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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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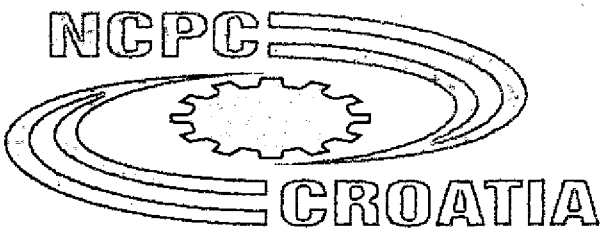


# REPUBLIC OF CROATIA

## *NATIONAL IMPLEMENTATION PLAN*

## *FOR THE*

## *STOCKHOLM CONVENTION*

**(Rev. 1)**

June 2006

Content:

# Executive Summary

## Introduction

The National Implementation Plan (NIP) for implementation of the Stockholm Convention in the Republic of Croatia is developed within the framework of the project "*Enabling Activities to Facilitate Early Action on the Implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs) in the Republic of Croatia*" (UNIDO project GF/CRO/02/007). The Project is financed by GEF (Global Environmental Facility) in co-operation with UNIDO (United Nations Industrial Development Organisation) as the implementation agency.

The Croatian Cleaner Production Centre was appointed by the Ministry of Environmental Protection and Physical Planning as the national focal point for this project in the Republic of Croatia.

The objective of the Project was to ensure timely preparation for the Republic of Croatia for the implementation of the Stockholm Convention requirements regarding reduction/elimination of use and release of persistent organic pollutants (POPs) into environment.

Implementation of the Project included five phases, as follows:

- determining co-ordinating mechanism and organising process
- establishing POPs inventory and assessing national infrastructure and capacity
- priority setting and determining objectives
- formulating a NIP, and specific action plans on POPs
- endorsing the NIP by stakeholders

The Project completion will expedite Croatian ratification of the Stockholm Convention.

## Requirements of the Stockholm Convention

The Convention was adopted and signed on 23 May, 2001. It is directed to reducing or - where it is appropriate - eliminating releases of 12 POPs (aldrin, chlordane, dieldrin, DDT, endrin, heptachlor, mirex, toxaphene, hexachlorobenzene, PCBs, PCDD/PCDFs) into environment. Convention came into force on May 17, 2004. The Convention prescribes the conditions to be fulfilled by the Parties in order to ban production, use, import and export of POPs chemicals on global level. As a consequence, the releases into environment would be considerably reduced or even eliminated. Croatia has signed, but still not ratified the Stockholm Convention.

## Assessment of the POPs issue in Croatia

### 1. *Assessment for ANNEX A, part I POPs chemicals (POPs pesticides)*

There is no production, import, export and use of POPs pesticides, which is in line with the current legislation, in Croatia. Chlordane was banned in 1971, aldrin, dieldrin and DDT in 1972, HCB in 1980, toxaphene in 1982. The last banned POPs pesticide was endrin, which was withdrawn form use in 1989. Mirex has never been permitted for commercial use in Croatia.

No stockpiles, waste or locations contaminated with POPs pesticides have been detected by the inventory of POPs pesticides so far.
According to legal regulations, environmental levels of POPs pesticides have been monitored in waters only (there is no monitoring applied to other environmental media).

Data on the environmental levels of POPs pesticides have been collected either through various projects or by analysis of samples during food inspections. Unfortunately, this practice has not been done continuously.

In accordance with the above mentioned, it is clear that POPs pesticides don't pose a problem in Croatia. The introduction of a systematic monitoring of POPs pesticides in environment, as it is proposed by the Action Plan, will enable an early action on reducing the possible POPs pesticides transboundary pollution from surrounding countries.

## 2. *Assessment for ANNEX A, Part II Chemicals (PCB)*

Current Croatian legal regulations do not ban any import of PCBs and PCBs containing equipment. However, the use of PCBs is legally allowed only in closed systems.

PCBs have never been manufactured in Croatia, although PCBs containing equipment (transformers and capacitors) were manufactured in the country. PCBs being in use in Croatia are mostly applied in the closed systems (as dielectrics in transformers and capacitors). The use of PCBs in open systems has not yet been identified in Croatia.

The most of installed equipment is old and no reliable information on quantities of PCBs is presently available. However, data referring to total weight of PCBs containing equipment are presented as the quantities of PCBs in closed systems. This kind of assessment, i.e. consideration of total weight of equipment instead of quantities of dielectrics/cooling fluids, is usual from the viewpoint of replacing and final disposal of equipment.

According to latest updated inventory data (2006.), the following quantities of PCBs in the closed systems have been identified Croatia:

- 22 859 capacitors 655 705 kg
- 311 transformers 735 878 kg.

Consequently, the total amount of PCBs identified in closed systems in Croatia is **1 391 583 kg.**

As the inventory shows, even 19 910 capacitors containing PCBs (i.e. 87.1 % of all capacitors used) are still operating in Croatia. Their total weight is 579 055 kg.

The analysis showed that the optimal lifetime of majority of equipment being in use (80 % of capacitors and 90 % of transformers are older than 20 years) has already expired. Therefore, they all should be replaced and finally disposed very soon.

Stockpiles of PCBs comprise equipment with PCBs that is not in function and some liquid PCBs. Both are kept as the back up.

According to the inventory there are 15 transformers with PCBs weighing totally 57 680 kg, and 957 capacitors with PCBs weighing 337 450 kg kept as back up. The recorded weight of the liquid (unused) PCBs stockpiles is around 1 ton.

**<u>Import of PCBs</u>**

In former Yugoslavia (up to the year 1991) Croatia purchased most of the equipment with PCBs (capacitors and transformers) from the Slovenian manufacturer ISKRA, as well as from Serbian companies MINEL and AVALA. Some quantities were imported mainly from the former USSR and DDR. Since the equipment purchased in Slovenia and Serbia (as parts of former Yugoslavia) was not recorded as imported, it was not possible to establish its exact quantities. In addition, there

is no information available about any equipment with PCBs imported since 1991 onward. Namely, it was not possible to establish any traceability due to lack of special customs tariff number for imported transformers and capacitors containing PCBs.

Data on the imported polyhalogenated bi/terphenyls refer to the period 1996-2001 and are generally related to imported PCBs. Actually, polychlorinated biphenyls have their tariff number (along with polychlorinated terphenyls and polybrominated biphenyls) which can provide the information about the imported quantities. According to the Customs Administration, there were imported totally 167 t of liquid PCBs in the period from 1 July 1996 till 31 December 2001.

The Law on Waste bans the import of any hazardous waste, which includes also wastes contaminated with PCBs. Ministry of Environmental Protection, Physical Planning and Construction reported that no waste containing PCBs is being imported in Croatia.

**Export of PCBs**

Since there is no manufacturing of either PCBs or equipment with PCBs (capacitors and transformers with PCBs) in Croatia, the country does not export goods containing PCBs.

The only export of PCBs relates to waste containing PCBs for final disposal, done in accordance with the Basel Convention.

Since 1994 Croatia has exported 267.7 t of waste containing PCBs.

***PCBs waste***

There are no registered transformers containing PCBs for final disposal.

There are 1 992 pieces of PCBs capacitors for final disposal, with total weight 42 900 kg, being currently kept within the plants, i.e. the waste owner in-door area.

There is also around 5 t of liquid PCBs waste.

No legalised landfill site for PCBs waste disposal is operating in Croatia. According to the Inventory of landfills (APO, 1993-1997) there are around 600 registered sites where PCBs might be found in disposed quantities of miscellaneous waste.

## 3. *Assessment of Releases from Unintentional Production of Annex C in Croatia*

In order to identify possible environmental presence of dioxin and furan and to assess their emissions, there were analysed available data and reports by the Ministry of Environmental Protection, Physical Planning and Construction, numerous publications of the State Institute of Statistics, reports by PUTO (hazardous waste incineration plant), such as publications issued by the Croatian Chamber of Economy, Ekonerg and UNEP Toolkit.

The assessment of overall environmental emissions of PCDD/PCDF in the year 2001 is presented in the following table.

*Table 1: Assessment of overall environmental emissions of PCDD/PCDF in the year 2001*

| | Main categories of PCDD/PCDF sources | Annual emissions of PCDD/PCDF (g TEQ/year) | | | | |
|---|---|---|---|---|---|---|
| | | air | water | soil | product | leftover/waste |
| 1 | Waste incineration plants | 1.4 | | | | 3.6 |
| 2 | Ferrous and non-ferrous metals production | 3.1 | ? | ? | | 22.3 |
| 3 | Power generation and heat production | 105.7? | | | | 20.6 |
| 4 | Production of mineral products | 2.3 | | | | 0.01? |
| 5 | Transport | 0.9 | | | | |
| 6 | Uncontrolled combustion processes | 2.2? | | 1.7 | | ? |
| 7 | Production of chemicals, consumer goods | 0.1 | 0.002? | | 0.8 | 0.3? |
| 8 | Miscellaneous | 0.001? | | | ? | ? |
| 9 | Waste treatment/disposal | ? | ? | ? | | 2.7 |
| 1-9 | **TOTAL** | **115.7?** | **0.002?** | **1.7?** | **0.8?** | **49.5?** |

** the values shown are medians; empty boxes show that the potential route is insignificant.*

*?- potential route of emission is significant, but either EF or activity is missing.*

*?- if "?" follows the number, the number (information) is not representative because some sub-categories have not been fully processed.*

The most significant routes of PCDD/PCDF emissions are the emissions into air and leftovers/waste.. Major emissions of dioxin and furan occur during burning wood for heating of households. Other significant sources are uncontrolled burning processes, combustion of fuel in power plants (e.g. thermo-electric power plants, heating plants, etc.), production of ferrous and non-ferrous metals, road transport, etc.

## 4. *POPs monitoring*

There is no systematic monitoring of POPs in environment or humans in Croatia. Existing investigations of sources and distribution of organochlorine compounds into environment are referring to organochlorine pesticides, PCBs and PCDD/PCDFs. Their levels are determined in food, surface and ground waters, sea, river and sea sediments, soil, air, rain, snow, conifer needles and some animal samples.

The food control over the years shows that in majority of samples concentrations are bellow legal requirements. Concentrations of OC pesticides in tissues of dolphins, Gyps fulvus and seagull eggs were similar to the concentrations determined in the same species in other countries.

At population occupationally exposed to organochlorine pesticides and PCBs, detected serum levels of these substances were above average, but still below those producing acute poisoning symptoms due to high absorption.

In general, the available data shows that environmental and population concentrations of POPs in Croatia are within lower half of the range determined in other countries.

## 5. *POPs priority activities*

Aiming to meet requirements of Stockholm Convention, the analysis of data obtained from the POPs inventory and the assessment of current infrastructure were performed to identify the areas requiring changes or adjustments.

They are as follows:

- *updating current or pass new legislation to determine institutional responsibilities*
- identification and accurate determination of PCBs equipment quantities
- identification of devices in use and other products containing POPs
- monitoring of POPs in the environment and population
- identification and quantification of sources of unintentional POPs sources;
- identification of possible POPs contaminated sites
- construction of a new and improvement of the existing infrastructure (hazardous waste storage facilities, laboratories for analysing of PCDD/PCDFs)
- improving the level of public awareness and enabling the better education of all interested groups.

## 6. *Action plans and strategies*

Developed action plans and strategies are reflecting national priorities, such as phasing out and replacing PCB equipment, reducing or eliminating release of unintentional by-products, introducing the systematic monitoring of POPs compounds, identification of contaminated sites and their remediation, education, raising of public awareness and improving the level of information.

### ➢ Activity: institutional and regulatory strengthening measures

The Action Plan lists the areas that require the existing legislation to be updated or new one to be developed. Institutional responsibilities have to be clearly determined. The most important areas of the Action Plan are:

- import of PCBs and PCB containing equipment
- systematic monitoring of POPs
- identification of contaminated sites
- introducing BAT and BEP into the national economy.

These institutional and regulatory strengthening measures are essential for ensuring the implementation of the Stockholm Convention requirements.

➢ **Activity: measures to reduce or eliminate releases from intentional production and use**

An overview of measures (legislative and technical) for successful reduction and elimination of POPs chemicals releases from intentional use and production were given.

➢ **Activity: Production, Import and Export, Use, Stockpiles and Waste of Annex A POPs Pesticides (ANNEX A, Part I Chemicals)**

Since the current situation with POPs pesticides complies with requirements of the Stockholm Convention, additional activities are not suggested.

➢ **Activity: Production, Import and Export, Use, Identification, Labelling, Removal, Storage and Disposal of PCBs and Equipment Containing PCBs (Annex A, Part II Chemicals)**

Priority proposals of are:

- to define co-ordinating body for all activities related to fulfilment of the commitments from the Stockholm Convention
- to promulgate corresponding regulations, i.e. amend and supplement the existing ones
- to define institutional responsibilities
- to create capacities for temporary storage of waste containing PCBs
- to improve public education and information levels.

➢ **Activity: Production, Import and Export, Use, Stockpiles and Waste of DDT (Annex B Chemicals)**

Separate Action Plan has not been developed, since the DDT is not presenting priority in Croatia (no production and import, and the usage is banned since 1972.)

➢ **Activity: register for specific exemptions and the continuing need for exemptions**

Croatia has not filed any specific exemptions to Annex A or Annex B chemicals. The country has decided that it will not file such exemptions in the future; therefore no activities are required to address the obligation of Article 4 of the Convention.

➢ **Action Plan: measures to reduce releases from unintentional production**

The Action Plan determines and describes those steps and activities that Croatia should undertake to effectively implement the Convention. The most important areas regarding unintentional production of PCDD/PCDF, HCB and PCBs are:

- improvement of legal, financial and institutional frameworks for reducing/eliminating by-product releases into environment
- establishment of a comprehensive monitoring
- strengthening of public awareness and their integration into decision-making processes and implementation of measures.

➢ **Activity: measures to reduce release from stockpiles and waste**

Measures are given in the strategy for identification of stockpiles, articles in use and wastes

➢ **Strategy: identification of stockpiles, articles in use and wastes**

All activities necessary for development of the strategy for the identification of possible POPs stockpiles, articles or waste are listed.

➢ **Activity: manage stockpiles and appropriate measures for handling and disposal of articles in use**

All activities are included in the strategy for identification of stockpiles, articles in use and wastes.

➢ **Strategy: identification of contaminated sites (Annex A, B and C Chemicals) and remediation in an environmentally sound manner**

The Strategy lists the activities and measures necessary for development of the national strategy for identification of possible POPs contaminated sites, their scope and potential environmentally sound remediation. The time schedule and cost assessment of the Strategy implementation are also enclosed.

➢ **Activity: facilitating or undertaking information exchange and stakeholder involvement**

The organisation and scheme of information exchange strategy on two levels (national and international) are foreseen.

➢ **Activity: public awareness, information and education**

Priority proposals of the Action Plan are to:

- suggest optimal, feasible and efficient programmes for education and informing of the public
- define the body that would co-ordinate and implement the promulgated programmes
- identify target groups for which educational and information programmes are intended, and
- distribute information appropriately.

The time schedule and cost assessment of Action plan implementation are also enclosed.

➢ **Activity: effectiveness evaluation**

This activity will be elaborated, after the COP determines the system of effectiveness evaluation.

➢ **Activity: reporting**

The reporting system should be developed after the 1st Conference of the Parties identifies reporting modes and procedures to the Conference Secretariat.

➢ **Activity: research, development and monitoring**

Since according to the Convention R&D activities should be undertaken according to country capability and available resources, only areas with identified additional R&D project were listed.

For monitoring activities detail plan was developed, together with an implementation plan and the budget.

Priorities of the monitoring Action Plan are:

- to supplement and develop legal regulations for establishment of POPs monitoring
- to propose the structure of institutions responsible for establishment and implementation of POPs monitoring
- to propose timelines for establishment and implementation of POPs monitoring
- to propose the mode and scope of reporting and informing the public
- to propose scope and dynamics of funding, and
- to ensure the funds through an authorised body.

The time schedule and cost assessment for implementation of the Monitoring Action Plan are also enclosed.

➢ **Activity: technical and financial assistance**

Since Croatia is a country with economy in the transition, it is predicted that Croatia will apply for the funds available from the developed countries based on the arrangements established by the COP.

## 7. Time schedule for the NIP implementation

The time schedule for the implementation of the whole NIP is based on the implementation of action plans and strategies. Time schedule includes:

- organisation and co-ordination of NIP activities
- adjustment of the existing or development of new legal regulations
- development of technical instructions, directives and procedures to ensure implementation of legal regulations, and
- implementation of the proposed measures.

## 8. Funds for the NIP implementation

Total implementation costs of NIP's key segments are estimated to amount of 23 millions of USD.

# 1 INTRODUCTION

The proposal of the National Implementation Plan for implementation of the Stockholm Convention in the Republic of Croatia was drawn up within the project "*Enabling Activities to Facilitate Early Action on the Implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs) in the Republic of Croatia*"; UNIDO project GF/CRO/02/007.

The project is financed by GEF (Global Environmental Facility) in cooperation with UNIDO (United Nations Industrial Development Organisation) as the implementation agency.

The Ministry of Environmental Protection, Physical Planning and Construction nominated the Croatian Cleaner Production Centre as a national focal point for this project in the Republic of Croatia. The project's primary objective was to prepare the Republic of Croatia for the implementation of the obligations under the Stockholm Convention. The basis for achieving this objective is the National Implementation Plan (NIP) stating the list of measures and activities necessary for the successful implementation of the Stockholm Convention.

Implementation of the Project included five phases, as follows:

- determining co-ordinating mechanism and organising process
- establishing POPs inventory and assessing national infrastructure and capacity
- priority setting and determining objectives
- formulating a NIP, and specific action plans on POPs
- endorsing the NIP by stakeholders

A number of experts, representatives from interested institutions and foreign experts took part in the realisation of the project.

Representatives of the involved ministries, institutions, companies and non-governmental organisations:

| | |
|---|---|
| 1. Anđelka Bedrica | Ministry of Environmental Protection, Physical Planning and Construction |
| 2. Roko Andričević | Ministry of Environmental Protection, Physical Planning and Construction |
| 3. Jasenka Nećak | Ministry of Environmental Protection, Physical Planning and Construction |
| 4. Hrvojka Šunjić | Ministry of Environmental Protection, Physical Planning and Construction |
| 5. Ivana Halle | Ministry of the Economy, Labour and Entrepreneurship |
| 6. Mirta Mandić | Ministry of Foreign Affairs |
| 7. Karmen Sinković | Ministry of Agriculture, Forestry and Water Management |
| 8. Zdenko Šmit | Ministry of Health and Social Welfare; Public Health Institute |
| 9. Fran Marović | Ministry of the Economy, Labour and Entrepreneurship |
| 10. Domagoj Križaj | State Inspectorate |
| 11. Zdravko Lovrić | Croatian National Institute of Toxicology |
| 12. Nikola Čabrajec | Croatian Chamber of Economy |
| 13. Zoran Stanić | Croatian Electric Power Industry Ltd. |
| 14. Mladen Marković | Pliva |
| 15. Velimir Pravdić | NGO – Knowledge for Environment |
| 16. Blanka Krauthacker | NGO – Air Protection Association |
| 17. Sandra Krmpotić | Ministry of Environmental Protection, Physical Planning and Construction |
| 18. Savka Kučar Dragičević | APO Ltd. Environmental Services |
| 19. Vladimir Lokner | APO Ltd. Environmental Services |
| 20. Antun Schaller | APO Ltd. Environmental Services |
| 21. Sanja Grabar | APO Ltd. Environmental Services |

| | |
|---|---|
| 22. Andrea Rapić | APO Ltd. Environmental Services |
| 23. Željko Jelačić | APO Ltd. Environmental Services |
| 24. Tea Mišić | APO Ltd. Environmental Services |
| 25. Dražen Lovrić | APO Ltd. Environmental Services |
| 26. Mirjana Čerškov Klika | APO Ltd. Environmental Services |
| 27. Darka Hamel | Institute for Plant Protection in Agriculture and Forestry of Croatia |
| 28. Ivan Mikec | Institute for Plant Protection in Agriculture and Forestry of Croatia |
| 29. Goran Hrlec | Institute for Plant Protection in Agriculture and Forestry of Croatia |
| 30. Gorana Hrlec | Institute for Plant Protection in Agriculture and Forestry of Croatia |
| 31. Niko Malbaša | Ekonerg - Energy And Environmental Protection Institute |
| 32. Žarko Jakovljević | Ekonerg - Energy And Environmental Protection Institute |
| 33. Maja Jerman | Ekonerg - Energy And Environmental Protection Institute |
| 34. Vlasta Drevenkar | Institute for Medical Research and Occupational Health |
| 35. Želimir Vasilić | Institute for Medical Research and Occupational Health |
| 36. Snježana Herceg Romanić | Institute for Medical Research and Occupational Health |
| 37. Blanka Krauthacker | Institute for Medical Research and Occupational Health |
| 38. Mladen Picer | Rudjer Boskovic Institute |
| 39. Tanja Kovać | Rudjer Boskovic Institute |
| 40. Ana Antolović | Eco Services |
| 41. Marijan Host | Croatian Cleaner Production Centre |
| 42. Goran Romac | Croatian Cleaner Production Centre |
| 43. David La Roche | UNIDO |
| 44. Ivan Holoubek | UNIDO |
| 45. Viera Feckova | UNIDO |
| 46. Szabolcs Fejes | UNIDO |

## 1.1 Stockholm Convention

The purpose of the Stockholm Convention adopted on May 23, 2001 is to reduce and, where appropriate, to eliminate the release of 12 POPs (persistent organic pollutants) compounds. It refers to nine chemicals used only as pesticides (aldrin, chlordane, DDT, dieldrin, eldrin, heptachlor, hexachlorobenzene, mirex and toxaphene) two industrial chemicals (PCBs - polychlorinated biphenyls and HCB – hexachlorbenzene) and four by-products (PCDD/PCDF[1], HCB and PCB) which form as unintentional products in various human activities.

The Convention entered into force on May 17, 2004, 90 days after the fiftieth ratification, which was France.

The Convention provides for the objectives, principles and procedures that are to be fulfilled by its signatories. The Convention refers to:

1) products (PCB, pesticides, insecticides, rodenticides, fungicides);
2) by-products of human activity;
3) products used for disease control (e.g. DDT against malaria)

[1] *PCDD/PCDF in this document refers to all congeners of polychlorinated-dibenzo-p-dioxins and dibenzofurans*

The chemicals referred to in the Convention are listed in Annexes A (Part I and II), B (Part I and II) and C. Annex D determines the requirements and criteria for entering new chemicals in the list. The requirements under the Convention relating to the chemicals are stated in three articles: Article 3 refers to the manufactured chemicals, Article 5 refers to by-products and Article 6 refers to stockpiles and wastes of all 12 groups of chemicals.

**The Stockholm Convention requirements relating to the POPs pesticides**

All parties, signatories to the Stockholm Convention shall:

- Prohibit and/or take all legal and administrative measures necessary to eliminate the production, use, import and export of POPs pesticides listed in Annex A;
- Control/monitor the use of POPs pesticides for the laboratory research purposes, and their occurrence as unintentional trace contaminants in products and articles;
- Restrict import and export of POPs pesticides, except under the conditions in Article 4 of the Convention (exemptions registered with the Secretariat) or for the purpose of environmentally sound disposal of POPs pesticides;
- Develop and apply strategies for identification of stockpiles, products and articles in use, and waste containing POPs pesticides;
- Prohibit the use, recycling, recovery and direct or alternative uses of persistent organic pollutants;
- Manage stockpiles in a safe, efficient and environmentally sound manner upon their becoming waste;
- Take appropriate measures so that POP pesticides are handled, transported and stored in an environmentally sound manner, as well as disposed of, so that the POPs content is destroyed or transformed in a way that they do not exhibit the characteristics of persistent organic pollutants. Their disposal should be made in an environmentally sound manner taking into account international regulations, standards and guidelines.

**The Stockholm Convention requirements relating to DDT**

All parties, signatories to the Stockholm Convention shall:

- Eliminate the production and use of DDT except for the exemptions in Annex B part I for:
  - Disease vector control in accordance with the World Health Organisation (WHO) recommendations;
  - Production and use of DDT as intermediate in production of dicofol.
- Promote the research and development of alternative chemicals to DDT.

Other requirements relating to DDT are the same as for POPs pesticides stated in Annex A of the Convention.

Annex B Part II states the conditions permitting the production and use of DDT.

**ANNEX B**
**Restriction**
**Part II**

DDT (1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane)

1. The production and use of DDT shall be eliminated except for Parties that have notified the Secretariat of their intention to produce and/or use it. A DDT Register is hereby established and shall be available to the public. The Secretariat shall maintain the DDT Register.

2. Each Party that produces and/or uses DDT shall restrict such production and/or use for disease vector control in accordance with the World Health Organisation recommendations and guidelines on the use of DDT and when locally safe, effective and affordable alternatives are not available to the Party in question.

3. In the event that a Party not listed in the DDT Register determines that it requires DDT for disease vector control, it shall notify the Secretariat as soon as possible in order to have its name added forthwith to the DDT Register. It shall at the same time notify the World Health Organisation.

4. Every three years, each Party that uses DDT shall provide to the Secretariat and the World Health Organisation information on the amount used, the conditions of such use and its relevance to that Party's disease management strategy, in a format to be decided by the Conference of the Parties in consultation with the World Health Organisation.

5. With the goal of reducing and ultimately eliminating the use of DDT, the Conference of the Parties shall encourage:

(a) Each Party using DDT to develop and implement an action plan as part of the implementation plan specified in Article 7. That action plan shall include:

(i) Development of regulatory and other mechanisms to ensure that DDT use is restricted to disease vector control;

(ii) Implementation of suitable alternative products, methods and strategies, including resistance management strategies to ensure the continuing effectiveness of these alternatives;

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(iii) Measures to strengthen health care and to reduce the incidence of the disease.

(b) The Parties, within their capabilities, to promote research and development of safe alternative chemical and non-chemical products, methods and strategies for Parties using DDT, relevant to the conditions of those countries and with the goal of decreasing the human and economic burden of disease. Factors to be promoted when considering alternatives or combinations of alternatives shall include the human health risks and environmental implications of such alternatives. Viable alternatives to DDT shall pose less risk to human health and the environment, be suitable for disease control based on conditions in the Parties in question and be supported with monitoring data.

6. Commencing at its first meeting, and at least every three years thereafter, the Conference of the Parties shall, in consultation with the World Health Organisation, evaluate the continued need for DDT for disease vector control on the basis of available scientific, technical, environmental and economic information, including:

(a) The production and use of DDT and the conditions set out in paragraph 2;

(b) The availability, suitability and implementation of the alternatives to DDT; and

(c) Progress in strengthening the capacity of countries to transfer safely to reliance on such alternatives.

7. A Party may, at any time, withdraw its name from the DDT Registry upon written notification to the Secretariat. The withdrawal shall take effect on the date specified in the notification.

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**The Stockholm Convention requirements relating to Polychlorinated Biphenyls**

All parties, signatories to the Stockholm Convention shall:

- **Immediately** stop the production of PCBs (by the date of entry into force of the Convention);
- Eliminate the use of PCBs in equipment by 2025 (e.g. transformers, capacitors and other receptacles containing liquid stocks);
- Identify, label and remove from use the equipment containing greater than 10% PCBs and volumes greater than 5 litres;
- Identify, label and remove from use the equipment containing greater than 0.005% PCBs and volumes greater than 0.05 litres;
- Prohibit the export and import of PCBs and equipment containing PCBs (except for the purpose of environmentally sound waste management);
- Not allow the recovery of liquids with greater content of 0.005% PCBs for the purpose of their reuse in equipment, except for maintenance and servicing;
- Achieve the environmentally sound management of PCB waste as soon as possible, but not later than 2028;
- Develop and implement strategies for identification of stockpiles, products and articles in use and waste containing PCBs;
- Manage stockpiles in a safe, efficient and environmentally sound manner upon their becoming waste;
- Take appropriate measures so that PCBs are handled, transported and stored in an environmentally sound manner, or disposed of so that the PCB chemicals in waste is destroyed or transformed in a way that they do not exhibit the characteristics of polychlorinated biphenyls. Their disposal should be made in an environmentally sound manner taking into account international regulations, standards and guidelines.

- Prohibit the use, recycling, recovery and direct or alternative uses of polychlorinated biphenyls

- Develop strategies for identifying contaminated sites and for their remediation in an environmentally sound manner.

- Every five years make the report on development of PCB elimination and submit it to the Conference of the Parties pursuant to Article 15 of the Convention.

**The Stockholm Convention requirements relating to the POPs compounds formed as by-products (PCDD/PCDF, HCB and PCB)**

All parties, signatories to the Stockholm Convention shall:

- Promote the application of available, feasible and practical measures to achieve a realistic and significant level of release reduction or source elimination;

- Promote the development, and where appropriate, require the use of substitute materials, products and processes to prevent the formation and release of chemicals listed in Annex C of the Convention;

- Promote and introduce the best available techniques (BAT) as soon as possible, but not later than four years after the entry into force of the Convention, for new sources within the particular industrial categories (Annex C - Part I) which have the potential for formation and release of POPs compounds in Annex C to environment;

- Promote the use of the best available techniques and best environmental practices for the existing sources within the categories listed in Annex C – Part II and III, and for new sources within the categories listed in Annex C – Part III.

**Annex C of the Stockholm Convention: Unintentional production**

**Part I**
**Persistent organic pollutants according to Article 5**

This Annex applies to the following organic pollutants when formed and released unintentionally from anthropogenic sources:

- Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/PCDF)
- Hexachlorobenzene (HCB)
- Polychlorinated biphenyls (PCB)

**Part II**

Polychlorinated dibenzo-p-dioxins and dibenzofurans, hexachlorobenzene and polychlorinated biphenyls are unintentionally formed and released from thermal processes involving organic matter and chlorine as a result of incomplete combustion or chemical reactions. The following industrial source categories have the potential for comparatively high formation and release of these chemicals to the environment:

(a) Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge;

(b) Cement kilns firing hazardous waste;

(c) Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching;

(d) The following thermal processes in the metallurgical industry:

a) Secondary copper production;
b) Sinter plants in the iron and steel industry;
c) Secondary aluminium production;
d) Secondary zinc production.

**Part III**

Polychlorinated dibenzo-p-dioxins and dibenzofurans, hexachlorobenzene and polychlorinated biphenyls may also be unintentionally formed and released from the following source categories, including:

(a) Open burning of waste, including burning of landfill sites;

(b) Thermal processes in the metallurgical industry not mentioned in Part II;

(c) Residential combustion sources;

(d) Fossil fuel-fired utility and industrial boilers;

(e) Firing installations for wood and other biomass fuels;

(f) Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil;

(g) Crematoria;

(h) Motor vehicles, particularly those burning leaded gasoline;

(i) Destruction of animal carcasses;

(j) Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction);

(k) Shredder plants for the treatment of end of life vehicles;

(l) Smouldering of copper cables;

(m) Waste oil refineries.

## 1.2 Persistent organic pollutants

Persistent organic pollutants (POPs) are organic compounds resistant to photolytic, chemical and biological degradation. They have low solubility in water but very high solubility in fats resulting in their bio-concentration in fatty tissues of live organisms. They can be found in low levels in the environment, but they are transported through air and water far from their place of release. They are widely spread over the world including the areas where they have never been used. The persistent organic pollutants include the organochlorine compounds. Numerous organochlorine compounds exist and they enclose all organic compounds containing one or more of chlorine atoms. Organochlorine pesticides (OCP) such as DDT, aldrin, dieldrin, hexachlorobenzene (HCB)

hexachlorocyclohexane (HCH) and heptachlor, and polychlorinated biphenyls (PCBs) are two widely used groups of persistent organic pollutants.

Basic characteristics of the PCBs are their high chemical and thermal stability (resistance to chemical reactions and burning), good dielectric properties, water-insolubility, high affinity to fats (lipofility) and slow decomposition. Out of 209 available polychlorinated biphenyl isomers, the commercial mixtures usually contain 100 isomers. Commercial PCBs are the combination of congeners of different degree of chlorination. Relevant to their chlorine content (the commonest range is 48- 60%) they differ in colour, ranging from light yellow to brown. Also, less chlorinated products (e.g. Aroclor 1221 with 21% of Cl) are moderately viscous liquids, whereas those more chlorinated are solids (e.g. Aroclor 1260 with 60% of Cl).

Large-scale production of PCBs started in the USA in 1929 and reached its peak in 1970. It is estimated that total production within the period from 1930 till 1980 amounted to approximately 1 200 000 tons. Major manufacturers of PCBs are: Monsato (USA), Bayer (Germany), Rhone Poulenc and PCUK (France); Kanegafuchi (Japan), Cros (Spain), Cafaro (Italy) and east European countries. There has been no production of PCBs in the Republic of Croatia. Depending on the manufacturer and chemical composition, the PCBs mixtures were marketed under different names. The choice of name generally denoted the number of atoms (e.g. AROCLOR 1248 was the PCBs mixture with 48% of chlorine; CLOPHEN A60, PHENCLOR DPC and KANECHLOR 600 were made by different companies and contained about 60% of chlorine).

Polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) are two groups of compounds together known as "dioxins". They have never been applied intentionally and they are not natural compounds. These two groups of compounds include 210 congeners. Some of them are highly toxic which made them very interesting for monitoring and evaluation. Dioxins (PCDD) and furans (PCDF) are formed as by-products from thermal processes and chemical reactions mostly by two mechanisms: *«de novo»* synthesis where dioxins and furans are generated from the basic elements: carbon, hydrogen, oxygen and chlorine (the process takes place on catalytically active surfaces at the temperature from 250-500 °C) or with *formation of precursors* where dioxins and furans are generated from the chlorinated organic substances in various chemical processes at the temperature from 200-450 °C.

These four groups of compounds include over four hundred chemicals, some of which are proved to be carcinogenic and many are considered that they can act in a carcinogenic way. Due to their properties and impact as well as their presence in all parts of biosphere as well as in a man, organochlorine compounds today are still the most researched ones.

# 2 THE REPUBLIC OF CROATIA – Country baseline

## 2.1 Country profile

### 2.1.1 Geography and Population

**General Information:**

Croatia is the Adriatic and Central European country. In the form of a bow it stretches from the Danube in the northeast to Istria in the west and Boka Kotorska in the southeast. The mainland surface covers 56 542 km$^2$ and the surface of the territorial sea is 31 067 km$^2$. Croatia is situated on the crossroads between Central Europe and the Mediterranean.

**Geographical Position**

Croatia is situated near densely populated and economically developed European countries. Many internationally important roads run through Croatia. The importance of its geographical position is even increased by the Adriatic Sea, as a part of the Mediterranean, which penetrates deepest and furthest to the north of the central part of the European continent.

The most important traffic routes run along the river Sava-valley and the Adriatic, then along the river Drava-valley and there are several transversal routes extending from Austrian and Hungarian borders to the Adriatic (Rijeka, Split).

**Natural and geographic characteristics**

The surface area of Croatia is divided into three big natural and geographic regions:

- Panonian and peripanonian area covers the lowlands and rolling hills of the eastern and northwestern Croatia. Mountains higher then 500 metres are rare and isolated. Most of the surface is used for agriculture and cattle breeding. Slavonija and Baranja on the east are the most suitable for cereal growing, moist lowlands and mountain regions are rich in woods, while the north-western part, which distinctly gravitates towards Zagreb, is the most industrially developed.

- Mountain region, which mainly separates the Panonian Croatia from its coastal area, is less developed region. Its future development is based on the important traffic routes, further development of wood industry, on the still insufficiently exploited possibilities for the production of healthy food, and on the development of the winter and rural tourism.

- The Adriatic region covers the narrow coastal zone, separated from the hinterland by high mountains. This is mostly a karst region with exceedingly dry summers. Few water streams pass through usually by narrow gorges towards the sea. Croatian coastline is divided in northern (Istra and Kvarner) and southern (Dalmatia) region, together with three distinctive longitudinal divisions to island zone, coastline zone and hinterland. Croatian Adriatic coast is one of the most indented coasts in Europe; it has 1,185 islands, cliffs and reefs. The largest island is Krk (410 km$^2$) and prominent by its size are also the islands of Cres (404 km$^2$), Brač (395 km$^2$), Hvar (300 km$^2$), Pag (285 km$^2$) and Korčula (276 km$^2$). The largest peninsulas are Istra and Pelješac, and of the bays it is the maritime zone of Kvarner.

**Surface and length of the Croatian territory:**

| | |
|---|---|
| Total state area: | 89 810 $km^2$ |
| Land area: | 56 542 $km^2$ |
| Territorial sea area: | 31 067 $km^2$ |
| Length of coast with islands: | 5 835 km |
| Length of mainland coast: | 1 777 km |
| Length of island coast: | 4 058 km |

**Population:**

According to the last population census in 2001, Croatia has 4 437 460 inhabitants (51.84% women, 48.16% men). The birth rate in Croatia has been decreasing the last decade. Of the total number of inhabitants 54 per cent lives in 123 cities. Zagreb is the largest city and the capital with approximately 800 000 citizens. More then 400 000 citizens live in three cities, Split, Rijeka and Osijek. The population density of 78.5 inhabitants per square kilometre ranks Croatia among the medium populated countries of Europe.

### 2.1.2 Political and economic profile

**Political structure**

According to the Constitution of the Republic of Croatia adopted on 22 December 1990, Croatia is a unitary, indivisible, democratic and social state. Power in the Republic of Croatia derives from the people and belongs to the people as a community of free and equal citizens.

In the Republic of Croatia, the government is organized on the principle of the separation of powers into:

- legislative
- executive and
- judicial.

The principle of the separation of power includes levels of mutual cooperation and reciprocal control of the holder of power prescribed by the Constitution and law.

In the Republic of Croatia, laws must conform to the Constitution and other rules and regulations must conform to the Constitution and law. Everybody must abide by the Constitution and law, and respect the legal order of the Republic of Croatia.

*Legislative Power*

The Croatian Parliament (Sabor) is the body of elected representatives of the people and is vested with the legislative power in the Republic of Croatia. The Parliament also performs the function of control over the executive power. The Croatian Parliament has a President and one or more Vice-Presidents. The Croatian Parliament decides on the enactment and amendment of the Constitution, passes laws, adopts the state budget, decides on war and peace, passes acts which express the

politics of the Croatian Parliament, passes the Strategy of National Security and the Strategy of Defence for the Republic of Croatia, carries out civil control of the armed forces and security forces of the Republic of Croatia; it decides on the change of the state borders, calls referendums, carries out elections, appointments and relief of office in conformity with the Constitution and law, it supervises the work of the Croatian Government and other holders of public powers responsible to the Croatian Parliament in conformity with the Constitution and laws, grants amnesty for penal offences and conducts other affairs as specified by the Constitution.

*Executive Power*

1. President of the Republic of Croatia

The President of the Republic of Croatia presents and represents the Republic of Croatia at home and abroad. The President of the Republic cares for the regular and conformed operation and stability of the state power. The President of the Republic is responsible for the defence of the independence and territorial integrity of the Republic of Croatia. The President of the Republic is elected on the basis of universal and equal voting rights in direct elections by secret ballot for a term of five years. Nobody can be elected President of the Republic more than two times.

2. Government of the Republic of Croatia

The Government of the Republic of Croatia exercises executive power in conformity with the Constitution and law, and its organisation, operation and decision making is regulated by the Law on Government of the Republic of Croatia and its rules of procedures. The Government of the Republic of Croatia proposes laws and other acts to the Croatian Parliament, proposes the state budget and annual financial statement, implements laws and other decisions of the Croatian Parliament, passes regulations for the implementation of laws, conducts foreign and internal politics, directs and controls the work of a state administration, works on the economic growth of the country, directs the activities and development of public services, conducts other affairs as specified by the Constitution and law. The Government is responsible to the Croatian Parliament.

The Government consists of the Prime Minister, Deputy Prime Ministers and Ministers. Pursuant to the decision of the Croatian Parliament on the expression of confidence to the Government of the Republic of Croatia, the President of the Republic issues an order appointing the Prime Minister, countersigned by the Chairman of the Croatian Parliament; the order appointing the members of the Government is issued by the Prime Minister and countersigned by the Chairman of the Croatian Parliament.

