coated components).
- **Council Directive on Landfill of Waste (1999/31/EC) - Establishing Criteria and Procedures for the Acceptance of Waste at Landfills Pursuant To Article 16 of and Annex II to Directive 1999/31/EC:** Inert waste should contain less than 1 mg/kg as the sum of 7-indicator PCBs if it is to be accepted to landfills.

4. CURRENT STATUS OF TURKEY ON PCB MANAGEMENT

4.1. National Implementation Plan (NIP)

4.1.1. The First NIP and the Revised NIP

Turkey has prepared a NIP in regards to POPs, which include PCBs, according to the requirements of the Stockholm Convention, and is using it is a living document in planning. The first NIP, prepared between 2005-2008 and sent to the Stockholm Secreteriat in 2010 after revision of the inventory. This first NIP is prepared for the 12 original POPs. Action plans are also included in this NIP for PCBs. The revised NIP is completed in 2015 and mostly focused on the 10 new POPs. This revised NIP is sent to the Stockholm Secretariat in November 2016.

4.1.2. The most recent PCB Action Plan (Revised NIP - Section 3.3.3. Management of PCBs and Equipment Containing PCBs)

When compared to the first NIP, the revised NIP puts more emphasis on coordination between institutions and timelines. The revised action plan contains less number of actions for which progress is relatively more easy to follow. The action plan on management of PCBs and PCB containing equipment is given in Table 2.

Ministry of Environment and Urbanization emphasizes that for Action Plans AP3.1, 3.2, 3.3, 3.4, 3.6 and 3.7 to be completed, the online PCB Inventory Program should be put into action first. Ministry states that currently service and maintenance activities of the program are being undertaken. It is emphasized that only after the inventory program is put into operation, registration, labeling of equipment can be carried out and follow-up of registered equipment for a sustainable inventory system can be realized.

AP 3.5 in Table is already realized, as stated by the Ministry. All firms disposing hazardous wastes are now subjected to a licensing. Initially this licensing is stated in the currently outdated By-Law on Control of Hazardous Wastes, dated 14.03.2005 and No: 25755, where licensing for firms conducting decontamination of PCB containing equipment is present in the By-law on Control of Polychlorinated Biphenyls and Polychlorinated Terphenyls, dated 27.12.2007 and No: 26739. The existing environmental licensing concerning hazardous waste disposal and decontamination of PCB containing equipment is covered in the Regulation on Environmental Permission and Licensing dated 10.09.2014 and No: 29115. Such licenses are issued by the Ministry of Environment and Urbanization.

Activities that fall under AP3.8 was started by the Ministry with the preparation of Guidelines for the Management of PCBs and PCB Containing Equipment. Furthermore, the Ministry states that a more detailed technical guideline will be prepared as a part of the POPs Legacy Elimination and POPs Release Reduction Project.

Table 2. Action plans for the management of PCBs and PCB containing equipment as included in the NIP revised in 2015.

Activity 3: Manufacture, import, export, use, identification, labeling, removal, storage and disposal of PCBs and PCB containing equipment			
AP number	**Action Plan**	**Time**	**Control**
AP3.1	Ensuring the continuation PCBs inventory of closed, semi closed and open PCBs sources	2017	XII/2016, XII/2017
Responsibility	Ministry of Environment and Urbanization in cooperation with industrial associations		
AP3.2	Identification and labelling the equipment containing PCBs more than 50 ppm before 2018	2019	XII/2017, XII/2018, XII/2019
Responsibility	Ministry of Environment and Urbanization in co-operation with industrial associations		
AP3.3	Ceasing the usage of PCBs and PCB containing equipment as soon as possible	2023	Annually XII
Responsibility	Ministry of Environment and Urbanization in co-operation with industrial associations		
AP3.4	Ensuring the inventory of PCBs contaminated sites and lands, PCBs stock sites	2018	XII/2017, XII/2018
Responsibility	Ministry of Environment and Urbanization in co-operation with universities, research institutions as well as industrial associations		
AP3.5	Constituting a system that licenses the facilities, which collect and dispose PCB wastes to solve the PCB waste problem.	2016	XII/2016
Responsibility	Ministry of Environment and Urbanization in co-operation with industrial associations		
AP3.6	Defining liabilities for public institutions about PCB containing wastes in the National Hazardous Waste Management Plan and complete the National Implementation Plan for the management of PCB containing wastes	2018	XII/2017 XII/2018
Responsibility	Ministry of Environment and Urbanization in cooperation with the Ministry of Interior, Ministry of Economu and industrial associations		
AP3.7	The stockrooms with PCB including waste and equipment have to be secured by the owners of the facilities. Regular control of these stockrooms and all transfers of wastes and equipment have to be done.	2017	XII/2016, XII/2017
Responsibility	Ministry of Environment and Urbanization		

Activity 3: Manufacture, import, export, use, identification, labeling, removal, storage and disposal of PCBs and PCB containing equipment			
AP number	**Action Plan**	**Time**	**Control**
AP3.8	Choosing environmentally sound methods for the purification and disposal of the transformers and capacitors, disposal of the PCBs and PCB containing wastes has to be key point of PCB waste management.	2018	XII/2017, XII/2018
Responsibility	Ministry of Environment and Urbanization		
AP3.9	Environmentally sound management of PCBs and PCB containing wastes in ship recycling industry	2020	XII/2019, XII/2020
Responsibility	Ministry of Environment and Urbanization in cooperation with the Ministry of Transport, Maritime Affairs and Communications, Ministry of Interior and industrial associations		

4.2. Projects that Aid PCB Management in Turkey

4.2.1. Technical Assistance for implementation of the persistent organic pollutants regulation - EuropeAid/132428/D/SER/TR

The purpose of the project was to establish the necessary capacity for effective implementation of EU Persistent Organic Pollutants Regulation in Turkey at national and regional level taking into account social and economic impacts. Within this framework, between June 2013 and June 2015, three main groups of activities were realized:

1. Defining and strengthening the institutional and technical capacity for the implementation of the POPs Regulation (e.g. Eight set of training activities were organized)
2. Conceiving the steps to be taken for effective implementation the POPs Regulation (e.g. revision of NIP, etc.)
3. Determination of national and sectoral effects of the implementation of the POPs Regulation (e.g. Sectoral and Regulatory Impact Assessment).

4.2.2. CP/RAC and MEDPOL – Component 2.3: Environmentally Sound Management of PCBs in Mediterranean Countries (UNEP MAP)

The purpose of the project is destruction of PCBs, conducting an inventory study, capacity building as well as raising awareness of the public through training activities. Within this framework, approximately 640 tons of contaminated equipment, oil or pure PCBs were identified in many sectors, analyzed and sent for disposal. Hence, valuable contributions were made to the PCB inventory, capacity building was performed in terms of sampling, analysis and other aspects relevant to equipment containing PCBs, as well as general awareness rising of public on PCBs.

4.2.3. POPs Legacy Elimination and POPs Release Reduction Project - Component 2.1. Planning and Capacity Building for Environmentally Sound Management of Future PCB Stockpiles

In the project aiming for POPs legacy elimination (HCH and PCBs) and POPs release reduction (BAT/BEP), there are five components:

1. Elimination of Current POPs Stockpiles/Wastes

2. Planning/Capacity building for environmentally sound management of future PCB stockpiles
3. Unintended POPs release reduction
4. Management capacity for POPs contaminated sites
5. Institutional and regulatory capacity strengthening for sound chemicals management and contaminated sites

The project has started as of end of 2015 and is planned to be complete in four years.

4.3. Current Institutional Framework regarding PCBs

As a party to the Stockholm Convention, within the scope of the Revised NIP, the list of the regulations and its related statements for POP management by various institutions in Turkey as per Stockholm Convention are presented in tables (NIP Annex III).

In the revised NIP, current regulation for POPs management in Turkey was analyzed, Turkish and EU regulation gap analysis have been performed, components regarding institutional capacity (human resources, administrative resources, financial, informational, technical resources), were evaluated. While evaluating the capacity of the institutions, political, legal framework, current regulation's implementation, economic framework, resources, public support and coordination issues were also considered. Stockholm and EU POPs Protocol provisions were summarized, the organizational structure of the authorized departments were analyzed. In this analysis, requirements were put forward to manage tasks and responsibilities and activities in the most effective and efficient way. As it is the case with POPs, also for PCBs, individual responsibilities of governmental institutions create less of a problem, whereas problems may arise due to lacking coordination mechanisms between institutions. Increasing inter-institution coordination would enable a more efficient use of human resources and financial resources. It is emphasized that, while planning for a mechanism in management of POPs (and PCBs which are covered by POPs), requirements of Basel and Rotterdam Convention should also be considered as well as the Stockholm Convention and EU legislation.

The sixth article of the By-law on Control of Polychlorinated Biphenyls and Polychlorinated Terphenyls identifies the responsible parties as:

- Ministry
- Provincial Directorates
- Waste Producers
    - Production industry (iron and steel, energy, food etc.)
    - Scrap metal industry, etc.
- Waste Processing Facilities
    - Decontamination
    - Transportation
    - Disposal

5. EXAMPLE PCB MANAGEMENT PLANS

A number of countries have established PCB management plans. Table 3 provides a comparative evaluation of the plans of 4 selected countries (Ireland, Australia, Germany and Russia). Russia has not yet submitted its NIP to the Stockholm Secretariat. However, Russia has a characteristic profile in terms of PCBs, because the country continued to produce PCBs until 1993 and countrywide PCB concentrations

are high. Russia is not included because it has the best model report, but because the country is still in the early stages of PCB management, so it can provide a different perspective when compared to the other countries. Approaches in countries' plans, are compared on the basis of our country's revised NIP actions. In order to provide an equal basis, information for the countries (except for Russia) is taken from their first NIP reports (Table 3). As such, it is intended to form a better base for Turkey's PCB Management Plan.

Table 3. A comparative evaluation of Section 3.3.3 PCB action plans from the revised NIP (2015) when compared to Ireland, Australia, Germany and Russia.

Turkey NIP Section 3.3.3 Action Plans	**Ireland[a]**	**Australia[b]**	**Germany[c]**	**Russia[d]**
Inventory Information (E.P.3.1)	Open and closed use are categorized. 44008 L PCB or PCB containing substances is listed in 2012 inventory.	14,936 tons PCB are destroyed between 1994 and 2004. Approximately 3,547 ton (including contaminated soil) liquid and solid waste is waiting for disposal. 20,800 tons are still in use, but 96% of that is composed of PCBs of which disposal is not planned.	Large closed equipment is mostly disposed of at national scale. In 2004, approximately 1650 ton small capacitors are sent to underground landfills and 2005 values are also similar. In 2010 only 2 transformers will be waiting for disposal.	10,000 transformers and 500,000 capacitors are in use. They may be separated and their use may be ceased, but they are not disposed yet. They contain approximately 31000 tons of PCBs.
Identification and labelling the equipment containing PCBs more than 50 ppm before 2018 (E.P.3.2)	Not much information is present about national codes, transportation standards, storage. However, stored PCBs are labelled accordingly.	All content is categorized as hazardous substance. Australia Safety Committee is the authority to determine national standards and codes.	Anyone who produces waste is responsible from its appropriate management and disposal.	Russia does not have a legal arrangement for labelling requirement at the date of the report. It is suggested in Russia that labelling is done in compatible with the EU legislation.
Ceasing the usage of PCBs and PCB containing equipment as soon as possible. (E.P.3.3)	There was a ban and control on PCBs in the late 1980s and The Waste Management (Hazardous Waste) Regulations, provisions of the European PCB Directive are valid in the country.	Australia's PCB Management Plan requires the phasing out and destruction of PCB material with concentrations of >50mg/kg and quantities of >50 g PCBs by 2009.	Until 1982, PCBs were manufactured in Germany on an	There was a ban and control on PCBs in the late 1980s and The Waste Management (Hazardous Waste) Regulations, provisions of the European PCB Directive are valid in the country.

Turkey NIP Section 3.3.3 Action Plans	Ireland[a]	Australia[b]	Germany[c]	Russia[d]
Ensuring the inventory of PCBs contaminated sites and lands, PCBs stock sites. (E.P.3.4)	Limited environmental monitoring of PCBs in soils in Ireland was carried out. PCBs in soils examined as sample were consistently low indicating no serious addition of this material by spillage to soil and it is indicated that the narrow range of values (1.2-6.8 μgkg^{-1}) was consistent with adsorption from the atmosphere.	The Site Contamination National Environment Protection sets criteria for a range of POPs. A review of the Site Contamination NEPM commenced in 2005 and will continue through to the end of 2006. The Management Plan also includes a short case study for contaminated soil example.	PCB levels in sewage sludge were analyzed. It is observed that the levels remained constant in recent years. Thus no significant reduction potential can be identified. The only way to reduce the input of PCBs to the environment from sewage sludge would be to treat the sludge thermally.	Russia carried out a study in the heavily PCB contaminated Serpukhov area (6-7 m^2) and the total amount of PCBs in the area is estimated as 350 tons. As a result of the cost benefit analysis, the recommended methodology for rehabilitation is selected as thermal desorption and cyclone kiln PCB destruction. It is also indicated in the report that for each contaminated site, the methodology of rehabilitation should be identified case by case, since the characteristics of the site may vary significantly.
Constituting a system that licenses the facilities which collect and dispose PCB wastes to solve the PCB waste problem. (E.P.3.5)	There is 1 operational municipal waste incinerator with a Waste License in accordance with the Waste Incineration Directive. 2 other licenses have been issued for incinerators, but, the operation of these facilities has not commenced. There are 4 cement plants. Only 1 of them is licensed for firing with hazardous waste (no firing with hazardous waste has yet taken place).	Not much information is provided in the report. It is stated that strict levels of dioxins (0.1 ng TEQ/m3 of dioxins) has been accepted. The responsibility for licensing facilities rests with the States and Territories and not the Australian Government.	In Germany, Federal Emission Control controls the need for license. Disposal of insulating fluids containing PCBs takes place as a rule in incinerators licensed for that purpose.	Ministry of Natural Resources gives companies the permission to carry out activities, e.g. involving PCB collection and storage. It is not mandatory, but recommended that carriers shall be equipped with a special license allowing them to carry PCB and PCB-containing equipment

Turkey NIP Section 3.3.3 Action Plans	Ireland[a]	Australia[b]	Germany[c]	Russia[d]
Defining liabilities for public institutions about PCB containing wastes in the National Hazardous Waste Management Plan and complete the National Implementation Plan for the management of PCB containing wastes (E.P.3.6)	Regulations entered into force in 2009 that assign rules on liability. This liability covers remediation of contaminated land as well. The EPA has developed a number of tools for assessing environmental liability and for the assessment and management of contaminated land and groundwater at IPPC licensed and waste licensed sites in Ireland. NIP mentioned that regular Hazardous Waste Management Plans are present in the country since 2001; however, not much detail is provided. Ireland Hazardous Waste Management Plan valid between 2014 and 2020 indicates that PCBs are included in these plans; tasks and responsibilities of public establishments and institutions are considered within the scope of Environmental Liability Law.	Liability is with the state and territory governments. The responsibility for licensing facilities rests with the States and Territories and not the Australian Government. NIP mentions that Waste Management Plans are present in the country, these plans also cover PCBs. Moreover, liabilities within the legislation and responsibilities of European Environment Agency about the topic are also mentioned.	There is a division of responsibilities between federal and state governments. The report underlines the effective structures for communication and action being essential. Working groups were set up for this purpose. NIP mentions that Waste Management Plans are present in the country, these plans also cover PCBs. Moreover, relevant responsibilities are defined in the Hazardous Waste Regulation referred in the report.	Information is not provided in this respect in the report. Literature search did not also provide qualified information regarding Russian Hazardous Waste Management Plan.
The stockrooms with PCB including waste and equipment have to be secured by the owners of the facilities. Regular control of these stockrooms and all transfers of wastes	The report does not define owner's responsibility. Indeed, EPA is held responsible for cooperating in the identification of any person who holds a stockpile containing a POP or who holds,	Information is not provided in this respect in the report.	Information is not provided in this respect in the report.	Information is not provided in this respect in the report.

Turkey NIP Section 3.3.3 Action Plans	Ireland[a]	Australia[b]	Germany[c]	Russia[d]
and equipment have to be done. (E.P.3.7)	produces, disposes of or recovers a POP-containing waste. Local Administrations, on the other hand, are hold responsible from provision of data to the EPA resulting from monitoring, inspections, checks, examinations and investigations concerning POPs.			
Choosing environmentally sound methods for the purification and disposal of the transformers and capacitors, disposal of the PCBs and PCB containing wastes has to be key point of PCB waste management. (E.P. 3.8)	The management is done through separating according to the amount of PCBs as large PCB holdings or small PCB holdings.	The PCBs are categorized as scheduled (PCBs at or greater than the threshold concentration of 50 mg/kg.) and non-scheduled PCBs (below the threshold concentration of 50 mg/kg). The country gives technical assistance to other countries in terms of PCB management.	The 1st NIP indicates that while not to continue to landfill option in the future, contaminated materials such as non-emptied capacitors and building materials containing PCBs is permanently stored in salt rock in underground landfills.	Since the amount of contaminated equipment is very high, three scenarios are run through a baseline (no convention), a late compliance (elimination in 2028) and an advanced compliance scenario (elimination in 2023). The cost of late compliance is 30 M USD whereas advanced compliance cost is 50 M USD*.
Environmentally sound management of PCBs and PCB containing wastes in ship recycling industry. (E.P. 3.9)	Information is not provided in this respect in the report.	Information is not provided in this respect in the report.	Information is not provided in this respect in the report.	Information is not provided in this respect in the report.

[a] Ireland First National Implementation Plan, 2006, Stockholm Convention Web Site, http://chm.pops.int/Implementation/NIPs/NIPTransmission/tabid/253/Default.aspx

[b] Australia First National Implementation Plan, 2006, Stockholm Convention Web Site, http://chm.pops.int/Implementation/NIPs/NIPTransmission/tabid/253/Default.aspx

[c] Germany First National Implementation Plan, 2012, Convention Web Site, http://chm.pops.int/Implementation/NIPs/NIPTransmission/tabid/253/Default.aspx

[d] Environmentally Sound Management and Elimination of PCBs in Russia, Arctic Council Action Plan, http:// www.amap.no/documents/download/1109

Case Study – Morocco (GEF and UNIDO, 2008)

In the case of Morocco, during discussion of domestic/regional/global benefits, non-official or illegal handling of equipment containing PCBs are also discussed. In relation to the socio-economic effects of the proposed project, it is indicated that PCB containing equipment is recycled in unofficial sectors and reused. While metal parts are sold as scrap metal, most probably without any pre-treatment, PCB containing oil is used in domestic combustion for heating purposes. The risk of emission of polychlorinatedbenzo-dioxins and polychlorinateddibenzo-furans are very high since the dismantling of PCB contaminated equipment is frequently done with welding operations in unofficial sectors. In the project document, the below are proposed for Morocco:

- Installation of a facility for dismantling metal parts of PCB containing transformers after PCB drainage and treating these metal parts. In this facility, pure PCB oils or porous materials such as insulating paper and wood exposed to PCBs will be packaged and sent abroad for disposal, after being drained from transformers.
- Installation of a dehalogenation facility for PCB contaminated mineral oil. It is indicated that this facility may be stationary or mobile, and that it could be used for mineral oil contaminated with PCBs and for decontamination of mineral oil that is used for cleaning metallic parts of PCB contaminated transformers.