*Judicial Power (Constitutional, Supreme and Other Courts)*

Courts exercise judicial power. Judicial power is autonomous and independent. Courts administer justice on the basis of Constitution and law. The Supreme Court of the Republic of Croatia, as the highest court, ensures the uniform implementation of laws and the equality of all citizens.

The Constitutional Court of the Republic of Croatia consists of thirteen judges, selected by the Croatian Parliament for a term of eight years from among outstanding jurists, especially judges, public prosecutors, lawyers and university professors of law. The Constitutional Court decides on the conformity of laws with the Constitution, decides on the conformity of other regulations with the Constitution and law, can assess the constitutionality of a law and the constitutionality and legality of other regulations which have expired if less than a year has passed between the date of expiry and the date of the application, decides on the constitutional applications against individual decisions of state administration and local and regional self-government bodies and other public authority bodies, when decisions interfere with human rights and fundamental freedoms, as well as the right of local and regional self-government administration guaranteed by the Constitution of the

Republic of Croatia; it monitors the realisation of constitutionality and legality, informing the Croatian Parliament of any signs of constitutionality or illegality, decides on jurisdictional disputes between legislative, executive and judicial bodies, decides, in conformity with the Constitution, on the impeachability of the President of Republic, supervises the constitutionality of the programs and activities of political parties, and may, in conformity with the Constitution, prohibit their work, supervises the constitutionality and legality of elections and national referendums, and decides on electoral disputes which do not fall within the jurisdiction of courts, performs other duties specified by the Constitution.

**Economic characteristics**

Table 1 shows the economic indicators for 2002. (Source: Croatian Bureau of Statistics (DSZ), Croatian National Bank of (HNB), Ministry of Finance (MF), and Croatian Chamber of Commerce

Table 1. *Economic indicators*

| | Year | |
|---|---|---|
| **GDP, billion USD** | **2002** | **22.4** |
| **GDP per capita, 000 USD** | **2002** | **5.6** |
| **Population, million (listed)** | **2001** | **4.4** |
| **Industrial production (%)** | **2002** | **5.4** |
| **Inflation rate (%)** | **2002** | **2.2** |
| **Unemployment rate (%)** | **2002** | **22.5** |
| **Exports, bln USD** | **2002** | **4.9** |
| **Imports, bln USD** | **2002** | **10.7** |
| **Foreign Exchange reserves HNB, bln USD end of period** | **2002** | **5.9** |

### 2.1.3 Profiles of Economic Sectors

**Agriculture, Fishing, Forestry and the Food Industry**

Croatia can be divided into three geographic and climate zones: the lowland zone in the north of the country, which has a continental climate, the Mediterranean coastal zone in the south, and the mountainous zone stretching across the central part of the country. Various types of climate, landforms and soil are favourable for the production of a wide range of agricultural products, from field and industrial crops to vineyards, continental and Mediterranean fruits and vegetables. Agriculture and fishing generate 7.4 % of Croatian GDP.

Out of a total of 3.15 million hectares of agricultural land, 63.4% is cultivated and the rest is pastureland, marshes and fish-ponds. 81.6% of the cultivated land is privately owned. The Agricultural Land Act regulates concessions for the exploitation of agricultural land owned by the state. Farming fully covers domestic needs for cereals and sugar. It also supplies the majority of

industrial crops. The vineyards cover 58 000 hectares of area. 30 larger winemaking companies, 35 production co-operatives and about 250 family businesses represent wine production. Wines made of autochthonous grape are becoming increasingly popular on the European and world markets.

Cattle raising have always played an important role in this region. Some world famous products are famous Slavonian salami (*slavonski kulen*), Dalmatian smoked ham (*dalmatinski pršut*), Istrian smoked ham (*istarski pršut*) and cheese from the Island of Pag (*paški sir*). Fishing and fish processing have traditionally been the most important activities along the coastal part of Croatia and on the islands. There are currently 11 fish-processing factories in Croatia, which produce 15 500 tons of various fish products per year. The 2001 production of fresh-water fish amounted to about 5 590 tons, and of salt-water fish and other seafood to about 25 000 tons. A new production line, tuna breeding for the Japanese market, was launched in 1997. The result of this production in 2002 is exports of tuna fish to Japan in the value of 44.7 million USD, i.e. 72.6% of the total exports of freshly frozen fish. It is considered to be one of the most significant export products.

Out of a total of 1.98 million hectares of forests, 80% are state owned and the rest IS in private hands. Conifers make up 13 per cent of the forests, while oak and beech are among the most important broad-leafed species. The production of food, beverages and tobacco generates 20.5% of Croatian GDP. The Croatian food industry includes some of the most successful Croatian companies: 10 out of 50 Croatian companies with the highest revenues in 2001 are producers of food, beverages and tobacco. The major export products of these companies are: Vegeta (food seasoning), biscuits and wafers, chocolate, canned fish, soups, olive oil, cigarettes, beer and strong alcoholic beverages.

**Industry**

Croatian industry is changing radically. The effects of the full scale restructuring of this sector are evident in many areas. The basic guidelines of Croatian industrial production are the strengthening of exports, development of manufacturing processes, increasing the level and standardisation of quality, satisfying environmental requirements and reaching the cost effectiveness.

The 2002 industrial production growth totalled 5.4% in comparison with 2001, and approximately the same growth rate is expected in 2003, which shows a trend towards recovery and further strengthening of the Croatian economy.

Industry employs approximately 267 000 workers, i.e. 25 percent of the employed in Croatia, and generates approximately 20 percent of the Croatian gross domestic product.

Within the industry, the largest total income comes from the production of food and beverages, production of petroleum derivatives, chemicals and chemical products, non-metals, construction material, electrical and optical appliances, paper, printing and publishing, and shipbuilding.

In terms of exports, shipbuilding, production of chemicals and chemical products, clothes manufacturing, production of food and beverages, machine and equipment manufacturing and electrical appliances manufacturing are the leading industry branches.

Industrial goods account for 97% of Croatia's total exports and having the highest share of Croatia's GDP, the industry remains the most important branch of the Croatian economy.

**Tourism**

As one of the most important tourist destinations in the Mediterranean, Croatia boasts a long tradition in tourism and favourable developmental opportunities. International tourism revenues amounted to USD 3.3 billion in the first nine months of 2002.

Croatia offers 160 000 beds in hotels and in tourist facilities, 300 000 beds in private accommodation, and 190 000 places in camps. There are 49 marinas with 13.000 berths along the entire coast. The advantages of Croatian tourist products are primarily a well-preserved environment, cultural and historical heritage, a mild Mediterranean climate, its vicinity to European markets and a possibility of active holidays at the ecologically protected destinations.

Croatia possesses all the prerequisites for the further development of tourism - one of the most beautiful coasts with more than 1 000 islands, well-preserved nature including 8 national parks (Plitvice Lakes, Paklenica, Risnjak, Northern Velebit, Kornati, Mljet, Brijuni and Krka) and 10 nature parks, cultural and historical heritage with numerous cultural monuments protected by UNESCO (Diocletian's Palace in Split, the towns of Trogir and Dubrovnik, Euphrasian's Basilica in Porec). Due to a mild climate, the Croatian coast is attractive for tourists throughout the year.

**Construction Industry**

In 2002 the Croatian building industry, an important sector of the national economy, had 71 788 employees in 7 000 companies. The total value of construction contracts carried out abroad within the first nine months of 2002 amounted to USD 131.5 million, 95.6% of which was earned in Europe.

In order to improve the accessibility of housing loans, Croatia has adopted legislation that enables a combined use of budgetary incentives and personal savings held in banks. Several building societies have been established as an important source of domestic earmarked long-term savings for which an annual budgetary premium is allocated.

Large foreign companies have already penetrated the Croatian investment market. Since April 2001, two companies have been in charge of the management, building and maintenance of roads in Croatia: HAC-Croatian Highways Ltd. and HC-Croatian Roads Ltd. Professional work related to concessions and supervised by the Ministry of Public Works, Reconstruction and Construction is conducted by Croatian Highways Ltd.

**Transport**

Croatia's advantageous geographical position in terms of traffic enables the development of traffic infrastructure and transport as one of the most important factors of the overall economic and social development of the Republic of Croatia.

The current status of transportation in Croatia is not satisfactory, especially with regard to harbours, maritime and river transport and railways.

The share of combined transportation in the overall transportation of cargo is very small. It is necessary to develop this sector as one of the most modern and environmentally friendly types of transportation in order to facilitate integration into the already developed European system of combined transportation.

There is a surplus of transport providers; i.e. disproportion to transportation needs, in road transportation.

Road and railway infrastructures are not equally developed in all parts of Croatia. Even though great efforts have been put in the construction of new roads in the last several years, substantial investments are still necessary both in terms of the existing as well as new infrastructure, with a special emphasis on better connection between the coastal and continental part of the country.

**Infrastructure**

Roads:

Total 28 275 km (state, municipality, and local) out of those 429-km motorways, 197-km rapid roads, 2 268 km E-roads

Railways:
2 726 km of tracks

Pipelines:
601 km of pipelines, 1 625 km of gas pipelines

TRANSPORTED PASSENGERS

in road traffic - 58.8%

in railway traffic - 32.2%

in air traffic - 1.1%

in maritime and river traffic - 7.9%

TRANSPORTED FREIGHT

in road traffic - 43.4%

in maritime and coastline traffic - 54.1%

in railway traffic - 12.7%

through pipelines - 8.5%

in inland water traffic - 1.2%

in air traffic - 0.1%

The share of transport in GDP is 8.1%, and in the total number of employees 7.1%.

(Data for 2001 - Source: CBS - Statistical Yearbook 2002)

**Utility services**

Utility services are regulated by the Utility Services Act, which stipulates the principles, operation and financing of utility services. Utility services are performed as a public service. Units of local self-government which provide utility services are obliged to ensure the continuity and quality of services as well as to ensure the maintenance and functionality of utility facilities.

Utility services can be operated only by companies, public institutions and their departments-own facilities established by units of local government, legal entities and natural persons, on the basis of concession contracts or contracts for the delivery of utility services. The Act defines the scope of utility services, which include the following: water supply; drainage and waste water treatment; gas and thermal energy supply; public transport of passengers; garbage disposal; maintenance of public areas, non-classified roads, retail market places, cemeteries and crematories; funeral and cemetery services; chimney sweep services; street light maintenance and activities of local significance as defined by the representative body of a local self-government.

**Trade**

Distributive trade has an important place in the overall economy in the Republic of Croatia. Almost 45% of Croatian business entities are engaged in distributive trade. Its significance is reflected in the generated added value in GDP (10.0%). This sector employs more than 165 000 workers, i.e. 15.9% of the total workforce in the Republic of Croatia.

Companies engaged in distributive trade have generated a turnover of 169 billion HRK in 2002 (VAT included), of which wholesale has generated 89 billion HRK, i.e. 20.5% more in real value, and retail 74 billion HRK with an increasing trend.

**Education**

Europe's joining the global information society has made studying a life-long activity in all fields. Croatia is also facing the challenge of adapting its educational system to altered economic and social needs.

Promoting the development of small and medium-sized enterprises and their adjustment to the conditions of business operations in the global market have resulted in the flexibility of educational activities within the chamber system.

Programmes are oriented on practical application of knowledge and on the development of personal skills for managers and entrepreneurs. Several Croatian universities offer postgraduate management courses, and numerous consultants and institutions providing various forms of training are available to Croatian business people.

### 2.1.4 Environmental overview

**Air**

Over the past decade, the emissions into air have been reduced and the air quality has improved. The main reasons are the overall economic recession and initiation of economic reforms. In comparison with many other European countries, per capita emissions in Croatia are low and, in terms of transboundary movement it mostly "imports" different pollutants.

Croatia is a party to the UN Framework Convention on Climate Change and it is among countries that committed themselves to maintain the greenhouse gas emissions on the 1990 level. Croatia also signed the Kyoto Protocol and after its entry into force, it must reduce the greenhouse gas emissions to 95% of those in 1990 in the period from 2008 to 2012.

The existing monitoring of the air quality in Croatia includes approx. 38% of the overall population, i.e. 90% of inhabitants in cities and towns. In 15% of towns the air is excessively polluted (category III), in 60% moderately polluted (category II) and in 25% of towns the air is clean or slightly polluted (category I). Excessive or moderate air pollution has been recorded in the cities of Zagreb, Sisak, Rijeka, Split, Šibenik, Pula and Kutina. Only four measuring stations presently are furnished with automatic measuring devices. The monitoring is improved with forming of network of measuring stations. However this network doesn't include monitoring of POPs.

**Inland waters**

Croatia is comparatively rich in water resources, has relatively big rivers and the karst area that is especially important for the water regime. The per capita volume of waters is estimated roughly at 7 000 $m^3$ annually while taking into account the border and cross-border waters, not including the rivers of Danube and Neretva, it is approx. 17 000$m^3$. Drinking water reserves are relatively large.

85% of water for the water supply system is obtained from groundwater reserves. 75% of the population is connected to public water supply system.

60% of the population is connected to the sewerage system, mainly in the cities. The typical sewerage system is a combined drainage system. The wastewater drainage in villages is made only by septic sludge.

The quality of river waters is most often one quality level lower than that desired. Croatia has a very small number of treatment plants of municipal wastewater. The central facility for mechanical wastewater treatment exists in the capital of Zagreb only. In 1997, only 21% of wastewater was treated, of which 81% was pre-treated by the first level treatment, approx. 6% by the second level (biologically), and 13% concerned the pre- treated industrial wastewater.

The water quality and quantity are monitored through a wide national network.

Flood protection system covers approximately 500 000 hectares. There are more than 460 flood torrents that are partly regulated, or in need of regulation. The flood control should be one of national priorities.

**Waste**

9.0 million tons of waste is generated annually in Croatia (2.0 tons per capita). Three quarters of generated waste is the technological waste. Municipal waste accounts for 13% and separated secondary raw materials (over 95% from technological waste) account for 11% of the total waste. Disposal of solid waste is presently the only way of its treatment.

Less than 60% of population is included in the organised collection of municipal waste. About 98% of total disposed waste ends up in 160 official (large) landfills that are all, with rare exceptions, constructed without basic protection measures. The hazardous waste together with the municipal waste is disposed of in 80 landfills; the evident environmental pollution was registered in 40 of them. Only seven landfills have been granted operating permit.

Emissions of methane from dumpsites account for 4.5% of the total greenhouse gas emissions in Croatia.

The remediation of a few industrial and hazardous waste landfills is under consideration. According to the Croatian regulations, the existing municipal waste landfills should have been remedied or made sound for further operation or closed until the end of 2002. Very little has been done in order to fulfil this obligation. Up to now, not a single landfill for hazardous waste has been constructed; only about 10% of the total amount of hazardous waste is disposed of in a regular and adequate manner. The implementation of a comprehensive waste management has started only in Zagreb, so far.

**Nature conservation**

Owing to its geographic position and relief diversity, in proportion to its size, Croatia abounds in a great number of various types of habitats i.e. ecosystems, a karst region being the most specific.

About 8% of the territory is under some kind of protection within 325 protected areas: eight national parks, 10 nature parks, 2 strict nature preserves. The horticultural landmarks are the largest group (114). About 400 endemic plants and mushrooms and 40 animal species are identified. A growing number of species is endangered, e.g. 226 species of spermatophytes and 41 species of mammals. Adopting the Strategy for Biological and Landscape Diversity and Action Plan (1999) shows the particular state care for the biodiversity protection.

**Soil and forests**

The total continental area of the Republic of Croatia consists of 50% of agricultural land, 44% of forests and 6% of arid land (soil for technical purpose) According to the statistical data, 203 000 hectares of arable land or 5 200 hectares annually were lost in the period 1959 – 1998. Simultaneously the surfaces of pasturelands, ponds, reed land and fishponds were increased for 44 000 hectares meaning that the total loss of arable land in the same period amounted to 159 000 hectares or 4 000 hectares annually.

Approximately 85% of forestland has a great manufacturing potential. Forests are mainly a result of natural growth. The monitoring of forest degradation in Croatia indicates various levels of damage done to major species of forest trees in the period from 1992 to 1998. The percentage of considerably damaged trees ranged from 15.6% to 30.3% at the most (1995) with a slightly decreasing trend, so that the total damage of all species amounted 21% in 2000. The forest degradation in the Republic of Croatia has never exceeded the European average values.

Forest fires make exceedingly serious problems occurring mostly in the coastal area. In year 2000, 33 212 hectares were affected by fire, generally in southern Croatia, 25% relating to high and low forest. Due to the war activities 243 700 hectares of forests is under mines, i.e. 12% of the overall forest resources.

**State of the coastal and island area**

A great part of the Croatian Adriatic Sea is still oligotrophic and clean. In northern Adriatic zone, the intensive "algae blooming" was recorded in 1988, 1989, 1991, 1997 and 2000, as a consequence of an intensified eutrohication. The "algae blooming" was also registered in some part of the Central Adriatic.

The North Adriatic rivers have the greatest impact on the concentration of nutritive salts, the river Po contributing more than half of the total amount of phosphor and nitrogen, i.e. circa 75% of inorganic nutritive salts. The greatest part of these is of anthropogenic origin. The centralised sewerage systems are constructed only in larger town and industrial centres. Less then 35% of wastewater goes to sewerage systems, and less then 10% are treated in wastewater treatment facilities.

Fires remain one of the greatest dangers in the coastline zone.

**Chemicals management**

The Law on Chemicals is prepared, its implementation starting on January 1, 2005. It will improve the existing legal basis and eliminate deficiencies resulting from of the sectoral approach in the chemicals management.

A number of companies introducing health security and environmental protection programs, HSE programme, and ISO 9000 and ISO 14000 is growing steadily, if not quickly enough. No scientific researches are developed for analysing the properties of new chemicals so far. An information system for data exchange regarding the movement of hazardous chemicals and chemical waste has not yet been established. The labelling and packaging systems have their deficiencies as well.

**Transport**

Most of the transport is done by roads. The vehicles are old-fashioned and the fuel quality is below that of the developed countries. Concerning the impact on air quality in urban areas, transport is one of the greatest health and environmental risks, primarily due to the low quality of liquid fuels/high concentrations of lead, sulphur and benzene) and their improvement is the matter of top priority.

**Cleaner production in environmental protection.**

No mechanisms for stimulating adjustments of the economy to a cleaner production have been developed. A comparatively small number of companies have introduced the ISO 9000 quality system, to say nothing of ISO 14000. Legal, institutional and technical frameworks have been set up for prevention, alertness and response in case of accidents at work, accidents during transportation of hazardous substances, explosions and fires, accidental contamination of waters and sea, and accidents in the environment.

A system has been developed for the implementation of Environmental Emergency Plan, National Plan of Water Protection and Emergency Plan of Accidental Adriatic Sea Contamination. The crisis and ecological teams on national and municipal levels are formed, as well as communication units, emergency action units and expert teams.

**Biological safety**

Except in industrial biotechnology involving genetic modifications of industrially important micro-organisms, the genetic modifications on plants and animals are not conducted for the commercial purposes in Croatia. Separate law is developed for regulation of usage and import of GMO in Croatia.

**Radiation**

According to the IAEA (International Atomic Energy Agency) criteria, Croatia is classified as type B country: radiation sources are widely used in industry, medicine and research, but there are no commercial nuclear reactors. The treatment of low-active and mid-active nuclear waste is not solved for good, but the temporary solutions exist. Approximately 50 $m^3$ of used ionising radiation sources and other used radioactive substances, their total activity being 1.4 TBq, have been temporary disposed of (i.e. stored). Preparations have been made for the selection and construction of a permanent disposal site.

**Noise**

Problems concerning the noise protection have not been given a due consideration, especially in the early stages of planning and projecting. Data for calculation of noise imissions recorded by monitoring are not available. Major noise sources are not identified, a number of those affected by this type of "contamination" are not determined and the competencies are not clearly defined either. The Ministry of Health and Welfare launched the initiative and made a new draft proposal of Law on Noise Protection.

**Environment and public health**

The pollution of air, water and soil, inadequate waste treatment as well as excessive noise and exposure to ionising and non-ionising radiation may cause an increase of the sick, i.e. the deterioration of the sick population condition.

It is estimated that the harmful quality of drinking water affects the health of 10 to 15 percent of the Croatian population.

As in Croatia the lead gasoline is still chiefly used, the impact of this contaminant to health is possible, especially to the youngest population.

The recent war has left also a specific danger: minefields. It is estimated that more than 10% of the national territory is mined.

**Environmental protection priorities**

In order to improve the environment quality it is imperative to take numerous actions and make considerable investments. As expected, the priorities are solid waste and wastewater treatment, and large investments in this field should be undertaken in the following years (e.g. construction of a number of new waste disposal sites, remediation of the existing dumpsites, urgent construction of sewerage systems in approximately 70 cities and the construction of some twenty wastewater treatment plants). A particular attention should be given to hazardous waste treatment. The air quality will be improved by using fuels with reduced content of lead and sulphur concentration, i.e. free of them, and by redirecting goods and travellers to ecologically sound means of transportation.

## 2.2 Institutional, policy and regulatory framework in Croatia

This chapter gives an overview of the present institutional and legal frameworks that will be a basis for implementation of the National Implementation Plan (NIP). Forms of the international and regional co-operation of Croatia are also shown relating to POPs.

### 2.2.1 Environmental policy, sustainable development policy and general legislative framework

The Constitution of the Republic of Croatia, as the fundamental legislation upon which all other laws are based was brought 22, December 1990.

The policy of the environmental protection is within the competence of the Ministry for Environmental Protection, Physical Planning and Construction while the State Directorate for Water Management is competent for the matters concerning waters. Legislation of environmental protection consists of laws, regulations and rules. On the proposal of the Government and ministries the laws are adopted by the Croatian Parliament after they have been discussed in the Committee for Environmental Protection and Physical Planning.

In terms of POPs chemicals the most important laws are: *Law on Environmental Protection, By-Law on Emission of Hazardous Substances into Air from Stationary Sources, Law on Waste, Rules on Requirements for Water Treatment, Law on Water, By-Law on Water Classification, By-Law on Hazardous Substances in Water, Rules on Indicator Limit Values of Hazardous and Other Substances in Waste Waters, Law on Toxins, Law on Chemicals, Law on Plant Protection.*

The most important laws concerning the environmental protection in Croatia are as follows: National Environmental Protection Strategy (Official Gazette 46/02), Law on Environmental Protection (Official Gazette 82/94 and 128/99), National Environmental Action Plan 46/02) and Strategy of Waste Management.

**National Environmental Protection Strategy**

The Strategy comprises the basic guidelines for the adjustment of economic, technical, scientific, educational, organisational and other measures, as well as measures for the implementation of international obligations aimed at environmental protection. The Strategy includes the state of environmental pollution by sectors and an assessment of the state of the environment. In addition, it proposes objectives and criteria for a comprehensive environmental protection management categorised according to specific components and the priority protection measures. It also contains the basis for a balanced economic development and efficient environmental protection measures, as well as the basic provisions for the most favourable technical, production and economic measures in environmental management. The Strategy comprises short-term and long-term measures for preventing and containing environmental pollution and their order of implementation with set

deadlines. The basis for environmental protection monitoring, as well as a review of sectors in need of recovery, defining conditions for its implementation, are also included in the Strategy. The Strategy incorporates financial sources and an estimate of the funds needed for the implementation of the environmental protection measures, a basis for directing and improving education and training, as well as scientific research in the environment protection field.

**National Environmental Action Plan**

National Environmental Action Plan is a document based on the National Environmental Protection Strategy. It includes the action plans elaborated by chapters of the Strategy.

**Law on Environmental Protection**

This Law regulates the environmental protection with a view to protecting the environment, reducing risks to human health and lives, providing and improving the quality of life for the benefit of both present and future generations. Environmental protection ensures the integrated preservation of environmental quality, preservation of natural communities, rational use of natural resources and power in environmentally sound manner, as a basic condition for a healthy and sustainable development

It should be pointed out that as opposed to the initial environmental policy dealing with the existing environmental problems, the environmental policy of developed countries (particularly in the EU member states) nowadays is based on the sustainable development principles and on integration of the environmental policy and the sectoral policies and changes in social and economic behaviour, using numerous and various instruments to promote the principles of shared responsibility. In order to solve many existing problems and to ensure that the most critical problems will not repeat in the future, the Croatian environmental policy must be based on these principles, with a clear emphasis on prevention.

### 2.2.2 Roles and responsibility of ministries, agencies and other government institutions in POPs management

**POPs Pesticides**

Ministry of Health and Welfare and Ministry of Agriculture, Forestry and Water Management are responsible for POPs pesticides management (licences and use requirements).

Ministry of Health and Welfare is responsible for issuing of

- import licence for active substances used for formulation of various pesticides,
- import licence for finished pesticides formulations in the public health field
- formal decision on active substance classification in list of toxins
- formal decision of pesticide classification in groups according to their toxicity

The same Ministry is also responsible for determining the maximum permitted values of pesticides that products may contain when in commercial use, and a certificate permitting their household use.

Ministry of Agriculture, Forestry and Water Management is competent for the registration, i.e. for issuing a trade permits for plant health products, and trade permit for products of animal vector control used in the veterinary field.

The products used in agriculture and forestry are within the competence of the Croatian Institute for Plant Protection in Agriculture and Forestry in Zagreb, while the research of pesticides effectiveness in the veterinary field is conducted by the Faculty of Veterinary Medicine in Zagreb.

**PCBs**

Ministry of Economy, Labour and Entrepreneurship and Ministry of Environmental Protection, Physical Planning and Construction are responsible for the management of devices containing PCBs and liquid PCBs.

Ministry of Economy, Labour and Entrepreneurship is responsible for issuing permit for operation of equipment containing PCBs.

Inspectors of occupational safety within the State Inspector's Office conduct the control and monitoring of devices containing PCBs.

Ministry of Environmental Protection, Physical Planning and Construction is responsible for both PCB-contaminated waste and all hazardous waste management. The Ministry grants authorisations to companies dealing with hazardous waste.

The equipment containing PCBs that is removed from use is determined as PCB-contaminated waste and as such is within the competence of the inspector for environmental protection within the Ministry of Environmental Protection, Physical Planning and Construction

**PCDD/PCDF, HCB and PCBs**

Ministry of Environmental Protection, Physical Planning and Construction and the Ministry of Economy, Labour and Entrepreneurship are responsible for the release control of PCDD/PCDF, HCB and PCB.

Ministry of Environmental Protection, Physical Planning and Construction is responsible for the emission control of hazardous substances into air from stationary sources in accordance with the Law on Air Protection (Official Gazette 178/04)

Ministry of Economy, Labour and Entrepreneurship is responsible for the control of maximum permitted concentrations of specific harmful substances (gases, vapours and suspended substances – aerosols) in the air of working premises and area.

**Competence for POPs control and monitoring in humans and the environment**

The monitoring of POPs compounds in various matrix can be considered from two aspects:

- control for purposes of level assessment and comparison with levels prescribed by laws, rules and regulations,
- monitoring of compounds distribution and levels for a research purpose, namely for evaluation of persistent pollutant concentrations in the environment and humans.

Methodologies of POPs determination levels, used for regular controls by institutes for public health, are agreed upon and adjusted and inter-laboratory quality checks of analytical procedures are performed from time to time.

Water monitoring organised by the Croatian Waters is also executed in laboratories, which had successfully participated in circular tests for the quality control of analytical procedures concerning specific pollution indicators. The quality controls of analytical procedures are also performed for some matrixes that, according to laws and regulations, have to be tested before use. Such an example is the PCB analysis in heating oil and waste oils, while the State Office for Standardisation and Metrology conducted the quality control of analytical procedures. The State Office for Standardisation and Metrology is currently conducting the evaluation and acceptance of European standards for sampling, processing and analysis of various samples. Thus, analysis methods of various samples will be harmonised, although this is primarily intended for the quality control of these samples. In research work, as everywhere in the world, the selection of sampling and analysis

methodology is free depending on research objectives. However, all methods should be validated in accordance with internationally accepted criteria.

A comprehensive monitoring of POPs levels in the environment, food and humans is not carried out in our country. Partial monitoring program of some POPs compound levels in samples of animal origin is organised on the state level by the Ministry of Agriculture, Forestry and Water Management. Croatian Waters perform monitoring of organochlorine pesticide levels in waters (rivers and accumulations). However, considering the number of compounds, the unstandardized results are probably due to the municipal laboratory equipment conducting analyses.

Research institutes (Institute of Medical Research and Vocational Medicine and Institute Rudjer Bošković, both in Zagreb) also conduct environmental monitoring programs within research projects, but a number of analysed samples and sampling frequency are limited by lack of financial possibilities that do not permit employment of more researchers and equipment purchase.

Taking into consideration a number of laboratories with available equipment and qualified staff for POPs compound analysis in various formulations, it is estimated that our country has a satisfactory capacity and knowledge for analysing organochlorine pesticides and PCB in the environment, food and biological samples collected by people. Analyses of PCDD and PCDF pose a problem because of a lack of adequate and sophisticated instruments, i.e. lack of financial support necessary for such type of analyses.

In accordance with the Law on Toxins the following institutions: Institute for Medical Research and Vocational Medicine, Faculty of Veterinary Medicine and Faculty of Food Science and Biotechnology carry out toxicological analyses of active substances and finished formulation of pesticides. Croatian Institute for Public Health conducts researches of pesticides impacts on organisms for which they are going to be used in the public health field (public sanitation). Based on research and proposal, the Commission for Toxins within the Ministry of Health and Welfare brings an opinion in accordance with which the Ministry of Health and Welfare issues trade permits for a pesticide. The longest validity period for the trade permit is 10 years. After certain period the toxicological and physicochemical researches are repeated.

Croatian Institute for Public Health carries out the physicochemical analyses and residue analyses in food, while municipal institutes for public health determine the presence of pesticide residuals in food.

No obligatory regulations or laws are provided for a systematic monitoring of all pesticides, including POPs pesticides, and consequently there is no institutional authority.

### 2.2.3 The international commitments in the environmental protection of the Republic of Croatia

Republic of Croatia co-operates in the environmental protection on several levels: multilaterally, regionally, sub-regionally and bilaterally. The co-operation is based on a series of legal instruments (conventions, agreements, contracts) and programs to which Croatia is a party or participant. A number of international and obligatory documents is signed and is waiting for adoption by the Croatian Parliament.

In order to fulfil international commitments made in the environmental protection field, Croatia has to make modifications in legislation, ensure implementation resources (as they often relate to emission limitation caused by technological processes, adjustment to new technologies and most frequently to adjustment of technology to new and more demanding ways of production). It should also initiate administrative and institutional modifications in the existing environmental protection system.

It is of particular importance that under numerous provisions of international agreements, whether they are on a global or regional level, Croatia accepted that access to information on environmental state and the public participation in achieving the environmental targets is an important segment of a social and economic environment. Various questions in connection with international cooperation are coordinated within several ministries and state administration, divided according to their competence, including also financial resources, i.e. environmental protection projects as well as the elaboration of specific action programs and guidelines.

**International conventions and agreements**

The Republic of Croatia has signed some thirty international conventions and agreements having various implications. For instance, in the implementation of the Montreal Protocol, Croatia is grouped under article 5, meaning it is among countries that are granted a ten-year grace period in introducing new technologies and use of non-hazardous substances in production of cooling appliances, air-conditioning units, cosmetics and similar.

Under Kyoto Protocol Croatia is obliged to reduce total emissions of six major greenhouse gases by 5%. The "evident" improvement should be achieved by the year 2005.

The Stockholm Convention is signed but has not yet been ratified.

Croatia is also a party to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, and consequently the hazardous waste, including POPs wastes, are treated in accordance with the Convention.

International Treaties Ratified or Signed by the Republic of Croatia

**General**

- **Convention of Environmental Impact Assessment in a Transboundary Context**
  Official Gazette – International Agreements 6/96
  Entry into force as regards The Republic of Croatia – September 10, 1997
- **Convention on Transboundary Effects of Industrial Accidents**
  Official Gazette – International Agreements 7/99
  Entry into force as regards The Republic of Croatia – April 19, 2000
- **Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters**
  The Republic of Croatia signed the Convention in Aarhus 1998
- **Protocol to the Aarhus Convention on Register Pollutant Release and Transfer Register**
  The Republic of Croatia signed the Convention in Aarhus 1998
- **Convention on European Landscapes**
  Official Gazette – International Agreements 12/02
  Entry into force as regards The Republic of Croatia – March 2, 2004
- **Protocol on Strategic Environmental Assessment**
  The Republic of Croatia signed the Protocol in Kiev 2003

**Atmosphere**

- **United nations Framework Convention on Climate Change**
  Official Gazette – International Agreements 2/96
  Entry into force as regards The Republic of Croatia – April 7, 1996
- **The Kyoto Protocol to the Framework Convention on Climate Change**

The Republic of Croatia signed the Protocol in Kyoto 1999

- **Convention on Long-range Transboundary Air Pollution**
  The Republic of Croatia is Party to the Convention by succession notification
  Official Gazette – International Agreements 12/93
  Entry into force as regards The Republic of Croatia – October 8, 1991
- **Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Long Term Financing of the Cooperative Financing for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)**
  The Republic of Croatia is Party to the Convention by succession notification
  Official Gazette – International Agreements 12/93
  Entry into force as regards The Republic of Croatia – October 8, 1991
- **Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Further Reduction of Sulphur Emissions**
  Official Gazette – International Agreements 17/98 and 3/99
  Entry into force as regards The Republic of Croatia – April 27, 1999
- **Protocol to the 1979 Convention on Long-range Transboundary Air Pollution of Heavy Metals**
  The Republic of Croatia signed the Protocol in Aarhus 1998
- **Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Persistent Organic Pollutants**
  The Republic of Croatia signed the Protocol in Aarhus 1998
- **Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to the 1979 Convention on Long-range Transboundary Air Pollution**
  The Republic of Croatia signed the Protocol in Goeteborg 1999
- **Vienna Convention for the Protection of the Ozone Layer**
  The Republic of Croatia is Party to the Convention by succession notification
  Official Gazette – International Agreements 12/93
  Entry into force as regards The Republic of Croatia – October 8, 1991
- **Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal 1987**
  The Republic of Croatia is Party to the Convention by succession notification
  Official Gazette – International Agreements 12/93
  Entry into force as regards The Republic of Croatia – October 8, 1991
- **Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, London 1990**
  Official Gazette – International Agreements 11/93
  Entry into force as regards The Republic of Croatia – October 15, 1993
- **Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, Copenhagen 1992**
  Official Gazette – International Agreements 8/96
  Entry into force as regards The Republic of Croatia – February 11, 1997
- **Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal 1997**
  Official Gazette – International Agreements 10/00
  Entry into force as regards The Republic of Croatia – December 7, 2000

- **Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, Peking 1999**

  Official Gazette – International Agreements 12/01

  Entry into force as regards The Republic of Croatia – April 25, 2002

- **Stockholm Convention on Persistent Organic Pollutants, Stockholm 2001**

  The Republic of Croatia signed the Convention in Stockholm 2001

**Sea**

- **Convention on Protection of Marine Environment and Coastal Region of the Mediterranean**

  Official Gazette – International Agreements 17/98

  Convention has not entered into force

- **Protocol for the Prevention of Pollution of the Mediterranean Sea Caused by Dumping of the Ships and Aircraft or Incineration at Sea**

  Official Gazette – International Agreements 17/98

- **Protocol Concerning Cooperation in Combating Pollution Caused by Ships and in Case of Emergency, Preventing Pollution of the Mediterranean Sea**

  Official Gazette – International Agreements 4/04

- **Protocol on Specially Protected Areas and Biological Diversity in the Mediterranean Sea**

  Official Gazette – International Agreements 10/01

- **Protocol for the Protection of the Mediterranean Sea against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Sea-Bed and its Sub-Soil (*Offshore protocol*)**

  Croatia signed the Protocol in Madrid 1994

- **Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter, London 1972**

  The Republic of Croatia is Party to the Convention by succession notification

  Entry into force as regards The Republic of Croatia – August 8, 1991

**Soil**

- **United Nation Convention to Combat Desertification in Countries Experiencing Serious Draughts and/or Desertification , Particularly in Africa**

  Official Gazette – International Agreements 11/00

  Entry into force as regards The Republic of Croatia – January 4, 2001

**Waste**

- **Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal**

  Official Gazette – International Agreements 3/94

  Entry into force as regards The Republic of Croatia – April 22, 2004

**Regional cooperation**

During 1998 the Republic of Croatia ratified modification of the Convention on Protection of Marine Environment and Coastal Region of the Mediterranean Sea and Modifications and Amendments to the Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft. The ratification of the Protocol for the Protection of the Mediterranean Sea

against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Sea-Bed and its Sub-Soil from 1994 is under preparation.

In addition, since 1992 the Republic of Croatia has been actively participating in Programme for the Environmental Protection of the Danube Basin. The purpose of the Programme is to initiate better environmental protection in the basin, primarily the water protection, and to strengthen the basin management, as defined in the Convention on Cooperation for the Protection and Sustainable Use of the Danube (Official Gazette 2/96).

**Sub-regional and bilateral cooperation**

The Republic of Croatia participates actively in the Croatian-Italian-Slovenian Commission on the Protection of the Adriatic Sea within the Stability Pact, and with neighbouring countries particularly in matters of water protection. Essential questions concerning environmental protection are given particular significance when dealt with bilaterally as they are solved in direct contacts.

### 2.2.4 Description of existing legislation and regulation addressing POPs (manufactured chemicals and unintentionally produced POPs)

In Croatia there is no POPs compound production nor is it planned so far. Law prohibits any possible future production of POPs pesticides, but at the same time, any possible future PCBs production is not explicitly prohibited. Unintentional POPs formation and release are not covered by regulations. Namely, there is no legal obligation for industry and industrial processes (potential sources of chemicals in Annex C of the Stockholm Convention) to apply BAT - Best Available Techniques or BEP - Best Environmental Practices and there is no ban on open burning of weed and waste either. Detailed overview of existing legislation is given in the chapters 2.3.1. – 2.3.4.

The field of legislation that should be adjusted and modified, or eventually developed, will be elaborated in detail in action plans and strategies.

### 2.2.5 Key approaches and procedures for POPs chemical an pesticide management including enforcement and monitoring requirements

Law on Chemicals (Official Gazette 173/03) regulates the management of chemicals, procedures for protection of human health, property and environment from harmful impacts of chemicals, as well as binding requirements and procedures that legal entities and natural persons producing, dealing with and using chemicals in Croatia have to fulfil. The provisions of this Law relate also to the biocide products. This Law also regulates requests to be submitted and procedures for registration of new substances and assessment of new and existing substances, determination of their content, a means and conditions for information exchange on chemicals, classification, their labelling and packaging in relation to their danger degree, as well as other requirements and commitments for safe chemical management. The implementation of provisions of this Law starts as of January 1, 2005. This Law includes also POPs chemicals listed in the Convention.

## 2.3 Assessment of the POPs issue in Croatia

The present situation in Croatia concerning the POPs management and problems is not satisfactory and equal, when considering simultaneously all 12 chemicals listed in the Convention. The awareness level about the POPs chemicals and their adverse effects to the environment and human health is satisfactory within the scientific and professional institutions in the country, but at the same time the awareness within the average population is on the poor level. Therefore, the national

programs for education and training of population should be developed in the near future. In addition, it is necessary to regulate by law and provide financing of programmes for the systematic monitoring of POPs chemicals in the environment and humans.

### 2.3.1 Assessment with respect to Annex A, Part I chemicals (POPs pesticides): historical, current and projected future production, use, import and export; existing policy and regulatory framework; summary of available monitoring data (environment, food, humans) and health impacts

The situation concerning the chemicals listed in Annex A – Part I is very good, as the necessary institutional and legal frameworks for the implementation and application of the Convention exist, and currently there is no production of these chemicals nor it is planned. Law prohibits the use, application and production of these chemicals in Croatia.