If only a small portion of the waste is PCBs, the most environmentally sound solution would be selectively destroying PCBs in the matrix instead of completely destroying the matrix as incineration would do. It is emphasized that this approach will not only decrease the amount of carbon dioxide formed, but also will enable recovery and recycling of valuable material such as transformer mineral oil, copper and steel.

It is understood from environmental monitoring and certain scientific studies that similar situation can be present in Turkey. Çok et al. (2009) made a research about PCDD/F values in 51 mother milk samples collected from Ankara, İstanbul, Antalya, Kahramanmaraş and Afyon. Total TEQ values were the lowest in Afyon and the highest in Antalya among the five regions the study was conducted. The reason for observing the highest value in Antalya, and not in any of the other cities where there is greater industrial activity may be that in Antalya, PCB containing oil could be illegally used for the purpose of heating greenhouses. The average values of PCDD/Fs and PCBs in human milk are comparable to the levels observed in other countries.

Case Study – Success Story from Turkey: Elektrik Üretim A.Ş.

A positive model has been implemented by EÜAŞ about identification, management and disposal of PCB containing equipment (EÜAŞ, 2015). EÜAŞ, once within Turkish Electrical Institution, initiated studies on PCBs in 1993. 197 transformers were identified (idle and in use, in total). Inventory and disposal efforts (İZAYDAŞ) have been continuing since 2003. All equipment was sent for disposal using EÜAŞ's own financial resources. Average disposal cost was 2472 USD/ton as per all activities regarding disposal. The breakdown cost is as follows:

- Total number of transformers sent for disposal: 197
- Total disposal cost: 1,5 million USD
- New transformer cost: 2,124 million USD
- Dismantling/installation/transportation cost: 1,5 million USD

The success here comes from the fact that the institution did not wait for the national legislation to be published, but tracking the international updates and initiating to work on these hazardous chemicals early on and continuously. EÜAŞ continued inventory studies with an institutional continuity, realized training for provincial establishments, and made great effort towards reduction of PCB exposure. All identified equipment were disposed of within the framework of a financial plan and replaced with new ones.

6. CURRENT STATUS OF IMPLEMENTATION OF NATIONAL PCB REGULATION PERTAINING TO PCB MANAGEMENT

6.1. Inventory

The first inventory study for PCBs was prepared in the first National Implementation Plan within the scope of Stockholm Convention and the pertaining report is dated as 2010. The inventory contains EÜAŞ data (148 tons transformer weight), distribution of the sum of transformers and capacitors in the inventory (260 transformers and 1972 capacitors) with regards to limited number of sectors, and data of PCB disposed by İZAYDAŞ (83.56 tons).

The first NIP also indicates that 15.5 tones of PCB waste (liquid, solid, contaminated waste, soil, equipment) were exported from Turkey for disposal between 1997 and 2008. As per the report, there were 187 transformers in EÜAŞ in 1995. The report also foresees that possible amount of substances and equipment containing PCBs were 140,000 tons in Turkey.

The inventory was updated within the scope of NIP revision studies. As per the data indicated in this report, number of contaminated equipment including transformers, capacitors and other equipment is 2,990. It is observed that the weight of the contaminated transformers is higher in NIP dated 2016 (148 tons in 2010 and 912 tons in 2015), because with time, more information is revealed in terms of contaminated equipment through questionnaires filled in or through site visits. However, the number of transformers in the inventory was higher in 2010 (There were 260 transformers in 2010 and 177 transformers in 2015). The average transformer weight is calculated from 2015 inventory as 5.152 tons, which means that they could be rather large transformers. Moreover, it should be noted that PCB equipment is being sent for disposal since the first inventory. It is known that disposals are realized by the individual efforts of the institutions and with the help of various internationally supported projects.

Within this scope of UNEP MAP Project, approximately 640 tons of contaminated equipment, oil or pure PCBs were disposed from various sectors (data is present in Table 4 as summary, in detail in Annex I). The project's final report indicates that the total weight disposed as 639.9 tons. The Annex I and final report indication of total weight may differ slightly, since the project's final report does not contain all information like the weight of contaminated materials like drums, etc. When PCB equipment identified in facilities is analyzed further, many capacitors in electrical transmission sector are identified. Transformers in other sectors are also identified.

It is probable that there are other PCB containing equipments still present in the mining, sugar, iron-steel sector and other industrial sectors. For instance, UNDP-UNIDO-GEF POPs project document also indicates that ERDEMİR has PCBs waiting for disposal that is both in service and in storage at a total of 172 tons; whereas ISDEMIR has in service and in storage of about 20 tons.

Table 4. Inventory and disposal data.

Inventory Data Combined					
The data resource	**Equipment Type**	**Weight of Equipment (tons)**	**Number of Equipment**	**Comments**	
NIP dated 2010	Transformer	148	260	-	
NIP dated 2010	Capacitor	N/A	1972	-	
NIP dated 2016	Capacitor, contaminated equipment	168	2813	-	
NIP dated 2016	Transformer	912	177	-	
May 2016 data from MoEU	Transformer	498.2	87	Includes 6 transformers left at EÜAŞ	
May 2016 data from MoEU	Capacitor	14.4	288	-	
Latest Inventory Information, May 2016 data, weight of contaminated equipment		**512.6**			
Data of Disposed Equipment so far in Turkey					
The data resource	**Equipment Type**	**Weight of Equipment (tons)**	**Number of Equipment**	**Weight of Isolation Liquid**	**Disposal Location**
NIP dated 2010	Contaminated Oil or Pure PCB	83,5	-	-	İzaydaş
NIP dated 2010	Contaminated Equipment	15,5	-	-	Abroad
UNEP MAP Project Final Report	Contaminated Equipment	640	-	-	Mostly abroad, UNEP MAP Project
EÜAŞ Presentation	Transformer	654	197	210	-
Total weight of equipment disposed until now		**1294**			

The largest transformers have the least possibility of containing PCB oil, since they are too big to be filled in with such expensive PCB oil. Electricity Transmission Company (TEİAŞ) has the largest transformers in size. It is not expected that these large transformers contain PCBs due to economic reasons (EÜAŞ, personal communication). Larger transformers are being used in electrical transmission, when compared to production and distribution. Within this scope, Electrical Transmission Company TEİAŞ possesses the largest scale transformers. It is evaluated that due to economic reasons, it is a very low possibility that TEİAŞ possess PCB transformers. In electricity production (EÜAŞ in Turkey), on the other hand, medium size transformers are typically used and studies continue since 1995 to identify the ones containing PCBs. The latest inventory indicates that 197 transformers were sent to disposal. Disposed isolation liquid is reported as approximately 203 tons. As per May 2016 data, only 6 transformers are left for disposal and the isolation liquid weight is 1246 kg (EÜAŞ, 2015).

Electricity Distribution Company (TEDAŞ) on the other hand, has the smallest transformers in size, which are widespread geographically. The smallest transformers generally are located within the buildings, they have a weight of approximately 200-300 kg, including a maximum of 2 tons of oil. These small transformers are categorized as “transformers not requiring special maintenance”, hence it is of high likelihood that they may contain PCBs. Because PCB containing transformers were produced with the purpose of being in use for a very long time without necessitating any maintenance and they were supplied to the market to be used inside the buildings or for other inaccessible places. Hence, it is suggested that transformers in the electricity distribution sector, whose data are not yet evident in inventory studies, should be analyzed for inclusion in the inventory.

Annex II contains the latest PCB inventory values that are provided by the Ministry of Environment and Urbanization in May 2016. This data shows all known contaminated equipments remaining after the UNEP MAP study. Inventory includes a total of 542 tons of contaminated equipment, (498 tons of transformers, 14 tons of capacitors, 30 tons of contaminated equipment) that are waiting to be disposed of in an environmentally sound manner.

The use of consistent and one format for the database in inventory studies would provide a significant advantage. Formats in two NIPs are different and this situation makes it hard to compile information. By-law on Control of Polychlorinated Biphenyls and Polychlorinated Terphenyls requires institutions and establishments that possess these equipment and oils record their data into an electronic database. The By-law was put into force in 2007, the database was initiated in 2010. However, the system was adversely affected from organizational changes between Ministries and afterwards it could not be made operational. It is evaluated that establishments which own these equipment and oils may have reservations in registering information to the database since the disposal alternatives are very limited and expensive in the country. A living inventory that is as complete as possible is critical for the management of PCBs. For this purpose, the inventory requested by the subject by-law should be made efficient to avoid data collection in different formats and in different level of details and to settle an online information gathering system. All available inventory data together with the amounts sent for disposal are summarized in Table 4.

6.2. Transport and Storage of PCBs/PCB containing Materials and Equipment

Transport and storage of PCBs and PCB containing material and equipments bear significant risk factors. In the course of transport and loading, PCBs may be released. Additionally, for every kind of transboundary movement, requirements of the Basel Convention are binding. There are also specific criteria for the storage of PCBs and PCB containing materials and equipments.

6.3. Remediation and Disposal of PCBs/PCB Containing Materials and Equipment

Stockholm Convention lists the necessary steps to be taken to ensure safe management of all POPs containing equipment that exceeds the expiration date, considering human health and the environment. Convention also mandates taking suitable measures regarding wastes. In Article 6 (d) (ii) and (iii) it is stated as:

> (ii) Disposed of in such a way that the persistent organic pollutant content is destroyed or irreversibly transformed so that they do not exhibit the characteristics of persistent organic pollutants or otherwise disposed of in an environmentally sound manner when destruction or irreversible transformation does not represent the environmentally preferable option or

the persistent organic pollutant content is low, (iii) Not permitted to be subjected to disposal operations that may lead to recovery, recycling, reclamation, direct reuse or alternative uses of persistent organic pollutants;

For the determination of the "low POP content", it is stated in Article 6, part 2 (c) as "conduct studies to define the low POP content" in close cooperation with Basel Convention organizations.

As elaborated in Section 3.2.1 of this report, under Annex-A Elimination, Part II lists priorities for Parties of the Stockholm Convention to eliminate the usage and completely dispose of all equipment containing PCBs by 2025/2028. In this context: (1) Stockholm Convention, (2) Turkey's National Implementation Plan and (3) all relevant legislation are the most important tools.

Points of Consideration

As for every POPs, issues to consider regarding PCB containing wastes include:

- Prioritizing the disposal of high PCB content wastes
- Increasing decontamination/disposal capacity (here the choices of building the capacity in the country and/or sending wastes abroad for disposal should be evaluated)
- Having feasible threshold concentrations in the national Legislation (in Turkey, the regulatory limit for PCBs is 50 mg/kg, which is compatible with Stockholm Convention and widely used by other countries)
- Having widespread analytical methods (there is sufficient capacity in Turkey on analysis of PCBs)
- Considering and trying to minimize the gaps in information and data (there is progress within the context of various activities and international projects)

Criteria

The criteria to be taken into account during selection and application of decontamination or disposal technologies in our country are listed in Table 5.

Table 5. Criteria for decontamination/disposal technology selection.

Title	Criterion
Performance	Removal/destruction efficiency
	Possible by-product generation
	Need for treatment of emissions
	Confinement of contamination
	Potential for dioxin generation
	Risk of unintentional release
	Pre-treatment requirement
Cost	Capital cost
	Operational Cost (consumables, energy, other required materials)
	Sampling and monitoring cost
	Cost of patent etc.

Title	Criterion
Local Requirements	Energy
	Water
	Manpower
	Technical manpower
	Laboratory/analysis
Impact	Possible impacts on air, water and soil
	Social acceptability
Hazard	Solvent related
	Technology related
	Operation related

A general technical guidance manual on POPs which including PCBs and PCB containing materials/ equipments, is available on the Basel Convention Secretariat's webpage, with final revision in May 15, 2015 (UNEP, 2015a). For specifically PCBs, there is another technical guidance with the same date, which is accepted by the Conference of Parties (UNEP, 2015b). Another technical guidance, listed in Annex C of the Stockholm Convention and intended to prevent and reduce unintentional generation of PCBs was revised in 2008 (UNEP, 2008). This document, after introducing some general concepts explains the techniques to prevent unintentional POPs generation specifically for each possible source.

For the decontamination or disposal of PCB containing equipment, firstly the equipment inventory should be evaluated. The technical document prepared in the scope of Basel Convention explains this issue in strategy selection part (as a 4th part after inventory preparation and evaluation) and with considerations on PCB content of equipment, size, whether or not it is in use; it describes the strategical guidance for decisions related to decontamination, retro-filling, metal recovery and/or disposal (UNEP, 2002). After the determination of the strategies regarding inventory, it is specified that the decision of sending these to local, national or international facilities should be made.

In the United States, North Dakota State's 2009 dated (URL 2) relevant document, the reduction of amount of wastes day-by-day and the importance of recovery of wastes are emphasized. Here the aim is not only the protection of the environment, but also finding various solutions to the increasing waste disposal problem. Recovery of metal components of wastes help both to protect the natural resources and effective usage of very precious landfill space. For instance in Canada, drained waste PCB transformers with PCB content higher than 50 ppm are forbidden in landfills (CCME, 1995). Even, the operators of landfills were reported to be reluctant to take waste transformers having PCB content less than 50 ppm. In this context, some practices and criteria with respect to metal recovery from materials and equipments contaminated with PCB oil are included in this section.

One of the most important factor, cost, in the disposal of PCB containing equipment and materials, especially transformers and capacitors are not only affected by disposal technology related expenses, but also by the replacement of capacitors and transformers, cost of any kind of installation/dismantling prior to disposal and cost of transportation. Since these expenses are considerably high, any new application to reduce them that are compatible with environmental standards are welcome. According to a technical guidance document of the Basel Convention (UNEP, 2002), income may be generated from the recovery of metal, even after taking into account the cost of decontamination by autoclaving.

A major step in encouraging PCB owners to phase-out equipment and encouraging PCB service companies to invest in decontamination, treatment and destruction facilities, is to ensure that consistent national standards for the decontamination of equipment for re-use, recycling and disposal are clearly documented, disseminated and applied throughout the country (Canadian Council of Ministers of Environment, 1995).

Decontamination

For recovery of the metal components of PCB containing equipment, the most important step is decontamination. mostly thermal process and solvent washing were used in past for this purpose (UNEP Chemicals, 2004). After decontamination, there are always some parts and components that could not be completely decontaminated. These should be subjected to disposal. Separation of PCB oil, solvent washing of transformer, followed by dismantling and further decontamination of metal components enable metal recovery. There are a variety of firms undertaking these operations and they are listed in UNEP documents (UNEP Chemicals, 2000). The decontaminated equipment may then be recycled in conventional plants such as metal foundries. Remaining contaminated components (such as paper and wooden parts) are disposed of in destruction facilities by incineration or other methods.

Canada prepared a document for standards and protocols after the amount of PCB transformers in country was determined (CCME, 1995). CCME guidelines allow the recycling of drained, PCB-contaminated mineral oil transformers having less than 500ppm. CCME deems incineration of waste PCB transformers an acceptable method of decontamination of metal for eventual recycling. The contaminated mineral oil or PCB oil is also destroyed in this process. However, retrofilling of pure PCB transformers with mineral oil after decontamination and reuse is regarded impossible from an economical and practical viewpoint. In Canada, incineration is performed in stationary hazardous waste treatment facilities or at mobile PCB processing facilities. Another decontamination method is solvent cleaning. For example, mobile autoclaves enable disassembled transformer parts to be cleaned using heated solvent vapors. The drained fluids, contaminated solvents and all wastes originating from the process must be stored and treated (if more than 50 ppm in concentration) by approved methods.

Criteria for reuse and recovery after decontamination. Various criteria are employed for decontamination of transformers, among them for reuse for example, in Canada, PCB concentration in transformer oil after 90 days of operation and for recycle, surface contamination criteria are used (CCME, 1995). Besides, in Australia, non-porous solid items may be reused or recycled if the surface PCB residue is less than 1 milligram per square meter of surface area. (ANZECC, 2003) (Environment Heritage Protection, 2016). The amount of PCB retained in porous material or on non-porous contaminated metal can be directly measured using solvent extraction or the wipe test, respectively. Canada also explains the details of the wipe test (CCME, 1995).

In Russia, the method of cleaning using methylene chloride vapor as a solvent was recommended as the basic option for cleaning of transformers. (URL 3). By using methylene chloride, the approximate cleaning costs for 200 transformers/year is stated to be 750000 USD. One ‘average’ operation of transformer processing takes 72 hours. The cost of the first operation is 1180 US dollars. One ‘base module’ can carry out 100 operations/year. After washing down to a PCB-concentration of 50 mg PCB/kg steel/metal, the transformers are dismantled and the metal parts sent for recycling. Re-use of cleaned transformers by refilling with non-PCB-liquid is not recommended. Nonmetallic parts (paper, wood), which, after washing, usually fail to meet the required PCB concentration limits, should be sent for

disposal. According to European standards, methylene chloride is considered to pose a health hazard and is possibly carcinogenic to humans. Special attention should therefore be given to labor protection at installations using methylene chloride. Skin and eye protection is of main concern (URL 3).

In the United States, PCB containing equipment is subject to numerous restrictions if it is to be used as input in scrap metal recovery ovens and smelters (URL 4, §761.72 Scrap metal recovery ovens and smelters). US Federal regulation 761.72 specifies the restrictions and criteria for such activities:

- Specifications of scrap metal recovery oven (number of chambers, min operation temperature of each chamber, minimum % excess O_2 requirement, retention time, and monitoring of in-chamber gases CO, CO_2, excess O_2, etc.), monitoring of emissions (particulates, SO_2, NO_x, CO, HCl, etc. as well as any national requirements for incineration),
- Specifications of smelting (min operating T, time interval of successive charges, applicable emission standards, etc.)

According to US **§**761.79 Decontamination Standards and Procedures Regulation, there are decontamination standards for any material that has been decontaminated from PCBs. These standards are applicable after chopping (including wire chopping), distilling, filtering, oil/water separation, spraying, soaking, wiping, stripping of insulation, scraping, scarification or the use of abrasives or solvents to remove or separate PCBs. The standards are grouped according to:

- Water containing PCBs:
  - less than 200 ppb PCBs if water to be used in non-contact closed systems where there are no releases
  - less than 3 ppb if water to be discharged to treatment works or ambient water body
  - less than or equal to 0.5 ppb for unrestricted use
- Organic liquids and non-aqueous inorganic liquids containing PCBs (less than 2 ppb)
- Non-porous surfaces in contact with liquid/non-liquid PCBs:
  - For unrestricted use: e.g. Less than 10 µg/100 cm^2 as measured by a standard wipe test, number of samples and sampling scheme is subject to other specifications
  - For disposal in a smelter: <100 µg/100 cm^2 as measured by a standard wipe test

There are also standards listed for self-implementing decontamination procedures. These are listed for decontamination of a PCB container, a non-porous surface in contact with mineral oil containing varying degrees of PCBs (e.g. less than 10000 ppm, more than 10000 ppm, etc.) . Specifications include procedures of cleaning, acceptable solvents that can be used, etc.

Handling of PCB-Containing Transformers. Transformers are best drained on-site before transportation to the specialist retrofilling facility. The PCB fluid needs to be transferred to metal drums of appropriate quality for transportation prior to their disposal. It is recommended that absorbent material be made readily available so as to facilitate dealing with any spillage that may occur. To reduce potential exposure to the fluid, it is necessary to avoid all manual operations such as decanting. Mechanical pumping of fluids should be preferred. It will be necessary of course to wear personal protective clothing (PPE) during these procedures to prevent exposure to skin. During draining there will be a need to prevent splashing and any spillage. Precautions will also need to be taken to avoid and prevent the spread of any leaks or overflow. Respiratory protective equipment will be necessary if ventilation is poor***.***

Provisions about the facilities where PCB containing equipments are treated. Facilities that process PCB containing equipments should be designed in a form that it does not threaten the environment or human health. There are detailed provisions related to area, entrances/exits, relationship of

contaminated/clean areas to each other, planning of ground and bench surfaces and for many other characteristics (UNEP, 2002).