As regards the production period and application of these chemicals in the Republic of Croatia, the persistent organic pollutants can be divided in three groups:

- those that have never been permitted in commercial use in the Republic of Croatia (mirex),
- those that were in mass production and use, and were prohibited twenty or more years ago (DDT, hexachlorobenzene, chlordane, heptachlor, aldrin, dieldrin, endrin, toxaphene).
- those that were used recently (lindane – not yet on the list of the Stockholm Convention)

Most pesticides from the persistent organic pollutants (Table 2) listed in the Stockholm Convention were prohibited in the Republic of Croatia in the late nineteen sixties and seventies. The last pesticide prohibited, categorised as persistent organic pollutant but not listed in the Stockholm Convention, was lindane. It was prohibited in 2001, the same year as in the European Union. In the Republic of Croatia today, the permission for commercial use has totally 743 plant health products and 280 active substances of which not one is on a list of persistent organic pollutants of the Stockholm or Rotterdam Convention.

Table 2. List of active substances from the group of pesticides categorised as persistent organic pollutants according to the Stockholm Convention, years of their prohibition

| ACTIVE SUBSTANCES | ALLOWED SINCE | PROHIBITTED SINCE |
|---|---|---|
| Aldrin | 1958 | 1972* |
| DDT | 1944 | In agriculture 1972* |
| Dieldrin | 1958 | 1972* |
| Endrin | 1957 (since 1971 only as rodenticide) | 29 May 1989 |
| HCB | 1962 | 11 July 1980 |
| Heptachlor | 1956 | 7/1973* |
| Chlordane | Data before 1955 not known | 1971 |
| Mirex | Not allowed for plant protection in the Republic of | |

| ACTIVE SUBSTANCES | ALLOWED SINCE | PROHIBITTED SINCE |
|---|---|---|
| | Croatia. | |
| Toxaphene (camphechlor) | 1957 | 27 April 1982 |
| Dicophol | 1949 | 2001 |
| Hexachlorocyclohexan (HCH) | 1944 | 1972* |
| Chelevan | 18 December 1969 | 31 December 1977 |
| Lindane | 1944 | July 2001 |

In making the decision about stopping the use of some of the quoted active substances, it has been approved that the reserves, i.e. existing produced amounts, can be used in order to prevent the occurrence of hazardous waste.

Although the majority of POPs pesticide bans came into force 20-30 or more years ago, the data on residues of POPs pesticides on the Croatian territory in the environment, food, animals and people have been found by means of the inventory-making of POPs pesticides. This is a consequence of their intensive usage in the past, as well as the long persistence and slow decomposition. Levels of the POPs pesticide residues in the components of the environment and people in Croatia are lower than in the developed and Western-European countries, in which their use had been much more intensive.

#### 2.3.1.1 Legal regulations from the field of POPs pesticides

In Croatia pesticides can be used for the following purposes:

- for protection of plants and plant products,
- for protection of animals against parasites,
- for suppression of harmful insects on humans,
- in public health (communal hygiene),
- to fight pest on wood and textile and
- as general usage accessories (sprays and other formulations for household usage with the minimum quantity of active substances in pesticide).

In Croatia pesticides are put into circulation in compliance with regulations of several various laws and rulebooks within the competence of various ministries. There are different institutions that propose the use of pesticides on the basis of their research, and the responsible ministry issues an approval their marketing. There are also regulations that ban circulation of pesticides. The list of legal regulations is given in Table 3.

Table 3. List of legal regulations for circulation, import, export, usage, storage, disposal and management of pesticides

| PLANT PROTECTION |
|---|
| The law on Plant Protection *10/94* |

| |
|---|
| Rules on conditions and way of putting plant protection products into circulation *75/98* |
| Rules about sanitary plant control and control of plant protection products in transboundary movements *12/95* |
| List of plant protection products with a license for circulation and usage in the Republic of Croatia *95/03* |
| **TOXINS** |
| Law on Toxins *27, 39, 55/99* |
| Rules for marking and labelling toxins coming into circulation *47/99* |
| Rules stating criteria for classification of toxins into groups *47/99* |
| Rules on conditions concerning special measures of protection while working with toxins for corporations using toxins in scientific research *148/99* |
| List of toxins that can be put into circulation *7/01* |
| List of toxins used for maintenance of communal hygiene, disinfecting, rodent control, removal of bad smell and decontamination *151/02* |
| Rules on packaging and handling of poison *39/03* |
| Rulebook on minor amounts of poison meant for laboratory and scientific purposes *39/03* |
| **WATERS** |
| *Law on Waters 107/95* |
| Regulation on hazardous substances in waters *78/98* |
| State plan for water protection *8/99* |
| Regulation on water classification *77/98* |
| Rules on sanitary propriety of potable water *46/94* |
| **VETERINARY MEDICINE** |
| Law on Veterinary Drugs and Veterinary-medicinal Products *79/98* |
| Rules for quality control procedures of veterinary drugs, curative supplements and veterinary-medicinal products, their storage and registry keeping of the quality control 148/99 |
| List of finished veterinary drugs, curative supplements and veterinary-medicinal products approved for usage *75/99, 18/99, 21/00, 73/00* |
| Ordinance on prohibition of use of certain veterinary drugs for animals whose meat and products are used for human food *4/02* |
| **ENVIRONMENT** |
| Law on Environmental Protection *82/94* |
| Law on Waste 178/04 |
| **AGRICULTURE** |
| Law on Agricultural Land *66/2001* |
| Rules on protection of agricultural soils from harmful substances *15/92* |

It is important to mention that a list of banned substances that are not allowed to be put neither on the list of toxins nor into circulation, has been made. Its forthcoming issue in the Official Gazette is expected.

### 2.3.1.2 Former, present and future production of POPs pesticides

In the period when the POPs pesticides were allowed for application, there were several manufacturers that used to put pesticides of different formulations to market. It is necessary to emphasize that the amounts produced in Croatia during former Yugoslavia were meant for use in the whole country.

INA Kutina produced NPK fertiliser from 1969 to 1972 (12:12:12) with 1% aldrin, which was soon banned. Since 1975 production has been substituted with another type of fertilizer (Florina 3).

Although endrin was used in the beginning of the first applications in 1959, as well as dieldrin (the first application in 1958), due to high level of risk for the appliers and the environment it was used only in small quantities and only as rodenticide, in form of concentrated emulsion. Endrin has not been mentioned in the detailed reports on the application of insecticide on sugar-beet ever since 1959, i.e. it was not in use any more.

POPs pesticides are not produced in Croatia, nor are active substances for production of finished formulations of POPs pesticides.

Nowadays in Croatia there are numerous preparations registered, that have completely replaced the toxicologically unfavourable pesticides, including POPs.

Future production of POPs pesticides is neither planned nor possible as their manufacture has been prohibited.

### 2.3.1.3 Past, current and future use of POPs pesticides

Until the ban of POPs pesticides, the quantities used were those indicated in the respective licences. Their elimination has not caused big problems because of the substitutes which were less toxic, less hazardous and ecologically sounder.

Before the ban, POPs pesticides had been used in the control of many pests. With respect to the wide use against the pest and to the target cultures, their quantities were significant. Tables 4–7 show the use of POPs pesticides by years.

Table 4. Use of the active substances in POPs pesticides (kg) in Croatia in the period 1962-1976

| **Active substance** | **1962** | **1963** | **1964** | **1965** | **1966** |
|---|---|---|---|---|---|
| Aldrin | - | - | 48 353 | 9 982 | 13 448 |
| DDT in agriculture | - | - | 1 784 | 1 196 | 14 051 |
| DDT in forestry | - | 2 312 | - | 53 428 | 280 |
| Dieldrin | - | - | 610 | 186 | 5 298 |
| Endrin | - | - | 172 | 78 | 132 |
| HCH | 126 000 | > 280 000 | 176 212 | 166 800 | 35 610 |
| Heptachlor | - | - | - | - | - |

| | | | | | |
|---|---|---|---|---|---|
| Chlordane | - | - | - | - | - |
| Lindane | 8 000 | - | 12 450 | 4 293 | 15 906 |
| Toxaphene | 5 200 | 6 400 | 5 395 | 1 728 | 790 |

| **Active substance** | **1967** | **1968** | **1969** | **1970** | **1971** |
|---|---|---|---|---|---|
| Aldrin | 53 400 | 496 | 64 821 | 39 260 | 21 840 |
| DDT in agriculture | 16 325 | 4 183 | 6 051* | 5 450 | 4 296 |
| DDT in forestry | - | 600 | - | - | 2 363 |
| Dieldrin | 1 980 | 142 | 284 | 132 | 1 278 |
| Endrin | 120 | 84 | 94 | 164 | 131 |
| HCH | 271 800 | 126 338 | 203 406 | 2 900 | 32 150 |
| Heptachlor | - | 370 | 1 175 | 1 264 | 2 336 |
| Chlordane | - | - | 320 | 380 | 452 |
| Lindane | 7 948 | 8 066 | 6 304 | 15 172 | 17 126 |
| Toxaphene | 5 375 | 2 025 | 2 250 | 1 625 | 2 463 |

* forestry and fruit production excluded

| **Active substance** | **1972** | **1973** | **1974** | **1975** | **1976** |
|---|---|---|---|---|---|
| Aldrin | 0 | 0 | 0 | 0 | 0 |
| DDT in agriculture | 1 078 | 0 | 0 | 0 | 0 |
| DDT in forestry | 4 912 | 884 | 8 437 | 6 907 | 8 437 |
| Dieldrin | 0 | 0 | 0 | 0 | 0 |
| Endrin | 60 | 86 | 160 | 92 | 0 |
| HCH | 4 380 | 0 | 0 | 0 | 0 |
| Heptachlor | 0 | 0 | 0 | 0 | 0 |
| Kelevan | 3 918 | 5 940 | 6 479 | 56 430 | 123 375 |
| Chlordane | 0 | 0 | 0 | 0 | 0 |
| Lindane | 22 612 | 28 015 | 26 509 | 20 061 | 19 597 |
| Toxaphene | 2 765 | 3 953 | 1573 | 3 604 | 4 420 |

Table 5. Use of DDT in Croatia by air spraying (kg of active substance /year)

| | 1947 | 1948 | 1949 | 1950 | 1951 | 1952 | 1954 | 1955 | 1956 |
|---|---|---|---|---|---|---|---|---|---|
| forests | 26 | 82 | 4 807 | 2 371 + 67 | 165 olives | 0 | 756 | 6 020 | 4 919 |
| potato | 0 | 162 | 325 | 165 | 590 | 1 700 | | | 312 |

No change was registered in the years 1945, 1946, 1953, 1967 and 1969

| | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1968 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| forests | 5 360 | 1 584 | 0 | 0 | 268 | 0 | 2 312 | 262 | 53 428 | 280 | 600 |
| Sugar beet | 280 | 180 | 128 | 32 | 44 | 72 | 0 | 48 | 0 | 0 | 0 |

Table 6. Use of DDT (kg/year) in Croatia in the period 1971-1975

| Year | 1971 | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|---|
| kg of active substance in DDT | 2 363 | 4 912 | 884 | 8 437 | 6907 |

Table 7. Use of DDT in Croatia in forest treatment during the period 1979-1989 (*Source: Institute of Forestry, Jastrebarsko*)

| Year | 1979 | 1980 | 1981 | 1982 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|---|---|---|
| Use of active substance (kg) | 4 | 75 | 399 | 551 | 16 450 | 679 | 360 | 140 | 0 | 0 |

In the above period the lands under forest in Croatia accounted for 23.7 % of the whole territory of former Yugoslavia. Significant oscillations are recorded in the past use of organochlorine insecticides. They were the result of major influence of weather conditions, crop rotation, shortage of foreign currency for import, developed resistance, weather forecasts, integrated plant protection i.e. combination of agrotechnical procedures, sometimes mechanical pest control and application of plant protection agents only when pest exceeded threshold, as well as alternate use of the products from various groups (e.g. in forestry). To some extent that slowed down accumulation of the pesticides environmental residues.

With respect to current legal provisions POPs pesticides cannot be either used or manufactured. When marketing and use approvals are issued for pesticides, the attention is paid to avoid the persistent ones.

#### 2.3.1.4 Imports and exports of POPs pesticides

Given that Croatia does not produce POPs pesticides, there is no way of their export.

It is permitted to import only the substances listed as toxins or finished pesticide formulations with registered use. Each import must be approved by the Ministry of Health and Welfare (MH) or Ministry of Agriculture, Forestry and Water Management (MAFWM). Every border crossing has a competent sanitary inspection, inspection for plant protection or veterinary inspection which, based on the permit of the competent ministry and the registry of the permitted products in the Croatia, approve the import of pesticides. Although the law approves import for the treatment for export, it is not very likely that there will be no such applications. Because customs control of import bases itself on the approvals of respective ministries, not many misuses are possible in this respect.

It is not likely that POPs pesticides will be illegally traded because neighbouring countries have prohibited most of them, while Croatia has their corresponding substitutes. According to the regulations regarding operations of agricultural and veterinary pharmacies, only the pesticides approved by MH or MAFWM can be marketed. For determination of residual POPs pesticides in water, soil, food, plants and vegetable products, various institutions are importing small quantities as laboratory standards.

#### 2.3.1.5 Current stockpiles, waste with POPs pesticides, disposal sites and sites contaminated with POPs pesticides

The inventory of POPs pesticides has not detected any stockpiles.

The products including currently used pesticides do not contain POPs. Consequently, there is no risk that waste with POPs can be generated. Special landfills for such POPs waste do not exist up to now. If there has been any, disposed at municipal waste landfill, then it must have been covered by layers and layers of other waste during some 30 years, making it difficult to find them. Empty packaging materials for old pesticides could be the exemption.

So far there has been no site identified for disposal of hazardous waste i.e. POPs. Considering that there are other types of POPs persistent compounds requiring special landfills, these landfills should be foreseen for disposal of POPs too, in case of their occurrence.

According to available, rather scarce and often contradictory data no site contaminated with POPs pesticides has been identified. The information about use of POPs pesticides in some Croatian areas requires studies of their presence there. However, by knowing their applied dosages and those they have been used as recommended, it is quite certain that there is no such site which would be highly contaminated with POPs pesticides.

#### 2.3.1.6 Current capacities/potentials in the field of POPs

In connection with this topic it must be pointed out that the laboratories in Croatia are not adequately equipped for physical-chemical analyses. Actually, absence of data is not only due to the absence of corresponding legislation or monitoring, but it is also due to inadequate equipment of most laboratories which need appropriate financing for their organization. Equipment is old and insufficiently precise; staff members are not qualified for use of sophisticated appliances and technologies. That means that establishing the monitoring of plant and plant products, food, water, and soil with respective legislation requires the set up of several laboratories pursuant to the EU regulations. These laboratories would research with new up to date equipment for determination of POPs residues as well as other persistent chemicals, which will be entered in the list of POPs in the future.

### 2.3.1.7 Conclusion about POPs pesticides

According to the available data in Croatia POPs pesticides are not manufactured, used, exported or imported. Their inventory has not identified any contaminated sites or stockpiles.

According to legal regulations environmental levels of POPs pesticides are monitored in waters only. It is, therefore, proposed to promulgate regulations for systematic and permanent monitoring of these substances in all environmental elements and humans.

Some data are being collected through various projects and from the analysis of inspection samples, but this is not done permanently and within a national monitoring programme.

Also, it is necessary to establish legally compulsory collection of the results and continuous monitoring of their levels at the central registry.

Poorly equipped analytical laboratories and their staff in need for proper training require the funds that would also enable certification of these laboratories. Despite the falling trend of residual POPs residue in the analyzed samples of vegetable and animal origin, water, soil and human biomaterial, still reliable information are needed to know their realistic status. After all, this is the requirements of many international agreements and regulations, such as is the Stockholm Convention.

### 2.3.2 Assessment with respect to Annex A, Part II Chemicals (PCBs)

PCBs have never been produced in Croatia although the equipment (transformers and capacitors) containing PCBs was manufactured. For this purpose the liquid PCBs were imported. The most adjustments and changes to be done within the regulatory and institutional fields of the country concern PCBs. Namely, the import of PCBs is still allowed in Croatia, as well as their use in the closed and semi-closed systems. In addition, there is no proper control of the import of PCBs and of the equipment containing PCBs. The additional problem is the fact that in Croatia there is no physical capacity for collecting and managing the POPs waste as well as other hazardous wastes. The field of hazardous waste management should be regulated legally and institutionally.

In Croatia, along with PIRALEN, the most commonly used PCBs was ASKAREL, actually a mixture of tetrachlorobenzene with 60-80% PCBs content.

**Methodology for PCBs inventory**

**Analysis of the available data about equipment containing PCBs**

National institutions of the Republic of Croatia responsible for healthcare, environment and overall economic development, initiated in 1993 a number of activities on the reduction of potential hazards related to the equipment and facilities containing or polluted by PCBs. During the years 1993 - 1997, together with the Ministry of Labour and Welfare and the occupational safety inspectors, APO d.o.o. processed and analysed the inspection records about equipment containing PCBs and conducted a survey to establish a database of the holders of such equipment (transformers and capacitors), of liquid containing PCB and PCBs contaminated waste.

For the needs of PCB inventory the database was processed for each county separately, by the age and status of the installed equipment (in use, out of order, stockpiles) as the base for National implementation plan.

With the aim of updating the existing database, the questionnaire was designed and addressed to some 400 new destinations. The questionnaire was primarily focused on the entities not included in the PCBs analyses performed to that date. These were hotels, hospitals and major business entities having failed to report the existence of the equipment and facilities containing PCBs.

The cooperation has been established with the state, county and scientific institutions i.e. Ministry of Environmental Protection, Physical Planning and Construction, Ministry of Finance, Customs Administration of the Republic of Croatia, Croatian Chamber of Commerce, Institute for Medical Research and Occupational Medicine - Zagreb, Institute "Ruđer Bošković"- Zagreb, State Institute for Public Health and county Institutes for Public Health, etc.

Data were collected and compiled about: import and export of PCBs into and from Croatia, control and monitoring of the import/export of PCBs into and from the Croatia, way and place of PCBs use in Croatia, and national capacities for PCBs monitoring, control and analysis and for monitoring of PCBs in the environment.

In connection with the use of PCB-based fluids in the Republic of Croatia, the equipment manufacturers (KONČAR) were asked about the materials they used/are using for their production i.e. whether they have ever used PCB-based coolants.

### 2.3.2.1 Legal regulations concerning PCBs

Republic of Croatia regulates handling of the equipment with PCBs, disposal and transport of waste with PCBs and maximum permitted concentrations of PCBs in the media by the following legislation:

- Rules on occupational safety regarding the substances containing polychlorinated biphenyls, polychlorinated naphthalenes and polychlorinated terphenyls (Official Gazette No. 7/89);
- (Official Gazette No 178/04);
- Rules on the Types of Waste (Official Gazette 27/96);
- Basel Convention on the Control of Transboundary Movements of Hazardous Waste and its Disposal (Official Gazette 3/94);
- Law on Transportation of Hazardous Substances (Official Gazette 97/93);
- Rules on the Maximum Permitted Concentrations of Hazardous Matters in the Air of Working Premises and Areas and on Biological Limiting Values - (Official Gazette No. 92/93)
- Rules on the Levels of Pesticides, Toxins, Mycotoxins, Metals, Histamines and the Related Substances in Food and on other Conditions Regarding Sanitary Accuracy of Dietary Food and Articles for General Consumption - (Official Gazette No. 46/94)
- Rules on the Protection of Agricultural Land from Pollution with Harmful Substances (Official Gazette No. 15/92)
- By-law on Hazardous Substances in Water (Official Gazette No. 78/98)
- By-law on Water Classification (Official Gazette No. 77/98)

***Republic of Croatia has no legal framework that prohibits the import and use of PCBs in the closed systems and it has not set a legal deadline for elimination of the equipment with PCB from use.***

**Legal framework for handling of the equipment with PCBs**

«**Rules on occupational safety regarding the substances containing polychlorinated biphenyls, polychlorinated naphthalenes and polychlorinated terphenyls**» **(Official Gazette No. 7/89)** is the only effective official act in the Republic of Croatia that governs handling and labelling of the equipment with PCBs/PCTs and occupational safety measures in their respect. At special approval of the competent inspectorate these Rules also ***permit the use of PCBs in the closed systems*** in fire-protected areas. Unlike majority of countries, Croatia does ***not prohibit import of the equipment with PCBs or of PCBs alone***, and it does not have any regulation about the timeframes for the replacement of such equipment or for reporting of their defects and related accidents.

**Legal framework for disposal of the equipment with PCB that is out of use and of the waste contaminated with PCB**

Handling of waste is regulated by the **Law on Waste (Official Gazette No. 178/04)**, while waste classification is performed according to the **Rules on the types of waste (Official Gazette No. 27/96).**

According to the **Rules on the types of waste (Official Gazette No. 27/96)** i.e. their part Waste Catalogue "transformers and capacitors with PCBs or PCTs" are stated under reference number ***16 02 01** and represent **hazardous waste**. Waste Catalogue also contains classification of other types

of waste with PCBs or PCTs defined as **hazardous waste** (e.g. ***13 01 01** and ***13 03 01** denoting waste oils with ( PCBs or PCTs).

The recommendation is to thermally treat all types of waste after prior conditioning treatment. The equipment containing PCBs and liquid PCBs is incinerated exclusively in the **incinerators for hazardous waste** (pre-cleaned housings may be disposed to the landfills for hazardous waste).

Waste oils with PCBs are handled as specified by the **Rules on the Types of Waste (Official Gazette No. 27/96),** relevant to the content of PCBs and halogen

According to the **Law on Waste (Official Gazette No. 178/04)** the Republic of Croatia **shall not** import hazardous waste contaminated with PCBs.

In 1994 the Republic of Croatia ratified the **"Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal» (Official Gazette No. 4/94).**

By this Convention "waste materials and objects containing or contaminated with polychlorinated biphenyls (PCB) i.e. polychlorinated terphenyls (PCT) i.e. polybrominated biphenyls (PBB)" (labelled Y10) are classified as waste requiring control i.e. as hazardous waste (Annex I). In compliance with the Basel Convention, hazardous waste can be exported to the countries having no ban on the import of hazardous waste and at written approval of the competent institution of the importing country. Also, transboundary movement of hazardous waste and of other types of waste must be reduced to the least possible extent, in compliance with environmentally harmless and efficient waste disposal practices, and in the manner that prevents harmful impact of such movements to human health and environment.

**Legal framework for transportation of PCBs waste and equipment contaminated with PCBs**

Transportation of PCBs and of the equipment with PCB must comply with the provisions of the **Act on Transportation of Hazardous Substances (Official Gazette No. 97/93).** This Act is based on the European Agreement concerning the International Transport of Goods by Roads (ADR). According to ADR PCBs are classified as dangerous substances that during transportation pose danger to the participants in traffic, to people and environment (Class 9). PCBs level of hazard is **2b** (substances that in case of fire may generate dioxins) and of the equipment with PCBs is **3.** The vehicles carrying PCBs and waste contaminated with PCBs must be technically in order, equipped and labelled in compliance with the set standards. PCBs must always be transported under necessary safety measures, as a rule at daytime, and the consignment has to be packed in the manner satisfying the conditions for safe carriage.

**Legally permitted PCBs levels in various media**

Republic of Croatia has legally established maximum permitted concentration of PCBs in the atmosphere, water, foodstuffs and agricultural land.

***Rules on the Maximum Permitted Concentrations of Hazardous Substances in the Air of Working Premises and Areas and on Biological Limiting Values*** (Official Gazette No. 92/93) specify limit values of polychlorinated biphenyls in working premises and gives various MPCs, relevant to chlorine content in the mixture of compounds. Polychlorinated biphenyls with 42% chlorine content allowed in the working premises in the concentration of 0.1 ppm i.e. 1 mg/m$^3$ are stated under No. 116, CAS No. 53469-21-9. Polychlorinated biphenyls with 54% chlorine content are under No. 117, CAS No. 11097-69-1 and their MPC is 0.05 ppm i.e. 0.5 mg/ m$^3$. There is a precautionary statement related to both groups of compounds about potential carcinogenic effects of CA-2 and about their skin resorption. ***By-law on Hazardous Substances in Waters (Official Gazette No. 78/98***) classifies polychlorinated biphenyls as class A hazardous substances that «have been proven to represent a risk to water environment and humans and for which highest

concentrations in water systems are set i.e. which shall not be released into waters». Maximum permitted concentration of polychlorinated biphenyls is set by the above Regulation and the ***By-law on Water Classification (Official Gazette No. 77/98)***. Relevant to the type of water it ranges from 0.01-0.2 μg $L^{-1}$. Namely, concentration limit value for PCBs in waters class I is <0.01 μg $L^{-1}$, in waters class II 0.01-0.02 μg $L^{-1}$, in waters class III 0.02-0.04 μg $L^{-1}$, in waters class IV 0.04-0.2 μg $L^{-1}$ and in waters class V >0.2 μg $L^{-1}$.

***Rules on the Protection of Agricultural Land from Pollution with Harmful Substances (Official Gazette No. 15/92)*** specify maximum permitted levels of PCBs in municipal sludge and compost from municipal sludge and in waste and that level should not exceed 0.05 mg/kg of dry matter.

***Rules on the Levels of Pesticides, Toxins, Mycotoxins, Metals, Histamines and the Related Substances in Food and on other Conditions Regarding Sanitary Accuracy of Dietary Foods and Articles for General Consumption (Official Gazette No. 46/94)*** specify permitted levels of polychlorinated biphenyls in the following foodstuffs:

- meat and meat products 0.2 mg $kg^{-1}$
- milk and dairy products 0.05 mg $kg^{-1}$
- eggs 0.3 mg $kg^{-1}$
- poultry and poultry products 0.2 mg $kg^{-1}$
- fish, shells, crabs and their products 2.0 mg $kg^{-1}$

### 2.3.2.2 Former, current and future production and use of PCBs and PCBs containing equipment

According to the available data PCBs mixtures have not been and are not being manufactured in the Republic of Croatia.

According to the statements of domestic manufacturers of transformers and capacitors in 1975 twenty six transformers type 2 TBN 1600-12/K were produced with the cooling oil system based on PCB and installed by Petrokemija - Kutina.

In the production of other equipment of various types and dimensions there has been no use of dielectrics or cooling oil systems based on PCBs. Production of PCBs and of the equipment with PCBs is not planned.

PCB compounds are still in use in the Republic of Croatia mostly in the closed systems (as dielectrics in transformers and capacitors). Future use of the equipment with PCBs will be limited according to the ban on the import of PCBs and of the related equipment, and according to the planned gradual replacement of the equipment to be brought after ratification of the Stockholm Convention.

**Volumes of PCBs in the closed systems (capacitors and transformers)**

Volumes of PCB in the equipment depend on the capacity and size of the equipment. As most of the equipment in the Republic of Croatia is out of date, there are no detailed technical data (the volume of dielectrics in equipment). In this chapter data about total weight of the equipment containing PCBs, as well as the volume of PCBs in a closed system are stated.

Such evaluation is customary and from the aspect of their replacement and final disposal, total waste of the equipment for disposal is always taken into consideration and not only the quality of dielectrics/insulation materials.

Volumes of PCBs in the closed systems have been taken from the database and the 2003 year survey. According to them Croatia has:

- 22 859 capacitors 655 705 kg
- 304 transformers 728 678 kg,

with PCBs i.e. total volume of PCBs in the closed systems in Croatia amount to **1 384 383 kg.**

Before the PCBs inventory project the database contained some 480 business entities with either the equipment or waste containing PCBs (including Croatian electrical utility – HEP, as the biggest owner of such equipment) and after updating it has expanded for about 20 of such business entities more. According to the US EPA (the United States Environmental Protection Agency) a timeframe can be designed on the basis of the optimal lifetime of electrical equipment if it is not removed for other reasons. Hence, (according to the US standards) to compensate for the reactive power of the capacitor batteries at low voltage a defined optimal lifetime is 15 years, at high voltage it is 20 years and for transformers 40 years.

**Status analysis of the equipment with PCBs**

Status analysis of the equipment comprised the identification of the equipment in use, damaged and for reserve. Table 8 shows the number and weight of capacitors in use, damaged and for reserve by each county.

Table 8. Number and weight of the capacitors in use, damaged and for reserve by counties

| COUNTY | Number/pieces | | | | Weight /kg | | | |
|---|---|---|---|---|---|---|---|---|
| | Use | Damaged | Backup | Total | Use | Damaged | Backup | Total |
| **Zagreb** | 2411 | 205 | 129 | 2745 | 97116 | 2647 | 8285 | 108048 |
| **Krapina-Zagorje** | 397 | 43 | 1 | 441 | 13686 | 1321 | 44 | 15051 |
| **Sisak-Moslavina** | 2406 | 274 | 8 | 2688 | 34250 | 1938 | 262 | 36450 |
| **Karlovac** | 811 | 67 | 24 | 902 | 28044 | 11608 | 1868 | 41520 |
| **Varaždin** | 493 | 13 | 12 | 518 | 10282 | 561 | 516 | 11359 |
| **Koprivnica-Križevci** | 686 | 59 | 44 | 789 | 14204 | 2066 | 1215 | 17484 |
| **Bjelovar-Bilogora** | 683 | 26 | 29 | 738 | 11772 | 790 | 661 | 13224 |
| **Primorje-Gorski Kotar** | 1804 | 338 | 196 | 2338 | 66723 | 5813 | 5341 | 77877 |
| **Lika-Senj** | 60 | 2 | 0 | 62 | 0 | 0 | 0 | 0 |
| **Virovitica-Podravina** | 225 | 9 | 0 | 234 | 8285 | 431 | 0 | 8716 |
| **Požega-Slavonija** | 813 | 14 | 9 | 836 | 22013 | 393 | 258 | 22664 |
| **Brod-Posavina** | 3262 | 165 | 17 | 3444 | 86588 | 4519 | 852 | 91959 |
| **Zadar** | 520 | 8 | 31 | 559 | 12741 | 223 | 411 | 13375 |
| **Osijek-Baranja** | 1368 | 21 | 203 | 1592 | 59670 | 344 | 6618 | 66631 |
| **Šibenik-Knin** | 522 | 132 | 59 | 713 | 26604 | 5328 | 2491 | 34423 |
| **Vukovar-Srijem** | 147 | 12 | 2 | 161 | 3156 | 359 | 57 | 3571 |
| **Split-Dalmacija** | 2032 | 546 | 147 | 2725 | 46137 | 3080 | 3231 | 52448 |
| **Istra** | 445 | 28 | 27 | 500 | 10416 | 532 | 1079 | 12027 |
| **Dubrovnik-Neretva** | 205 | 7 | 17 | 229 | 10472 | 201 | 475 | 11148 |
| **Međimurje** | 620 | 23 | 2 | 645 | 16896 | 748 | 86 | 17730 |
| **TOTAL** | **19910** | **1992** | **957** | **22859** | **579055** | **42901** | **33750** | **655705** |

Status analysis of the equipment in Croatia shows that the majority of capacitors are in use and accounts for 87.1 %, i.e. 19 910 pieces i.e. 579 055 kg. Damaged equipment accounts for 8.7 % i.e. 1992 pieces i.e. 42 901 kg and the stockpiles account for 4.2%, i.e. 957 pieces i.e. 33 750 kg.

By territorial distribution i.e. counties, majority of the so far recorded capacitors in use can be found in the counties of Brod-Posavina and Zagreb, followed by Sisak-Moslavina County. Majority of the damaged capacitors has been recorded in the counties of Split-Dalmacija, Primorje-Gorski Kotar and Sisak-Moslavina. The number of capacitors in reserve is the biggest in the counties of Osijek-Baranja, Primorje-Gorski Kotar and Split-Dalmacija. The smallest number of capacitors can be found in Lika-Senj county (60 pieces in use, 2 pieces damaged), Vukovar-Srijem county and Dubrovnik-Neretva county.

Table 9 shows the number and weight of transformers in use, damaged and for reserve by each county.

Table 9. Number and weight of the transformers in use, damaged and for reserve by counties

| COUNTY | Number/pieces | | | | Weight /kg | | | |
|---|---|---|---|---|---|---|---|---|
| | Use | Damaged | Backup | Total | Use | Damage | Backup | Total |
| **Zagreb** | 30 | 0 | 0 | 30 | 28750 | 0 | 0 | 28750 |
| **Krapina-Zagorje** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Sisak-Moslavina** | 57 | 0 | 0 | 57 | 244874 | 0 | 0 | 244874 |
| **Karlovac** | 108 | 0 | 12 | 120 | 261890 | 0 | 57680 | 319569 |
| **Varaždin** | 4 | 0 | 0 | 4 | 4970 | 0 | 0 | 4970 |
| **Koprivnica-Križevci** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Bjelovar-Bilogora** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Primorje-Gorski Kotar** | 10 | 0 | 0 | 10 | 22670 | 0 | 0 | 22670 |
| **Lika-Senj** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Virovitica-Podravina** | 3 | 0 | 0 | 3 | 4071 | 0 | 0 | 4071 |
| **Požega-Slavonija** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Brod-Posavina** | 19 | 0 | 1 | 20 | 41460 | 0 | 0 | 41460 |
| **Zadar** | 1 | 0 | 0 | 1 | 950 | 0 | 0 | 950 |
| **Osijek-Baranja** | 22 | 0 | 1 | 23 | 29500 | 0 | 0 | 29500 |
| **Šibenik-Knin** | 2 | 0 | 0 | 2 | 3990 | 0 | 0 | 3990 |
| **Vukovar-Srijem** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Split-Dalmacija** | 2 | 0 | 0 | 2 | 1890 | 0 | 0 | 1890 |
| **Istra** | 23 | 0 | 0 | 23 | 21184 | 0 | 0 | 21184 |
| **Dubrovnik-Neretva** | 8 | 0 | 1 | 9 | 4800 | 0 | 0 | 4800 |
| **Međimurje** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **289** | **0** | **15** | **304** | **670 999** | **0** | **57 680** | **728 678** |

Status analysis of the transformers shows that the majority transformers are in use and account for 95.1 % i.e. 289 pieces i.e. 670998 kg. Stockpiles account for 4.9 % i.e. 15 pieces i.e. 57680 kg whereas the damaged ones have not been recorded.

The highest number of transformers in use can be found in the counties of Karlovac and Sisak-Moslavina. The most transformers in reserve have also been recorded in Karlovac county.

The transformers have not been registered in the counties of Krapina-Zagorje, Koprivnica-Križevci, Bjelovar-Bilogora, Lika-Senj, Požega-Slavonija, Vukovar-Srijem and Međimurje counties. However, given that these counties did not respond to the questionary, it does not mean that there is no transformer.

**Equipment analysis by age**

Tables 10 and 11 show the number, weight of capacitors and manufacturing years, which served as the basis for determining their replacement deadlines.

Table 10. Number of the capacitors by the year of their manufacture by counties

| COUNTY | Number/pieces | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | By 1970 | 1971 -75 | 1976 -80 | 1981 -85 | 1986 -90 | after 1990 | unknown | Total |
| Zagreb | 328 | 329 | 1219 | 518 | 2 | 33 | 316 | **2745** |
| Krapina-Zagorje | 89 | 137 | 158 | 28 | 6 | 0 | 23 | **441** |
| Sisak-Moslavina | 1139 | 190 | 1104 | 95 | 21 | 0 | 139 | **2688** |
| Karlovac | 65 | 217 | 486 | 18 | 0 | 0 | 116 | **902** |
| Varaždin | 62 | 63 | 141 | 216 | 0 | 0 | 36 | **518** |
| Koprivnica-Križevci | 513 | 96 | 112 | 68 | 0 | 0 | 0 | **789** |
| Bjelovar-Bilogora | 182 | 62 | 276 | 198 | 0 | 0 | 20 | **738** |
| Primorje-Gorski Kotar | 325 | 503 | 746 | 248 | 47 | 0 | 469 | **2338** |
| Lika-Senj | 0 | 0 | 62 | 0 | 0 | 0 | 0 | **62** |
| Virovitica-Podravina | 19 | 55 | 114 | 36 | 10 | 0 | 0 | **234** |
| Požega-Slavonija | 25 | 38 | 640 | 106 | 11 | 0 | 16 | **836** |
| Brod-Posavina | 2430 | 22 | 749 | 210 | 15 | 0 | 18 | **3444** |
| Zadar | 88 | 422 | 13 | 34 | 0 | 0 | 2 | **559** |
| Osijek-Baranja | 676 | 156 | 418 | 132 | 91 | 3 | 116 | **1592** |
| Šibenik-Knin | 0 | 695 | 18 | 0 | 0 | 0 | 0 | **713** |
| Vukovar-Srijem | 4 | 4 | 129 | 0 | 0 | 0 | 24 | **161** |
| Split-Dalmacija | 932 | 317 | 950 | 359 | 30 | 0 | 137 | **2725** |
| Istra | 33 | 157 | 95 | 48 | 27 | 0 | 140 | **500** |
| Dubrovnik-Neretva | 0 | 0 | 101 | 90 | 0 | 0 | 38 | **229** |
| Međimurje | 66 | 15 | 245 | 308 | 0 | 0 | 11 | **645** |
| **TOTAL** | **6 976** | **3 478** | **7 776** | **2 712** | **260** | **36** | **1 621** | **22 859** |

Table 11. Weight of the capacitors by the year of their manufacture by counties

| COUNTY | Weight / kg | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | By 1970 | 1971 -75 | 1976 -80 | 1981 -85 | 1986 -90 | After 1990 | Unknown | Total |
| **Zagreb** | 10696 | 6508 | 77303 | 9568 | 30 | 17 | 3927 | **108048** |
| **Krapina-Zagorje** | 2597 | 5316 | 5479 | 568 | 360 | 0 | 731 | **15051** |
| **Sisak-Moslavina** | 3881 | 3560 | 26243 | 113 | 323 | 0 | 2330 | **36450** |
| **Karlovac** | 1060 | 2416 | 30548 | 1302 | 0 | 0 | 6194 | **41520** |
| **Varaždin** | 63 | 427 | 5611 | 4611 | 0 | 0 | 648 | **11359** |
| **Koprivnica-Križevci** | 8836 | 3307 | 2504 | 2838 | 0 | 0 | 0 | **17484** |
| **Bjelovar-Bilogora** | 2427 | 2905 | 5438 | 2454 | 0 | 0 | 0 | **13224** |
| **Primorje-Gorski** | 4498 | 18441 | 30887 | 5815 | 2163 | 0 | 16074 | **77877** |
| **Lika-Senj** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Virovitica-Podravina** | 584 | 1564 | 5263 | 826 | 480 | 0 | 0 | **8716** |
| **Požega-Slavonija** | 670 | 984 | 18427 | 1503 | 610 | 0 | 470 | **22664** |
| **Brod-Posavina** | 65682 | 572 | 18892 | 5455 | 855 | 0 | 503 | **91959** |
| **Zadar** | 3366 | 9407 | 332 | 210 | 0 | 0 | 60 | **13375** |
| **Osijek-Baranja** | 39408 | 7739 | 11002 | 5110 | 2138 | 27 | 1207 | **66631** |
| **Šibenik-Knin** | 0 | 33883 | 540 | 0 | 0 | 0 | 0 | **34423** |
| **Vukovar-Srijem** | 118 | 59 | 2667 | 0 | 0 | 0 | 728 | **3571** |
| **Split-Dalmacija** | 7935 | 8954 | 27108 | 7043 | 0 | 0 | 1408 | **52448** |
| **Istra** | 526 | 4849 | 2751 | 801 | 0 | 0 | 3099 | **12027** |
| **Dubrovnik-Neretva** | 0 | 0 | 4505 | 3473 | 0 | 0 | 3170 | **11148** |
| **Međimurje** | 2987 | 537 | 10398 | 3533 | 0 | 0 | 275 | **17730** |
| **TOTAL** | **155 334** | **111 428** | **285 898** | **55 223** | **6 959** | **44** | **40 824** | **655 705** |

Age analysis of the capacitors in Croatia shows that the majority of capacitors were manufactured in the period from 1976-1980 (34.0 %), then by the year 1970 (30.5%). Those manufactured after 1990 represent the minority (0.2%). It was not possible to establish the year of manufacture of 1.1 % capacitors.