Necessary Precautions During Cutting PCB-Containing Equipment. When sealed transformers are dismantled (to allow access to the core), there is the possibility that PCB vapor, fumes or aerosols may be generated. Work practices should be adopted to minimize such emissions. For example, as the temperature increases, so will the vapor pressure of the PCB and hence its ability to form a vapor. This effect can be very pronounced at higher temperatures. The vapor pressure of Aroclor 1260 increases ten-fold between 300°C and 600°C and that of Aroclor 1248 increases a hundred-fold between 0°C and 500°C. There is also some evidence that under certain conditions, temperatures of between 200°C and 450°C can produce slow formation of furans and that with higher temperatures, between 450°C and 700°C dibenzofuran generation is possible. Because of this, it is clear that any sort of flame cutting or welding process should be avoided if it is reasonably practicable to do so. The heat from the flame will not only vaporize PCBs on the surface of the piece being cut, but will spread to adjacent parts and increase the volatilization of nearby PCBs.

Capacitors need to be punctured and drained (if they contain liquids) in a way that minimizes the production of aerosols or vapor. If this is an automated process, testing will confirm that any aerosol or vapor is confined to areas around the process where there are unlikely to be any personnel. If this process is performed manually then local exhaust ventilation may be required.

Mechanical cutting of equipment is the preferred option, but it should be remembered that it can generate localized heat or cause aerosol formation. These effects are most pronounced when cutting speeds are high. It is therefore recommended that when mechanical cutting is used, cutting speeds are reduced to as low as possible consistent with effective use (UNEP, 2002).

Handling PCB-Containing Capacitors. Capacitors are best removed from the site of origin as whole units and placed in metal containers that can be sealed to await transportation to a licensed storage site or a licensed disposal plant. Leaking units require specialized handling. It is recommended that all leaks be absorbed with sawdust, sand or earth and the units and the contaminated absorbing material, be stored in metal containers ready for disposal. As capacitors are likely to contain more volatile congeners, large spills or spills in confined spaces may require respiratory protection, as well as skin protection measures.

Necessary Measures to be Taken Throughout the Processes Related to PCB Containing Equipments. During establishment of health and safety measures, to protect employees and public from chemical hazards there are three different methods in order for preference (UNEP, 2015a):

1. Keeping employees and public away from all possible contamination sources
2. Controlling contaminants in order to minimize any possible exposure
3. Protecting employees with suitable PPE

Exposure to high dose of PCBs results in symptoms such as, chloracne, headache, irritation in eye, sore throat and numbness. Although there are no common maximum limits for exposure, e.g. in the United Kingdom, for Aroclor 1242, which contains 42% by weight chlorine, maximum threshold value for long term exposure is 1 mg/m^3. This value is determined as 0.5 mg/m^3 in Germany for Aroclor 1254, which contains 54% by weight chlorine. Health and safety measures differ among high risk (places/states where high concentration and volume of PCB waste exist and exposure of employees and public to those wastes are highly probable) and low risk situations (though not quantified, low amount or concentration

of PCB waste is present, and under controlled conditions places/states contain low amount of PCB waste and human exposure probability is low) (UNEP, 2015a).

While working with equipments that are known or suspected to contain PCBs, some restrictions/requirements should be established related to personnel and working conditions for following titles:

- Ventilation conditions of working place
- Properties of compulsory PPE
- Compulsory use of masks and their characteristics
- Environmental monitoring to be conducted
- Necessary actions in case of spill
- Emergency plans etc.

Technologies for the Disposal of PCB Containing Equipments. Pretreatments for environmentally sound disposal of PCB containing wastes (i.e. desorption, dewatering), technologies that destroy PCB irreversibly and technologies applied where other disposal methods are not preferred owing to environmental considerations are mentioned in the General Technical Guideline dated 2015, accessible from the Basel Convention Secretariat website (UNEP, 2015a). Valid technologies are listed in Table 6.

Table 6. Environmentally sound disposal technologies for PCB wastes (UNEP, 2015a).

Technologies which irreversibly destroy PCBs	Other removal technologies where the technologies which irreversibly destroy PCBs are not environmentally preferable
Alkali metal reduction	Specially designed sanitary landfill
Base Catalyzed Destruction (BCD)	Permanent storage in underground mines and formations
Catalytic hydrodechlorination (CHD)	Other remediation methods for low PCB content wastes
Cement Kiln Co-Processing High Temperature Treatment	
Gas-Phase Chemical Reduction (GPCR)	
Hazardous Waste Incineration	
Plazma Arc	
Plasma Melting-Decomposition (PMD)	
Supercritical water oxidation (SCWO) and subcritical water oxidation	

6.4. Retrofilling of PCBs/PCB containing equipments

Among PCB containing equipments, the most important ones are transformers both in terms of functioning and economy. Retrofilling of the transformer means draining of the dielectric fluid of corresponding equipment and filling it with non-PCB oil. As explained before, since the interiors of transformers are complex, this operation can last considerably long. The actual important problem is

that transformers generally include wooden and paper components as well. These materials are porous and they absorb PCB contaminated oil. Therefore, it is impossible to separate all PCB from oil in a relatively short time. No matter how perfectly care is be taken to remove the oil in transformer tank as much as possible and leaving transformer in standby for 2 hours to let the surface oil on its windings drain away, there will still remain some confined contaminated oil in main chamber and windings.

In the end, when new and clean oil is added to the previously PCB containing oil transformer, residual PCBs in porous components gradually leak to this new oil. In several weeks or more (for example in Canadian protocols a 90 day period is applied), measured PCB level in new transformer oil can increase slowly, and can even exceed the legally permitted value. For instance, in distribution transformers' main chamber and windings, usually 10% of PCB retention is found and 90 days later after the cycle of loading new oil PCB contamination is considered to reach an equilibrium in this retention. So if the original oil was contaminated with 500 ppm PCBs, new and clean oil, after 90 days may be expected to reach an equilibrium PCB level of 50 ppm.

The time for a transformer to stop leaching PCBs back to the clean oil depends on the equipment size and structure. In some instances retrofilling may be needed to be repeated a few times which can last more than several months. Before making a decision about retrofilling, many factors should be considered. These details, such as Retrofilling Control List can be found in related documents of UNEP (UNEP, 2002).

Required Measures while cleaning equipments to remove PCBs. If transformers are cleaned using solvents, exposure to these solvents should be taken into account and precautions should be taken. Reducing exposure at the workplace can be achieved either by increase of ventilation or decrease for the need of an operator. Usage of PPE against residual hazards should be considered a last resort.

6.5. Sites Contaminated with PCBs

Within the By-law on Control of Soil Pollution and Sites Contaminated by Point Sources (Date: 08.02.2010, No: 27607) if an area is defined as a "contaminated site" after a two-tier evaluation, then site remediation should be initiated. The electronic database established in conjunction with the regulation was initiated, and institutions are making data entries and field trips are being conducted by corresponding district's directorates. In current stage, at the initial stage a site that is denoted as a "suspected contaminated site", a second-tier investigation is carried out, after which if a decision as "contaminated site" is made, then cleaning/remediation studies should be initiated. Countries that are parties of the Stockholm Convention, some of which are also bound by the EU legislation, identified all suspected and established contaminated sites in their respective countries and prepared management plans for these sites. In Turkey, corresponding regulation was put into effect in 2010 and is just starting to be applied. Therefore, similarly in Turkey, sites suspected to be contaminated by PCBs will be expected to be determined in the coming years.

There are many studies in the literature, which determine the PCB concentrations in rural and industrial (Aliağa-İzmir, Gölbaşı-Ankara, İskenderun-Hatay) areas (Gedik & İmamoğlu, 2010). One contaminated site was identified by Yeniova (1998) in a transformer repair and maintenance facility. Moreover, sediments of Mersin, Boğaziçi, Aliağa, Akdeniz, Bosphorus, Ankara Creek were investigated in terms of their PCB levels (Gedik & İmamoğlu, 2010). Observed concentrations can be correlated with industrial

activities. In Aliağa, the electric arc furnaces used for steel manufacture was found to emit significant concentrations of PCBs (Odabaşı, 2009). The study of Odabaşı and others (2009) indicated that electric arc furnaces are significant sources for unintentional POPs emissions, especially PCBs. Atmospheric concentrations of PCBs were shown to be much higher than previously recorded levels in the region and the World in general. These illustrate that steel manufacturing plants with electric arc furnaces can be "hot spots" for POPs including PCBs. There is a possibility that contaminated sites may be identified in regions where such activities are undertaken.

PCB contaminated sites may exist in the vicinity of places where PCB containing equipment are used/drained/retrofilled/recovered under unsuitable conditions. Similarly, contaminated sites may be present around facilities which uses PCB related materials such as carbonless copy paper production or use of PCBs as plasticizers. Improper disposal of PCB oils can result in the formation contaminated sites (Gedik & Yurdakul, 2014). When PCB oils are burnt in a temperature lower than the optimum conditions (i.e. truck engines, house heating processes) it can result in toxic dioxin emissions.

6.6. PCB Analyses and Monitoring Activities

PCB analyses and monitoring activities should be carried out in places where decontamination, disposal, storage or metal recovery from previously PCB containing equipments are performed. These activities differentiate from each other in terms of sampling frequency, number and times depending on the situation. For instance, there are some basic monitoring procedures in places where PCBs are used (such as employing indicators sensitive to chlorine vapors). On the other hand, for direct measurement of indoor concentrations of PCBs, there are more complicated methods (sampling, extraction then gas chromatographic analysis) (UNEP, 2002).