Tables 12 and 13 show the number and quantity of transformers by their age and counties

Table 12. Number of the transformers by the year of their manufacture by counties

| COUNTY | Number of transformers (pieces) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | By 1970 | 1971 -75 | 1976 -80 | 1981 -85 | 1986 -90 | After 1990 | Unknown | Total |
| Zagreb | 5 | 5 | 7 | 5 | 4 | 0 | 4 | 30 |
| Krapina-Zagorje | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sisak-Moslavina | 28 | 5 | 24 | 0 | 0 | 0 | 0 | 57 |
| Karlovac | 36 | 13 | 10 | 41 | 10 | 0 | 10 | 120 |
| Varaždin | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 4 |
| Koprivnica-Križevci | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bjelovar-Bilogora | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Primorje-Gorski | 4 | 0 | 6 | 0 | 0 | 0 | 0 | 10 |
| Lika-Senj | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Virovitica-Podravina | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 3 |
| Požega-Slavonija | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Brod-Posavina | 5 | 2 | 9 | 2 | 2 | 0 | 0 | 20 |
| Zadar | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Osijek-Baranja | 4 | 5 | 4 | 2 | 4 | 0 | 4 | 23 |
| Šibenik-Knin | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| Vukovar-Srijem | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Split-Dalmacija | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| Istra | 10 | 2 | 4 | 6 | 1 | 0 | 0 | 23 |
| Dubrovnik-Neretva | 1 | 0 | 0 | 8 | 0 | 0 | 0 | 9 |
| Međimurje | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 93 | 34 | 68 | 68 | 21 | 2 | 18 | 304 |

Table 13. Weight of the transformers by the year of their manufacture by counties

| COUNTY | Weight of transformers/kg | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | By 1970 | 1971 -75 | 1976 -80 | 1981 -85 | 1986 -90 | After 1990 | Unknown | Total |
| Zagreb | 12220 | 4536 | 3520 | 2394 | 2080 | 0 | 4000 | 28750 |
| Krapina-Zagorje | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sisak-Moslavina | 128352 | 16960 | 99562 | 0 | 0 | 0 | 0 | 244874 |
| Karlovac | 157840 | 16420 | 19970 | 80809 | 36010 | 0 | 8520 | 319569 |
| Varaždin | 0 | 0 | 1890 | 3080 | 0 | 0 | 0 | 4970 |
| Koprivnica- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bjelovar-Bilogora | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Primorje-Gorski | 10870 | 0 | 11800 | 0 | 0 | 0 | 0 | 22670 |
| Lika-Senj | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Virovitica- | 0 | 0 | 2971 | 0 | 1100 | 0 | 0 | 4071 |
| Požega-Slavonija | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Brod-Posavina | 11200 | 3600 | 17910 | 3560 | 5190 | 0 | 0 | 41460 |
| Zadar | 0 | 0 | 950 | 0 | 0 | 0 | 0 | 950 |
| Osijek-Baranja | 6590 | 6400 | 5340 | 4710 | 6460 | 0 | 0 | 29500 |
| Šibenik-Knin | 0 | 0 | 0 | 0 | 0 | 3990 | 0 | 3990 |
| Vukovar-Srijem | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Split-Dalmacija | 0 | 0 | 1890 | 0 | 0 | 0 | 0 | 1890 |
| Istra | 11440 | 0 | 0 | 7040 | 2700 | 0 | 0 | 21184 |
| Dubrovnik- | 4800 | 0 | 0 | 0 | 0 | 0 | 0 | 4800 |
| Međimurje | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 343 312 | 47 916 | 165 803 | 101 593 | 53 540 | 3 990 | 12 520 | 728 678 |

Status analysis of the transformers shows that the majority transformers were manufactured by the year 1970 (30.6%) then in the periods from 1981-1985, 1976-1980 and account for 22.4%. They are followed by those manufactured in the periods 1971-1975 (11.2%) and 1986-1990. Those manufactured after 1990 represent the minority (0.7%). There are no manufacturing data about 5.9 % of the transformers.

The county with majority of the oldest recorded transformers i.e. those manufactured by 1970 is the Karlovac county followed by Sisak-Moslavina and Istra counties.

**Age analysis of the equipment and its share in total quantity installed in the Republic of Croatia shows that optimal lifetime of majority has expired and that its replacement and final disposal must be done very soon.**

**Use of PCBs in semi-closed systems**

During the inventory the producers of oils (hydraulic fluid) indicated that they have never produced oils with PCBs. According to current estimates imported hydraulic fluids are free of PCBs. The

current inventory process could not be extended to cover the use of PCBs containing hydraulic fluids. This is the part which needs more attention in the future activities.

**Use of PCBs in the open systems**

Polychlorinated biphenyls in the open systems used to be applied as plasticizers in dyes, adhesives, plastics, lubricating oil formulations, etc.

During PCBs inventory process and collection of data about PCBs use, no PCBs in the open systems have been identified.

Given the fact that the Rules on Occupational Safety Regarding the Substances Containing Polychlorinated Biphenyls, Polychlorinated Naphthalenes and Polychlorinated Terphenyls (Official Gazette No. 7/89) was brought 14 years ago (1989) there is no single evidence or reasonable doubt about the presence or use of PCBs in the open systems.

**Prevention of PCBs production/use**

PCBs are legally permitted only in the closed systems

According to the Stockholm Convention all equipment with PCBs must be removed from use by the year 2025 and the following preventive measures must be taken with regard to PCBs production and use:

- legal ban on the import of PCBs, equipment with PCBs, transformers and capacitors;
- control and monitoring of the import of the equipment likely to contain PCBs;
- introduction of compulsory deadlines for replacement of the equipment with PCBs, compulsory reporting about damages and leakage of the equipment;
- designing of the timelines for replacement of the existing equipment in function with respect to its lifetime, economic situation in Croatia and European regulations regarding deadlines for replacement of the equipment with PCBs.

### 2.3.2.3 Import and export of PCBs

**Import of the equipment with PCBs**

In former Yugoslavia (up to the year 1991) Croatia used to purchase/import most of the equipment with PCBs, capacitors and transformers from the Slovenian manufacturer ISKRA – Semič, Serbian MINEL - Ripanj and AVALA – Belgrade, from former USSR and DDR and from other European and world manufacturers (ASEA - Sweden). **The purchases from Slovenia and Serbia were not recorded as the import of equipment and it is, therefore, not possible to establish their exact quantity.**

Similarly, for the period from 1991 till present day no information can be obtained about the import of any equipment with PCBs. Namely, there is no special customs tariff number (the reference to the imported goods) for the transformers/capacitors with PCBs, which prevents traceability of this import since 1991.

According to the Ministry of Labour and Welfare there has been no application for the permit to use PCBs in the closed systems, as per Article 2 of the Rules on Occupational Safety Regarding the Substances Containing Polychlorinated Biphenyls, Polychlorinated Naphthalenes and Polychlorinated Terphenyls (Official Gazette No. 7/89) (responsibility for issuing the licences for PCBs use in the closed systems has been transferred from the State Inspectorate to the Ministry of Labour and Welfare).

**Import of liquid containing PCBs**

Due to scarcity of time and complex monitoring system of specific imports by tariff numbers, the obtained data about the imported polyhalogenated bi/terphenyls cover the period from 1996 till 2001and are referred to as the data about imported PCBs. Actually, polychlorinated biphenyls have their tariff number (along with polychlorinated terphenyls and polybrominated biphenyls) which can provide the information about the imported quantities. According to Customs Administration, in the period from 1 July 1996 till 31 December 2001 total volume of the import of such liquid containing PCBs was 167 tons, as shown in Table 14.

Table 14. Volumes of the imported PCBs, PCT, PBB in the period 1996- 2001*

| Year of import | Volume of imported PCBs, PCT and PBB/kg |
|---|---|
| 1996 (1.7.96 – 31.12.96) | 15724.40 |
| 1997 | 47713.45 |
| 1998 | 30954.43 |
| 1999 | 21582.80 |
| 2000 | 37901.91 |
| 2001 | 13287.36 |
| **GRAND TOTAL (1996-2001)** | **167164.35** |

**(Source: Ministry of Finance, Customs Administration)*

Purpose of the imported liquids is still unknown and should be investigated in the future actions.

**Import of PCB waste**

Law on waste prohibits the import of hazardous waste, which includes waste contaminated with PCBs. Ministry of Environmental Protection, Physical Planning and Construction reported that Croatia is not the importer of waste with PCBs.

**Export of PCBs**

Republic of Croatia does not manufacture either PCBs or the equipment with PCBs (capacitors and transformers with PCBs) and, accordingly, is not the exporter of the goods with PCBs.

The only export of PCBs relates to **waste with PCB,** done in line with the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and its Disposal. This primarily concerns export of transformers, capacitors and other waste with PCBs. Purpose of this export is incineration of hazardous waste in the appropriate incinerators in France and Belgium or its disposal in German salt mines.

Collection and disposal of waste with PCBs is the responsibility of the companies approved by relevant institutions (Ministry of Environmental Protection, Physical Planning and Construction).

**Since 1994 Croatia has exported 267.7 t of waste with PCBs.** Quantities of the exported transformers, capacitors, liquid PCBs and other waste contaminated with PCBs are given in Table 15.

Table 15. Quantities of the exported waste with PCBs in the period 1994-2002*

| Year of export | Quantity of exported transformers with PCB/tons | Quantity of exported capacitors with PCB/tons | Quantity of exported liquid with PCBs and other waste contaminated with PCBs |
|---|---|---|---|
| 1994 | 10.3 | 12.9 | 0 |
| 1995 | 17.8 | 18,4 | 4.3 |
| 1996 | 33.7 | 25.9 | 0 |
| 1997 | 9 | 6.2 | 1 |
| 1998 | 37.5 | 0.6 | 4.0 |
| 1999 | 15.8 | 0 | 0 |
| 2000 | 5.5 | 38.4 | 0.5 |
| 2001 | 0 | 12.8 | 0 |
| 2002 | 0 | 13 | 0 |
| TOTAL (1994-2002) | 129.6 | 128.2 | 9.8 |
| **TOTAL/ ton** | **267.6** | | |

* Law on Waste was brought in 1994 and the Basle Convention was ratified. This was the onset of systemic monitoring of waste export.

#### 2.3.2.4 Market situation and customs control

The Croatian **Act on Customs Tariff** specifies the rules for calculation of customs duties, classification of goods by tariff numbers, sub-numbers and tariff items of the Customs tariff, as set in the **By-law on customs tariff**, published once yearly.

The by-laws that had been in effect from 1 July 1996 till 31 December 2001 classified ***polychlorinated biphenyls*** (together with polychlorinated terphenyls and polybrominated biphenyls) into Class VI (products of chemical industry or of the related industries), Section 38 (products of chemical industry or of the related industries), tariff No. 38.24 (prepared binders for casting moulds or casting cores; chemical products and preparations of chemical and related industries (including those which are the blends of natural products ) that are not mentioned or included elsewhere; leftovers of chemical and related industries that are not mentioned or included elsewhere), ***Tariff No. 3824.905***.

From 31.12.2001 on polychlorinated biphenyls have ***tariff No. 27109100*** – waste oils with PCB, PCT and PBB, and No. ***29029030*** – other cyclic carbohydrates-biphenyls terphenyls.

**Transformers and capacitors with PCB** do not have their special tariff number. They do not require any special customs control nor monitoring.

### 2.3.2.5 Illegal trade

In view of legal regulations that do not prohibit any import/export of the equipment with PCBs and liquid containing PCB and the data about import of liquid with PCB **there is no need for illegal trade with PCBs.**

### 2.3.2.6 Current stockpiles, PCB waste and disposal sites

Stockpiles of PCBs comprise usable equipment with PCBs that is not in function but is kept as the stockpile in case of damage to the operating facility, as well as the stockpiles of liquid with PCBs as reserve.

According to database and the 2003-year survey, for PCBs inventory project the records have been made of about ***57,680 kg i.e. 15 pieces of transformers with PCB*** and about ***33,745 kg i.e. 957 pieces of capacitors with PCB*** both kept as stockpile.

Recorded quantity of the ***liquid with PCB stockpiles*** (unused) in the Republic of Croatia is around **1 ton.**

**PCB waste**

PCB waste includes:

- transformers and capacitors with PCBs that are not in use and are not anticipated for further use;
- waste liquid with PCBs, and
- solid PCB waste (metal, non-metal or soil contaminated with PCBs) that can be generated by the leaks, damaged equipment or remediation and cleaning of the facilities and sites contaminated with PCBs.

In the Republic of Croatia there are no registered transformers with PCBs requiring disposal.

About 42900 kg i.e. 1992 pieces of capacitors with PCB requiring disposal are currently kept within the plants i.e. at the production site of waste owner.

There is around 5 tons of waste liquid with PCB and 5 kg of waste metal contaminated with PCB, and around 12 kg of miscellaneous material contaminated with PCB.

**Landfills**

Croatia has its legal regulations concerning the conditions for the landfills for PCBs and for hazardous waste in general. The conditions which an area has to comply with to be hazardous waste disposal facility are given in the ***By-law on Handling of Hazardous Waste (Official Gazette No. 32/98).***

***There is no legalized, constructed site for PCB waste disposal in the Republic of Croatia.*** This type of waste is exported.

According to database on landfills and damps (APO, d.o.o. 1993-1997) the Republic of Croatia has around ***600 registered sites where waste used to be or is still disposed*** and where PCB waste might be found.

### 2.3.2.7 National capacities for PCBs monitoring

**Laboratories equipped for PCBs analysis**

PCBs in Croatia are determined in various media e.g. air, water, soil, sediment, rains, pine needles, human milk, animals, oils and sera.

In compliance with the Article 17 paragraph 5 of the Rules regarding approved laboratories (Official Gazette No. 78/97) the State Water Directorate published a list of the laboratories approved for the analysis of specific substances in water, including PCBs.

There is no official list of the laboratories approved for PCBs analysis in other media.

**Locations for storage and destruction of PCBs**

Republic of Croatia has legal regulations regarding storage and destruction areas i.e. treatment areas for PCBs i.e. for hazardous waste in general.

The conditions, which an area has to comply with to be the facility for storage/treatment of hazardous waste, are set in the By-law on Handling of Hazardous Waste (Official Gazette No. 32/98).

Croatia does not have any legalised area for PCBs storage/treatment.

Waste is currently kept at the production sites all over Croatia, where the plants temporarily dispose of their equipment with PCBs that is either damaged or a stockpiled or is the material of PCB waste exporters.

### 2.3.2.8 The review of PCBs-contaminated locations

It has been found that there is no database about the PCBs-contaminated locations. Based on the survey results, discussions with research institutions, published works on the research and monitoring of environmental PCBs levels in the Republic of Croatia and knowledge about the studied sites, there are 3 types of PCBs-contaminated locations:

1) location suspected to be contaminated with PCBs and where PCBs have not been determined. These include Sisak, Karlovac, Gospić, Osijek - Ernestinovo, Vukovar, Pakrac, Šibenik - tvornica aluminija i ferolegura, Lipik, etc. i.e. the most heavily war-affected locations;

2) locations where PCBs have been detected, but not their level and size of pollution, and where remediation has not been done. These are power sub-stations and their environment in Delnice, Zadar, Šibenik - Bilice, Kaštel Sućurac and Dubrovnik (Rijeka Dubrovačka), and

3) location - facilities where PCBs have been detected and which have been remediated. So far two facilities of HEP have been cleaned after the accident with PCB equipment.

The contamination of locations was due to:

- ***Military activities during the Patriotic War (1991-1995), when many military vehicles, power-, industrial- and other facilities were damaged or completely destroyed, and caused leaking of PCBs.***
- ***Explosions, overheating, evaporation and leaks from transformers and capacitors.***
- ***Incompetent handling of the equipment with PCBs and surfaces for uncontrolled keeping of the equipment with PCBs which are not in use.***
- ***Accidents in the manufacturing plants***
- ***Uncontrolled disposal of the equipment with PCBs on the existing, undeveloped landfills in the Republic of Croatia.***

The data about such locations are given in Table 16.

Table 16. Mass fractions of PCBs in sampling (mg/kg-1)

| Area | Site | Year of sampling | Depth of sampling (m) | Number of samples | PCBs (median) |
|---|---|---|---|---|---|
| **Delnice** | oil well | 1996 | | 2 | 48.935 |
| | 2 m from the transformer | 1996 | 0-10 | 1 | 0.021 |
| **Kaštel Sućurac** | sub-station | 1996 | | 1 | 14.714 |
| | oil from hydraulic station | 1996 | | 1 | 18.968 |
| **Komolac nearby Dubrovnik** | oil well | 1996 | | 2 | 17.314 |
| | 20 m from the capacitor | 1996 | 0-10 | 2 | 1.64 |
| **Bilice nearby Šibenik** | capacitor | 1996 | 0-5 | 2 | 2094.151 |
| | 2.5 m from the capacitors | 1996 | 0-5 | 1 | 470.320 |
| **Zadar** | 1 m from the capacitors | 1996 | 0-10 | 4 | 172.909 |
| | 1 m from the capacitor | 1996 | 20-30 | 5 | 99.579 |
| | 7-14 m from the capacitor | 1996 | 0-10 | 2 | 0.286 |
| | 12,5-16 m from the capacitor | 1996 | 0-10 | 5 | 0.112 |
| **Zadar** | Vruljica site | 2000 | 0-10 | 3 | 0.112 |
| **Korenica** | "Likograf" site | 1997 | 0-10 | 3 | 0.018 |

Source: Picer et al., 1998, 2000

The text below gives the description and sites in the areas contaminated with PCB and their potential threat to environment and human health.

- *Delnice:* Power sub-station TS 35/10 kV located at the exit from Delnice on the way to Rijeka, on the elevation (approximately 20 m) at the south side of Zagreb-Rijeka highway. It is relatively close to the residential area. The shelled transformer is on the south side of the power sub-station. Soil samples were taken adjacent to the shelled transformer and from the oil well about 7 m from the sampling place.

  Analytical results of polychlorinated biphenyls in soil and in the oil extract from the oil well show that there has been no significant contamination with PCB at the site of «Delnice» power sub-station.

- *Kaštel Sućurac:* Soil samples were taken from the rocks beneath the capacitor battery in the power sub-station of the Ironworks "Split" and from oil in the hydraulic plant (both plants are in the building of the Ironworks which has concrete base).

  Soil taken from the rocks beneath the capacitor battery of the power sub-station in the Ironworks "Split" shows contamination with PCB. The level of

this contamination indicates that there is no realistic contamination risk of the surrounding ground and aquatic system.

- *Dubrovnik:* Power sub-station TS Komolac 110/35/10 kV is at the entrance of Dubrovnik, nearby Komolac, close to the coastal road Ston-Dubrovnik, relatively close (some 100 m) to Rijeka Dubrovačka, also in the immediate vicinity of the residential area. Samples of the oily mass were taken from the oil well situated adjacent to the shelled battery, and also from the soil in the channel about 20 m from the shelled capacitor battery.

  Oil extract from the oil well of the sub-station facility in Komolac nearby Dubrovnik does not show significant levels of PCB. Given the distance from the shelled capacitor battery the soil shows significant level of polychlorinated biphenyls.

- *Šibenik:* Power sub-station TS 220/110/30 kV "Bilice" is situated above the city of Šibenik, some 2 km in the valley and relatively close to the residential area.

  According to HEP Prijenos d.o.o. information, military activities at the site of the power sub-station TS 210/110/30 kV "Bilice" damaged 10 capacitor batteries.

  The shelled capacitor batteries are on the south side of the power station field. The ground approximately 20 meters around the batteries is covered with concrete, so that soil had to be sampled from a small crack adjacent to the shelled capacitors and also from another crack about 2.5 m from the first site.

  The ground beneath the shelled capacitor batteries shows significant level of soil contamination and, generally, the highest level of soil contamination with polychlorinated biphenyls in the Croatian karst.

- *Zadar:* Power sub-station 110/35 kV is at the NE of the suburban part of Zadar. Its south side is closer to the residential area and gardens than its north side.

  Soil analysis shows significant contamination with polychlorinated biphenyls.

  According to the information obtained from HEP Prijenos d.o.o. shelling at the site of the power sub-station 110/35 kV Zadar damaged 13 capacitor batteries.

Based on the geological-pedologic data about the soil in Croatia it can be concluded that karst is particularly vulnerable to contamination with polychlorinated biphenyls due to karst high permeability that facilitates PCBs access to underground waters. In the major part of the Croatian karst (especially in the areas affected by war), the issues of waste disposal and cleaning of the contaminated areas have not been resolved. On the other hand, most of this area is rich in water and has a highly vulnerable eco system. Deterioration of water quality there can cause immense effects on water supply, and on all living creatures in the rivers and sea.

Contamination of agricultural land is an immediate threat to human health. During the Patriotic War, Slavonia and Baranja, the areas with highest agricultural potentials and greatest opportunity for agricultural development were severely devastated. These are the areas where many military vehicles and production plants were destroyed. Preliminary soil analyses were performed around Vukovar in order to determine pollution with polychlorinated biphenyls, and the results of 15 samples have not shown any significant soil contamination.

In order to get a full picture of soil contamination in the Republic of Croatia, a systematic analysis is required of all areas suspected to be PCB-contaminated.

Based on to date research and data given in the preceding section, a significant contamination with PCBs is suspected at two karst areas (Bilice and Zadar). These areas require assessment of realistic threat to water sources and recipients, of the sorptive properties of soil and of the potentials for removal of PCBs from soil and water.

#### 2.3.2.9 To date experience in remediation of PCBs contaminated facilities in Croatia

Up to date in Croatia there has been only two remediation of PCBs contaminated facilities on two locations:

***KOMOLAC – caused by military activities***

According to the information obtained from HEP staff regarding ecological contamination with PCBs of the war-damaged power supply facility of the tone frequency network control in Komolac nearby Dubrovnik, the facility was remediate in 1994 by "C & G" d.o.o. from Zagreb. The building had been damaged in shelling, so HEP decided to have it repaired. Shelling physically damaged the building, causing over-potential or short circuit on the capacitor. Overpotential of the capacitor inflated the housing for which reason the capacitor exploded. The capacitor impregnated with PCBs contaminated the area. The inspection decided that contamination could be treated as medium, local contamination with liquid with PCBs and contamination with PCBs soot as medium contamination. Leaked out liquid with PCBs was recovered with the absorptive material: saw-dust, cloths and special absorptive material. Mechanically removed surfaces were, smoothed and painted. The takeover Minutes established satisfactory recovery of impurities. The facility in Komolac was the first remediate facility that was damaged in the war and contaminated with PCBs.

TE PLOMIN – caused by handling with PCBs contaminated equipment

Remediation project for TE Plomin (carried out in 1991) contaminated with PCBs, comprised maintenance works and replacement of pyralen's transformers, remediation of the rooms contaminated with PCBs, temporary storage of PCBs waste, transport and destruction of PCBs waste and of pyralen's transformers.

#### 2.3.2.10 Conclusion about PCBs

Based on collected information the following conclusions can be drawn:

- Republic of Croatia **does not legally prohibit import/export of the equipment with PCBs** and has no legal timelines for their replacement;
- **there is no manufacture of liquid PCBs** in the Republic of Croatia;
- **import of liquid with PCBs** has been recorded and its use has to be further investigated;
- import of PCB waste and of other hazardous waste is **prohibited**;
- according to database and the 2003-year survey there is are the stockpiles of about ***57680 kg i.e. 15 pieces of transformers with PCBs*** and the stockpiles of about ***33745 kg i.e. 957 pieces of reserve capacitors with PCB;***
- there are about ***5 tons of liquid waste with PCBs, 5 kg of waste metal contaminated with PCB and about 12 kg of other material contaminated with PCBs;***

- ***about 600 sites have been registered as former or present disposal sites.*** PCBs waste might be found on all of them;
- ***there is no legalized, developed site on the territory of the Republic of Croatia for PCBs waste disposal.*** This waste is disposed of abroad;
- according to database and survey carried out in 2003 the volumes of PCBs in the closed systems amount to:

22 859 capacitors: *655.7 ton*

304 transformers: *728.7 ton*

**Total volume of PCB in the closed systems in the Republic of Croatia is 1384.4 ton.**

- **Hrvatska elektroprivreda is the biggest owner of the capacitors batteries with PCBs.** It is the owner of 3660 pieces (100 tons) of the capacitors which makes 15% of the total weight of all capacitors in the Republic of Croatia.
- **Major owners of the transformers in the Republic of Croatia are** chemical industry with 56 transformers, total weight of which is 238.5 tons which makes 33 % of the total weight of all transformers in the Republic of Croatia and textile and metal-manufacturing industry with 34 transformers, total weight of which is about 177 tons which makes approximately 25 % of the total weight of all transformers in the Croatia.
- Croatia does not have any legalized site for PCB waste storage/disposal/treatment.
- PCB waste is exported abroad for treatment
- Institutional and legal frameworks regarding responsibility for environmental contamination with PCBs is defined by the Law on Environmental Protection.
- Major causes of soil contamination with PCBs were military actions during the Patriotic War (1991-1995)
- Overall level of contamination with PCBs is less affected by «peacetime» factors: unprofessional handling of the equipment with PCBs, uncontrolled incineration of industrial and municipal waste, volatilisation and leaks from transformers and capacitors.

### 2.3.2.11 Additional activities after NIP development

After development of NIP additional activities were initiated in cooperation with UNIDO in year 2005. These activities were defined as:

- Definition of "white spots" of the preliminary inventory, verification of some data on quantities of PCBs and their contents
- Analytical testing of possible PCBs contaminated oil transformers and PCB contaminated spots
- Organization of a high level awareness seminar about importance of Stockholm Convention for national stakeholders and decision makers.

#### 2.3.2.11.1 Rationale for additional activities

Defining "white spots" of the preliminary inventory and analytical testing of possible PCBs contaminated oil transformers and PCB contaminated spots.

Based on analysis and review of preliminary PCBs inventory performed by national and UNIDO experts need for clarification and checking of some of the data was determined. Since during the

inventory development phase data from some counties in Croatia related to amount of PCBs were missing, it was assumed that real amount of the PCB contained equipment *could be higher* than originally identified in the preliminary inventory.

Another issue which supported that assumption was the fact that NIP inventory development phase did not took into consideration the possibility of contamination of oil transformers with PCBs, as a results of improper manipulation during replacement and refilling of the transformers oil activities.

All above mentioned was the basis for additional activities oriented to definition of "white spots" and analytical testing of oil transformers, which would resulted in more precise PCBs inventory data and better information about the scope and extend of possible PCBs contamination of oil transformers in general in Croatia.

Organization of a high level awareness seminar about importance of Stockholm Convention

Since Croatia has not ratified the Stockholm Convention yet, it was assumed that the additional activities i.e. organization of high level awareness seminar about importance of Stockholm Convention for national stakeholders and decision makers would enhance the process of ratification.

Ratification of Stockholm Convention could be harmonized with Croatian recent start of EU accession negotiations *(end of 2005.)* especially since EU requirements related to PCBs are even stricter than the requirements of the Stockholm Convention.

#### 2.3.2.11.2 Performed activities

Defining "white spots" of the preliminary inventory

"White spots" within the PCBs preliminary inventory were defined as:

- counties in Croatia with no registered PCBs equipment,
- equipment which is nominally PCB free, but possibly PCB contaminated,
- PCBs contaminated spots.

Since during the inventory development phase PCBs contaminated spots were not identified *(chapter 2.3.2.8.)* activities were focused to the identification of the counties in Croatia in which there is no registered PCBs equipment and identification of possible PCBs contaminated oil transformers.

Due to the fact that HEP - Croatian electrical utility is the biggest owner of PCBs equipment it was decided that the focus of additional activities would be oriented to HEP's installation and facilities.

The new task team consisting some of the members of the PCBs inventory task team, included in the previous phases of the Project was established. The representative of the HEP responsible for all 21 distribution areas, as well as local staff member were included in the definition of "white spots" and collection of new data.

Determined criteria's for identification of possible contaminated oil transformers were:

- production year;
- performed conditioning of transformers oil (centrifuging, vacuuming, filtration);
- performed refilling of transformers;
- performed regular maintenance;

It was assumed that during these activities by using the improper equipment and oil, the possible contamination with PCBs could have appeared.

These activities were performed from September to November 2005.

Sampling and analytical testing of oil transformers

Sampling of oil transformers

Collection of oil transformers samples was performed from October 2005 to February 2006 in coordination with HEP.

These activities resulted with sampling of 197 transformer oil samples from 11 Croatian counties *(territorial distribution of the samples is shown in the Annex II of the Report).*

Analytical testing

Analytical testing of samples was mostly done within the KONČAR[2] (Electro Technical Institute) laboratory by using the Clor-N-oil 50 ppm test kits (200 pieces). During the analytical testing 3 samples were analyzed twice with Clor-N-oil 50 ppm test kits to reconfirm positive result.

Summary of analytical testing results are given in Table 17:

*Table 17: Results of analytical testing*

| Number of oil transformer samples | Number of samples confirmed as PCBs free | Number of samples identified as PCBs | Percentage of positive samples on PCBs |
|---|---|---|---|
| 197 | 188 | 9 | 4,6 |

Analytical testing of oil transformers was performed parallel with sampling activities and it was finished by the end of February 2006.

After reviewing the results, two of the samples were analyzed in laboratory (April 2006).

Result of the laboratory analysis confirmed the assumption that during the analytical testing with Clor-N-oil test kits, these two samples had false positive result, i.e. these two samples are not PCBs contaminated.

Taking above mentioned into account the new updated results of the analytical testing are given in the Table 18.

*Table 18: Updated results of analytical testing*

| Number of oil transformer samples | Number of samples confirmed as PCBs free | Number of samples identified as PCBs | Percentage of positive samples on PCBs |
|---|---|---|---|
| 197 | 190 | 7 | 3.6 |

[2] *The biggest producer of transformers and electrical equipment in south-east Europe*

Organization of a high level awareness seminar about importance of Stockholm Convention

During the initial talks with the representatives of the Ministry of Environmental Protection, Physical Planning and Construction about the current status of the ratification process, it was concluded that the holding of the high level seminar about the importance of the Stockholm Convention fits in line with the current initiation of the ratification process started within the Ministry.

Seminar was held on the 14th of November 2005, in Zagreb office of Croatian Chamber of Economy. Participants from relevant ministries, national agencies, companies, NGO's and scientific institutions attended the seminar.

Seminar covered the topics of POPs legal requirements on Croatian, European and International level, as well as the review of performed activities up to now and practical implications of PCBs waste management problem in Croatia.

After the presentation and comprehensive discussion in as a conclusion it can be pointed out:

- hazardous waste in general and PCBs waste in particularly is the national priority from the point of accession to the EU.
- the most important precondition is the PCB data base and its regular updating.
- Croatian National Waste management Strategy (Official Gazette 130/05) has adopted the guidelines from the NIP related to the PCBs management.
- Stockholm Convention is in the plan for the ratification in the 2006.

Additional meetings and contacts with the representatives of the Ministry of Environmental Protection, Physical Planning and Construction were held in the period after the seminar to discuss how the process of ratification can be supported and catalyzed.

### 2.3.2.12 Updated PCB inventory data

In total, 7 new PCBs transformers were identified as the result of the analytical testing campaign. Their amount accounts for 7.2 t.

Based on the above, the updated quantities and amount of PCBs in Croatia are as follows:

22 859 capacitors 655.7 t

311 transformers 735.9 t.

Increase in total amount of PCBs in transformers is 1.0 %, and increase in total amount of PCBs in closed systems is 0.5 %.

Consequently, the total amount of PCBs identified in closed systems in Croatia is **1391.6 t.**

Updated number and weight of the transformers together with their distribution by the year of manufacturing and by counties is given in the tables in Annex I.

### 2.3.3 Assessment with respect to Annex B Chemicals (DDT)

DDT synthesis in Croatia has never been present, while the use of DDT in agriculture was prohibited in 1972. The use of DDT for the purpose of disease vector control has never been present, as there was no malaria on the territory of Croatia in last 50 years, and the application and use of dicofol are prohibited.

Available data about DDT production, use, import and export are given in section 2.3.1. along with other POPs pesticides.

### 2.3.4 Assessment of releases from Unintentional Production of Annex C Chemicals (PCDD/PCDF, HCB and PCBs)

In the field of chemicals listed in Annex C in Croatia, there is a basic legislative framework for setting obligation to monitor and measure air emissions of PCDD/PCDF, but not of HCB and PCBs. Considering that the greatest source of releases is the fuel combustion in power plants, and the uncontrolled burning processes caused by firewood in households, in addition to the education of population it is necessary to direct the activities towards stimulating the use of fuels that reduce emissions of these chemicals (coal, wood – gas). It is necessary to ensure regulatory mechanisms for the continuous monitoring of PCDD/PCDF, HCB and PCBs releases.

PCDD/PCDFs emission reports are the integral part of annual reports on the pollutant emissions into air on the territory of Croatia. Release reports on persistent organic pollutants including PCDD/PCDFs in the Republic of Croatia, started in 1996 in accordance with the international methodology EMEP/CORINAIR, officially adopted by the executive body of the Convention on Long-range Transboundary Air Pollution (CLRTAP). Provisions of the Law on Air Protection (National Gazette 178/04) set the obligation to report the emissions. Estimate of dioxin and furan emissions is made in accordance with the SNAP 97 nomenclature of the EMEP/CORINAIR methodology.

During the inventory the releases of PCBs and HCB were not covered because of insufficient time and budget for their assessment. During the implementation of the NIP this issue will be covered.

**Methodology for PCDD/PCDFs inventory**

Inventory of PCDD/PCDF applies UNEP Chemicals methodology, «*Standardized toolkit for Identification and Quantification of Dioxin and Furan Releases*» (UNEP 2001) that ensures a comprehensive, consistent and clear review of the inventory of PCDD/PCDF environmental emissions.

UNEP methodology proposes five basic steps in the inventory of dioxins and furans:

(1) identification of the main categories of PCDD/PCDF sources;

(2) identification of sub-categories, current activities and potential routes of PCDD/PCDF expansion in environment;

(3) data collection about specific processes;

(4) quantification of PCDD/PCDF sources and calculation of the emissions using the emission factors, and

(5) summary of the inventory.

Based on the UNEP methodology, main sources of PCDD/PCDF have been classified into 10 categories and each main category consists of several sub-categories PCDD/PCDF sources shown in Table 17 along with potential routes of their expansion in the environment with denoted significant potential route («X») and the additional potential expansion route to be taken into account («x»).

Table 17. Main categories and sub-categories of PCDD/PCDF sources and potential routes of their expansion

| No. | | Main categories and sub-categories of PCDD/PCDF sources | Potential routes of PCDD/PCDF expansion in environment | | | | |
|---|---|---|---|---|---|---|---|
| | | | air | water | ground | products | waste |
| 1 | | **Waste incinerators** | **X** | | | | **X** |
| | a | Municipal solid waste incineration | | (x) | | | x |
| | b | Hazardous waste incineration | X | (x) | | | x |
| | c | Medical waste incineration | X | (x) | | | x |
| | d | Light-fraction shredder waste incineration | X | | | | x |
| | e | Sewage sludge incineration | X | (x) | | | x |
| | f | Waste wood and waste biomass incineration | X | | | | x |
| | g | Combustion of animal carcasses | X | | | | x |
| 2 | | **Ferrous and Non-Ferrous Metal Production** | **X** | | | | **X** |
| | a | Iron ore sintering | x | | | | x |
| | b | Coke production | x | X | x | x | x |
| | c | Iron and steel production | x | | | | x |
| | d | Copper production | x | | | | x |
| | e | Aluminium production | x | | | | x |
| | f | Lead production | x | | | | x |
| | g | Zinc production | x | | | | x |
| | h | Brass production | | | | | |
| | i | Magnesium production | | x | | | x |
| | j | Other non-ferrous metal production | x | x | | | x |
| | l | Shredders | x | | | | x |
| | m | Thermal wire reclamation | x | (x) | x | | x |
| 3 | | **Power generation and heating** | **X** | | | | **X** |
| | a | Fossil fuel power plants | X | | | | X |
| | b | Biomass power plants | X | | | | X |
| | c | Landfill, biogas combustion | X | | | | X |

| No. | | Main categories and sub-categories of PCDD/PCDF sources | Potential routes of PCDD/PCDF expansion in environment | | | | |
|---|---|---|---|---|---|---|---|
| | | | air | water | ground | products | waste |
| | d | Household heating and cooking (biomass) | X | | | | X |
| | e | Domestic heating (fossil fuels) | X | | | | X |
| 4 | | **Production of mineral products** | **X** | | | | **X** |
| | a | Cement production | X | | | | X |
| | b | Lime production | X | | | | X |
| | c | Brick production | X | | | | X |
| | d | Glass production | X | | | | X |
| | e | Ceramics production | X | | | | X |
| | f | Asphalt mixing | X | | | | X |
| 5 | | **Transport** | **X** | | | | |
| | a | Four-stroke engines | X | | | | |
| | b | Two-stroke engines | X | | | | |
| | c | Diesel engines | X | | | | (x) |
| | d | Heavy oil fired engines | X | | | | (x) |
| 6 | | **Uncontrolled combustion processes** | **X** | | | | **X** |
| | a | Biomass burning | X | (x) | (x) | | x |
| | b | Waste burning and accidental fires | X | (x) | (x) | | X |
| 7 | | **Production and use of chemicals and consumer goods** | **X** | **X** | | **X** | **X** |
| | a | Pulp and paper mills | x | x | | x | x |
| | b | Chemical industry | x | x | (x) | x | x |
| | c | Petroleum industry | x | | | | x |
| | d | Textile plants | | x | | x | |
| | e | Leather plants | | x | | x | |
| 8 | | **Miscellaneous** | **X** | **X** | **X** | **X** | **X** |
| | a | Drying of biomass | x | | | | |
| | b | Crematoria | x | | | | X |
| | c | Smoke houses | x | | | x | X |

| No. | | Main categories and sub-categories of PCDD/PCDF sources | Potential routes of PCDD/PCDF expansion in environment | | | | |
|---|---|---|---|---|---|---|---|
| | | | air | water | ground | products | waste |
| | d | Dry cleaning | | x | x | x | |
| | e | Tobacco smoking | x | | | | |
| 9 | | **Waste disposal** | | **X** | **X** | | |
| | a | Landfills and waste dumps | | | | | |
| | b | Sewage and sewage treatment | | | | | |
| | c | Waste disposal into rivers, lakes and sea | | | | | |
| | d | Disposal of waste oil (non-thermal) | | | | | |
| 10 | | **Identification of potential hot spots** | Recording possible upon expert assessment of the site | | | | |
| | a | Production sites of chlorinated organics | | | X | | |
| | b | Production sites of chlorine | | | X | | |
| | c | Formulation sites of chlorinated phenols | | | X | | |
| | d | Application sites of chlorinated phenols | x | X | x | x | |
| | e | Timber manufacture and treatment sites | | X | X | x | x |
| | f | PCB-filled transformers and capacitors | | | | x | x |
| | g | Dumps of wastes/residues from categories 1-9 | x | X | X | | x |
| | h | Sites of relevant accidents | | X | x | | x |
| | i | Dredging of sediments | | | | | x |
| | j | Kaolinitic or ball clay sites | | | x | | |

**Quantification of PCDD/PCDF sources and calculation of emissions using emission factors**

Basic formula for calculation of annual emissions of PCDD/PCDF into environment is the following equation:

*Emission of (PCDD/PCDF)/year = emission factor x activity (1)*

Activity is annual consumption of the starting raw material or annual production of individual products (e.g. tons of cement/year).

Emission factors are expressed by toxic equivalent per unit of the input raw material or the outgoing product, e.g. µg I-TEQ 2,3,7,8 – tetra-chlordibenzole-p-dioxine (TCDD) per ton of the manufactured cement. Emission factor is a number that denotes mass of the emitted polluting substance per unit of activity, and is determined by measurement or on the basis of experience from similar processes.

Annual emission of PCDD/PCDF is expressed in grams of the toxic equivalent I-TEQ per year.