For environmental exposure, only station with continuous monitoring data in Turkey is situated in Çamkoru, which is a rural background sampling station employing passive samplers. Continuous monitoring has been sustained since 2009 with partnership between RECETOX - Chechia Stockholm Convention Regional Center and Middle East Technical University (METU) Department of Environmental Engineering (http://www.genasis.cz). From December 2009 to May 2013 average total PCB concentrations (for a total of 7-indicator PCBs) is 34 pg/m^3 and each congeners average concentration is 5 pg/m^3. These concentrations are either comparable or lower than the results from other monitoring stations throughout the world.

From the findings of the new biomonitoring study by Odabaşı et al. (2015), it appeared that even though PCBs and polychlorinated naphthalenes (PCN) have never been produced and banned over thirty years ago, owing to increased number of the local sources, especially scrap-processing iron-steel facilities and ship dismantling places, their concentrations are increased. As also emphasized in the revised NIP, while universities conduct some monitoring studies within research projects, it is crucial to set up a monitoring network throughout Turkey, including rural/urban regions with different properties, that will be continuously sustained throughout the years.

6.7. Turkey's Current Status Regarding Training Requirements for PCB Management Issues

In Turkey, following the By-law on Control of PCB and PCTs (published on 27.12.2007 no: 26739), a number of training activities were conducted as part of national and international efforts, including the training as part of this project. Details of these activities are given in Annex III.

7. OVERVIEW AND RECOMMENDATIONS

As the negative impact of PCBs on the environment and humans was noticed during the 1970s, their production was stopped, first in Japan in 1972 and lastly in Russia in 1993, as can be seen in Table 7. PCBs were banned in the USA in 1979, in the EU in 1985, and in Turkey, 11 years later, in 1996. Thus, even though PCBs were not produced in Turkey, there was quite a long period of time for them to be imported and extensively used as documented by related research (Gedik & İmamoğlu, 2010). Even though the regulation related to the banning of PCBs was formed in 1996, the one directly related to PCBs and PCB including equipment was published in 2007, as is described in detail in section 3.1.1. of this report. The first NIP under the Stockholm Convention was first prepared between 2005 and 2008, and was officially accepted in 2010. The revision of the NIP with the inclusion of new POPs was carried out between 2014 and 2016, and was sent to the Stockholm Secretariat. As is described in detail within this report and the training in November 2016, the regulations related to the management of PCBs in Turkey is quite recent, all put into effect within the last 10 years.

Table 7. Global PCB production (Brievik et al., 2007).

Total PCB production as reported in the literature (in tonnes)

Producer	Country	Start	Stop	Amount	%
Monsanto	USA	1930	1977	641,246	48.4
Bayer AG	West Germany	1930	1983	159,062	12.0
Orgsteklo	U.S.S.R. (Russia)	1939	1990	141,800	10.7
Prodelec	France	1930	1984	134,654	10.2
Monsanto	U.K.	1954	1977	66,542	5.0
Kanegafuchi	Japan	1954	1972	56,326	4.2
Orgsintez	U.S.S.R. (Russia)	1972	1993	32,000	2.4
Caffaro	Italy	1958	1983	31,092	2.3
S.A. Cros	Spain	1955	1984	29,012	2.2
Chemko	Czechoslovakia	1959	1984	21,482	1.6
Xi'an	China	1960	1979	8,000	0.6
Mitsubishi	Japan	1969	1972	2,461	0.2
Electrochemical Company	Poland	1966	1970	1,000	<0.1
Zaklady Azotowe	Poland	1974	1977	679	<0.1
Geneva Industries	USA	1971	1973	454	<0.1
Total	Global	1930	1993	1,325,810	100

Globally accepted models and recommendations for Turkey.

The most important component in the management of PCBs is to accurately identify the total number of equipment where PCBs are used in closed applications. Ongoing inventory work, coordinated preferably by a permanent group of researchers is essential to come up with meaningful data through the years. Global examples indicate that such inventory teams include experts, law-enforcement agencies (responsible ministries, etc.), important stakeholders from the public and private sector.

Additionally, awareness rising in stakeholders is the foundation of a sustainable management system. It is imperative to inform the public using print and/or electronic media. Raising awareness within small and large scale industries, for example, sectors operating in remote locations where there is no connection to the interconnected electricity system, such as, mining, should not be forgotten. Public awareness campaigns should be diversified considering small scale urban industrial activities (such as scrap metal processing, repair, etc.) since they could be sources of PCBs, due to discharge of PCB containing wastes into the municipal wastewater collection system. Falling behind in such activities could lead to PCB containing oils to be burnt in unsuitable conditions, illegally sold or mixed into fuels, which would create an extremely dangerous situation due to generation of dioxins and should be avoided.

UNEP has documented success stories and lessons learned for preparation of NIPs, which also include models and examples regarding management of PCBs (UNEP, 2006). Relevant lessons learned from other countries are summarized below:

- Link PCB inventories with labeling schemes as an integrated part of a PCB register to secure sustainability.
- Defining further work needed to prepare more comprehensive and detailed inventories.
- Mandates for continuing work should be clear and incorporated into the regulatory framework.
- Relating the inventory with regulatory requirements pertaining to PCB containing equipments, such that, it does not only relate to identification and labeling, but also to registration, storing and disposal.
- Definition of inspection and reporting mechanisms to clearly identify responsibilities of all parties involved.

POPs monitoring activities are currently being conducted at the institutional level and only at very limited areas in Turkey. European Union monitoring and contamination modeling studies indicate that considering only industrial sources is not sufficient, and that emissions from contaminated sites could also be significant. There could be sites that are seemingly uncontaminated (below threshold concentrations), but significant in terms of emissions. In this context, in line with legislative requirements, and in order to accomplish relevant deductions for Turkey, monitoring studies should immediately be started:

- In a variety of areas (urban and rural)
- In areas either contaminated with POPs or in proximity to areas where POPs are stored.
- In various matrices (air, soil, mothers' milk, plants, fish, etc.)
- For all POPs
- Long-term (continuous)

Monitoring activities should be seen as a continuous activity, just like the inventory stage. Problems cannot be discovered unless the current situation is known. Monitoring systems provide this essential information. Guideline regarding the global monitoring plan for POPs was translated to Turkish, and is currently available online at the website of the Ministry of Environment and Urbanization (UNEP, 2013).

Prevention of unintentional PCBs is one of the main steps of PCB management. Technical guidelines on the best available techniques and best environmental practices (BAT/BEP) to reduce PCBs and dioxins by the Stockholm Convention are available (UNEP, 2008). Support in this area is also planned as part of the POPs Legacy Elimination and POPs Release Reduction Project.

A review of national and international legislation indicates that even though there is a congruence between main legislation regarding the management of PCBs in Turkey and the world, the mandates and fines are insufficient for the necessary activities to take place. In addition to such fines, mechanisms to compensate for these would lead to the desired outcomes. For example, Canada (1995) discovered that the lack of alternatives for removal and disposal of PCBs as the most important reason for the inability of identification and disposal of commercially and widely used equipment containing PCBs. Specification of consistent and comprehensive technical methods and guidelines is critical, as was emphasized in section 6.1.3. As a specific example on technical methods (CCME, 1995):

- To enable reuse of decontaminated transformers that originally had PCB contaminated mineral oil:
  - together with the criteria on PCB level in oil as 50 mg/kg,
  - time criterion (transformer is used for 90 days after decontamination and the PCB level in oil is measured), and
  - surface contamination criterion

  are proposed to be adopted.

On the other hand, Australia states that, metal parts can be recycled or recovered, provided that there are less than 1mg/1m^2 PCBs left on non-porous surfaces. United States requires less than 100 µg/100 cm^2 PCB concentration via the standard wipe test, for any material to be disposed off in a smelter. Mobile or hot retrofill decontamination methods are recommended to clean PCB contaminated transformers that are to remain operational. The success of these decontamination methods depends on strict adherence to the decontamination criteria.

Article 10 of the Stockholm Convention (regarding informing, raising awareness and education of the public) states that the parties will endeavor to develop contaminant release and registration mechanisms to gather and disseminate information on the estimated amounts of the release and disposal of chemicals listed in Annexes A, B and C. In this regard, as stated in section 3.2.5, Pollutant Release and Transfer Register (PRTR) system has been established in the EU (EU PRTR Directive 166/2006). Gathering information on the amount of contaminant emissions which are open to public, allows active public participation in the process, and enables a control mechanism. It is recommended for Turkey to take steps towards establishment of an e-PRTR system as well.

Management of hazardous, persistent chemicals, which include PCBs requires complex, long term planning. Some general recommendations to succeed in these efforts are summarized in the next panel.

Sound chemical management governance
Acting across government and amongst a wide-range of stakeholders to build an enabling environment
Using economic and market-based instruments
Increasing monitoring to focus interventions
Roles and responsibilities of industry
Building sound chemicals management into sustainable economies
Assisting Parties to implement strategical approaches regarding chemicals and waste
Building regulatory and technical capacities
Enhancing monitoring and assessment networks
Improving access to viable, safer alternatives and techniques

Turkey has accomplished a lot on the management of PCBs and PCB containing equipment, but there is still a lot of ground to cover. In this regard, the short-, middle- and long-term tasks that are suggested are summarized in Figure 2.

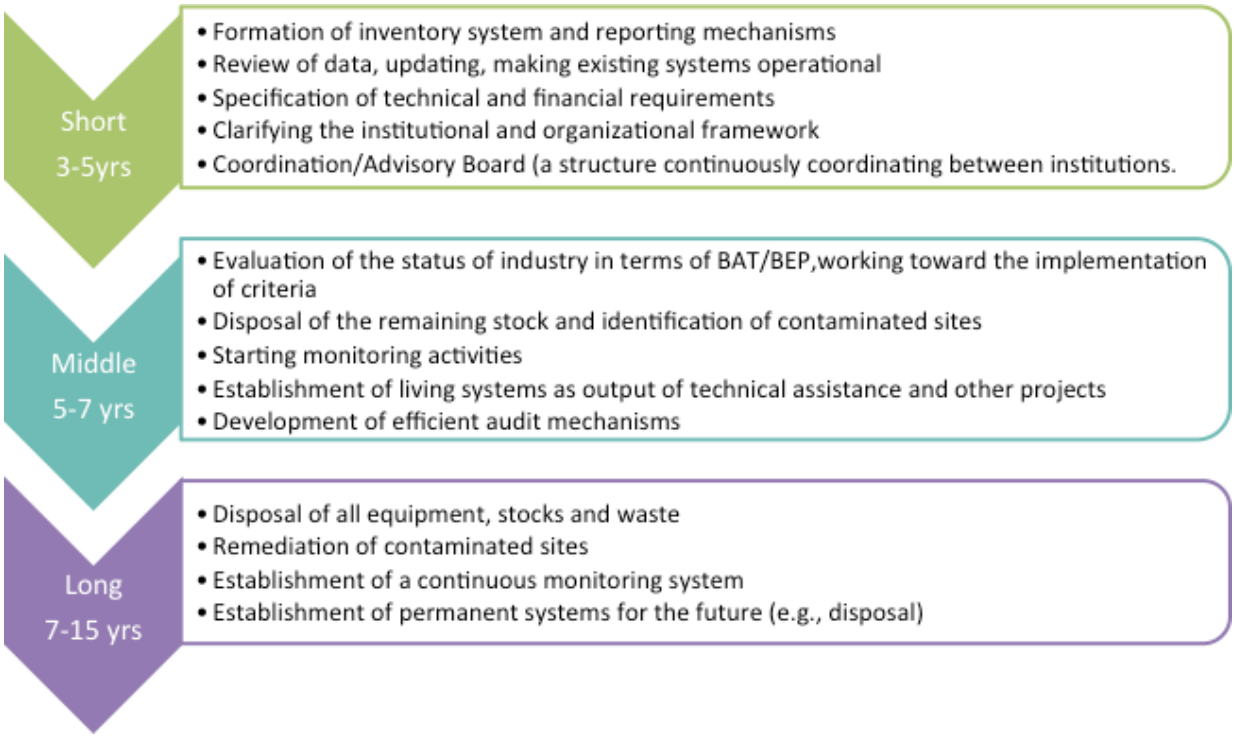

Figure 2. Short-, middle- and long-term activities proposed for the management of PCBs in Turkey.

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ANNEXES

Annex I – List of equipment containing PCBs that are identified and sent for disposal as part of the UNEP MAP Project

Annex II – Latest PCB inventory (May 2016) as obtained from the Ministry of Environment and Urbanization

Annex III - Turkey's Current Status Regarding Training Requirements for PCB Management Issues

Annex IIIA – Training Needs Assessment Survey prepared as part of POPs Legacy Elimination and POPs Release Reduction Project Component 2.1.1.

Annex IIIA – Training Program prepared as part of POPs Legacy Elimination and POPs Release Reduction Project Component 2.1.1.

ANNEX I

List of equipment containing PCBs that are identified and sent for disposal as part of the UNEP MAP Project

No	Sector	Contaminated Equipment	No of contaminated equipment	Wt of contaminated equipment (kg)	Wt of contaminated or pure PCB oil (kg)	Location of equipment
1	Fertilizer	Transformer	1	27000	10200	Kocaeli
2	Electricity Generation	Transformer	6	17000	6000	İstanbul
3	Electricity Transmission	Capacitor	63	3150	-	Kırklareli
4	Electricity Transmission	Capacitor	37	1900	-	Tekirdağ
5	Electricity Transmission	Capacitor	73	3650	-	Şanlıurfa
6	Iron and steel	Capacitor	293	14650	-	Hatay
7	Sugar	Transformer	14	66080	20300	Eskişehir
8	Mining	Transformer	2	4050	1314	Balıkesir
9	Mining	Varil	7	-	-	Kütahya
10	Electricity Generation	Transformer	2	8000	2000	Manisa
11	Electricity Generation	Transformer, İzolatör	4, 2	14900	2570	Aydın
13	Sugar	Transformer	11	52780	15250	Burdur
14	Mining	Transformer	3	9600	3270	Antalya
15	Electricity Transmission	Capacitor	74	3700	-	Antalya
16	Electricity Transmission	Transformer	1	2069	785	Zongulda k
17	Iron and steel	Transformer	43	264812	94592	Zongulda k
18	Iron and steel	Capacitor	6	300	-	Zongulda k
19	Electricity Transmission	Transformer	1	1000	300	Tokat
20	Sugar	Transformer	7	26000	7590	Tokat
21	Electricity Transmission	Capacitor	1938	97800	-	Kayseri

ANNEX II

Latest PCB inventory (May 2016) as obtained from the Ministry of Environment and Urbanization

No	No of equipment	Type of equipment	Producer	Power	Isolation Liquid	Total weight (kg)
1	4	Transformer	General Electric	750 kVA	Pyranol	11064
2	2	Transformer	Westinghouse	750 kVA	Inerteen	5572
3	54	Transformer	Westinghouse	750-7500 kVA	Inerteen	326176
4	9	Transformer	AEG	750-1600 kVA	Clophen, Technol	38190
5	5	Transformer	General Electric	638-7500 kVA	Pyranol	45109
6	1	Transformer	Standart	1000 kVA	Askarel	3742
7	1	Transformer	Brush	800 kVA	Pyranol	3920
8	1	Transformer	ETITAS	1500 kVA	Technol	4915
9	2	Transformer	YTM	355kVA	Sovtol	7000
10	261	Capacitor	VEB Isokond	3,64kV		13050
11	8	Transformer				52543
12	27	Capacitor		125 kVA	Askarel	1350

Ministry of Environment and Urbanization official correspondence, Document No: 51475790-145.01-E.4585

ANNEX III

Turkey's Current Status Regarding Training Requirements for PCB Management Issues

Previously Organized Activities

In Turkey, following the By-law on Control of PCB and PCTs (published on 27.12.2007 no: 26739), a PCB Specific Expert Commission was established for one year between 2009-2010. Within the scope of this commission, the following trainings were conducted with the partnership of Ministry of Environment and Forestry:

- On 16-17 April 2009 in Ministry Building, Ankara to the staff of District Environment and Forestry Directorates from 81 districts
- On 25-26 June 2009 in Ministry Building, Ankara to 57 representatives of 39 different sectors

Within "Project of Environmentally Sound Management of PCBs in Turkey", trainings were conducted related to disposal of PCB containing equipment and materials, preparation of inventory for PCB containing equipments, capacity building in PCB related sectors, education and increasing public awareness. This project was governed as a sub component of Mediterranean Wide Ecosystems Strategic Partnership Project (MedPartnership), financially supported by Global Environmental Fund (GEF) and executed by United Nations Environmental Program/Mediterranean Action Plan (UNEP/MAP). As part of this project, a variety of trainings were performed for the identification, draining, packing, disposal of pure PCB transformers in July 2015 in specified facilities, such as IGSAŞ, EÜAŞ, Ambarlı Facility.

Lastly, in the scope of the "Technical Assistance for Implementation of the POPs Regulation in Turkey (EuropeAid/ 132428/D/SER/TR)" project, eight trainings (Training of Trainers) were conducted for which details are given below. Even if they are not specifically prepared for PCBs, as PCBs are one of the POPs, trainings related to POPs are also valid for effective management of PCBs. Especially the first five trainings are considered to provide a solid background for participants as part of the POPs Legacy Elimination and POPs Release Reduction Project - Component 2:

- Legal instruments for the implementation of the POPs Regulation and prioritization for national priorities and objectives – 11 – 15 November, 2013, 35 participants
- National Implementation Plan preparation – 09 – 13 December, 2013, 26 participants
- Standard Toolkit for POPs inventory procedures and preparation – 13 – 17 January, 2014, 22 participants
- BAT and BEP Guidelines concerning POPs – 17 – 21 February, 2014, 34 participants
- POPs monitoring, remediation of contaminated sites, evaluation of the effectiveness of the Regulation – 17 – 21 March, 2014, 28 participants
- Reporting under Stockholm Convention and POPs Protocol – 14 – 18 April, 2014, 20 participants
- Sectoral Impact Assessment methodology – 26 – 20 May, 2014, 21 participants
- Regulatory Impact Assessment and social, economic and environmental impacts of the POPs Regulation – 20 – 24 October, 2014, 23 participants

Training Performed as Part of the Project

As part of the training planned in Component 2 of the POPs Legacy Elimination and POPs Release Reduction Project, Training Needs Assessment is conducted and afterwards the effectiveness of the training is assessed. Both are given below.