In some cases annual emission of PCDD/PCDF is calculated from the equation:

*Emission (PCDD/PCDF)/year = concentration x flow (2)*

Flow is a mass flow of the released gas, liquid or solid material per year, e.g. $m^3$ $year^{-1}$ or ton $year^{-1}$. It is the result of multiplication of mass or flow volume per hour ($m^3$ $h^{-1}$ or t $h^{-1}$) with the number of working hours in a year (h $year^{-1}$).

Finally, annual emission of PCDD/PCDF is determined by the following two factors:

Flow or activity expressed as: product (e.g. cement, steel, etc.); starting raw material (e.g. hazardous waste, coal, diesel, etc.) or outgoing substance from the process (e.g. waste water).

Emission factors: determined from the UNEPO Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases (2001), or a reliable data from the performed measuring (e.g. ng TEQ $L^{-1}$) or

- multiplication product of the factor from Toolkit and the measurement.

Annual emission of each sub-category is summarized to obtain the emission by potential expansion routes of PCDD/PCDF into environment for all ten main categories. Overall result of inventory is the summary of the emissions of ten main categories of dioxin and furan sources.

### 2.3.4.1 To date monitoring of PCDD/PCDF environmental emissions

The reports about PCDD/PCDF emissions are integral part of regular annual reports about air emission of pollutants from the territory of the Republic of Croatia. Croatia started keeping its balance sheet of the emissions of the persistent organic pollutants, including PCDD/PCDF, in 1996 and has been carrying it in line with the international methodology EMEP/CORINAIR, officially approved by the executive body of the Convention on Long-Range Transboundary Air Pollution (CLRTAP). The obligation to record the emissions arises from the Law on Air Protection (Official Gazette No. 178/04).

Calculation of dioxin and furan emissions was performed according to the SNAP 97 nomenclature of EMEP/CORINAIR methodology for the year 2000 and is shown in Table 18.

Table 18. Emissions of PCDD/PCDF from the sectors in the Republic of Croatia for the year 2000 in line with the SNAP 97 nomenclature of EMEP/CORINAIR methodology.

**1. Combustion in public thermo-electric power plants, heating plants and energy-conversion facilities** **2000**

| substance | fuel | E.F. ng $t^{-1}$ | consumption t $year^{-1}$ | emission gTEQ $year^{-1}$ | total gTEQ$year^{-1}$ |
|---|---|---|---|---|---|
| **PCDD and PCDF** | pit coal | 165.0 | 569 800 | 0.09402 | |
| | coke (ref. Sisak) | 165.0 | 0 | 0.00000 | |
| | extra light heating oil | 21.4 | 1 100 | 0.00002 | |
| | heating oils | 100.5 | 392 000 | 0.03940 | |
| E.F. ng $m^{-3}$ | natural gas /$m^3$ | 0.00102 | 519 200 000 | 0.00053 | |
| | refinery gas | 1.0 | 262 400 | 0.00026 | **0.13** |

**2. Combustion in small business, institutions, households, agriculture, forestry and fishery**

| substance | fuel | E.F. ng $t^{-1}$ | consumption t $year^{-1}$ | emission gTEQ $year^{-1}$ | total gTEQ$year^{-1}$ |
|---|---|---|---|---|---|
| **PCDD and PCDF** | brown coal | 50 000.0 | 21 500 | 1.07500 | |
| | lignite | 50 000.0 | 16200 | 0.81000 | |
| | heating wood | 87 000.0 | 1 043 000 | 90.74100 | |
| General consumption | extra light heating oil | 1 000.0 | 402 700 | 0.40270 | |
| Public boiler-rooms and heating plants | extra light heating oil | 21.4 | 4 400 | 0.00009 | |
| General consumption | heating oils | 1 000.0 | 25 400 | 0.02540 | |
| Public boiler-rooms and heating plants | heating oils | 100.5 | 37 000 | 0.00372 | |
| General consumption | natural gas / $m^3$ | 0.00102 | 609 300 000 | 0.00062 | |
| Public boiler-rooms and heating plants | natural gas / $m^3$ | 0.00102 | 53 000 000 | 0.00005 | |
| General consumption | LPG | 1.0 | 69 000 | 0.00007 | |
| Public boiler-rooms and heating plants | LPG | 1.0 | 0 | 0.00000 | **93.06** |

### 3. Combustion in industry

| substance | fuel | E.F. ng $t^{-1}$ | consumption t $year^{-1}$ | emission gTEQ $year^{-1}$ | total gTEQ$year^{-1}$ |
|---|---|---|---|---|---|
| **PCDD and PCDF** | anthracite | 165.0 | 53 200 | 0.00878 | |
| | brown coal | 165.0 | 28 200 | 0.00465 | |
| | lignite | 165.0 | 14 400 | 0.00238 | |
| | coke | 165.0 | 37 700 | 0.00622 | |
| | wood (combustible waste | 60 000.0 | 173 250 | 10.39500 | |
| | extra light heating oil | 21.4 | 72 200 | 0.00155 | |
| | heating oils | 100.5 | 543 400 | 0.05461 | |
| | refinery gas | 1.0 | 40 700 | 0.00004 | |
| | natural gas / $m^3$ | 0.00102 | 844 500 000 | 0.00086 | |
| | LPG | 1.0 | 23 600 | 0.00002 | **10.47** |

### 4. Production processes without fuel combustion

| substance | fuel | E.F. ng $t^{-1}$ | consumption t $year^{-1}$ | emission gTEQ$year^{-1}$ | total gTEQ$year^{-1}$ |
|---|---|---|---|---|---|
| **PCDD and PCDF** | Steel production (EL) | 70 000.0 | 71 021 | 4.97147 | **4.97** |

### 5. Road transport

| substance | fuel | E.F. ng $t^{-1}$ | consumption t $year^{-1}$ | emission gTEQ$year^{-1}$ | total gTEQ$year^{-1}$ |
|---|---|---|---|---|---|
| **PCDD and PCDF** | leaded gasoline | 500.0 | 262 100 | 0.13105 | |
| | diesel fuel | N/A | 557 800 | | |
| | LPG | 1.0 | 9 800 | 0.00001 | **0.13** |

### 6.Other movable machines and sources

| substance | fuel | E.F. ng $t^{-1}$ | consumption t $year^{-1}$ | emission gTEQ$year^{-1}$ | total gTEQ$year^{-1}$ |
|---|---|---|---|---|---|
| **PCDD and PCDF** | diesel fuel | N/A | 53 200 | | |
| | jet fuel | N/A | 72 300 | | |
| | heating oil | 100.5 | 1 400 | 0.00014 | **0.0001** |

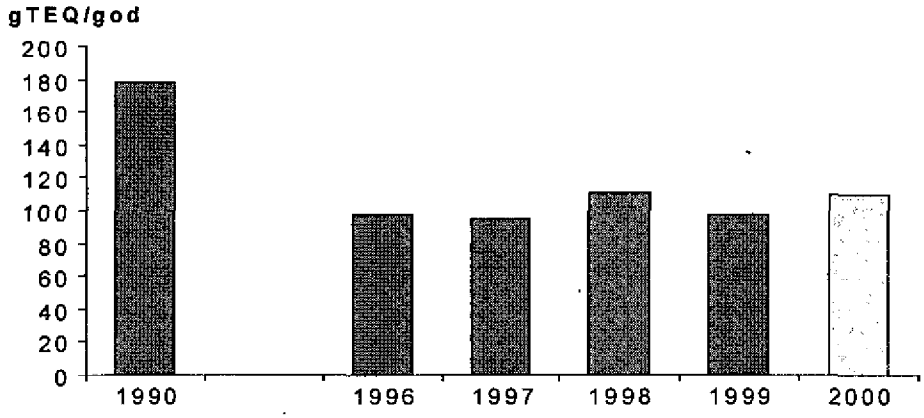
**7. Waste treatment and disposal**

| substance | fuel | E.F. ng $t^{-1}$ | consumption t $year^{-1}$ | emission $gTEQyear^{-1}$ | total $gTEQyear^{-1}$ |
|---|---|---|---|---|---|
| **PCDD and PCDF** | thermal treatment of waste | 89 000.0 | 3 152 | 0.28053 | **0.28** |

**TOTAL 109.05**

In 2000 the emissions of dioxin and furan to the year 1999 increased by approximately 11% due to increased consumption of the heating wood by households. Trend in the emissions of dioxin and furan is shown in Figure 1.

Figure 1. Trend in the emissions of dioxin and furan in Croatia




### 2.3.4.2 Legal regulations in the field of PCDD/PCDF

Below is the list of the laws and regulations relating to environmental emissions of PCDD/PCDF.

- Law on Air Protection (Official Gazette No. 178/04)
- By-Law on the Recommended and Limit Values of Air Quality (Official Gazette No. 101/96)
- By-Law on the Limit Values of Air Emissions of Pollutants from the Stationary Sources (Official Gazette No. 140/97).
- By-Law on the Amendments of and Supplements to the By-Law on the Limit Values of Pollutants Air Emissions from the Stationary Sources (Official Gazette No. 105/02).
- Law on Waters (Official Gazette No. 107/95)
- By-Law on Hazardous Substances in Waters (Official Gazette No. 78/98)
- Law on Agricultural Land (Official Gazette No. 34/91)
- Rules on the Protection of Agricultural Land from Pollution with Harmful Substances (Official Gazette No. 15/92)

### 2.3.4.3 Assessment of environmental emissions of dioxine and furan for the year 2001

During identification of environmental presence of dioxin and furan and the assessment of their emissions, available data were analysed along with the reports of the Ministry of Environmental Protection, Physical Planning and Construction, various publications of the State Institute of

Statistics, reports of PUTO (hazardous waste incineration plant), and various publications of the Croatian Chamber of Economy, Ekonerg and UNEP Toolkit.

**Assessment of emissions**

**Main category 1 – Waste incineration plants**

In this category the recognized potential source of PCDD/PCDF environmental emissions is sub-category 1.b. – waste incineration plant.

*Sub-category 1.b.: Waste incineration plant*

Till August 1,2 002 Zagreb had hazardous waste incineration plant - PUTO. During 2001, 3967 tons of hazardous waste was treated in PUTO. Twice yearly the levels of PCDD/PCDF were measured in dry waste gas (*LGA - Report on carrying out of emission Measurements in the waste gas of the hazardous waste incineration plant, 2001*). Both measurements showed that the limit value of the emissions (LVE) was above 0.1 ng I-TEQ $m^{-3}$ as set by the By-Law on LVE for air pollutants coming from the stationary sources (Official Gazette No. 140/97).

In order to reduce the risk of environmental emission of PCDD/PCDF from the hazardous waste incineration, the emission factors from UNEP Toolkit are applied. These factors range from 0.5 μgTEQ $t^{-1}$, for the state-of-the-arts technologies, to 35 000 μgTEQ$t^{-1}$ for the plants without the air pollution control system. For the existing technology of hazardous waste incineration in PUTO, for the controlled burning and the existing air pollution control system, PCDD/PCDF environmental releases are calculated using EF for air i.e.350 μgTEQ$t^{-1}$ and EF for leftover/waste i.e. 900 μgTEQ $t^{-1}$.

Assessment of environmental emissions of PCDD/PCDF from the main category 1 – waste incineration plant is shown in Table 19.

Table 19. Assessment of environmental emissions of PCDD/PCDF from the main category 1-waste incineration plant

| | **Source category** | **Potential routes of environmental expansion of PCDD/PCDF Emission factor (μg TEQ/t)** | | | | | | **Activity (t)** | **Annual emissions (g TEQ/year)** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Waste | | | | | | | |
| **Class** | | Air | Water | Soil | Products | Fly Ash | Bottom Ash | | Air | Water | Soil | Products | Waste |
| | **Waste incineration plants** | | | | | | | **3 967** | **1.4** | | **0** | **0** | **3.6** |
| | **Hazardous waste incineration plant** | | | | | | | 3 967 | 1.4 | | 0 | 0 | 3.6 |
| 2 | Controlled combustion, minimal control system for air pollution | 350 | | N/A | N/A | 900 | | 3 967 | 1.4 | | 0 | 0 | 3.6 |

* ND – not determined; N/A- not applicable, route of emission unimportant

**Main category 2 – Production of ferrous and non-ferrous metals**

The Croatian metal industry comprises production of steel, seamed and seamless steel pipes, reinforcement, rolled wires, wire mesh for construction works, processing of aluminium, casting of metal, production of ferroalloys and the so called metal-manufacturing activities. By total revenues in the year 2001 major manufacturers of metal and metal products were TLM Šibenik d.d., Dalekovod d.d.Zagreb, Željezara Sisak, Trgometal d.d. Zagreb, Jedinstvo PMD Krapina, MIV Varaždin, Limex Donji Miholjac, etc.

In these category potential sources of PCDD/PCDF environmental emissions were the following sub-categories:

- 2.c. – iron and steel production;
- 2.d. – secondary copper production;
- 2.e. – secondary aluminium production, and
- 2.f. – secondary lead production.

*Sub-category 2.c.: Iron and steel production*

Ironworks in Sisak and Split (seamed and seamless pipes, cold processing of pipes, steel beams, rolled concrete smooth and ribbed steel, rolled and drawn wire) use some raw materials from local sources (steel waste, limestone and dolomite) and some imported (ferroalloys, steel blocks, hot and cold steel blocks, hot and cold rolled bands, hot rolled seamless pipes, etc.). The capacities are not fully engaged and the ironworks are technologically outdated.

The Croatian foundries have approximate yearly castings production of 35 000 t. However outdated technology the castings are of very high quality, used by very demanding industries, e.g. automobile and shipbuilding.

In 2001 total production of steel and iron amounted to 208 229 t. Given the outdated technological status and minimal control of air pollution, the assessment applied the respective EF from UNEP Toolkit. Relevant to a technological process EF vary between 4.3 and 10 μgTEQ $t^{-1}$ for air and between 0.2 and 15 μgTEQ $t^{-1}$ for leftover/waste.

*Sub-categories 2.d/e/f: Secondary copper, aluminium and lead production*

In 2001 total production (secondary) of copper products amounted to 2 060 t, of aluminium products 52 385 t and of lead 1165 t.

The assessment of environmental PCDD/PCDF emissions from the main category 2 – ferrous and non-ferrous metals production is shown in Table 20.

Table 20. Assessment of environmental emissions of PCDD/PCDF from the main category 2 – ferrous and non-ferrous metals production

| | | Source category | Potential route of environmental expansion of PCDD/PCDF Emission factor (µg TEQ/t) | | | | | Activity (t) | Annual emissions (g TEQ/year) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-category | Class | | Air | Water | Soil | Product | Waste | | Air | Water | Soil | Product | Waste |
| | | **Ferrous and non-ferrous metals production** | | | | | | **263 839** | **3.11** | **0** | **0** | **0** | **22.33** |
| **c** | | **Iron and steel production – utilities and foundries** | | | | | | **208 229** | **1.2** | **0** | **0** | **0** | **0.13** |
| | | **Iron and steel plants** | | | | | | | | | | | |
| | 1 | Dirty scrap/limited control | 10 | ND | ND | N/A | 15 | 57 993 | 0.6 | 0 | 0 | 0 | 0.1 |
| | | **Foundries** | | | | | | | | | | | |
| | 2 | Rotary Drum - fabric filter | 4.3 | ND | ND | ND | 0.2 | 150 236 | 0.6 | 0 | 0 | 0 | 0.03 |
| **d** | | **Secondary copper production** | | | | | | **2 060** | **0.1** | **0** | **0** | **0** | **1.3** |
| | 2 | Secondary copper - well controlled | 50 | ND | ND | ND | 630 | 2 060 | 0.1 | 0 | 0 | 0 | 1.3 |
| **e** | | **Secondary aluminium production** | | | | | | **52 385** | **1.8** | **0** | **0** | **0** | **20.9** |
| | 2 | Scrap treatment, well controlled, good APCS | 35 | ND | ND | ND | 400 | 52 385 | 1.8 | 0 | 0 | 0 | 20.9 |
| **f** | | **Secondary lead production** | | | | | | **1 165** | **0.01** | **0** | **0** | **0** | **0** |
| | 2 | Sec. from PVC/Cl2 free scrap, blast furnaces with FF | 8 | ND | ND | ND | ND | 1 165 | 0.01 | 0 | 0 | 0 | 0 |

* ND – not determined; N/A – not applicable, route of PCDD/PCDF environmental emission unimportant

**Main category 3 – Power and heat production**

This category refers to combustion in thermal-power plants and power transformation plants, combustion in industry, combustion in households (biomass and fossil fuel).

In this category, potential sources of environmental emissions of PCDD/PCDF are the following recognized sub-categories:

- 3.a/b. –fossil and biomass fuel-fired utilities;
- 3.d/e. – residential combustion sources (biomass and fossil fuel).

Assessment of environmental emissions of PCDD/PCDF from the main category 3 – power and heat production is shown in Table 21.

Table 21. Assessment of environmental emissions of PCDD/PCDF from the main category 3 – power and heat production

| | | Source category | Potential route of environmental expansion of PCDD/PCDF Emission factor (µg TEQ/TJ) | | | | | Activity (t) | Annual emissions (g TEQ/year) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-category | Class | | Air | Water | Soil | Product | Waste | | Air | Water | Soil | Product | Waste |
| | | **Power and heat production** | | | | | | **1 286 822** | **105.68** | **0** | **0** | **0** | **20.6** |
| **a** | | **Fossil fuel-fired utilities** | | | | | | **17 645** | **0.4** | | | | **0.3** |
| | 2 | Coal fuel-fired power boilers | 10 | N/A | N/A | N/A | 14 | 19 645 | 0.2 | 0 | 0 | 0 | 0.3 |
| | 3 | Heavy fuel- fired power boilers | 2.5 | N/A | N/A | N/A | ND | 45 100 | 0.1 | 0 | 0 | 0 | 0 |
| | 4 | Light fuel oil/natural gas fired power boilers | 0.5 | N/A | N/A | N/A | ND | 111 900 | 0.1 | 0 | 0 | 0 | 0 |
| **b** | | **Biomass fuel-fired utilities** | | | | | | **12 200** | **0.6** | **0** | **0** | **0** | **0.2** |
| | 2 | Wood fired power boilers | 50 | NA | NA | NA | 15 | 12 200 | 0.6 | 0 | 0 | 0 | 0.2 |
| **d** | | **Residential combustion sources - biomass** | | | | | | **1 043 000** | **104.3** | **0** | **0** | **0** | **20.1** |
| | 2 | Virgin wood/biomass fuel-fired stoves | 100 | NA | NA | NA | 20 | 1 043 000 | 104.3 | 0 | 0 | 0 | 20.1 |
| | 1 | Coal fuel-fired stoves | 70 | NA | NA | NA | 5 | 543 | 0.04 | 0 | 0 | 0 | ? |
| | 2 | Oil fuel-fired stoves | 10 | NA | NA | NA | ND | 30 019 | 0.3 | 0 | 0 | 0 | 0 |
| | 3 | Natural gas fuel-fired stoves | 1.5 | NA | NA | NA | ND | 24 415 | 0.04 | 0 | 0 | 0 | 0 |

* ND – not determined; N/A – not applicable; route of PCDD/PCDF environmental emission unimportant

**Main category 4 – Mineral products production**

The category of mineral products production comprises relevant processes carried out at high temperatures. In 2001 total production in Croatia according to following sub-categories was as followed:

- 4.a – cement production: 3 246 120 t.
- 4.b – limestone production: 252 613 t.
- 4.c – brick production: 1 862 506 t
- 4.d – glass production: 142 201 t
- 4.e – ceramics production: 56 530 t
- 4.f – preparation of asphalt: 441 331 t

Assessment of environmental emissions of PCDD/PCDF is shown in Table 22.

Table 22. Assessment of environmental emissions of PCDD/PCDF from the main category 4 – mineral products production

| | | Source category | Potential route of environmental expansion of PCDD/PCDF Emission factor (µg TEQ/t) | | | | | Activity (t) | Annual emissions (g TEQ/year) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-category | Class | | Air | Water | Soil | Product | Leftover/ waste | | Air | Water | Soil | Product | Leftover |
| | | **Mineral products production** | | | | | | **5 919 917** | **2.333** | **0** | **0** | **0** | **0.01** |
| **a** | | **Cement kilns** | | | | | | **3 246 120** | **0.2** | **0** | **0** | **0** | **0.01** |
| | 3 | Wet kilns, ESP/FF temperature <200 °C and all types of dry kilns | 0.05 | N/A | ND | ND | 0.003 | 3 246 120 | 0.2 | 0 | 0 | 0 | 0.01 |
| **b** | | **Limestone** | | | | | | **171 229** | **1.7** | **0** | **0** | **0** | **0** |
| | 1 | Cyclone/no dust control | 10 | ND | ND | ND | ND | 171 229 | 1.7 | 0 | 0 | 0 | 0 |
| **c** | | **Brick** | | | | | | **1 862 506** | **0.4** | **0** | **0** | **0** | **0** |
| | 1 | Cyclone/no dust control | 0.2 | N/A | ND | ND | ND | 1 862 506 | 0.4 | 0 | 0 | 0 | 0 |
| **d** | | **Glass** | | | | | | **142 201** | **0.002** | **0** | **0** | **0** | **0** |
| | 2 | Good dust abatement | 0.015 | NA | ND | ND | ND | 142 201 | 0.002 | 0 | 0 | 0 | 0 |
| **e** | | **Ceramics** | | | | | | **56 530** | **0.001** | **0** | **0** | **0** | **0** |
| | 2 | Good dust abatement | 0.02 | NA | ND | ND | ND | 56 530 | 0.001 | 0 | 0 | 0 | 0 |
| **f** | | **Asphalt (preparation)** | | | | | | **441 331** | **0.03** | **0** | **0** | **0** | **0** |
| | 1 | Mixing plant with no gas cleaning | 0.07 | NA | ND | ND | ND | 441 331 | 0.03 | 0 | 0 | 0 | 0 |

* ND – not determined; N/A-not applicable; route of PCDD/PCDF environmental emissions unimportant

**Main category 5 – Transport**

This category comprises fuel combustion in transport. The category is divided in 4 sub-categories:

- 5.a - Otto – 4t (four-stroke engines)
- 5.b - Otto – 2t (two-stroke engines)
- 5.c. - Diesel engines
- 5.d – Engines driven by heavy heating oils

Total consumption of fuels in transport during the year 2001 was around 1 323 402 t.

There are no data about annual consumption of leaded and lead-free gasoline by Otto – 4x and Otto – two-stroke engines with catalyst and without the catalyst.

The only emission route and emission factor for PCDD/PCDF into air is: 0.1-4 μgTEQ $t^{-1}$ according to UNEP Toolkit.

Assessment of environmental emissions of PCDD/PCDF is shown in Table 23.

Table 23. Assessment of environmental emissions of PCDD/PCDF from the main category 5 – transport

| Sub-category | Class | Source category | Potential route of environmental expansion of PCDD/PCDF Emission factor (µg TEQ/t) | | | | | Activity (t) | Annual emissions (g TEQ/year) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Air | Water | Soil | Products | Waste | | Air | Water | Soil | Product | Waste |
| | | **Transport** | | | | | | **1 323 402** | **0.945** | **0** | **0** | **0** | **0** |
| **a** | | **Four-stroke engines** | | | | | | **661 572** | **0.505** | **0** | **0** | **0** | **0** |
| | 1 | Leaded fuel | 2.2 | N/A | N/A | N/A | ND | 209 680 | 0.5 | 0 | 0 | 0 | 0 |
| | 2 | Unleaded fuel without catalyst | 0.1 | N/A | N/A | N/A | ND | 45 189 | 0.005 | 0 | 0 | 0 | 0 |
| | 3 | Unleaded fuel with catalyst | 0.00 | N/A | N/A | N/A | N/A | 406 703 | 0 | 0 | 0 | 0 | 0 |
| **b** | | **Two-stroke engines** | | | | | | **102 630** | **0.33** | **0** | **0** | **0** | **0** |
| | 1 | Leaded fuel | 3.5 | N/A | N/A | N/A | ND | 52 420 | 0.2 | 0 | 0 | 0 | 0 |
| | 2 | Unleaded fuel without catalyst | 2.5 | N/A | N/A | N/A | ND | 50 210 | 0.13 | 0 | 0 | 0 | 0 |
| **c** | | **Diesel engines** | | | | | | **557 800** | **0.1** | **0** | **0** | **0** | **0** |
| | 1 | Diesel engines | 0.1 | N/A | N/A | N/A | ND | 557 800 | 0.1 | 0 | 0 | 0 | 0 |
| **d** | | **Heating oils fuelled utilities** | | | | | | **1 400** | **0.01** | **0** | **0** | **0** | **0** |
| | 1 | All types | 4 | N/A | N/A | N/A | ND | 1 400 | 0.01 | 0 | 0 | 0 | 0 |

* ND – not determined; N/A – not applicable; environment emission route of PCDD/PCDF unimportant

**Main category 6 – Uncontrolled combustion processes**

In this category the following sub-category has been recognized:

- 6.a -- combustion of biomass

Average surface affected by one fire is 57.69 ha (on karst 71.63 ha, inland 15.36 ha). Average burning surface per year is 9 917 ha, of which 53% are state forests and forested land managed by "Hrvatske šume" and 8 949 ha or 47% of other land (private forests and agricultural lands). Forest fire burns on average 23 t $ha^{-1}$ of biomass (EPA 1998).

For sub-category from UNEP Toolkit – uncontrolled combustion processes – main emission routes of PCDD/PCDF are air and soil. According to UNEP Toolkit emission factor for air is 5 µgI-TEQ $t^{-1}$, and for soil it is 4 µgI-TEQ $t^{-1}$ while other emission routes are not important.

Assessment of environmental emissions of PCDD/PCDF is shown in Table 24.

Table 24. Assessment of environmental emissions of PCDD/PCDF from the main category 6 – uncontrolled combustion processes

| | | Source category | Potential route of environmental expansion of PCDD/PCDF Emission factor (µg TEQ/t) | | | | | Activity (t) | Annual emissions (g TEQ/year) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-category | Class | | Air | Water | Soil | Product | Leftover/ waste | | Air | Water | Soil | Product | Leftover/ waste |
| **6** | | **Uncontrolled combustion products** | | | | | | **433 918** | **2.2** | **0** | **1.7** | **0** | **0** |
| **a** | | **Fires/burning of biomass** | | | | | | **433 918** | **2.2** | **0** | **1.7** | **0** | **0** |
| | 1 | Forest fires | 5 | ND | 4 | N/A | ND | 433 918 | 2.2 | 0 | 1.7 | 0 | 0 |

* ND – not determined; N/A – not applicable, route of environmental emissions of PCDD/PCDF unimportant

**Main category 7 – Production and use of chemical and consumer goods**

In this category the following sub-categories have been recognized:

- 7.a – pulp and paper production, and
- 7.b – chemical industry

Approximate assessment of environmental emissions of PCDD/PCDF according to the available data about technological processes and air pollution control systems is shown in Table 25.

Table 25. Assessment of environmental emissions of PCDD/PCDF from the main category 7 – Production of chemicals and consumer goods

| | | Source category | Potential route of environmental expansion of PCDD/PCDF Emission factor (µg TEQ/t) | | | | | Activity (t) | Annual emissions (g TEQ/year) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-category | Class | | Air | Water | Soil | Product | Leftover/ waste | | Air | Water | Soil | Product | Leftover/ waste |
| | | **Production of chemicals and consumer goods** | | | | | | **726 747** | **0.14** | **0.002** | | **0.804** | **0.3** |
| **a** | | **Pulp and paper** | | | | | | **578 835** | | | | **0.8** | |
| | | *Pulp and paper* | | | | | | | | | | | |
| | 3 | Kraft papers, new technology ($ClO_2$, TCF), unbleached papers | | | | 0.5 | | 533 835 | | | | 0.3 | |
| | 5 | Recycling paper | | | | 10 | | 45 000 | | | | 0.5 | |
| **b** | | **Chemical industry** | | | | | | **147 912** | **0.14** | **0.002** | | **0.004** | **0.3** |
| | | *ECD/VCM/PVC* | | | | | | | | | | | |
| | 2 | Modern plants | | | | | | | | | | | |
| | | EDC/VCM and/or EDC/VCM/PVC | 0.95 | 0.015 | | 0.03 | 2 | 147 912 | 0.14 | 0.002 | | 0.004 | 0.3 |

* ND – not determined; N/A – not applicable, route of environmental emissions of PCDD/PCDF unimportant

**Main category 8 – Miscellaneous**

In the category "Miscellaneous" the following sub-category has been recognized:

- 8.e – cigarette smoking

The data about cigarette production in Croatia in the year 2001 have been used.

Emission factor for air as the only expansion route is 0.1 μgI-TEQ $t^{-1}$ (according to UNEP Toolkit).

Approximate assessment of environmental emissions of PCDD/PCDF is shown in Table 26.

Table 26. Assessment of environmental emissions of PCDD/PCDF from the main category 8 – Miscellaneous

| | | Source category | Potential route of environmental expansion of PCDD/PCDF Emission factor (µg TEQ/t) | | | | | Activity (t) | Annual emissions (g TEQ/year) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-category | Class | | Air | Water | Soil | Product | Leftover/ waste | | Air | Water | Soil | Product | Leftover/ waste |
| | | **Miscellaneous** | | | | | | **14 567** | **0.001** | | | | |
| **e** | | **Cigarette smoking *** | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | 2 | Cigarettes (pieces) | 0.1 | N/A | N/A | N/A | N/A | 14 567 | 0.001 | | | | |

* ND – not determined; N/A – not applicable, route of environmental emissions of PCDD/PCDF unimportant

**Main category 9 – Waste treatment/disposal**

In the category Waste treatment/disposal, useful data for the assessment of environmental emissions of PCDD/PCDF are those for sub-category 9.d.

*Sub-category 9.d: Composting*

Total quantity of the composted waste amounted to 183 163 t in year 2001.

Emission factor according to UNEP Toolkit is 15 μgI-TEQ $t^{-1}$, and it was applied only for products. Other expansion routes are not applicable. Total emission amounts to 2.7 gTEQ $year^{-1}$

Table 27. Assessment of environmental emissions of PCDD/PCDF from the main category 9 – Waste treatment/disposal

| | | Source category | Potential route of environmental expansion of PCDD/PCDF Emission factor (µg TEQ/t) | | | | | Activity (t) | Annual emissions (g TEQ/year) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-category | Class | | Air | Water | Soil | Product | Leftover/ waste | | Air | Water | Soil | Product |
| | | **Disposal** | | | | | | **183 163** | | | | **2.7** |
| **d** | | **Composting** | | | | | | | | | | |
| | 2 | gardens, waste from food preparation | N/A | ND | N/A | 15 | N/A | 183 163 | | | | 2.7 |

* ND – not determined; N/A – not applicable, route of environmental emissions of PCDD/PCDF unimportant

***Assessment of overall environmental emissions of PCDD/PCDF (2001)***

Table 28. shows the assessment of overall environmental emissions of PCDD/PCDF in the year 2001.

Table 28. Assessment of overall environmental emissions of PCDD/PCDF in the year 2001

| No. | Main categories of PCDD/PCDF sources | Annual emissions of PCDD/PCDF (g TEQ/year) | | | | |
|---|---|---|---|---|---|---|
| | | air | water | soil | product | leftover/waste |
| 1 | Waste incineration plants | 1.4 | | | | 3.6 |
| 2 | Ferrous and non-ferrous metal production | 3.1 | ? | ? | | 22.3 |
| 3 | Power generation and heating | 105.7? | | | | 20.6 |
| 4 | Mineral products production | 2.3 | | | | 0.01? |
| 5 | Transport | 0.9 | | | | |
| 6 | Uncontrolled combustion processes | 2.2? | | 1.7 | | ? |
| 7 | Production of chemicals and consumer goods | 0.1 | 0.002? | | 0.8 | 0.3? |
| 8 | Miscellaneous | 0.001? | | | ? | ? |
| 9 | Waste treatment/disposal | ? | ? | ? | | 2.7 |
| **1-9** | **TOTAL** | **115.7?** | **0.002?** | **1.7?** | **0.8?** | **49.5?** |

** the values shown are medians; empty boxes show that the potential route is insignificant.*

*?- potential route of emission is significant, but either EF or activity is missing.*

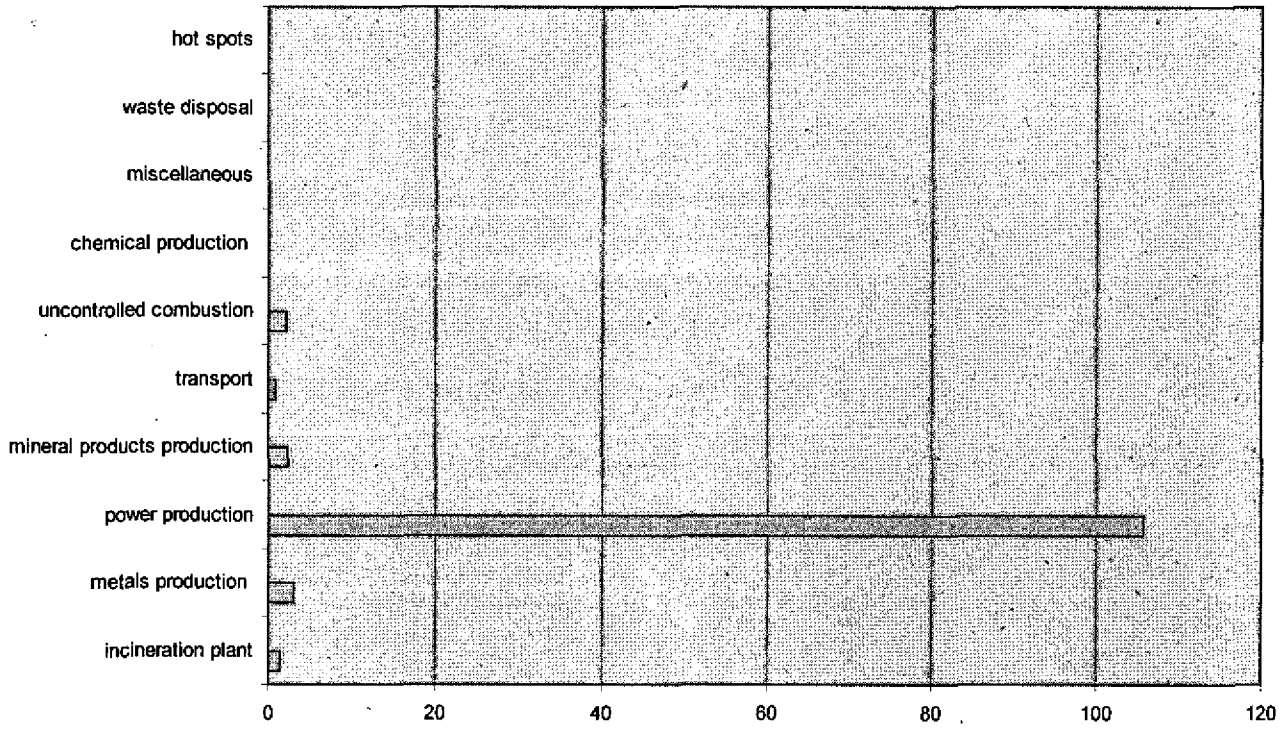
*? after the number means that the number (information) is not representative because some sub-categories have not been fully processed.*

The most significant routes of PCDD/PCDF emissions are the emissions into air and leftovers/waste.

Major emissions of dioxin and furan occur during burning of heating wood in residential combustion sources. Other significant sources are uncontrolled burning processes, combustion of fuel in power plants (thermo-electric power plants, heating plants, etc.), production of ferrous and non-ferrous metals, road transport, etc.

Dioxins and furans are by-products of industrial processing, large-scale production and combustion. They occur as leftovers/waste from the air pollution control system.

Figure 2: Assessment of PCDD/PCDF air emissions from all sources in the Republic of Croatia in the year 2001.




*Reliability of calculation of PCDD/PCDF environmental emissions*

Assessment of calculation reliability is one of the key elements in inventory of dioxin and furan in the Republic of Croatia. Information about calculation reliability is not aimed at challenging validity of calculation. It is rather an aid for determination of priority measures and efforts to increase calculation accuracy and to select methodological options.

The assessed overall reliability of PCDD/PCDF environmental emissions is the combination of individual reliabilities of emissions assessment elements:

- reliability of the immediate determination of emission factors;
- reliability of the data about activities (technological processes, air pollution control systems and production), and
- reliability of individual measurements of PCDD/PCDF environmental emissions

At this point, overall quantitative reliability of calculation is not expressed, but relatively subjective qualitative assessments for separate categories, sub-categories and specific processes have been made, with the intention to quantify this assessment sometime as much as possible.

### 2.3.4.4 Conclusion

Inventory of PCDD/PCDF (according to UNEP Toolkit) has recognized main categories and sub-categories as well as specific processes in which PCDD/PCDF is released into environmental elements (soil, air and water), products and waste.

Main routes of PCDD/PCDF releases are air and leftovers/waste.

Major emissions of dioxin and furan occur during residential combustion of heating wood. Other significant sources are the uncontrolled combustion processes, combustion of fuel in power plants (thermo-power plants, heating plants, etc.), ferrous and non-ferrous metals production, road transport, etc. Dioxins and furans are by-products of industrial processing and manufacture and of combustion. They occur as leftovers/waste of air pollution control systems.

Table 29. Results of PCDD/PCDF inventory (2001)

| **Annual emissions of PCDD/PCDF (g TEQ/year)** | | | | |
|---|---|---|---|---|
| **air** | **water** | **soil** | **products** | **Leftover/waste** |
| **115.7?** | **0.002?** | **1.7?** | **0.8?** | **49.5?** |

*"?" means that the number (information) is not representative because some sub-categories have not been fully processed.*

According to the provisions of the Stockholm Convention and with regard to the results of the inventory, the following guidelines have been specified:

- facilitate access to data about activities in each category and sub-category, and to data about specific technological processes;
- enable and improve review of the status of the equipment for emissions reduction and of filters capacity in the plants, and correct correspondingly the emission factors for assessment of PCDD/PCDF emissions;
- establish and organize on the national level monitoring of critical points of PCDD/PCDFs releases i.e. establish the network of sampling points, and measure the environmental PCDD/PCDFs releases at least twice per year;
- implement prevention measures for uncontrolled combustion in nature (burning of waste, fires, etc.);
- apply best available techniques and practices for environmental protection (BAT and BEP);
- improve waste management, and
- reduce and/or avoid the use of substances found to generate PCDD/PCDFs releases.

### 2.3.5 Information on the state of knowledge on stockpiles, contaminated sites and wastes, identification, likely numbers, relevant regulations, guidance, remediation measures an data on release from sites

During POPs inventory there has been no record of major POPs stockpiles or POPs waste ***(except for the equipment with PCB that is either damaged or stockpiled).*** However, the sites potentially contaminated with POPs have been identified. They require further investigation to determine their level of contamination. Certain data from former studies and samples analyses from some sites where the equipment with PCBs was damaged during the war (1991-1995) are presented in sections 2.3.2.8. and 2.3.7.2.

In addition to these information, during the inventory, carried out with the Croatian Army Forces and the Ministry of Defence, preliminary laboratory tests of soil from eastern Slavonia (where many military vehicles were damaged) were carried out which have not shown significant local contamination with PCBs. Given the fact that this area is used for intensive agricultural production, soil samples from it were also analysed for DDT and lindane, and the results have not indicated any increased contamination with these substances.

Sections 2.3.1.5. and 2.3.2.6. give the review of available information about POPs compounds and POPs waste stockpiles.

During the inventory process the potential contaminated sites were identified and available data were collected. Prioritisation among identified sites could not be developed dues to lack of resources and time. Since the prioritisation requires detailed sampling and analysis of the identified sites, this will be covered during the NIP implementation.

### 2.3.6 Summary of future production, use and release of POPs – requirements for exemptions

Current production, use and release of POPs is indicated in the following Table.

Table 30. Current production, use and release of POPs.

| **Year** | **2002/03 (Baseline Inventory)** | **2005** | **2010** | **2020** | **2030** |
|---|---|---|---|---|---|
| **POPs PESTICIDES** | | | | | |
| **Production** | (Tonnes) | (Tonnes) | (Tonnes) | (Tonnes) | (Tonnes) |
| Aldrin | 0 | 0 | 0 | 0 | 0 |
| Chlordane | 0 | 0 | 0 | 0 | 0 |
| Dieldrin | 0 | 0 | 0 | 0 | 0 |
| Endrin | 0 | 0 | 0 | 0 | 0 |
| Heptachlor | 0 | 0 | 0 | 0 | 0 |
| Hexachlorobenzene | 0 | 0 | 0 | 0 | 0 |
| Mirex | 0 | 0 | 0 | 0 | 0 |
| Toxaphene | 0 | 0 | 0 | 0 | 0 |
| **Use** | (Tonnes) | (Tonnes) | (Tonnes) | (Tonnes) | (Tonnes) |
| Aldrin | 0 | 0 | 0 | 0 | 0 |
| Chlordane | 0 | 0 | 0 | 0 | 0 |
| Dieldrin | 0 | 0 | 0 | 0 | 0 |
| Endrin | 0 | 0 | 0 | 0 | 0 |
| Heptachlor | 0 | 0 | 0 | 0 | 0 |
| Hexachlorobenzene | 0 | 0 | 0 | 0 | 0 |
| Mirex | 0 | 0 | 0 | 0 | 0 |
| Toxaphene | 0 | 0 | 0 | 0 | 0 |
| **DDT** | (Tonnes) | (Tonnes) | (Tonnes) | (Tonnes) | (Tonnes) |
| **Production** | 0 | 0 | 0 | 0 | 0 |
| **Use** | 0 | 0 | 0 | 0 | 0 |
| **PCB** | (Tonnes) | (Tonnes) | (Tonnes) | (Tonnes) | (Tonnes) |
| **Production** | 0 | 0 | 0 | 0 | 0 |
| **Use** | 1 384 | | | | |
| Closed and semi-closed applications | 1 384 | ** | | | |
| Open applications | * | | | | |
| **Releases from Unintentional Production** | (g I-TEQ) | (g I-TEQ) | (g I-TEQ) | (g I-TEQ) | (g I-TEQ) |
| **Dioxins and furans (PCDDs/PCDFs)** | | | | | |
| Waste incineration | 5.2 | **[3] | | | |

| Year | 2002/03 (Baseline Inventory) | 2005 | 2010 | 2020 | 2030 |
|---|---|---|---|---|---|
| Ferrous and non-ferrous metal production | 25.4 | ** | | | |
| Power generation and heating | 126.3 | ** | | | |
| Production of mineral products | 2.3 | ** | | | |
| Transport | 0.9 | ** | | | |
| Uncontrolled combustion processes | 3.9 | ** | | | |
| Production of chemicals and consumer goods | 1.2 | ** | | | |
| Disposal | 2.7 | ** | | | |
| Hot-spots | | ** | | | |
| Miscellaneous | 0.001 | ** | | | |
| **Hexachlorobenzene (HCB)** | 0 | ** | | | |
| **Polychlorinated biphenyls (PCBs)** | 0 | ** | | | |
| | | | | | |

* - not yet determined. ** - to be decided

Based on this table Croatia has decided not to apply for the exemption from the Convention and it is neither anticipated that it will apply.

### 2.3.7 Existing programmes for monitoring releases and environmental and human health impacts, including findings

Monitoring of POPs compounds in various matrices is performed for the following purposes:

- checking of their levels and their comparison with the levels set by law, rules and By-laws, and
- monitoring of distribution and levels of the compounds for research purposes i.e. for evaluation of environmental and human burden of persistent pollutants;

The institutes for public health, which perform routine control of POPs levels, have generally agreed and harmonized relevant control methods and occasionally carry out interlaboratory checks of analytical procedures.

Water monitoring organized by «Hrvatske vode» (Croatian waters) is also performed by the laboratories that had been successful in circular tests of analytical procedures for specific contamination parameters. For some matrices, which by relevant laws and rules are subject to compulsory testing prior to their use, quality checks of analytical procedures are also performed. Such is the example of the analysis of PCBs in heating and waste oils performed by the State Office for Standardization and Metrology. Within its scope the Office is working on evaluation and adoption of the European standards of sampling, processing and analysis of various samples in

order to standardize all analytical methods for various types of samples, however primarily quality control of the aforementioned ones. Here too, as everywhere in the world, research implies free choice of sampling and analytical methods, relevant to the research objectives. However, all of them must be validated according to the accepted international criteria.

Croatia lacks organized comprehensive monitoring of POPs compound levels in the environmental, food and human samples. Partial monitoring programme for some POPs compounds in the samples of animal origin was organized by the Ministry of Agriculture, Forestry and Water Management on the state level. «Hrvatske vode» are organizing monitoring of organochlorine pesticides in waters (rivers and artificial water impoundments), but the results are not uniform given the number of the tested compounds, probably due to capability of the involved regional laboratories. Partial monitoring programmes, within the research projects, are also underway at the research institutes (Institute for Medical Research and Occupational Medicine and Ruđer Bošković Institute, both from Zagreb). However, analysed samples and sampling frequency are limited primarily for financial reasons, which also restrict the number of researchers and provision of equipment.

With respect to the number of laboratories with proper equipment and competent staff for the analysis of POPs compounds in various matrices, Croatia has good capacities and knowledge for OCPs and PCBs analyses in the environmental, food and biological samples taken from humans. The problem is only PCDD and PCDF analysis, primarily because of the lacking sophisticated instruments i.e. financial support to such analysis.

#### 2.3.7.1 Potential sources of persistent organochlorine compounds

According to the available data and information, it can be concluded that Croatia has potential sources of POPs compounds.

***Pesticides***

Irrespective of the prohibited or restricted use of organochlorine compounds, they might appear, as the remaining stocks, in the uncontrolled use, primarily in households and small agricultural farms. Their volumes, in such instances, being insignificant should not represent significant environmental and human exposure.

***Polychlorinated biphenyls***

Croatia still has the sources of PCBs, primarily in the form of equipment (capacitors and transformers) and stockpiles of oils with PCBs (approximately 1 ton) which might end up in the environment and humans by leaking, evaporation, improper storage or improper disposal of the used up equipment. In the view of the fact that PCBs import is still permitted, it is quite possible that some additional quantities enter the country either in the equipment or as oils with PCBs.

Analytical results show that military activities during the war caused PCB contamination of soil in some areas where equipment and utilities with PCBs were damaged. Unfortunately, there is scarcity of analytical data about soil contamination all over the country for comprehensive assessment of contamination scope.

This is explained either by inaccessibility of some mined areas, or by the restrictive property rights, or the lack of interest from the side of the competent ministries and institutions to get a realistic picture of the situation and to finance investigations of wider scope. Such assessments are based on some results of scientific research.

Potential sources of PCBs are also the landfills. Most of them having been uncontrolled might contain PCBs. Hence, the scope of so uncontrolled disposal is unknown.

***PCDD/PCDF***

PCDDs and PCDFs have never been used, but are either unwelcome ingredients of synthetic compounds (pesticides and PCBs) or by-products of industrial processes (metal industry, cement plants and pulp and paper production). They may be generated by combustion, especially if uncontrolled, and occur in the exhaust gases of the leaded gasoline fuel-fired vehicles. Potential sources of PCDD/PCDF are industrial facilities, incineration plants for technological and hospital waste, traffic, uncontrolled fires (especially on landfills), uncontrolled combustion of municipal, garden and technological waste and crematoria.

### 2.3.7.2 Presence of organochlorine compounds in foodstuffs, environment and humans

**Food levels of POPs**

For several decades foodstuffs have been regularly controlled in line with the effective regulations on maximal permitted limits of these compounds in food, in various species of freshwater and sea fish, animal fatty tissues and cow's milk. Not many data have been published about the levels of organochlorine compounds in vegetable foodstuffs. Table 31 summarizes the data published in the period 1992-1996.

Table 31. Mass fractions of pesticides (median ranges of HCB, α-HCH, γ-HCH, total DDT) and of total PCBs in foodstuffs analysed in the period 1992-1996

| | Pesticides | PCBs |
|---|---|---|
| **Beef** μg $kg^{-1}$ fat | | |
| domestic | 0-1 | N/A |
| imported | 0-29 | N/A |
| **Pork** μg $kg^{-1}$ fat | | |
| domestic | 0-6 | 12 |
| imported | 0-15 | N/A |
| **Fish** μg $kg^{-1}$ of edible part | | |
| domestic | 0-41 | 46 |
| imported | 0-16 | 6 |
| **Poultry** μg $kg^{-1}$ fat | | |
| domestic | 0-6 | 14 |
| imported | 0-39 | N/A |
| **Cow's milk** μg $kg^{-1}$ fat | | |
| domestic | 0-47 | 73 |
| **Butter** μg $kg^{-1}$ fat | | |
| domestic | 0-5 | 20 |

*N/A = not analyzed*

*0 = below determination limit*

Table 32 compares the levels of organochlorine compounds in the foodstuff samples analyzed by the Croatian Institute for Public Health in the period 1986-89 and after 10 years. Their mass fractions in all types of food were apparently decreased.

Table 32. Levels (mean, μg kg-1 fat, μg kg-1 of wet fish b.w.) of organochlorine compounds in foodstuff samples. The number of analyzed samples is within the brackets.

| | HCB | α-HCH | γ-HCH | DDT complex |
|---|---|---|---|---|
| Fish and fish products | | | | |
| - 1986/89 (153) | 5 | 2 | 25 | 127 |
| - 1999 (46) | 0.1 | 0.1 | 0.5 | 4.7 |
| Meat and meat products | | | | |
| - 1986/89 (733) | 3 | 2 | 25 | 75 |
| - 1999 (80) | 0 | 1 | 6 | 62 |
| Milk and dairy products | | | | |
| - 1986/89 (438) | 7 | 3 | 24 | 83 |
| - 1999 (52) | 1 | 1 | 6 | 35 |

*0 = below determination limit*

Analytical results of organochlorine pesticides and PCBs levels in beef, pork, poultry and fish, sold in the period 1985-1996 and polled by the Croatian Institute for Public Health, are shown in Table 33. During the 1992-1996 period 466 samples from domestic and imported foodstuffs were analysed. The results were compared with those published in 1985 and 1986. Fish samples taken in the period 1984-1988 were from the central Adriatic coast and those taken subsequently were from the area of Rijeka and Zadar. The imported meat was from the EU, Eastern and Central Europe, China, Australia and New Zealand. Poultry was from Slovenia and Hungary, and fish from Argentina.

The results show that in the reviewed period lindane levels and total DDT in domestic beef and pork significantly decreased, whereas in the imported meat they were significantly higher. Lindane was higher in the imported poultry. Other compounds were about the same level.

Mass fractions of organochlorine pesticides were lower in the Adriatic fish, but in the imported fish PCBs were higher. PCBs in domestic fish were markedly lower in the 1992-1996 period compared to 1984-1988 period.

Figure 3 shows the frequency of organochlorine pesticides and PCBs positive findings in foodstuff samples. According to the findings of the Croatian Institute for Public Health the levels of organochlorine pesticides in eggs (poultry farms and individual households) analyzed in 2000 were within the range of 0-30.4 μg $kg^{-1}$ of wet b.w. For total DDT determined were the highest levels. With respect to the eggs' origin total DDT was significantly higher in the eggs from households.

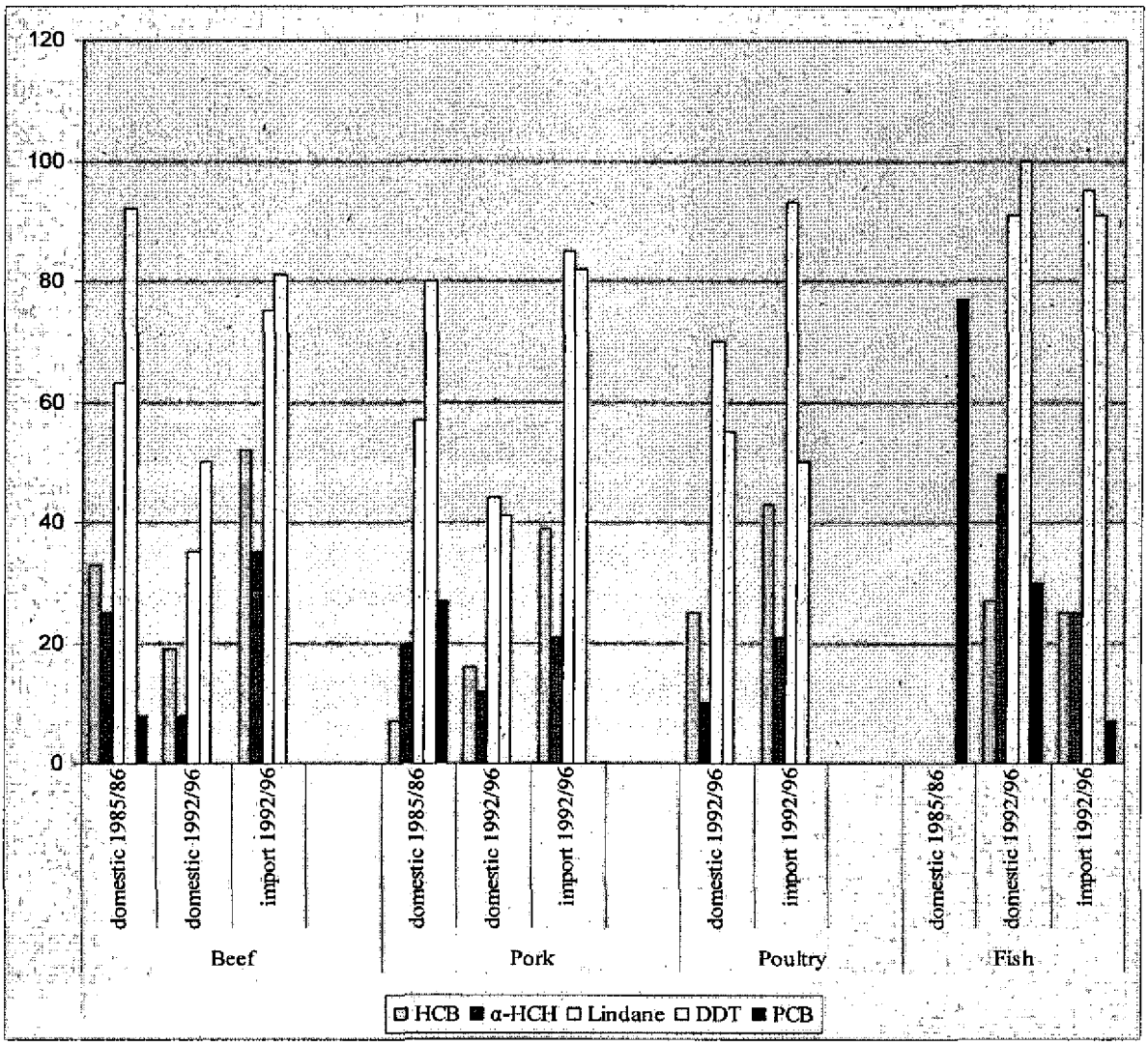
Table 33. Mass fractions of organochlorine compounds and PCBs (μg kg-1 fat, μg kg-1 of fish edible part) in foodstuffs of animal origin analyzed over 10-year period

| | HCB | | α-HCH | | Lindane | | Total DDT | | Total PCBs* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Median | Max. | Median | Max. | Median | Max. | Median | Max | Mean value | Max. |
| Beef | | | | | | | | | | |
| -domestic 1985/86 | 0 | 9 | 0 | 10 | 1 | 115 | 18 | 571 | - | |
| -domestic 1992/96 | 0 | 18 | 0 | 27 | 0 | 67 | 1 | 157 | - | |
| -imported 1992/96 | 1 | 43 | 0 | 29 | 10 | 116 | 29 | 427 | - | |
| Pork | | | | | | | | | | |
| -domestic 1985/86 | 0 | 10 | 0 | 25 | 1 | 82 | 9 | 626 | - | |
| -domestic 1992/96 | 0 | 24 | 0 | 9 | 0 | 152 | 0 | 235 | - | |

| | HCB | | α-HCH | | Lindane | | Total DDT | | Total PCBs* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Median | Max. | Median | Max. | Median | Max. | Median | Max | Mean value | Max. |
| -imported 1992/96 | 0 | 25 | 0 | 15 | 13 | 152 | 15 | 265 | - | |
| Poultry | | | | | | | | | | |
| -domestic 1992/96 | 0 | 3 | 0 | 4 | 6 | 49 | 4 | 89 | - | |
| -imported 1992/96 | 0 | 12 | 0 | 9 | 39 | 79 | 3 | 88 | - | |
| Fish | | | | | | | | | | |
| -domestic 1984/88 | - | | - | | - | | - | | 59-287 | 2303 |
| -domestic 1992/96 | 0 | 0.3 | 0 | 2.1 | 1 | 10.2 | 1.6 | 159 | 46 | 117 |
| -imported 1992/96 | 0 | 6.4 | 0 | 12.8 | 1 | 13.9 | 4.1 | 169.8 | 6 | 167 |

*mean value, total PCB vs. Aroclor 1254 and Aroclor 1260*

Figure 3. Frequency of organochlorine pesticides and PCBs positive findings in foodstuff samples



**Environmental levels of POPs**

Systematic monitoring of the levels of POPs compounds in environmental samples is not organized at any level. The studies of OC pesticides and PCBs in the surface, ground and drinking water and in the sea, sea sediments and fish started in late 1970's and in early 1980's. Sometime later they were expanded to river sediments and it was not until past few years that soil, air, rain, tree leaves, conifer needles, birds and dolphins became included in the studies of OC compounds. Recent research has been focused on OC pesticides and total or individual PCB congeners, and on determination of PCDD and PCDF in order to detect sources and environmental levels of these highly toxic substances. Majority of the analyses of organochlorine pesticides and PCBs included surface and ground waters, owing to many years of recipients monitoring organized by «Hrvatske vode». Monitoring of the levels of persistent pollutants in other environmental elements is not organized, while the available results come from local and international research projects. Hence, the results have not been collected systematically, and differences in the approach make their interpretation difficult.

**Samples of animal origin**

Information about the levels of organochlorine compounds in the samples of animal origin is scarce, except for those referring to food. The analyses included 25 eggs of sea gull *klaukavac,* three samples of a dead dolphin (liver, muscle and fat tissue), two samples (liver and blood) of a dead *Gyps fulvus*, and various sea and freshwater fish and shells.

**- sea gull *klaukavac***

The eggs, collected from three sites were analyzed at the Croatian Institute for Public Health in 1994. Except these, there are no other analytical results of OC compounds in avian eggs.

Table 34. Levels of organochlorine compounds in the eggs of sea gull klaukavac collected on the Adriatic islands in 1994 (µg kg-1 of wet b.w.; arithmetic mean of the positive results, range; N=number of samples; n=number of positive findings)

| Site | HCB | LINDANE | TOTAL DDT | PCBS (Ar 1254+Ar 1260) |
|---|---|---|---|---|
| Zec island/Kvarner N_10 | 16 (3-47); n_10 | 15 (7-61); n_8 | 491 (80-1102); n_10 | 4847 (998-4802); n_10 |
| Dvije Sestrice island/Rovinj N_5 | 4 (4-5); n_5 | 8 (4-14); n_5 | 421 (220-564); n_5 | 4580 (1120-10729); n_5 |
| Kraljevac island/Čiovo N_10 | 4 (1-8); n_10 | 8 (3-14); n_9 | 298 (76-664); n_10 | 10667 (1298-27610); n_10 |
| ALL EGGS N_25 | 9 (1-47); n_25 | 11 (3-61); n_22 | 400 (76-1102); n_25 | 7522 (998-27610); n_25 |

*- Gyps fulvus from the island of Cres*

Blood and liver of one Gyps fulvus that died at the island of Cres in June 2002 (suspected poisoning) were analysed for suspicion that the bird was poisoned. Blood sample showed the presence of lindane only (6.75 μg $L^{-1}$ blood), whereas liver sample showed the traces of HCB, γ-HCH, 4,4'-DDE-a, 4,4'-DDD-a, 4,4'-DDT-and of PCBs in the levels (33-501 mg $kg^{-1}$ in fats) usually found in humans. Consequently, poisoning was not attributed to persistent organochlorine compounds, so the levels of detected substances were found to be the usual ones for avian.

*- Adriatic dolphin*

Fat tissue were analysed, liver and muscles of a dolphin (Stenella coeruleoalba) that died at the island of Krk in June 1998.. These are the only available data about the levels in Adriatic dolphins.

Mass fractions of OC pesticides and their metabolits (α-HCH,β-HCH, γ-HCH, 4,4'-DDE, 4,4'-DDD i 4,4'-DDT) in sample were in range 0.015-3.871 mg $kg^{-1}$ in fat tissue of the sample, while the levels of six PCB congeners (PCB-28, PCB-52, PCB-101, PCB-138, PCB-153 i PCB-180) were in range 0.059-2.941 mg $kg^{-1}$ in fat tissue of the sample. Total PCBs (Aroclor 1260) were in range 6.148-17.383 mg $kg^{-1}$ in fat.

*- fish and shells (sea and freshwater)*

The research carried out in 1974/75 by the Institute Ruđer Bošković included samples of sea fish and shells. Organochlorine pesticides and PCBs were present in significantly higher levels than ten years afterwards (Table 34). Fish from the Kupa River analysed in the period 1985-1988 contained significantly higher levels of PCBs which was the consequence of the river's pollution i.e. improper disposals of the electrical industry (of waste containing PCBs) from Bela Krajina (Slovenia).

Table 35. Mass fraction ranges of OC pesticides and PCBs in the fish and shells (μg kg-1 of wet b.w.; edible part) analysed from 1974-1988

| Sample /site/year | N | 4,4'-DDE +4,4'-DDD +4,4'-DDT | Dieldrin | PCB |
|---|---|---|---|---|
| *Sea fish and shells/1974-1975* | | | | |
| Istria | 27 | 0-135 | 0-15 | 0-520 |
| Rijeka | 33 | 0-131 | 0-10 | 0-356 |
| Zadar | 18 | 0-113 | 0-4 | 0-390 |
| Lošinj | 29 | 0-870 | 0-13 | 0-624 |
| | | | | |
| *Sea fish* | | | | |
| Rijeka/1983 | - | 1-12 | 0.2-0.4 | 48-79 |
| Rijeka/1987 | - | 0-6.2 | - | 16-120 |
| *Freshwater fish from the Kupa River* | | | | |
| Letovanić/1985 | 7 | 0.5-14 | 0.1-3.4 | 49-659 |
| Sisak/1986* | 47 | - | - | 1-42000 |
| Petrinja/1987-1988 | 28 | 0.2-175 | 0.1-2.2 | 70-1233 |

N=number of samples, 0=below detected limits, *non-stated basis for results expression

■ level ranges of individual compounds

In 1997, within risk assessment of PCBs contamination in case of sub-stations destruction during the Patriotic War, PCBs and DDT levels were analysed in the samples of fish and molluscs from the coastal part of the Zadar area (Brodanovo, Kolovare, the marina and the island of Vruljica), the Vransko lake nearby Biograd, Šibenik (a small marina in the Mikulandra bay) and Dubrovnik (Rijeka Dubrovačka – the reserve and the marina); Table 35. The reference areas were two sites in the marina and outside it in Selce, nearby Crikvenica. The samples taken from the Vransko Lake having shown very low PCBs and DDT levels this aquatic system can be considered practically clean. Not even the area of Šibenik showed the levels indicative of PCBs from the war damaged sub-station Bilice. In Dubrovnik area fish from several points and molluscs from the marina contained rather high levels of PCBs. It was not possible, however, to determine whether relatively high PCBs levels were related to military activities, given that the site had not been investigated before the war. Mussels and fish from the Zadar area were superior in the levels of PCBs and DDT. PCBs there were the highest in the samples from the Zadar marina and at the mouth of the Vruljica stream. Within that area the highest PCBs levels were recorded in the samples from the Zadar marina and the mouth of the Vruljica stream. Some fish samples contained PCBs in the levels rarely found in to date investigations of the Adriatic, even of the Mediterranean Sea.

Table 36. Weight component of PCBs and DDT (μg kg−1 of wet b.w.) in sea fish and molluscs analysed in 1997

| Sample | Weight component/μg $kg^{-1}$ of wet b.w. | |
|---|---|---|
| | PCBs | DDT |
| **Fish (N=32)** | | |
| Range | 10 - 4004 | 0.6 - 36 |
| *Median* | *259* | *3.0* |
| **Molluscs (N_15)** | | |
| Range | 12.5 - 1510 | 1.5 - 45 |
| Median | 168 | 3.6 |

N = number of samples

## Air

The first data about national levels of OC pesticides and PCBs in the air referred to air samples taken from the Zagreb area during 1997. The samples were taken from two sites - northern periphery and Jakuševec village (southern periphery). All samples contained OC pesticides: HCB, α-, β- and γ-HCH, 4,4'-DDT and its metabolites 4,4'-DDE and 4,4'-DDD, as well as six PCB congeners: PCB-28. PCB-52, PCB-101, PCB-138, PCB-153 and PCB-180. Concentrations of all compounds, except 4,4'-DDD-a and 4,4'-DDT, were higher in the samples from Jakuševec, which was attributed to the nearby municipal landfill. Distribution of the compounds in air samples from Zagreb resembled that found in other countries. Similar results were obtained during further research performed at the same sites from 1999-2001. The results are shown in Table 37.

PCDD and PCDF in the air in Croatia were analyzed for the first time in 1993 on two samples - one taken in Zagreb (Ksaver) and the other in Jastrebarsko. Both samples were analysed in Norway. In the sample from Zagreb the PCDD/PCDF level was 92.3 fg I-TEQ $m^{-3}$, and in that from Jastrebarsko 105 fg I-TEQ $m^{-3}$. Construction of a movable facility for thermal waste treatment and

municipal waste landfill at Jakuševac encouraged measuring of air PCDD and PCDF at various sites in Zagreb: around waste incineration plant (PUTO), in the centre of Zagreb where air levels of PCDD/PCDF can depend on traffic and on other non-specific sources (Đorđićeva street), in the industrial zone in the eastern part of the city (Žitnjak) and in northern peripheral parts of Zagreb (Ksaverska c.). Measuring were performed in the period from 1997 to 2000. Compounds' levels, expressed as toxical equivalent calculated with international factors of equivalent toxicity based on the toxicity of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin are shown in Table 38.

Table 37. Weight concentrations (pg m-3) of organochlorine pesticides and polychlorinated biphenyls in the air samples collected in Zagreb from 1997 till 2001

| Compound | Ksaver | | | | Jakuševec | | | |
|---|---|---|---|---|---|---|---|---|
| | 1997 (N=14) | | 1999/2000 (N_47) | | 1997 (N_10) | | 2000/2001 (N_33) | |
| | range | median | range | median | range | median | range | median |
| HCB | 0,5-49 | 29 | 1-36 | 9 | 15-61 | 31 | 2-34 | 10 |
| α-HCH | 2-52 | 25 | 4-44 | 12 | 14-61 | 28 | 0.6-61 | 10 |
| β-HCH | 3-22 | 8 | 0,5-40 | 6 | 5-35 | 15 | 0-17 | 4 |
| γ-HCH | 3-80 | 49 | 12-247 | 53 | 36-91 | 77 | 6-246 | 75 |
| 4,4'-DDE | 2-26 | 10 | 0-36 | 17 | 8-29 | 19 | 0-32 | 8 |
| 4,4'-DDD | 2-65 | 11 | 0-101 | 8 | 3-17 | 7 | 0-27 | 5 |
| 4,4'-DDT | 4-32 | 12 | 2-63 | 12 | 4-40 | 9 | 0.8-143 | 24 |
| PCB-28 | 17-57 | 29 | 3-312 | 36 | 15-92 | 36 | 5-204 | 81 |
| PCB-52 | 9-36 | 19 | 2-65 | 13 | 10-44 | 21 | 2-173 | 14 |
| PCB-60 | NA | NA | 0-23 | 8 | NA | NA | 1-33 | 10 |
| PCB-74 | NA | NA | 0-19 | 2 | NA | NA | 0-23 | 8 |
| PCB-77 | NA | NA | / | 0 | NA | NA | 0-8 | 0 |
| PCB-101 | 4-28 | 10 | 2-223 | 14 | 5-36 | 14 | 1-163 | 27 |
| PCB-105 | N/A | N/A | 0-36 | 2 | N/A | N/A | 0-30 | 6 |
| PCB-114 | N/A | N/A | 0-14 | 0 | N/A | N/A | 0-13 | 3 |
| PCB-118 | NA | NA | 0-24 | 3 | NA | NA | 0-24 | 8 |
| PCB-123 | NA | NA | 0-12 | 3 | NA | NA | 0-17 | 7 |
| PCB-126 | NA | NA | 0-4 | 0 | NA | NA | 0-10 | 0 |
| PCB-138 | 2-21 | 8 | 12-128 | 6 | 4-24 | 10 | 1-72 | 13 |
| PCB-153 | 3-16 | 7 | 1-92 | 4 | 9-20 | 12 | 1-55 | 9 |
| PCB-156 | NA | NA | 0-1 | 0 | NA | NA | 0-3 | 0 |
| PCB-157 | NA | NA | / | 0 | NA | NA | 0-1 | 0 |
| PCB-167 | NA | NA | 0-4 | 0 | NA | NA | 0-3 | 0 |
| PCB-169 | NA | NA | 0-3 | 0 | NA | NA | / | 0 |
| PCB-170 | NA | NA | 0-2 | 0 | NA | NA | 0-6 | 0 |
| PCB-180 | 1-13 | 5 | 0-7 | 2 | 10-51 | 13 | 0-23 | 2 |
| PCB-189 | NA | NA | 0-2 | 0 | NA | NA | / | 0 |

N – number of analysed samples; N/A- not analyzed; 0 – below determination limit

Table 38. Levels of PCDD/PCDF in the sir samples collected in Zagreb from May 1997 till March 2000

| SAMPLING POINT | SAMPLING TIME | MEAN TEMP. (oC) | fg I-TEQ m-3 |
|---|---|---|---|
| PUTO-1 | 16.5-19.5.1997 | 22.2 | 39 |
| PUTO-2 | 11.6.-14.6.1997 | 23.2 | 12 |
| ŽITNJAK-1 | 29.1.-2.2.1998 | -2.5 | 83 |
| ŽITNJAK-2 | 25.2.-27.2.1998 | 8.2 | 306 |
| JAKUŠEVEC-1 | 16.5.-19.5.1997 | 22.2 | 47 |
| JAKUŠEVEC-2 | 11.6.-14.6.1997 | 23.2 | 18 |
| JAKUŠEVEC-3 | 16.1.-19.1.1998 | 3.1 | 94 |
| JAKUŠEVEC-4 | 13.2.-16.2.1998 | 10.5 | 124 |
| JAKUŠEVEC-5 | 16.3.-19.3.1998 | 4.9 | 49 |
| JAKUŠEVEC-6 | 5.11.-8.11.1999 | 0.1 | 29 |
| JAKUŠEVEC-7 | 10.1.-13.1.2000 | -0.5 | 25 |
| JAKUŠEVEC-8 | 6.3.-09.3.2000 | 9.8 | 15 |
| ĐORĐIĆEVA-1 | 23.5.-26.5.1997 | 15.4 | 9 |
| ĐORĐIĆEVA-2 | 6.6.-9.6. 1997 | 20.1 | 41 |
| ĐORĐIĆEVA-3 | 19.01.-22.1.1998 | 4,6 | 56 |
| ĐORĐIĆEVA-4 | 13.2.-16.2.1998 | 13,7 | 169 |
| ĐORĐIĆEVA-5 | 16.03.-19.3.1998 | 5,8 | 78 |
| ĐORĐIĆEVA-6 | 5.11.-8.11.1999 | 0.1 | 26 |
| ĐORĐIĆEVA-7 | 10.1.-13.1.2000 | -0.5 | 50 |
| ĐORĐIĆEVA-8 | 6.3.-09.3.2000 | 9.8 | 17 |
| KSAVERSKA-1 | 23.5.-26.5.1997 | 15,4 | 10 |
| KSAVERSKA-2 | 6.6.-9.6.1997 | 20,1 | 11 |
| KSAVERSKA-3 | 2.2.-9.2.1998 | 1,4 | 72 |
| KSAVERSKA-4 | 2.3.-04.3.1998 | 7.9 | 47 |
| KSAVERSKA-5 | 31.3.-3.4.1998 | 14.6 | 17 |
| KSAVERSKA-6 | 02.11.-5.11.1999 | 5.6 | 21 |
| KSAVERSKA-7 | 17.1.-19.1.2000 | 0.3 | 39 |
| KSAVERSKA-8 | 28.2.-3.3.2000 | 6.7 | 90 |

**Organochlorine pesticides and polychlorinated biphenyls in the samples of the airborne particles collected in Zagreb**

Major portion (>90%) of sparingly volatile compounds, such as PCBs and organochlorine (OC) pesticides, usually occurs in the atmosphere in the gaseous form.

First measuring of OC compounds in the fractions of airborne particles $PM_{10}$ and $PM_{2,5}$ from Zagreb were carried out on the samples collected at the sampling station in the north part of the city (Ksaverska cesta) from end October 2000 till end May 2001. Determined were HCB, α-HCH, β-HCH and γ-HCH, 4,4'-DDT, 4,4'-DDE and 4,4'-DDD and six indicator congeners of polychlorinated biphenyls - PCB-28, PCB-52, PCB-101, PCB-138, PCB-153 and PCB-180. The analyses covered 30 samples of each of the airborne particles $PM_{10}$ and $PM_{2,5}$ collected over 5-12 consecutive days. The results are shown in Table 39.

Table 39. Weight concentrations ( pg m-3) of the compounds in the airborne particles PM10 and PM2,5 collected in Zagreb from October 2000 till May 2001

| COMPOUND | $PM_{10}$ (N=30) | | | $PM_{2,5}$ (N_30) | | |
|---|---|---|---|---|---|---|
| | n | Range* | Median | n | Range* | Median |
| HCB | 18 | 1 - 21 | 2 | 16 | 1 – 17 | 1 |
| α-HCH | 12 | 1 - 4 | 0 | 11 | 0,5 – 5 | 0 |
| β-HCH | 27 | 2 - 26 | 11 | 27 | 4 – 36 | 15 |
| γ-HCH | 27 | 3 - 18 | 8 | 30 | 3 – 19 | 9 |
| 4,4'-DDT | 25 | 1 - 39 | 5 | 22 | 2 – 28 | 5 |
| 4,4'-DDE | 27 | 1 - 19 | 4 | 25 | 0.2 – 19 | 4 |
| 4.4'-DDD | 9 | 0.5 - 7 | 0 | 11 | 1 – 11 | 0 |
| PCB-28 | 13 | 1 - 26 | 0 | 11 | 1 – 19 | 0 |
| PCB-52 | 0 | | | 1 | 5 | 0 |
| PCB-101 | 2 | 5 - 12 | 0 | 2 | 2 – 8 | 0 |
| PCB-138 | 18 | 0.5 - 6 | 1 | 20 | 0.5 – 12 | 1 |
| PCB-153 | 11 | 2 - 5 | 0 | 8 | 2 – 10 | 0 |
| PCB-180 | 0 | | | 0 | | |
| ∑ PCBs | 25 | 0.5 - 33 | 4 | 24 | 1 – 28 | 2 |

N = total number of samples; n _ number of positive samples; * _ range in the positive samples;

0 - concentrations below detection limits; ∑ PCBs _ total concentration of six PCB indicator congeners

Monitoring of the levels of OC compounds in the airborne particles was continued at the same site from early January till end December 2002. During that period fifty two 7-day sample fractions of the airborne particles $PM_{10}$ were collected to determine OC pesticides (Table 40), while Table 41 shows the results of determination of 20 PCBs congeners with six indicator congeners inclusive. The most frequent were the congeners PCB-28 (in 65 % of the samples), PCB-60 (in 63 % of the samples), PCB-101 (in 58 % of the samples) and PCB-180 (in 56 % of the samples). The highest weight concentrations showed congeners PCB-28 and PCB-101.

Measurements of OC pesticides and PCBs congeners in the airborne particles performed in 2002 did not show any significant seasonal variations. Weight concentrations of the compounds sorbed in the airborne particles equalled these in the year 2000/2001. They were characteristic of global environmental pollution and were not indicative of any significant local introduction of these compounds into the atmosphere.

Table 40. Weight concentrations ( pg m-3) of organochlorine pesticides in fifty two 7-day samples of airborne particles $PM_{10}$ collected in Zagreb from January till December 2002.

| COMPOUND | WEIGHT CONCENTRATION / pg $m^{-3}$ | | |
|---|---|---|---|
| | n | Range [a] | Median |
| HCB | 44 | 0.28 – 24.5 | 6.24 |
| α-HCH | 50 | 0.02 – 15.6 | 1.73 |
| β-HCH | 46 | 0.48 – 28.8 | 4.82 |
| γ-HCH | 52 | 0.31 -19.0 | 3.22 |
| 4,4'-DDE | 45 | 0.07 – 17.0 | 2.43 |
| 4,4'-DDD | 20 | 1.18 – 20.7 | 0 |
| 4.4'-DDT | 41 | 0.12 – 8.39 | 3.60 |
| ∑ DDT | 48 | 0.87 – 41.5 | 7.70 |

n –number of positive samples; [a] range in the positive samples;
0 – below detection limit; ∑DDT – sum of 4,4'-DDE-a, 4,4'-DDD and 4,4'-DDT concentrations

Table 41. Weight concentrations (pg $m^{-3}$) of PCB congeners in fifty two 7-day samples of airborne particles $PM_{10}$ collected in Zagreb from January till December 2002

| COMPOUND | WEIGHT CONC./ pg $m^{-3}$ | | | COMPOUND | WEIGHT CONC. / pg $m^{-3}$ | | |
|---|---|---|---|---|---|---|---|
| | n | Range [a] | Median | | n | Range [a] | Median |
| PCB-28 [b] | 34 | 0.50-101 | 2.67 | PCB-138 [b] | 24 | 0.15-5.76 | 0 |
| PCB-52 [b] | 23 | 0.06-5.65 | 0 | PCB-153 [b] | 23 | 0.09-2.83 | 0 |
| PCB-60 | 33 | 0.08-14.4 | 1.01 | PCB-156 | 3 | 1.65-3.67 | 0 |
| PCB-74 | 18 | 0.39-35.8 | 0 | PCB-157 | 20 | 0.28-7.17 | 0 |
| PCB-77 | 22 | 0.16-14.1 | 0 | PCB-167 | 0 | 0 | 0 |
| PCB-101 [b] | 30 | 1.13-76.4 | 3.78 | PCB-169 | 12 | 0.29-4.65 | 0 |
| PCB-105 | 8 | 0.29-2.49 | 0 | PCB-170 | 1 | 2.91 | 0 |
| PCB-114 | 6 | 0.06-1.79 | 0 | PCB-180 [b] | 29 | 0.02-3.07 | 0.08 |
| PCB-118 | 22 | 0.54-11.8 | 0 | PCB-189 | 0 | 0 | 0 |
| PCB-123 | 11 | 0.24-5.13 | 0 | ∑ 6 PCB | 48 | 0.12-111 | 12.3 |
| PCB-126 | 19 | 0.70-4.32 | 0 | ∑ 20 PCB | 52 | 2.39-131 | 22.6 |

n – number of positive samples; [a] range in the positive samples; [b] indicator PCBs congeners;
0 – below detection limit; ∑6PCB – sum of six PCB indicator congeners;
∑PCBs – sum of twenty PCB congeners

**Rain/snow and pine needles**

***- OC pesticides and PCBs***

Scarce results of OC pesticides and PCBs determination in the samples of rain and snow collected in Croatia are given in a brief form in Table 42. Concentration ranges of OC pesticides refer to individual compounds. Traces of dieldrin, 4,4'-DDT-a and its metabolites and of PCBs were recorded as early as in 1979 and 1980 in rain samples collected in Rijeka. Organochlorine compounds in rain and snow were measured in Zagreb and surroundings in the period 1990-1992. γ-HCH was the only OC pesticide detected in all samples of rain and snow, and very often α- and β-HCH, HCB and aldrin were found as well. Majority of compounds were in the levels of <1-8 ng $dm^{-3}$, with γ-HCH as the only exception, ranging in rain from 2 to 38 ng $dm^{-3}$.