Training Needs Assessment. In order to determine the level of information of the participants that will attend the training, a survey given in Annex IIIA was prepared. After correspondence with the Ministry of Environment and Urbanization, the survey was sent to related partners, hence data regarding the level of education of participants was obtained. A total of 19 surveys were collected, and the following information was obtained:

Distribution of respondents	
Ministry of Environment and Urbanization and other ministries	**47%**
Other Institutions (TŞFAŞ, İZAYDAŞ, İGSAŞ etc.)	**32%**
Not identified	**21%**

Awareness of POPs/PCBs	
No information related to POPs	**16%**
No information related to PCBs	**11%**

Conducting PCB related activities in the workplace	
Ratio of the respondents carrying out PCB related activities	**47%**
Ratio of the respondents conducting reporting/monitoring activities	**21%**

Level of knowledge on PCB related national/international legislation	
Level of knowledge on PCB related national legislation	No information: **5%** Skimmed a few times: **85%** Well known: **5%** Very well known: **5%**
Level of knowledge on PCB related international legislation	No information: **22%** Skimmed a few times: **68%** Well known: **5%** Very well known: **5%**

Participation in PCB related training activities	
Participated in PCBs/POPs related opening/other meetings	**47%**
Participated in PCBs/POPs related training activities	At least one training: **47%** Never: **53%**

According to the replies of the respondents, the two-day training program, given in Annex IIIB was designed. Methods and materials used in this program are identified as the following:

- Formal presentation (Computer assisted PowerPoint presentations)
- Discussions after each topic in terms of question & answer sessions
- Working Group sessions: by forming groups among participants, interactive discussion on a case study and its presentation by the participants
- Survey for evaluation of the effectiveness of the training
- Supplying training materials to participants in a downloadable manner through project's webpage (kalicikirleticiler.com)

Evaluation of the Training. Within the specified framework, training titled Management of PCBs and Legislation was carried out on 3-4 November 2016, at Ankara Limak Ambassadore Hotel with 77 participants. Apart from formal lectures, participants were encouraged to participate in interactive discussions, and at the end of the training, they were grouped in five and evaluated the distributed case studies. At the end of the training, a survey was applied to participants for the evaluation of the training. In the survey, both the content (main topics of the training were given title by title), and the various modes of training (presentation technics, working group activity etc.) and finally organizational issues were assessed. A total of 27 participants (35 % of the participants) filled the survey and the data obtained is presented in Figure 1.

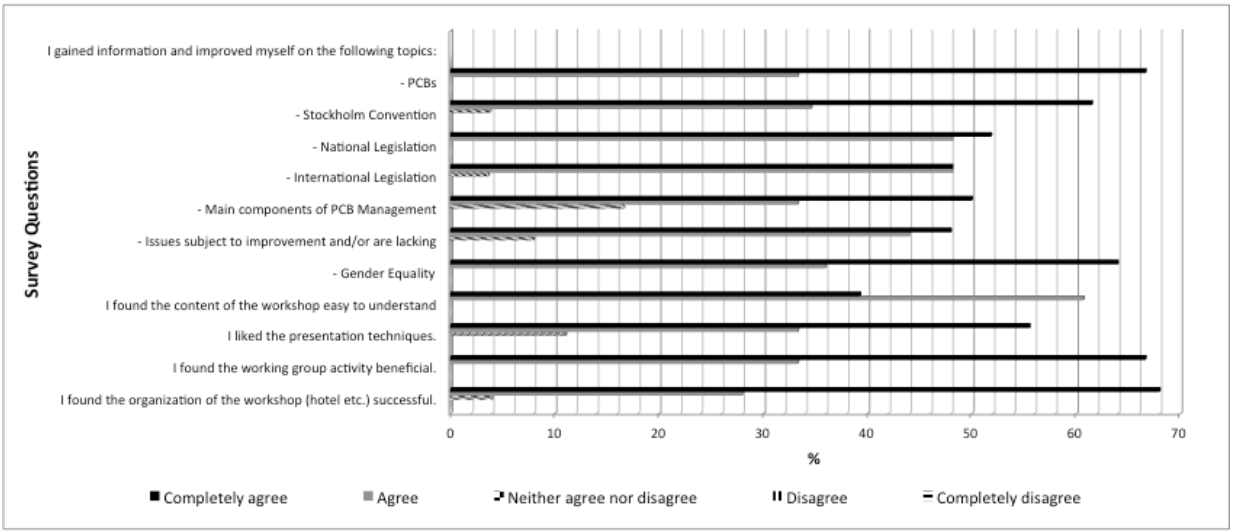

Figure 1. Outcomes of the training evaluation survey.

As can be understood from Figure 1, all participants provided very positive feedback about the training. None of the participants replied with a negative answer ("completely disagree" and "disagree"), to any of the questions. Regarding the topics: PCBs, national legislation and gender equality, all of the respondents stated that they were now better informed about these issues and improved themselves (sum of the answers of "completely agree" and "agree" was 100%). For the other subjects (such as main components of PCB management, issues subject to improvement and/or those that are lacking) only 4 - 16% of the participants chose the "neither agree nor disagree" response. Similarly, the content of the training, working group activities were also found to be very successful.

Participants indicated that the content of the training was very comprehensive and it was very successful, in survey's freestyle feedback section. Beside these positive comments, it was also suggested that due to the very comprehensive content of training, the duration period could have been extended to 3 or 4 days. Other issues pointed out by the respondents are listed below:

- Training for on-site identification of PCBs would be helpful.
- Elaboration of the national legislation by the Ministry's corresponding units would be useful.
- More examples can be incorporated into the training.
- It would be a good idea if such expert people in their field also participated in the continuing education series currently held within the Ministries.

Lastly, at the end of the training, participants verbally pointed out that the training materials distributed were very detailed and meticulously prepared and that they would be a valuable resource for the future.

ANNEX IIIA

POPS LEGACY ELIMINATION AND POPS RELEASE REDUCTION PROJECT COMPONENT 2.1.1.

TRAINING NEEDS ASSESSMENT SURVEY

Name:
Surname:
Institution/Section:

1) Do you have information about persistent organic pollutants (POPs)?

2) Do you have information about PCBs?

If your answer is NO to questions 1 and 2, then you can terminate the survey.

3) Write down the total number of personnel in your institution that is dealing with PCBs and/or POPs:
Please add the below information for this personnel:

Name-Surname	Title	Level of Education/Expertise	Responsibility in Institution regarding PCBs

4) Are there any activities carried out in your institution regarding PCBs and/or POPs? If your answer is Yes, please summarize:

5) Are regular reporting/monitoring activities conducted at your institution regarding PCBs and/or POPs? If your answer is Yes, please summarize:

6) Please indicate your level of knowledge on national regulation pertaining to PCBs by marking on the sentence that applies to you:
..... I know it very well, evaluate the legislation due to my responsibilities continuously
..... I know it well
..... I have skimmed the documents a few times
..... I have no information about the legislation

7) Please indicate your level of knowledge on international legislation pertaining to PCBs by marking on the sentence that applies to you: :
..... I know it very well, evaluate the legislation due to my responsibilities continuously
..... I know it well
..... I have skimmed the documents a few times
..... I have no information about the legislation

8) Have you participated in the preparation of Turkey's National Implementation Plan? If your answer is Yes please indicate your level of involvement:

9) Have you attended project opening/closing/informative meetings regarding PCBs and/or POPs? If more than once, please specify the number of times:

10) Have you participated in training or workshops on PCBs and/or POPs?

If your answer is Yes, please indicate below which trainings you attended. You can also write the name of the training if not present in the list.

Training	**Attended**
16-17 April 2009 PCB Specific Expert Comission – Training on PCBs	
25-26 June 2009 PCB Specific Expert Comission – Training on PCBs	
15-17 July 2013 Training on Management of PCBs – Theoretical Training	
18-19 July 2013 Training on Management of PCBs – Practical Training	
11-15 November 2013 Legal instruments for the implementation of the POPs Regulation and prioritization for national priorities and objectives	
09-13 December 2013 National Implementation Plan preparation	
13-17 January 2014 Standard Toolkit for POPs inventory procedures and preparation	
17-21 February 2014 BAT and BEP Guidelines concerning POPs	
17-21 March 2014 POPs monitoring, remediation of contaminated sites, evaluation of the effectiveness of the Regulation	
14-18 April 2014 Reporting under Stockholm Convention and POPs Protocol	
16-20 May 2014 Sectoral Impact Assessment Methodology	
20- 24 October 2014 Regulatory Impact Assessment and social, economic and environmental impacts of the POPs Regulation	
Other (please specify):	

Thank you for your time and patience.

ANNEX IIIB
TRAINING PROGRAM

POPS LEGACY ELIMINATION AND POPS RELEASE REDUCTION PROJECT Component 2.1.1. Technical annex and guidance documents regarding the existing PCB regulation Training Program on Management of PCBs and Legislation		
Limak Ambassadore Otel, Ankara 3-4 November 2016		
Day I	**Topic**	**Presenter**
09:00 – 09:45	Arrival of Participants and Registration	
09:45 – 10:00	Opening Speeches	Ministry of Environment and Urbanization UNIDO
10:00 - 10:40	General Information about POPs and PCBs	Prof.Dr. İpek İmamoğlu
10:40 – 11:00	Tea/Coffee Break	
11:00 – 11:30	Stockholm Convention	Prof.Dr. İpek İmamoğlu
11:30 – 12:00	By-law on Control of PCBs and PCTs	Ministry of Environment and Urbanization
12:00 – 12:45	Main Components of Management of PCBs	Prof.Dr. İpek İmamoğlu
12:45 – 13:45	Lunch Break	
13:45 – 15:00	Main national legislation and responsibilities regarding management of PCBs - I	Prof.Dr. İpek İmamoğlu
15:00 – 15:30	Tea/Coffee Break	
15:30 – 16:30	Gender equality	Zeliha Ünaldı
16:30 – 17:00	Main national legislation and responsibilities regarding management of PCBs - II	Prof.Dr. İpek İmamoğlu

POPS LEGACY ELIMINATION AND POPS RELEASE REDUCTION PROJECT Component 2.1.1. Technical annex and guidance documents regarding the existing PCB regulation Training Program on Management of PCBs and Legislation		
Limak Ambassadore Otel, Ankara 3-4 November 2016		
Day II	**Topic**	**Presenter**
09:00 – 09:45	Arrival of Participants and Registration	
09:45 – 10:30	International legislation and responsibilities regarding management of PCBs	Prof.Dr. İpek İmamoğlu
10:30 - 11:00	Tea/Coffee Break	
11:00 – 12:30	International legislation and responsibilities regarding management of PCBs, examples of PCB management, methods, models	Prof.Dr. İpek İmamoğlu
12:30 – 13:30	Lunch Break	
13:30 – 15:00	Working Group	
15:00 – 15:30	Tea/Coffee Break	
15:30 – 16:30	Working Group Presentations	
16:30 – 17:00	Question and discussion, evaluation of training	
17:00	CLOSING	