Table 42. OC pesticides and PCBs in rain and snow: concentration range (ng $L^{-3}$) in aqueous phase and weight component (ng $g^{-1}$ of dry sample) in the particles

| Sample | Site (sampling time) | OC pesticides | Total PCBs |
|---|---|---|---|
| rain | Rijeka (1979/80)* | | |
| - aqueous phase | | <1 - 2 | 1 - 12 |
| rain | Zagreb (1990/92)* | | |
| - aqueous phase | | <1 - 38 | 2 - 205 |
| - particles | | 1 - 512 | 40 - 4155 |
| snow | Zagreb (1990/92)** | | |
| - aqueous phase | | <1 - 4 | 4 - 50 |
| - particles | | 1 - 242 | 306 - 4082 |

* analyzed OC pesticides: dieldrin, 4,4'-DDT, 4,4'- DDE, 4,4'-DDD

** analyzed OC pesticides: α-, β- i γ- HCH, HCB, aldrin, 4,4'-DDT, 4,4'- DDE, 4,4'-DDD

Presence of OC pesticides and of PCBs in the air has been also confirmed by their studies in the samples of tree leaves, particularly in the needles of conifers. Plants, especially conifers, are good indicators of environmental pollution at a given site. Coniferous needles are waxed, so airborne lipophilic OC compounds are sorbed on them. Because every conifer carries several generations of needles, it is possible to determine pollution of a wider region and/or of a specific site in one or more years. Samples of larch, pine, lime, spruce, *Thuja* and fir tree (22 samples in total) collected at several sites around Ogulin in 1993 and 1994 contained OC pesticides in the levels of 0-15 ng $g^{-1}$ of dry needles (median range by species), and PCBs (after Aroclor 1260) in the levels of 1.2-17 ng $g^{-1}$ of dry needles (median range). Pine-tree needles were collected in Zagreb in March and April 1995 (3 samples at different sites), on the Medvednica and the Velebit. OC pesticides were in the range of 0-7.4 ng $g^{-1}$ of dry needles (α- and γ-HCH were present in the highest levels) while PCBs (after Arocloru 1260) ranged from 3.8-8.0 ng $g^{-1}$ of dry needles. Pine-tree needles were collected in Osijek during 1997. OC pesticides were in the range of 0.34-3.76 ng $g^{-1}$ of dry needles and six PCB

indicator congeners were in the range of 2.91-4.54 ng $g^{-1}$ of dry needles. In 1998 the needles were collected at seven sites in Zagreb as well as at 15 other sites all over Croatia. The results are shown in Table 43.

Table 43. Levels of organochlorine pesticides and polychlorinated biphenyls in pine needles (ng/g of dry weight) collected in 1998

| Sampling site | HCB | α-HCH | β-HCH | γ-HCH | 4,4'-DDE | 4,4'-DDD | 4,4'-DDT | PCB-28 | PCB-52 | PCB-101 | PCB-138 | PCB-153 | PCB-180 | α-/γ-HCH | DDE/DDT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zagreb-Borongaj | 1.38 | 0.44 | 0.57 | 1.59 | 0.35 | 0.22 | 0.72 | 1.74 | 5.09 | 1.96 | 1.76 | 0.74 | 0.56 | 0.28 | 0.49 |
| Zagreb-Opatovina | 0.70 | 0.33 | 2.10 | 1.13 | 0.66 | 0.22 | 0.14 | 2.52 | 0.34 | 1.79 | 0.56 | 0.50 | 0.16 | 0.29 | 4.89 |
| Zagreb-Novaki | 1.00 | 1.15 | 2.84 | 5.25 | 0.84 | 0.29 | 0.33 | 1.33 | 0.78 | 1.45 | 0.92 | 0.54 | 0.12 | 0.22 | 2.55 |
| Zagreb-Odra | 0.69 | 0.39 | 2.03 | 2.17 | 1.45 | 0.21 | 0.41 | 1.64 | 0.56 | 2.32 | 1.65 | 0.79 | 0.24 | 0.18 | 3.58 |
| Zagreb-Trnava | 0.64 | 0.63 | 3.01 | 3.80 | 0.72 | 0.32 | 0.23 | 3.71 | 0.42 | 2.96 | 1.74 | 0.41 | 0.35 | 0.17 | 3.15 |
| Zagreb-Ksaver | 0.83 | 0.97 | 1.14 | 3.63 | 0.64 | 0.44 | 2.62 | 1.58 | 2.80 | 2.72 | 0.69 | 0.74 | 0.48 | 0.27 | 0.24 |
| Zagreb-Jakuševec | 1.55 | 1.27 | 0.96 | 4.91 | 0.72 | 0.50 | 2.65 | 0.68 | 6.63 | 1.63 | 1.23 | 1.30 | 0.54 | 0.26 | 0.27 |
| Zagreb - median | 0.83 | 0.63 | 2.03 | 3.63 | 0.72 | 0.29 | 0.41 | 1.64 | 0.78 | 1.96 | 1.23 | 0.74 | 0.35 | 0.26 | 3.15 |
| Jastrebarsko | 0.64 | 0.99 | 0.29 | 0.60 | 0.95 | 0.41 | 1.18 | 1.88 | 0.25 | 1.22 | 0.63 | 0.48 | 0.15 | 1.66 | 0.80 |
| Karlovac | 0.83 | 0.58 | 0.68 | 1.46 | 0.43 | 0.19 | 0.43 | 1.72 | 7.25 | 1.44 | 1.36 | 0.80 | 0.61 | 0.40 | 1.00 |
| Kamanje | 0.49 | 0.42 | 1.77 | 1.45 | 0.86 | 0.37 | 0.29 | 2.35 | 0.58 | 1.84 | 0.79 | 0.56 | 0.14 | 0.29 | 2.94 |
| Ludbreg | 1.04 | 0.47 | 0.47 | 0.98 | 0.48 | 0.15 | 0.45 | 1.07 | 3.72 | 1.10 | 0.81 | 0.51 | 0.49 | 0.48 | 1.07 |
| Bednja | 1.05 | 0.91 | 0.31 | 1.01 | 1.43 | 0.09 | 0.32 | 2.86 | 0.86 | 3.13 | 1.94 | 0.94 | 0.19 | 0.90 | 4.52 |
| Krapina | 1.57 | 0.99 | 0.51 | 0.22 | 1.42 | 0.55 | 0.55 | 2.50 | 0.77 | 1.97 | 1.22 | 1.07 | 0.20 | 4.48 | 2.60 |
| Čakovec | 1.84 | 0.27 | 0.6 | 1.30 | 2.56 | 0.25 | 0.39 | 5.87 | 2.68 | 3.25 | 2.39 | 1.27 | 0.34 | 0.21 | 6.56 |
| Koprivnica | 1.07 | 0.27 | 0.36 | 2.04 | 0.67 | 0.09 | 0.35 | 2.23 | 0.68 | 1.10 | 1.05 | 0.40 | 0.19 | 0.13 | 1.94 |
| Našice | 0.81 | 0.47 | 0.49 | 1.49 | 0.38 | 0.19 | 0.23 | 1.70 | 3.28 | 1.08 | 1.60 | 1.16 | 2.83 | 0.32 | 1.65 |
| Požega | 0.85 | 0.37 | 1.62 | 1.95 | 1.00 | 0.27 | 0.67 | 3.50 | 8.31 | 2.10 | 3.17 | 2.05 | 2.61 | 0.19 | 1.49 |
| Županja | 0.92 | 0.07 | 0.59 | 1.34 | 1.78 | 0.10 | 0.22 | 3.20 | 0.49 | 1.75 | 1.29 | 0.94 | 0.27 | 0.05 | 8.08 |
| Vinkovci | 0.85 | 0.55 | 1.36 | 3.81 | 0.97 | 0.31 | 0.78 | 0.82 | 5.03 | 1.24 | 0.88 | 0.77 | 0.42 | 0.14 | 1.24 |
| Dubrovnik | 0.42 | 0.05 | 0.26 | 0.26 | 1.16 | 0.37 | 1.05 | 1.57 | 1.33 | 2.17 | 1.24 | 0.87 | 0.40 | 0.20 | 1.11 |
| Kaštel Sućurac | 0.63 | 0.26 | 0.13 | 2.18 | 1.03 | 0.11 | 0.19 | 3.38 | 1.96 | 1.69 | 0.96 | 0.47 | 0.34 | 0.12 | 5.52 |
| Plomin | 0.61 | 1.31 | 0.40 | 5.93 | 2.38 | 0.35 | 0.72 | 3.57 | 0.93 | 4.08 | 2.13 | 1.42 | 0.24 | 0.22 | 3.29 |
| Median of all samples | 0.84 | 0.47 | 0.59 | 1.54 | 0.90 | 0.26 | 0.42 | 2.06 | 1.13 | 1.82 | 1.23 | 0.78 | 0.34 | 0.24 | 2.58 |

Samples of pine-tree needles were taken from the same tree species at five coastal sites (in Križišće and in Baška, Dobrinje, Omišalj and Punat on the island of Krk twice – in 1992 and 2000 – with the aim of investigating time trend in the change of levels. The results are shown in Table 44.

Table 44. Levels of organochlorine pesticides in pine needles (ng g-1 of dry needles) collected at the same sites in 2000 and 1992

| Sampling site | God. | HCB | α-HCH | β-HCH | γ-HCH | 4,4'-DDE | 4,4'-DDD | 4,4'-DDT | PCBs |
|---|---|---|---|---|---|---|---|---|---|
| Križišće | 2000 | 0.14 | 0.60 | 1.10 | 0.10 | 0.40 | 0.20 | 0.90 | 6.4• |
| | 1992 | 0.50 | 0.40 | 0 | 0.50 | 1.20 | 0.30 | 0.40 | 2.2* |
| Krk- Dobrinj | 2000 | 0.03 | 0.03 | 0.20 | 0.10 | 0.70 | 0.20 | 0.20 | 8.7• |
| | 1992 | 0.60 | 0.0 | 0 | 0.70 | 0.80 | 0.40 | 0.40 | 1.4* |
| Krk-Punat | 2000 | 0.30 | 0.10 | 1.20 | 0.10 | 1.00 | 0.20 | 0.30 | 11.4• |
| | 1992 | 0.50 | 0.20 | 0 | 0.70 | 2.10 | 0.30 | 0.50 | 3.1* |
| Krk-Omišalj | 2000 | 0.20 | 0.50 | 1.10 | 1.10 | 0.50 | 0.40 | 0.70 | 6.5• |
| | 1992 | 0.40 | 0.30 | 0 | 0.50 | 1.20 | 0.40 | 0.60 | 1.4* |
| Krk-Baška | 2000 | 0.10 | 0.05 | 0.20 | 0.30 | 0.30 | 0.20 | 0.10 | 6.8• |
| | 1992 | 0.30 | 0.20 | 0 | 0.50 | 1.60 | 0.30 | 0.50 | 2.5* |
| Median | 2000 | 0.10 | 0.08 | 1.05 | 0.10 | 0.50 | 0.20 | 0.30 | 6.5• |
| | 1992 | 0.50 | 0.30 | 0 | 0.50 | 1.20 | 0.30 | 0.50 | 1.7* |

0 – below determination limits
* after Aroclor 1260
• sum of twenty PCB congeners

- ***PCDD/PCDF***

In addition to OC pesticides and PCBs in the rain and snow samples collected in Zagreb during 1990-1992, PCDD and PCDF were also detected in traces. Of individual congeners in rain and snow detected were 2,3,7,8-TCDF (1 pg $L^{-1}$), 1,2,3,4,6,7,8-HpCDF (1 pg $L^{-1}$), OCDF (2 pg $L^{-1}$), 1,2,3,4,6,7,8-HpCDD (1 pg $L^{-1}$) and OCDD (2 pg $L^{-1}$ in snow and 6 pg $L^{-1}$ in rain). Relevant to a specific congener, these levels were either lower or comparable with those found in rain samples from industrialized countries.

**OC compounds in soil**

Data about levels of persistent OC compounds in soil in Croatia are very scarce, given that their systemic research has not been carried out. Levels of total PCBs were determined in the samples of surface soil collected adjacent to several industrial and power plants, around airports, and municipal and rural areas nearby potential pollution sources of this kind. Table 45 gives the summary of these studies. In majority of samples from municipal and rural areas weight concentration of PCBs was characteristic of global environmental pollution (<10 μg $kg^{-1}$ of a dry sample). Higher levels were found in the soil adjacent to power sub-stations, especially those damaged during the war, around airports and in the industrial areas.

These are the highest levels of soil pollution with PCBs found in all studied areas in the Croatian karst regions affected by military activities. Risk levels, caused by oil spills from the capacitors, were recorded at several sites nearby damaged sub-station in Zadar.

Table 45. Mass fraction (μg kg-1 of a dry sample) of PCBs in soil

| Site | Sampling time | Range (N) |
|---|---|---|
| Airports | 1994/96 | 3 - 41 327 (18) |
| Nearby industrial plants | 1997 | 21 - 1 207 (7) |
| Around sub-stations destroyed in the war | | |
| - Konjsko (Split) | 1993 | 7 - 166 (17) |
| - Komolac (Dubrovnik) | 1996 | 1 640 (2) |
| - Zadar | 1996 | 173 - 204 823 (6) |
| - Šibenik | 1996 | 470 320 - 2 094 151 (3) |
| - Delnice | 1996 | 21 (1) |
| **Municipal and rural areas** | 1994/97 | 2 - 39 (18) |

N = number of samples

The highest weight components of PCBs in soil within airports were found in the samples collected just adjacent to the apron and runaway. That might be the outcome of the past, uncontrolled release of these compounds into environment from the electrical and hydraulic systems of aircrafts. It is a fact that PCBs around airports used to be on the level of global environmental pollution, which points to local sources of contamination, within the very airports.

The only to date published data about soil PCDD and PCDF are those obtained from the airport, where PCBs weight component was in excess of 5000 μg $kg^{-1}$, and from the soil adjacent to former chloroalkaline electrolysis-facility. Total PCDD and PCDF in the airport soil was 843.4 ng $kg^{-1}$ of dry sample with I-TEQ 9.7 ng I-TEQ $kg^{-1}$ of a dry sample which was within typical ranges for municipal and rural areas (<10 ng I-TEQ $kg^{-1}$ of a dry sample). Soil samples from the former chloroalkaline electrolysis facility (Kaštel Sučurac in Split) contained around fifty times higher I-TEQ: 493 and 549 ng I-TEQ $kg^{-1}$ of a dry sample where weight components of total PCDD and PCDF were in excess of 17 000 ng $kg^{-1}$ of a dry sample. However, in these soil samples too I-TEQ levels were far below 10 000 ng I-TEQ $kg^{-1}$ of a dry sample. This is in Germany a legally established limit value which, if in excess, requires remediation of the polluted industrial areas.

**OC pesticides and PCB in surface, ground and drinking waters**

Data about the levels of OC pesticides in surface and ground waters have been collected already since the end of 1970's. From 1980-1983 ground water was studied for OC pesticides as the potential source of drinking water at several sites in eastern Slavonija, including the area of Osijek. The commonest compounds which were also present in the highest levels were γ-HCH (up to 28 ng $L^{-1}$), DDT and its metabolites (up to 25 ng $L^{-1}$) and HCB (up to 3 ng $L^{-1}$). According to annual reports of the Institute of Public Health of the Istra county, from 1980 to 1984 the highest levels of DDT-type compounds in the Istrian rivers (Boljunčica, Mirna, Raša and Pazinčica) were from 500 to as high as 8 800 ng $L^{-1}$. Later (1986-1994), in line with the restricted use of 4,4'-DDT, these levels went down significantly (<100 or <50 ng $L^{-1}$). At the same time γ-HCH in the Istrian rivers fell. Whereas in the period 1980-1984 the highest levels of γ-HCH were found in the Boljunčica and Raša (about 50), Mirna (about 30) and Pazinčica (about 200 ng $L^{-1}$), from 1991-1994 the highest levels in the first three rivers dripped to below 10, and in the Pazinčica to about 100 ng $L^{-1}$.

According to the annual reports of the Institute for Public Health of Split-Dalmacija county, the highest levels of DDT-type compounds in the Dalmatian rivers were measured in the period 1988-1993, when they reached 20 ng $L^{-1}$ (the Jadro river, 1993) and 195 ng $L^{-1}$ (the Krka river, 1988/89). The highest level of γ-HCH (56 ng $L^{-1}$) was in the Čikola in 1988/89. However, water samples from the rivers of Jadra, Cetina, Žrnovnica and Pantana taken during 1993-1994 contained HCB, α- and γ-HCH and DDT-type compounds in very low levels, from <0,5 to max. 2 ng $L^{-1}$.

The highest levels of DDT-type compounds measured in several rivers of continental Croatia (Sava, Drava, Korana, Dobra and Kupa) in the period 1979-1989 were always below 1 ng $L^{-1}$. However, some data were published showing that in the period 1988/89 several samples from the Kupa river collected near or in the area of Sisak contained 4,4'-DDT and its metabolites in the levels up to 6 ng $L^{-1}$.

Within these studies the Kupa river near Sisak was found to contain the highest levels ever recorded for γ-HCH (1-20 ng $L^{-1}$) detected in all samples. The second most frequent OC pesticide recorded in the Kupa was HCB (up to 3 ng $dm^{-3}$). Studies of OC pesticides in the river of Sava, in the streams, lakes and ground waters of the Zagreb area in the period 1992-1995 confirmed frequent occurrence of γ-HCH in traces and occasional presence of very low concentrations of other compounds.

OC pesticides were also detected in drinking water. In the Sisak water supply their occurrence in 1988/89 was similar to that in the water supply of the Kupa river, which was then improved by treatment. Levels of γ-HCH were within the range 1-59 ng $L^{-1}$. Simultaneous tests of OC pesticides in Zagreb and Labin drinking water detected regular traces of γ-HCH, while other compounds appeared periodically. In the period 1981-1990 the levels of total OC pesticides in raw water of karst springs used for preparation of drinking water in the Labin area were 7-574 ng $L^{-1}$, in the Buzet area 11-260 ng $L^{-1}$and in the Pula area 1-180 ng $L^{-1}$.

There are not many data about OC pesticides in the river sediments in Croatia, although for their tendency to sorb and bioconcentrate in these media one might expect their higher water levels. In the river sediments of central Dalmatia (the rivers of Jadro, Cetina, Pantana and Žrnovnica) HCB-a, α- and γ-HCH and DDT and its metabolites were found in traces, which can be attributed to global environmental pollution.

The commonest sources of aquatic environment pollution with PCBs are direct releases of untreated waste water and greenfield disposals of waste oils in the first place. Table 46 compares the levels of these compounds found during past twenty years in some rivers, drinking water and in river sediments.

Table 46. PCBs levels in rivers and drinking water (ng dm-3) and in river sediment (µg kg-1 of a dry sample)

| Sample (N) | Sampling time | Concentration range/ weight component |
|---|---|---|
| Rivers | | |
| Sava (7) | 1992/95 | <1 - 25 |
| Kupa (22) | 1985 | <1 - 52 |
| Kupa (6) | 1985/86 | 2 - 16 |
| Kupa (24) | 1988/89 | <1 - 8 |
| Drava (8) | 1981/82 | <1 - 7 |
| Cetina (7) | 1993/94 | 2 - 8 |
| Jadro (7) | 1993/94 | 3 - 13 |
| River sediments | | |
| Kupa (6) | 1985/86 | 1 - 39 |
| Jadro (8) | 1993/94 | 2 - 507 |
| Cetina (18) | 1993/94 | <1 - 7 |
| Drinking water (pre-treated karst springs) | | |
| Labin | 1980/90 | 2 - 48 |
| Pula | 1980/90 | 4 - 176 |
| Buzet | 1980/90 | 4 - 50 |
| Drinking water (treated) | | |
| Zagreb (10) | 1988 | <1 - 5 |
| Sisak (16) | 1988/89 | <1 - 5 |
| Labin (10) | 1989 | <1 - 3 |

N = number of analysed samples

Table 47 shows the levels of OC pesticides and of PCBs in the period 2000-2002.

Generally, the data about organochlorine compounds and polychlorinated biphenyls in waste waters have not been published, although it is known that they were measured, most frequently at the points of their release from the industrial plants.

Table 47. Levels of organochlorine pesticides and of polychlorinated biphenyls in the river water samples (ng L-1) collected from 1.1. 2000 till 31.12. 2002

| Site and year of sampling | PCBs | Total OC pesticides | Lindane | DDT |
|---|---|---|---|---|
| Rivers and artificial water impoundments in the Istria * 2000 | 0-13.3 | 0-30.9 | 0-5.5 | 0-7.7 |
| 2001 | 0-50 | 0-18.9 | 0-1.3 | 0-10.8 |
| 2002 | 0-7.5 | 0-32.6 | 0-4.4 | 0-9.5 |
| Drava (Nemetin, Donji Miholjac, Botovo, Varaždin, Terezino polje): 2000 | NR | NR | 1-100 | 1-100 |
| 2001 | NR | NR | 0-9 | 0-50 |
| 2002 | NR | NR | 0-34 | 0-5 |
| Danube (Borovo, Batina): | | | | |

| Site and year of sampling | | PCBs | Total OC pesticides | Lindane | DDT |
|---|---|---|---|---|---|
| | 2000 | NR | NR | 1-30 | 1-50 |
| | 2001 | NR | NR | 0■ | 0■ |
| | 2000 | NR | NR | 0■ | 0■ |
| Mura (Goričan): | | | | | |
| | 2000 | NR | NR | 100■ | 2-3200 |
| | 2002 | NR | NR | 100■ | 5■ |

* *Sampling sites: Mirna, Raša-Most Potpićan central part, artificial water impoundment Butoniga - surface, Sveti Anton, Mutvica, Balobani, Rakonek, Kokoti, Blaž, Tivoli, Gradole, Sveti Ivan, Bulaž, Mlini, Pazinčica - Dubravica central part, Pazinčica - Ponor central part, Boljunčica – mouth - central part*

■ the same level in all samples

NR = unavailable data

**OC pesticides and PCBs in sea water and sea sediments**

Majority of data about the levels of persistent OC insecticides and PCBs in the Adriatic Sea were collected during many study years of the origin and destiny of 4,4'-DDT and its metabolites 4,4'-DDE and of 4,4'-DDD, dieldrin and PCBs in the Rijeka Bay. Some of the pollutants enter the Rijeka aquatorium from the rain water as the result of global environmental pollution. OC compounds levels in waste water of the city of Rijeka were recorded in the period 1979-1981 and in 1986 when they ranged between <0.2 to 256.3 ng $L^{-1}$ for 4,4'-DDT, from <1 to 397.9 ng $L^{-1}$ for 4,4'-DDE, from <1 to 229.2 ng $L^{-1}$ for 4,4'-DDD and from <0.5 to 9115.5 ng $L^{-1}$ for total PCBs. Determination of the compounds in aqueous solution and on the suspended particles in waste water revealed that about 50% of the total DDT-type compounds and about 80% of PCBs were suspended on the particles. Comparison of the levels recorded in waste water in the period 1979/81 and in 1986 showed significant drop of DDT concentration and its metabolites over the time, but not of PCBs.

Systematic studies of OC compounds in the samples of the surface micro layer and sea water taken at 1 m depth at several collection sites in the Rijeka Bay were carried out from 1977 till 1987. The results are shown in Table 48.

Weight components of the total DDT-type compounds and total PCBs determined by the analysis of the surface sea sediment collected along the eastern Adriatic coast in the period 1976-1990 are also given in Table 48. The levels were either comparable or below those determined for the same compounds in the sediments from other parts of the Adriatic Sea and the Mediterranean Sea.

Table 48. Levels of OC compounds in water (ng L-1) at the surface layer of the sediment (μg kg-1 of a dry sample) from the east Adriatic

| Site (Period) | Sample | DDT + metabolites Range | DDT + metabolites Median (N) | PCBs Range | PCBs Median (N) |
|---|---|---|---|---|---|
| Rijeka Bay (1977-1987) | coastal sea | | | | |
| | - water | 0.07 – 104.9 | 0.98 (24) | 0.2-17.0 | 3.6 (23) |
| | - surface micro layer | 3 – 25.3 | 4.8 (7) | 28-597 | 112 (7) |
| | open sea | | | | |
| | - water | <0.06 – 0.99 | 0.21 (10) | <0.2-1.7 | 0.6 (10) |

| | | | | | |
|---|---|---|---|---|---|
| | - surface micro layer | 0.75 – 4.2 | 1.3 (10) | 1-52 | 6 (10) |
| Umag - Dubrovnik* (1976-1990) | sediment of the coastal sea (0-3 cm) | <0.1 – 93.9 | 1.6 (142) | <0,5 - 294 | 5.5 (141) |

N = number of samples

*Umag, Poreč, Rovinj, Pula, Rijeka, Šibenik and Dubrovnik

In 1997 the Institute "Ruđer Bošković" cooperated with the "Hrvatske vode" and the State Water Directorate in the study of PCBs and DDT in the sediments of the coastal area of Zadar, the Vransko lake near Biograd, Bilica near Šibenik and Komolac near Dubrovnik with regard to soil contamination from the power sub-stations destroyed during the Patriotic War. Reference area was the narrow coastal area in Selce, nearby Crikvenica. The analysis included 35 sediment samples in total, collected (with the exclusion of the Šibenik area and the Vransko lake) in the very narrow coastal zone, just a few meters from the coastal line i.e. in the zones of probably most intense local pollution. Weight components of PCBs in the analysed sediments were within the range of 5.7-2203 $\mu g\ kg^{-1}$ of dry weight (median 45 $\mu g\ kg^{-1}$), and of DDT 0.2-35 $\mu g\ kg^{-1}$ of dry weight (median 1.5 $\mu g\ kg^{-1}$). The highest level of PCBs was found in the coastal sediment of Zadar. The analyses have shown that the Vransko Lake is practically the unpolluted aquatic system. In the Šibenik area PCBs levels were not indicative of contamination from Bilica powersub-station. The area of Dubrovnik did not show increased levels of the studied compounds at Petka site nearby the point of Dubrovnik and Mokošica waste waters (a short-time landfill for crude waste too during the war) and at Ombli sites. Relatively high PCBs levels were found in the marina sediments in Rijeka Dubrovačka.

## Levels of organochlorine pesticides, PCBs and PCDD/PCDF in various groups of subjects

### Blood and milk levels

POPs compounds were first studied in humans in 1969 with the analyses of the fat tissue. More extensive studies of organochlorine compounds distribution in the Croatian population began in 1975 with the analyses of human serum and mother's milk. The results of many years monitoring of organochlorine compounds blood and milk levels are given in Tables 49 and 50. At the beginning the studies had been focused on organochlorine pesticides, but were subsequently expanded to total polychlorinated biphenyls.

Table 49. Mass fractions (μg L-1 serum) of pesticides (median ranges of individual compounds: DDT, DDD, DDE, α-HCH, γ-HCH) and PCBs (after Aroclor 1260) in general and job-related exposure. N is the number of samples

| Sampling site and year | N | Pesticides | PCBs |
|---|---|---|---|
| Zagreb, 1975 | 147 | 0-31 | NA |
| Zagreb, 1976 | 18 | 0.5-8.7 | NA |
| Bjelovar and Zabok, 1976 | 27 | 5.5-34.4 | NA |
| Zagreb,1976-77 | 11 | 0-33 | NA |
| Krk,1977 | 44 | 0-18 | NA |
| Klakar, 1979 | 41 | 0-7 | NA |
| Zagreb, 1977-79 | 35 | 0-18 | NA |
| **Sampling site and year** | **N** | **Pesticides** | **PCBs** |
| Zagreb, 1978-81 | 31 | 0.3-11.2 | NA |

| | | | |
|---|---|---|---|
| Pula, 1978-81 | 31 | 0-11.2 | NA |
| Zagreb, 1985 | 15 | 0-7 | 4 |
| Zagreb, 1987-88 | 24 | 0-4 | 3 |
| Zagreb, 1989-90 | 26 | 0-8 | 8 |
| Labin, 1989 | 10 | 0-18 | 7 |
| Zagreb, 1990 | 32 | 0-2 | 8 |
| Zagreb, 1994-95 | 14 | 0-3.4 | 2,4• |
| Zagreb, 1976* | 50 | 0-59 | NA |
| Zagreb, 1989♦ | 26 | NA | 8(25■) |
| Zagreb, 1994♦ | 15 | 0-4.9 | 9(6.6•) |

* job-related exposure to organochlorine pesticides
♦ job-related exposure to polychlorinated biphenyls
0=below limit of detection; NA_not analysed
• sum of six PCBs congeners
■ mixture of Aroclor 1260 and Aroclor 1016 (1:1)

Table 50. Mass fractions (μg kg-1 of milk fat) of pesticides (median ranges of weight components of individual compounds: DDT, DDD, DDE, α-HCH, β-HCH, γ-HCH) and PCBs (after Arocloru 1260) in human milk. N is the number of samples.

| **Sampling site and year** | **N** | **Pesticides** | **PCBs** |
|---|---|---|---|
| Bjelovar and Zabok, 1976 | 27 | 0-1537[A] * | NA |
| Zagreb, 1977-79 | 71 | 0-63[M] | NA |
| Osijek, 1978-79 | 20 | 0-176[A] | 0 |
| Zagreb, 1981-82 | 50 | 180-1900 | 620 |
| Zagreb, 1985 | 18 | 0-1060 | 440 |
| Sisak, 1985 | 20 | NA | 300-2700♦ |
| The island of Krk, 1986-87 | 33 | 0-108 | 500 |
| Labin, 1989 | 20 | 0-550 | 270 |
| Sisak, 1987 | 9 | 0-633 | 431 |
| Karlovac, 1988 | 9 | 0-600 | 300 |
| Zagreb, 1986-87 | 41 | 0-1480 | 450 |
| Zagreb, 1987-90 | 40 | 0-491 | 243 |
| Zagreb, 1990-91 | 30 | 0-450 | 230 |
| Zagreb, 1991-93 | 54 | 0-282 | 213 |
| Krk, 1992 | 27 | 0-325 | 412 |
| Jastrebarsko, 1992 | 18 | 0-285 | 180 |
| Zagreb, 1994-95 | 45 | 0-247 | 212 |
| Osijek, 1994 | 18 | 0-385 | 215 |
| Zagreb, 1995 | 14 | 0-250 | 219 |
| Rijeka, 1995-96 | 31 | 0-21,8[$] | 778 |
| Osijek, 1997 | 20 | 0-629 | 126 |

NA_ not analysed ; 0 _ below limits of detection

* aldrin, diledrin, endrin, heptachlor, heptachlorepoxide and δ-HCH were also analysed but not detected

[A] range of arithmetic means of weight components of individual compounds

[M] medians range of weight components of individual compounds expressed as μg $kg^{-1}$ of milk; β-HCH was not analysed

$ aldrin, diledrin, endrin and heptachlorepoxide were also analyzed (median range 0-0.7μg $kg^{-1}$ of milk fat)

♦ range of weight components of total PCBs in individual samples

Levels of individual PCBs congeners in the Croatian population was evaluated on 30 serum samples (25 males and 5 females aged 14-83 years) taken from general population and on 15 serum samples of the subjects (14 males and 1 female aged 31- 58 years) professionally exposed to PCBs. Measuring included six indicator PCBs, and in the sera of professionally exposed subjects measured were total PCBs after Aroclor 1260. All samples contained PCB-138 and PCB-153, while other congeners appeared in 80-98 % of cases. The results are shown in Table 51.

Table 51. Levels (median; ranges are in the brackets; μg L-1) of PCBs congeners and of total PCBs in blood serum of general population and professionally exposed subjects

| **PCB congener** | **General population** | | **Occupationally exposed subjects** |
|---|---|---|---|
| | 1995 (N=14) | 1997 (N=16) | 1994 (N=15) |
| PCB-28 | 0.1 (0 - 0.3) | 0.2 (0 - 0.5) | 0.4 (0 - 3.8) |
| PCB-52 | 0.7 (0.3 - 1.5) | 2.5 (0.5 -9.1) | 1.6 (0 - 4.6) |
| PCB-101 | 0.4 (0 - 3.4) | 0.5 (0 - 2.4) | 0.6 (0 - 0.7) |
| PCB-138 | 0.5 (0.2 - 1.2) | 0.5 (0.2 - 4.6) | 0.9 ( 0.3 -4.6) |
| PCB-153 | 0.5 (0.3 - 1.6) | 0.5 (0.1 - 2.4) | 1.3 (0.3 - 5.2) |
| PCB-180 | 0.3 (0.2 - 2.7) | 0.3 (0 - 0.9) | 0.9 (0 - 2.8) |
| Sum of six PCBs | 2.4 (1.5 - 6.4) | 4.4 (1.9 - 11.4) | 6.6 (1.1 - 20.5) |
| Total PCBs● | - | - | 9 (3 - 29) |

● after Aroclor 1260

In the subjects with job-related exposure to organochlorine pesticides i.e. PCBs serum levels of these substances were in excess of the average levels in general population, but below these producing acute poisoning symptoms due to high absorption. The levels of 4,4'-DDE in human serum (Figure 4) and in human milk (Figure 5) over more than ten years dropped significantly as the consequence of DDT elimination i.e. restriction and, thus, reduced intake through food, skin and air.

Figure 4. DDE in human serum of the subjects from Zagreb (μg $L^{-1}$ of serum)

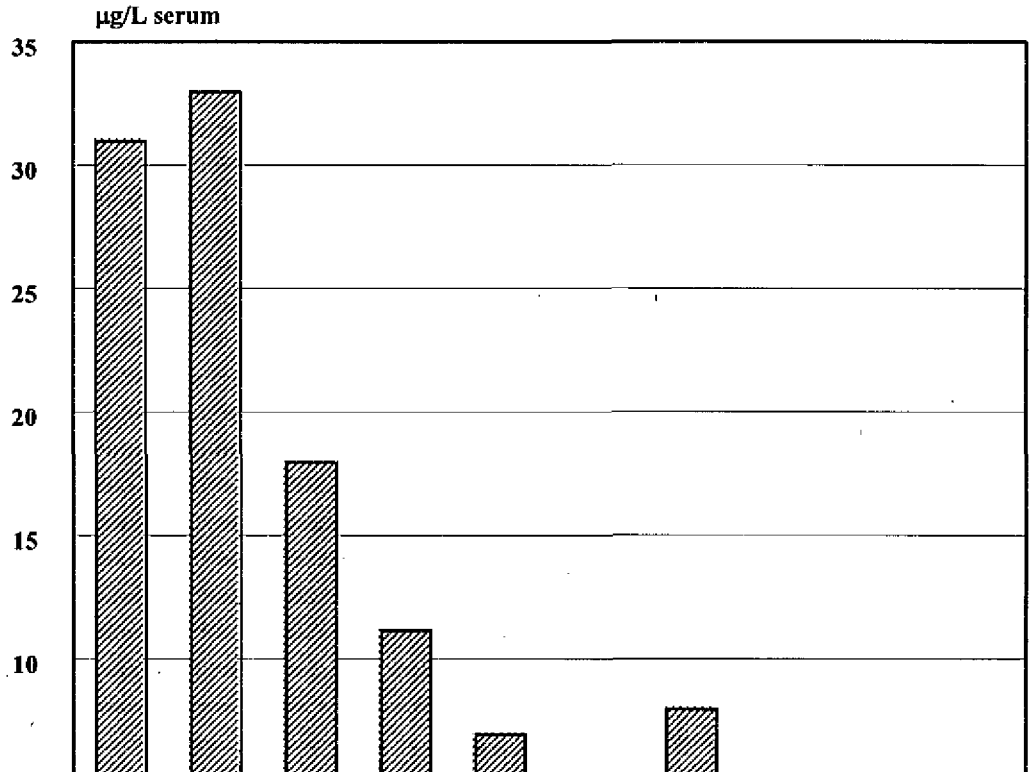
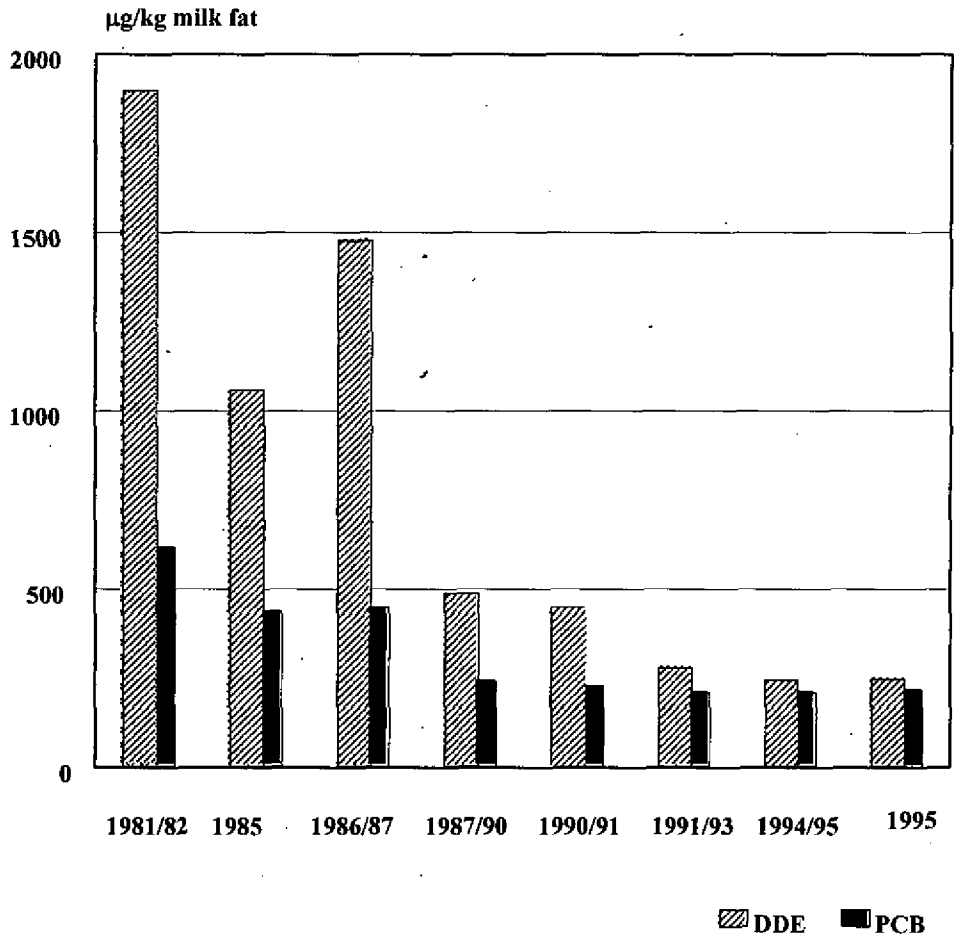


Figure 5.DDE and total PCBs in human milk of the nursing mothers from Zagreb (μg $kg^{-1}$ of milk fat)




PCDD and PCDF have not been analysed so far in Croatia because of the lacking appropriate equipment. In cooperation with the US Environmental Protection Agency (US EPA) and within cooperation with the World Health Organization a pooled sample of human milk was analysed for PCDD and PCDF.

Human milk samples had been collected in Zagreb, Jastrebarsko, Osijek, Labin and on the island of Krk during 1981-1997. The results summary is given in Table 52. Dioxin levels ranged from 8.4-26.7 μg I-TEQ $kg^{-1}$ of milk fat. A 5-year comparative study of the World Health Organization (1987-1992) found in the samples from Zagreb and the island of Krk an annual drop in dioxin levels by about 1.8 %, whereas in other European countries and Canada average drop was 7.2 %.

The studies continued in 2000 showed again a downward trend. It, however, must be pointed out that dioxin levels in human milk samples from Croatia compared with those in the samples of some European countries, Pakistan and Canada were within lower half of the range established for other countries. It is, therefore, unrealistic to expect their major drop.

Table 52. Levels of PCDD and PCDF in human milk calculated using I-TEQ. The number of milk samples in the pooled sample is shown in the brackets.

| Sampling site and year | | pg TEQ $g^{-1}$ of fat |
|---|---|---|
| Zagreb: | 1981-82 (50) | 24.2 |
| | 1985 (17) | 20.7 |
| | 1987-89 (10) | 26.7 |
| | 1987 (41) | 11.8 |
| | 1990-92 (13) | 13.5 |
| | 1993-95 (61) | 13.2 |
| | 2000 (12) | 5.9 |
| The island of Krk: | 1986-87 (14) | 12.0 |
| | 1992 (10) | 8.4 |
| | 2000 (10) | 5.2 |
| Labin: | 1988-89 (10) | 19.4 |
| Jastrebarsko: | 1992 (18) | 8.4 |
| Osijek : | 1994 (18) | 11.8 |
| | 1997 (20) | 15.8 |

### 2.3.8 Current level of information, awareness and education among the target groups; existing systems to communicate such information to the various groups; mechanisms for information exchange with other Parties to the Convention

Average Croatian population is not sufficiently well informed about POPs compounds and their untoward effect on humans and environment. During the inventory it was discovered that even the representatives of industry which operates with the POPs chemicals (PCBs) are not aware about their importance to the environment. In many cases they didn't even recognised that some commercial product contains PCBs (i.e. ASKAREL). This is a fact which clearly indicates that current programs are not sufficient and additional programmes for the target groups need s to be developed.

Not even primary and secondary schools curricula give to the issues related to them the attention which they deserve.

Sufficient level of information can be seen only at scientific institutions and among the professionals whose activities are related to this topic, and the universities which elaborate on POPs compounds and their issues through their comprehensive curricula.

Lack of knowledge of human interactivities and environmental impact comes from misinformation or insufficient information of the public. This problem is worldwide, common even to the industrialized European and other countries. Generally speaking, it has been always difficult to obtain the information about environment, and the procedures about environmental protection were frequently managed from "the top" and directed according to the needs of specific social structures.

Overview of public information policy/practice related to environment (legislation review)

**Croatian Law on Environmental Protection** (Official Gazette No. 82/94) stipulate that basic goals of environmental protection are achieved, among others, by informing the public about environmental status and by their participation in its protection. In other words, environmental protection requires abidance to the principles of publicity and participation, according to which *"...the citizens are entitled to being timely informed about environmental pollution, about the measures undertaken in this connection and the related free access to the data about environmental status..."*

The European Economic Commission of the United Nations for Europe (UN/ECE) brought in 1998 the "Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters". The Republic of Croatia took active part in preparation of this Convention and signed it in the same year. Ratification of this Convention by the Republic of Croatia is also under preparation.

Present public information tools and mechanism

The Croatian Environmental Protection Agency with its project «Cooperation with Public» acts in accordance with the Law on Environmental Protection and the aforementioned Convention. Target groups for the Agency in its cooperation with public are the bodies of state administration (offices of the Government of the Republic of Croatia, Parliament, Ministry of Environmental Protection, Physical Planning and Construction, county offices responsible for environmental issues, etc.), companies, institutions and academic society, economic institutions, NGOs and, finally, media (press, radio and TV).

Assessment of environment as a public priority

Generally the public recognises the environmental issues as priority, and they are conscious about negative impact of waste and waste management to the environment.

Currently the information dissemination is not sufficient. Detailed action plan is developed to cover this issue,

**Mechanisms for dissemination of information among the Convention parties**

At this point Croatia does not have a developed system that could be the basis for information exchange between the Convention parties. Information exchange action plan proposes organization and functioning of the national focal point that would act as the information exchange body.

### 2.3.9 Relevant activities of non-governmental stakeholders

Currently Croatia has over 200 registered non-governmental organizations and associations involved in environmental protection. Many of them are on the local basis and act locally.

Coordination of non-governmental sector being undeveloped splits the activities of NGOs and associations. Additional problem in their work is insufficient financing from the side of the state, which is not creating the key precondition for their continuous and systematic work.

Within the scope of POPs compounds in Croatia, there are now several associations which, within dealing with air, water and waste treatment, indirectly deal with POPs compounds. These activities are not sufficiently systematic and have to be developed sometime, through better cooperation with non-governmental sector that should take part in education and training of population and render consultancy in decision-making.

This would open the door to non-governmental sector in dealing with the issues of environmental accidents and waste management in due course rather than upon their occurrence.

List of NGOs is available on the official site of Ministry of Environmental Protection, Physical Planning and Construction *(www.mzopu.hr)*.

### 2.3.10 Overview of technical infrastructure in the scope of measuring, analyses, development and research of POPs compounds

**National capacities for monitoring of environmental releases of POPs compounds**

There are many laboratories all over Croatia equipped for the analyses of organochlorine pesticides and polychlorinated biphenyls. However, none of them has the equipment for monitoring of PCDD/PCDF imission levels, except the Institute for Public Health of the City of Zagreb. Such measuring are possible in the cooperation with internationally approved foreign institutions. The Croatian Institute for Public Health, Croatian Veterinary Institute, Institute for Public Health of Zagreb and to some extent some regional public health institutes are equipped and competent for determination of other POPs compounds. It is important to point out that many study results performed by public health institutes, Institute Ruđer Bošković and the Institute for Medical Research and Occupational Medicine confirm that they also have adequate equipment and competent university-level staff for such measuring, which is proved by numerous research results.

#### 2.3.10.1 National capacities for monitoring of the effect on human health

Organochlorine compounds and polychlorinated biphenyls in blood and mother's milk are measured in Croatia when PCDD/PCDF levels can be determined in cooperation with foreign institutions, which is possible to arrange. Croatia has sufficient number of medical doctors and occupational medicine specialists who should be able to recognize health changes caused by organochlorine compounds. Our health system does not have an organized network for data collection with regard to the exposure and health problems caused by persistent organochlorine compounds. The only data collected refer to suicides, but in the past 10 years none of the recorded has been referenced to the mentioned compounds. There are some suicidal cases with endosulfane, however, which is also organochlorine pesticide.

#### 2.3.10.2 Proposal to improve the existing practices

Irrespective of the fact that the information about human levels of these compounds are available, the studies have not covered all Croatian regions. In order to estimate their levels in our population, the research should expand to more regions, taking into account the way people live, primarily their dietary habits. It would be interesting to monitor groups of population living in the vicinity of the damaged industrial plants that are aware of PCBs contamination. Similarly, it would be useful to monitor the population nearby sources of pollution, especially with PCDD/PCDF, e.g. vicinity of industrial plants (metal and metal manufacturing facilities, cement plants, heating plants and landfills) and professionally exposed individuals (fire-fighters and the workers in sub-station workshops).

Out of all the compounds that are covered by this project, the least information has been collected about PCDD/PCDF in any media. Hence, further measuring should be channelled primarily towards evaluation of these compounds in the environmental samples and humans, taking into account their regional distribution.

### 2.3.11 Identification of impacted populations or environments, estimated scale and magnitude of threats to public health and environmental quality and social implication for workers and local communities

This chapter gives a short survey of those populations, which are at potential risk of POPs exposure.

**Population at potential risk**

Analysis of the available study results in Croatia shows absence of indications about a group at marked risk of professional exposure in the population occupationally exposed to organochlorine pollutants. Given that Croatia has eliminated organochlorine pesticides from the group of a «dirty dozen», it is realistic not to expect any job-related exposure to these substances.

Given the nature of their job, the workers at transformer stations are exposed to PCBs i.e. those making and repairing transformers and capacitors filled with PCBs. One cannot entirely eliminate potential risk of accidents with transformers and capacitors with PCBs and the resulting local contamination, the scope of which is hard to predict. Such accidents involve exposure of those, who handle these equipment, fire-fighters (exposure to PCDD/PCDF) and people working of remediation.

Fire-fighters are the population at risk because of their exposure to PCDD/PCDF. It is a known fact that any fire generates PCDD and PCDF and firemen are exposed to post-fire smoke the most. Croatia has no data about blood levels of PCDD and PCDF in fire-fighters, but neither do other countries.

Studies of general population show that the highest levels of persistent compounds occur in infants, from which it can be concluded that infants are the part of population at risk. Their daily intake through mother's milk is being reduced and increasingly rare exceeds acceptable daily intake recommended by international organizations. This intake is not considered harmful even if it is in excess of ADI because the period of breast-feeding is short in relation to lifetime, so breast-feeding is still very much encouraged.

Regarding pollution of the Kupa River more than 20 years ago, it has been shown that those who lived mostly on fish from the Kupa (fishermen and their families) were significantly exposed to PCBs, as their daily intake with food significantly exceeded acceptable daily intakes.

### 2.3.12 Details of any relevant systems for the assessment and listing of new chemicals

**Registration of chemicals and plant protection products**

In Croatia it is allowed to launch in the market only registered plant protection products and chemicals. For plant protection products this covers production, import, wholesale/retail and disposal of plant protection products and empty packaging materials. For dangerous substances it relates to keeping stocks, import/export, transport sale and any other way of launching the product in the market.

Registration procedure, which is in competence of Ministry of Health and Social Welfare and Ministry of Agriculture, Forestry and Water Management, has several steps. There are four different types of issued registration: plant protection products, pesticides used in veterinary, public health products (biocides) and other toxic chemicals or substances.

The first step which is common for all above mentioned new products in registration process is classification in the toxicity group according to the Act on dangerous substances (Official journal

NN 27/99). If the active ingredient is not yet on the list of toxic substances (Official journal NN 27/99) it has to pass following procedure.

Producer (or the official representative submits) of the product submits a request to the Institute for medical research and work medicine, Veterinary faculty or Faculty for food technology and biotechnology for toxicological assessments. The Croatian institute for toxicology is responsible only for evaluation of chemicals. Their opinion is sent to the Toxicological committee in the Ministry of Health and Social Welfare. Members of the committee are medical doctors, epidemiologists, toxicologist, chemists and agronomist. If the results of toxicological assessment is in accordance with the by law Standards for classifying poisons into groups (Official journal NN 47/99), substance is placed on the List of toxic substances.

The active ingredient must be registered in EU or OECD countries to be registered in Croatia. According to the recommendations of the Toxicological committee Ministry of Health an Social Welfare issues the decision for active ingredient or the ready-made product in the field of pesticides.

Distinguished are two procedures. One is for the registration of the active ingredient and other for the registration of the readymade product.

There are two important by laws concerning placing of toxic substances/pesticides on the market. One is about labeling of poisons on the market (Official journal NN 47/99) whereas the other regulates packaging and handling with packages for poisons (Official journal NN 39/03).

Although the list of forbidden substances is not yet published the written text exists and it is a guideline for decision making in registration process. This list includes almost all chemicals that are listed on the same type of list in the EU. For the registration procedures, not only EU regulations are taken into account but also relevant information from WHO, FAO and international conventions like Basel, Rotterdam and Stockholm. Each pesticide/chemical has to pass the same procedure to be classified in the group according to its toxicity. When a pesticide should be registered not only environmental friendly characteristics and less harmful to human qualities of the active ingredient are checked but also toxicological relevant impurities in products are taken into account.

Final decision on registration of plant protection products is in competence of Ministry of Agriculture, Forestry and Water Management and is provided in accordance with the Plant protection Act (Official journal NN 117/2003). The validity of the permission for placing in the market is maximum 10 years. For the registration it is important that the product should be registered in EU or OECD countries. Producer of the plant protection product or the official representative submits a request to the Institute for Plant protection in Agriculture and Forestry to provide biological studies for all new products (active ingredients) and physical chemical analysis. When the obtained results are found to be in accordance with the purpose of the product and demands concerning quality that is prescribed in the "By law about conditions and manners for placing plant protection products on the market (Official journal NN 90/04) the applicant brings the report to the Ministry of Agriculture, Forestry and Water Management. The Committee for plant protection meets approximately four times a year discussing the obtained requests. The product must have issued decision on placing in the hazard group issued by the Ministry of Health and Social Welfare. Members of the committee are agronomists, forestry specialist, chemists, environmentalist, water management specialist and toxicologist. The Committee gives recommendation to the Ministry of Agriculture, Forestry and Water Management to issue the registration.

In case where the registration is out (expired) the plant protection product can be used till the expired date printed on the original package. Unregistered product can be imported with the permission of the Ministry of Agriculture, Forestry and Water Management, only if total amount will be used for treatment of seeds, planting material or plant products and exported in the known

country.

Plant protection product for minor uses or for ecological agricultural production can be placed on the market only with partly provided biological, chemical and physical tests.

Preparation of a new Law on Plant Protection Products (harmonized with the EU Directive 91/414/EC) is foreseen. Prescriptions from mentioned international regulations will be taken into account for preparation of new act on plant protection products.

**Registration of veterinary products and public health products**

Difference from above mentioned procedure for chemicals and plant protection products derives from the fact that efficacy studies are provided by the veterinary (Veterinary faculty or Veterinary institute) as well as medical (Institute for public health) specialists.

Physical-chemical analyses are mostly made in the Institute for Plant protection or in the Institute for Public Health.

Pesticides used in veterinary are placed on the market according to the Act of veterinary medicines and other products (Official journal NN 78/98) and it's by law (Official journal NN 142/03)

Public health products are placed according to the regulations in the Act of toxic substances (Official journal NN 27/99).

List of registered pesticides (ready-made products) is published in the Official Journal "Narodne novine". Plant protection product list is published annually whereas list of public health products is published from time to time and list with veterinary products is fulfilled with amendments. List of toxic substances is published from time to time. However all relevant recent information in between are always available in the responsible Ministry. The existing Chemical act that should be in force with the beginning of 2005 is in collision with other acts that regulate toxic substances. Due to this many changes must be made to enable providing of regulations.

The chemical act prescribes two lists of chemical substance one regulates chemicals according to *EINECS (European Inventory of Existing Comercial Chemical Substances)* whereas other regulates them according to *ELINCS (European List of Notified Comercial Chemical Substances)*

### 2.3.13 Details of any relevant systems for the assessment and regulation of chemicals already in the market

All information concerning negative influence of the already registered plant protection product/chemical obtained in the mean time must be reported to the Ministry of competence and will influence on the change of the registration and the permission.

The registration procedure is the same for the re-registration after maximum ten years, as well as for the registration of the generic products.

In the re-registration procedure new findings (domestic and international as well) are taken into account for the decision making. If product is proven to be toxicologically or eco- toxicologically harmful or there are evidence on developed resistance permission for placing in the market can be limited or canceled. The decision making is based on case-by-case.

The generic plant protection products can be registered if the same product of different producer is already in the market minimum 3 years and has acceptable efficacy. Where patent protection is an issue letter of access is required. For registration it is necessary to do only chemical and physical tests and to classify the ready-made product in the toxicity group. Plant protection product can be

temporary registered without biological tests for the same purpose as it is registered in EU. The permission lasts till all the tests are finished.

In all stages of registration and re-registration process special care is taken for the status of old pesticides/chemicals at international level. The fact that Croatia POPs pesticides are obsolete years ago and replaced with other pesticides/chemicals shows that existing system of registration is sufficient in the light of Stockholm Convention. Some minor changes are needed and it is foreseen to harmonize national legislation with EU requirements.

# 3 STRATEGY AND ACTION PLAN ELEMENTS OF THE NATIONAL IMPLEMENTATION PLAN

## 3.1 Policy statement

Very well aware of the hazards that POPs compounds present to human health and environment, Government of the Republic of Croatia will undertake necessary measures and activities necessary for establishment of the control over their use, for their gradual reduction and elimination from deliberate use i.e. to reduce to sustainable levels the emissions of all POPs compounds that occur as by-products of human activities (unintentional sources).

The ways and modes to achieve these goals are defined after:

(1) analysis of the available data about former and current use of every POPs compound;

(2) review of the study results of POPs compounds levels in each environmental element;

(3) determination of the infrastructure status for the control of POPs compounds levels, and

(4) analysis of the regulations regarding the use, conditions of use and control in every environmental element.

To create the preconditions for fulfilment of the parties' commitments arising in connection of the Stockholm Convention, Government of the Republic of Croatia will nominate a state focal point that will be responsible for preparing ratification of the Stockholm Convention i.e. to organize and survey implementation of the measures and activities from the NIP. Therefore, the Multi Stakeholder Committee, which includes representatives of the:

- Ministry of Environmental Protection, Physical Planning and Construction
- Ministry of Economy, Labour and Entrepreneurship
- Ministry of Agriculture, Forestry and Water Management
- Ministry of Health and Social Welfare and
- Ministry of Foreign Affairs

endorses the NIP, as the way for Croatia to fulfil her obligations from the Convention.

Endorsement letters form Stakeholder ministries are given in the Annex.

Government of the Republic of Croatia undertakes to manage POPs compounds with the aim of protecting its people and environment of its territory, and as a member of international community undertakes necessary measures to protect the environment of the neighbouring countries from the outcomes of the long-range transport of POPs compounds.

In designing new regulations and harmonizing the existing ones with those arising from the Stockholm Convention, the competent ministry shall take account of environmental protection, sustainable development, public health, sound agricultural production, tourism, etc.

Informing of public and active participation of public, of potentially jeopardized groups and of the professionals in resolving the issues related to POPs compounds will be a part of Governmental policy, channelled towards increasing the awareness about the hazards from POPs and uncontrolled management of POPs compounds or from the activities that generate them as by-products.

## 3.2 Implementation strategy

### 3.2.1 Overview

The Croatia is in a process of ratifying the Convention, and it is expected to be done in 2005. This will confirm the country commitment in meeting all the obligations of the Convention. Since the NIP consist of different action plan and strategies, it is necessary to harmonise their implementation.

It is suggested that the coordination will be undertaken by the institution which has the necessary expertise and capacity in the POPs issue and project management.

### 3.2.2 Basic policy of NIP and goals

The basic goal of the NIP as well as the Stockholm Convention is to protect human health and the environment from POPs.

The priority goals of NIP implementation are:

- All potential PCBs sources are eliminated;
- Systematic control of the levels of POPs compounds in all environmental elements;
- Restriction and control of PCDD/PCDF, PCBs and HCB emissions from unintentional sources;
- Unintentional releases of PCDD/Fs PCBs, and HCB are controlled and continuously reduced
- Application of technological solutions (BAT/BEP) that facilitate emissions reduction or cessation of POPs compounds from unintentional sources;
- Informed public about influence of POPs compounds on human health through their intake, and about the measures to avoid exposure.

Government of the Republic of Croatia will give the mandate for NIP implementation to Ministry of Environmental Protection, Physical Planning and Construction. Because of the problem's multidisciplinary nature, the body for surveillance of NIP implementation should comprise representatives of other state bodies responsible for surveillance of the use of POPs compounds (Ministry of Agriculture, Forestry and Water Management; Ministry of Health and Welfare; Ministry of Economy, Labour and Entrepreneurship).

### 3.2.3 Implementation principles

It is important to state that the NIP is in line with the Environmental Protection Strategy, and that all legislation changes will be in line with the EU standards, as well.

The plan to gradually decrease POPs compounds in the environment means active participation of public and stakeholders in disseminating the information about action of POPs compounds, reduction of their use and the control of their unintentional production. Education of public is indispensable part of the activities and is achievable through public media, seminars, public inquiries, school activities, etc.

Monitoring results of environmental POPs compounds levels will become available to public through the media of Environmental Protection Agency (web pages, publications, reports to the Government i.e. technical reports of the relevant ministries).

In order to apply the principle of "polluter pays" the by-law on pollution taxes must be expanded to POPs compounds too.

Reduction of emissions of POPs compounds from unintentional sources requires that in the selection of technical solutions for the processes being their main source chosen are those that produce minimum emissions (BAT/BEP).

### 3.2.4 Priorities and conditions for their accomplishment

During the NIP development the following national priorities were determined and accepted by the Multi Stakeholder Committee. These priorities are elaborated in detailed in the action plans and strategies.

1. National legislation needs to be changed and modified according to requirements of Stockholm Convention and EU legislation.

   *- effective legislative measures are needed to regulate POPs management in the country, including obligation for introduction of new technologies, techniques and practices, inventory, monitoring and control programmes of POPs in environment and humans.*

2. Institutional responsibilities on each aspect of POPs matter have to be clearly defined and determined.

   *- this is needed because of overlapping of institutional responsibilities between different ministries and institutions.*

3. Systematic research programs for more efficient control and monitoring of each group of POPs chemicals in environment and humans,

   *- during inventory assessment phase it has been confirmed that current level of research programs in POPs area is not sufficient.*

4. Capacity building in the country to continue inventories and monitoring programs for reporting to the Secretariat of the Stockholm Convention - *establishment of national POPs office.*

   *- need was identified for more efficient inventory procedures, especially regarding landfills, dumps, possible hot spots and contaminated sites*

5. Building capacity for efficient management of POPs waste.

   *- in Croatia there is no capacity for destruction of POPs waste, which means that country needs to assure financial means for future export of PCB equipment, once when installed equipment will be phased out from use. Capacity building measures should aim to building storages for collection and temporary storage of POPs waste and equipment.*

6. Improvement of public awareness and need for improvement in level of education.

   *- level of public awareness about POPs threat to humans and environment is very low, which can result as inappropriate management of chemicals and waste*

7. Level of exchange of POPs related information needs to be improved.

   *- level of available information regarding health and human safety is very low.*

8. New financial sources and mechanism for implementation of SC should be found

   - *insufficient national financial sources.*

Conditions for successful implementation of the NIP are the following:

- necessary funds are provided by the Government or the international donors based on the estimation and time plan stipulated in the action plans and strategies
- successful coordination of all NIP activities

### 3.2.5 Major milestones in the coordination of the NIP implementation

First and the most important milestone in NIP coordination is determination of the institution which will coordinate the NIP implementation process. This institution could be the Ministry of Environmental Protection, Physical Planning and Construction or some other institution appointed by the Ministry.

Second step is to determine the other institutions for implementation of specific action plans and strategies and to assure proper coordination between those institutions.

If this is not adequately planned from the beginning, it can cause delays in the NIP implementation.

### 3.2.6 Institutional arrangement and assignment of responsibility

Steering Committee with representatives of all the stakeholder institutions will be founded as a control body for the NIP implementation.

National Implementing Agency (NIA) which will be responsible for the coordination of the NIP implementation will be appointed by the Ministry of Environmental Protection, Physical Planning and Construction.

For each action plan and strategy separate institution/agency will be nominated as implementation body. They will report to NIA about their fulfilment of the scheduled activities.

### 3.2.7 Implementation approach

Basic approach which will be used during the implementation of the NIP is the common and parallel implementation of every action plans and strategies, with an aim to insure proper NIP implementation and avoid duplication of efforts and overlapping activities.

### 3.2.8 Implementation strategy review mechanism

During the implementation of the NIP, each institution/agency will prepare periodical financial and progress report about completion of predicted activities and submit it to the NIA. According to the achievements payment will be made or the implementation process changed.

Based on this reports NIA will prepare a yearly report for presentation to the Ministry of Environmental Protection, Physical Planning and Construction for their evaluation and approval.

These activities will be presented to a Steering Committee with an aim to review and approve ongoing process of NIP implementation.

## 3.3 Activities, strategies and action plans

### 3.3.1 Activity: institutional and regulatory strengthening measures

#### 3.3.1.1 Objectives and priorities of the action plan

During inventory of POPs compounds institutional responsibilities and legal frameworks have been specified for each segment of POPs compounds treatment and management (production, use, import, export, monitoring, control, surveillance, etc.). Also, the areas have been found that require adjustment of legal regulations or new regulations for successful implementation of the Stockholm Convention once Croatia ratifies it. Important part of the foreseen changes is also defining institutional responsibilities in terms of more clear and logical assignment of tasks to relevant institutions in every segment of the management and use of POPs compounds. This action plan will state only the areas requiring the above mentioned adjustments. Further action plans (sections 3.3.2. – 3.3.12) will propose the measures and activities, and the related timeframes and required funds to ensure implementation of necessary changes in the national legal and institutional framework from the scope of POPs compounds.

#### 3.3.1.2 Identified areas requiring amendments

| |
|---|
| ANNEX A – Part I, ANNEX B |
| Stockpiles with or contaminated by the substances from Annex A and B of POPs pesticides |
| Sites contaminated with the substances from Annex A and B of POPs pesticides |
| Products and objects in use and waste comprising or containing the substances from Annex A and B of POPs pesticides |
| Systemic monitoring of POPs pesticides in humans and environment |
| ANNEX A – Part II |
| Production and use of PCBs |
| Import of PCBs and of the equipment with PCBs |
| Inventory of PCBs in the open and closed systems |
| Sites contaminated with the substances from Annex A – Part II |
| Systemic monitoring of environmental PCBs |
| ANNEX C |
| Monitoring of the levels of POPs compounds – ANNEX C |
| Elimination of the substances and products contaminated with POPs compounds or those which might generate POPs compounds |
| Introduction of the BAT and BEP principles into national economy |

### 3.3.2 Activity: measures to reduce or eliminate releases from intentional production and use

#### 3.3.2.1 Objectives and priorities of the Action Plan

Developed inventory has established that there is no production, usage, import and export of chemicals listed in Annexes A and B of the Convention. However, import and usage of PCBs and PCBs containing equipment was determined and it is still present. Consequently, in this area it is important to establish adequate legislative framework to eliminate the present and possible future import and usage of PCBs and PCBs containing equipment, with respect of preventing the potential releases to the environment during replacement and disposal/treatment of liquid PCBs and PCBs equipment.

Usage of PCBs in open system was not determined during the inventory. Legal regulation in this field is prohibiting the usage of PCBs in open system.

The objective of this Action Plan is to give an overview of measures (legislative and technical) for successful reduction and elimination of POPs chemicals releases from intentional use and production.

#### 3.3.2.2. Summary of current measures to reduce or eliminate releases from intentional production and use

Legal framework from the field of POPs pesticides prevents their usage and production, and is in line with the provisions of the Convention. This issue is more explained in the chapter 2.3.1.1.

Additional measures (legislative and technical) from the field of PCBs are given in the chapter 3.3.4.

#### 3.3.2.3. Implementation of the action plan

Given the fact that all the measures for successful elimination and reduce of POPs chemicals releases from intentional production and use, are oriented to the field of PCBs, developed PCBs action plan *(see chapter 3.3.4)* shows the necessary implementation activities.

#### 3.3.2.4 Costs of action plan implementation

Estimation of costs is included in the amount predicted in the chapter 3.3.4.

### 3.3.3 Activity: Production, Import and Export, Use, Stockpiles and Waste of Annex A POPs Pesticides (ANNEX A, Part I Chemicals)

Given the fact the inventory of POPs pesticides in Croatia has not registered any production, use, import or export of these substances, and has established the absence of their stockpiles and waste, it can be concluded that the area of POPs pesticides does not require any improvement of the current practices and legal framework for their management and treatment. The only area requiring improved organization and implementation is systematic monitoring of environmental POPs pesticides aimed at detecting their levels and confirming the conclusion of the inventory that POPs pesticides do not represent a true problem in Croatia with regard to their impact on the environment and human health. Monitoring action plan reviews necessary activities and measures for systematic monitoring of POPs compounds in environment and humans, and gives timeframes for their implementation and assessment of necessary funds.

The Table 53 gives the list of commitments arising from the Convention with regard to POPs pesticides. It shows that all requirements in connection with production, use, import and export of POPs pesticides have already been fulfilled. The part common to all POPs compounds and which

refers to identification of contaminated sites, stockpiles and objects in use with POPs pesticides, is stated in the action plans and strategies for the given areas.

Table 53. Compiled review of the commitments arising from Articles 3 and 6 of the Convention with the review of their current status in Croatia

| Commitment | Current status |
|---|---|
| Article 3.1 | |
| a) i | There is no production or use of POPs pesticides from Annex A |
| a) ii | There is no export or import of POPs pesticides from Annex A |
| b) | Production and use of POPs pesticides from Annex B are prohibited |
| Article 3.2 | |
| a) i | Import for disposal is prohibited in line with paragraph 1 (d) Article 6 |
| a) ii | There is no import because POPs pesticides from Annex A and B are not used |
| b) i | Possible stockpiles of POPs pesticides will be exported for ecologically sound treatment |
| b) ii | No quantities for use, no export |
| b) iii | No quantities for use, no export |
| c) | Possible stockpiles of POPs pesticides will be exported for ecologically sound treatment |
| 3.3. and 3.4 | When registering the attention is paid that the plant protector is not persistent, that the levels from Annex D 1 are not exceeded |
| 3.5 | There are provisions about the use of chemicals for laboratory purposes |
| 3.6 | There is no specific exemption for POPs pesticides |
| Article 4 | There is no specific exemption for POPs pesticides |
| Article 6 | |
| 1.a) i | Develop a strategy for identification of stockpiles of POPs pesticides from Annex A and B lists |
| 1 a) ii | There is no POPs pesticide as a product or object in use, and no waste has been identified to contain POPs pesticides |
| b) | Inventory has not revealed any stockpiles of POPs pesticides. Monitoring is proposed to detect possible major quantities of POPs pesticides from Annex A and B |
| c) | Stockpiles of POPs pesticides from Annex A and B have not been identified. Generally hazardous waste is being exported in line with Article 3.2. |
| d) | Lacking are the plants for ecologically sound treatment of POPs pesticides – hazardous waste |
| d) i | The law defines who may collect and handle hazardous waste and existing stockpiles of POPs pesticides – hazardous waste. There are also regulations regarding transport of hazardous waste and its storage. |
| d) ii | Lacking are the plants for ecologically sound treatment of POPs pesticides – hazardous waste |
| d) iii | In the Republic of Croatia the use of POPs pesticides – hazardous waste is not possible or permitted |
| d) iv | Provisions compliant with the Basel Convention and regulations on transport of hazardous substances |
| e) | There has been no remediation. There is no regulation on compulsory identification of the polluted sites, so there is no systematic study on potentially polluted sites. |

### 3.3.4 Activity: Production, import and export, Use, Identification, Labelling, Removal, Storage and Disposal of PCBs and Equipment Containing PCBs (Annex A, Part II Chemicals)

#### 3.3.4.1 Objectives and priorities of the Action Plan

Inventory of PCBs has established that there is no production of PCBs in Croatia but that the equipment with PCBs is in use. It has also been found out that the import and use of liquid PCBs and of the equipment with PCBs are not prohibited.

The goal of the Action Plan regarding PCBs is to describe and define the commitments of the Republic of Croatia and specific actions it has to undertake with regard to PCBs treatment that arise in connection with the Stockholm Convention. Final goal is to reduce and to gradually eliminate the use of PCBs, to prevent their environmental release and to ensure the conditions for PCB-waste disposal and treatment in the ecologically sound manner.

Priority proposals of the Action Plan are:

- to define coordinating body for all activities related to fulfilment of the commitments from the Stockholm Convention;
- to promulgate corresponding regulations i.e. amend and supplement the existing ones;
- to define institutional responsibilities;
- to create capacities for temporary storage of PCB-waste;
- education and public information.

*Possible restrictions in implementation of the Action Plan might be the limited funds of business* entities in possession of PCB equipment, limited budget for fulfilment of the Stockholm Convention and inability to establish accurate timelines for promulgation of new regulations i.e. for the amendments of and supplements to the existing one.

#### 3.3.4.2 Foreseen measures to manage PCB compounds in Croatia

This section states legal and technical measures necessary for adoption of the Stockholm Convention requirements and proper treatment of PCBs and the equipment with PCBs.

**Legal regulations:**

Croatia does not have legal acts related to PCBs to:

- prohibit the production of PCBs and the equipment with PCBs;
- prohibit import/export of the equipment with PCBs and of liquids with PCBs;
- (customs tariff does not make any difference between transformers and capacitors with PCB, but rather "waste oils with PCBs, PCT and PBB" – tariff No. 27109100 and "other cyclic carbohydrate-biphenyls, terphenyls"– tariff No. 29029030);
- prohibit the use of PCBs in the closed systems i.e. to define timelines for substitution of the equipment with PCBs;
- define timelines for treatment of PCB waste (liquid PCBs and equipment with PCBs where PCB content exceeds 0.005 %), and

- prohibit recovery, recycling, re-use and direct re-use or alternative use of the liquids with PCBs over 0.005%.

To facilitate fulfilment of the Stockholm Convention it is proposed to amend and supplement the existing legislation/promulgation of new legislation regarding PCBs:

- promulgation of the by-law that will ensure:
  - production elimination of liquid PCB and of the equipment with PCB;
  - import prohibition of the equipment that might contain PCBs (transformers and capacitors) and liquid PCBs;
  - prohibition of recovery, recycling, re-use and direct re-use or alternative use of the liquids with PCBs over 0.005%;
- amendments of and supplements to the By-law on customs tariff, so that the equipment with PCBs (transformers and capacitors with PCBs, liquids with PCBs) get their separate tariff number for the purpose of import control and surveillance of the equipment and utilities that might contain PCBs (*current national customs tariff does not recognize transformers and capacitors with PCBs, but rather "waste oils with PCB, PCT and PBB" –tariff No.. 27109100 and "other cyclic carbohydrates-biphenyls, terphenyls"– tariff No. 29029030);*
- promulgation of the By-law regarding timelines for substitution of the utilities with PCBs and deadlines for treatment of PCB-waste *(liquid PCBs and the equipment with PCBs).*

  *(According to the Convention deadline for elimination of the equipment with PCBs is the year 2025 and for treatment of PCB-waste is 2028. According to the EU legislation (Council Directive 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT)) deadline for treatment of all equipment with PCBs is the year 2010);*

- promulgation of a new or amendment of the existing regulations on occupational health and safety in connection with handling of the substances that contain polychlorinated biphenyls, polychlorinated naphthalenes or polychlorinated terphenyls (Official Gazette of No. 7/89)
  - introduce compulsory registration with the competent bodies of the ownership over the equipment with PCBs – Occupational H&S Inspectorate of the State Labour Inspectorate (compulsory application for the licence for operation of the utility submitted to the Republic Labour Inspectorate (a body from the times of former Yugoslavia). However, State Inspectorate stated that no such application has been submitted so far;
  - introduce compulsory recording of the ownership over PCB-waste (PCB-waste out of function and liquids with PCBs) with the competent body/agency that would monitor elimination of the equipment with PCBs and implementation of the Action Plan regarding PCBs;
  - introduce compulsory recording of the accidents with the equipment with PCBs that involve environmental leakage of PCBs with the competent bodies – environmental protection inspection;
  - amend Article 5 of the Rules given that it defines waste PCBs as toxins whereas they have been deleted from such list and defined as hazardous substances. Hence, waste PCBs must be labelled in line with the By-law on the Conditions for Handling Hazardous Waste (Official

Gazette No. 32/98) rather than in line with the Rules on Labelling of Toxins released on Domestic Market (Official Gazette of the No. 32/86), and

- introduce penalties for unfulfilment of the provisions of the Rules.

**System of licences related to handling, transport, storage and disposal of PCBs and the equipment with PCBs – draft of the more efficient system**

Currently, surveillance of PCBs distinguishes several forms of PCBs monitoring and control:

- licence for the operation of the equipment issued by the inspection for labour and occupational H&S (according to the State Inspectorate no application has been submitted so far);
- during operation of the utility with PCB, control and surveillance are performed by the inspectors for labour and occupational H&S;
- when the utility with PCB comes out of use, i.e. becomes waste with PCB, it comes under control and surveillance of environmental protection inspectors;
- (manufacturer of PCB-waste must register this waste with the state administration office at the regional self-government unit which is responsible for environmental issues, according to Article 34 of the Law on Waste, and
- final treatment is performed by the approved companies and institutions according to the approvals of the competent bodies of state administration (Ministry of Environmental Protection, Physical Planning and Construction).

To enable fulfilment of the Stockholm Convention regarding control and surveillance of the equipment with PCBs and PCB-waste the following is proposed:

- intensify inspection of compulsory registration of the ownership over the equipment with PCB with the occupational H&S inspection;
- introduce compulsory registration of the ownership over PCB-waste (when this equipment comes out of function and becomes waste) with the competent body/agency that would monitor removal of the equipment with PCBs and implementation of the Action Plan regarding PCBs - with the environmental protection inspection;
- intensify inspection of compulsory registration of the ownership over PCB waste with the office of the state administration at the regional self-government unit responsible for environmental protection.

**Current status of the companies and industries that gradually eliminate the use of the equipment with PCBs, and draft statement of 10 major owners that they will gradually, in line with the Stockholm Convention, eliminate the use of the equipment with PCB**

Status of the companies and industries gradually eliminating the equipment with PCB, is unknown given the fact that they are not permanently monitored for that. Compulsory application for the operation licence for such equipment with the Republic Labour Inspectorate (a body from former SFR of Yugoslavia) arises from the Rules on Occupational Safety Regarding the Substances Containing Polychlorinated Biphenyls, Polychlorinated Naphthalenes and Polychlorinated Terphenyls (Official Gazette No. 7/89). However, according to the obtained information, such application has ever been submitted to the State Inspectorate.

In cooperation with the Ministry of Labour and Welfare and occupational H&S inspectors in the years 1993/94/95/96/97 minutes on the inspections of the equipment with PCBs were processed and

analyzed and the survey was carried out to establish database about the owners of the equipment with PCBs (transformers and capacitors), liquids with PCBs and waste contaminated with PCBs. The database was updated in 2003 for the purpose of PCBs inventory.

To enable fulfilment of the Stockholm Convention related to monitoring of the removal of the equipment with PCBs the following is proposed:

- appoint a body/institution for permanent monitoring and updating of database about the owners of the equipment with PCBs (based on the registration of such equipment with occupational H&S inspection and the proposed registration of PCB-waste with the environmental protection inspection) for the purpose of getting realistic picture about the advancement in elimination of the use of such equipment;
- offer to business entities, which are major owners of the equipment with PCBs, signing of the statement on their voluntary gradual elimination of the equipment with PCBs from use, in line with the Stockholm Convention. This would enable access to international funding and reduce their financial burden related to treatment of the equipment with PCBs.

**Directives for identification, decontamination, use, transport, storage and disposal of the equipment or the products with PCBs**

Croatia does not have unique instructions for identification, decontamination, use, transport, storage and disposal of the equipment or the products with PCBs. Some business entities (e.g. Hrvatska elektroprivreda) have designed their own instructions for handling of the equipment with PCBs.

To enable fulfilment of the Stockholm Convention related to handling of the equipment with PCBs and PCB-waste the following is proposed:

- designing of the unique instructions that would define directives for:
  - identification and labelling of the equipment with PCBs that is in function (determination mode for PCB content in the equipment suspected to contain PCBs);
  - conditions for the use of the equipment with PCB (faultless equipment, area where it can/cannot be used);
  - handling of the equipment with PCBs;
  - transport of the equipment with PCBs;
  - treatment of the stockpiles of the equipment with PCBs and of PCBs;
  - handling of PCB-waste;
  - labelling of PCB-waste;
  - temporary storage of PCB-waste at the production site, and
  - intervention measures in case of PCB leakage from the corresponding equipment that is or is not in function;
- circulation of these instructions to all business entities that are the owners of the equipment with PCBs (upon registration of such utilities with the Inspection of labour and occupational H&S it is proposed to give the instructions to the business entity) and publishing them on the web page of the Ministry of Environmental Protection, Physical Planning and Construction.

**Plans for final treatment and disposal of PCB waste including identification of necessary spatial capacities**

The Republic of Croatia ***does not have the capacities for temporary storage of PCBs till their final disposal.*** Storages for the staging waste are the areas within production sites, all over Croatia, where the equipment with PCBs is temporarily kept. This equipment is either out of function or staging waste at the collection points of the PCB-waste exporters in Zagreb. According to Article 19 of the Law on Waste (Official Gazette No.178/04) storage time of hazardous waste (which includes PCBs) at the manufacturer's site is restricted to 12 months.

Draft of the ***"Strategy for waste management in the Republic of Croatia"*** that is under consideration, plans the construction of 10-15 Regional centres for waste treatment with the storage of hazardous waste.

Croatia ***does not have the capacities for treatment or disposal of PCBs*** and ***PCB-waste is exported*** in line with the Basle Convention.

To enable fulfilment of the Stockholm Convention related to final treatment of PCB-waste the following is proposed:

- construction of temporary storage for PCB-waste within one or more Regional centres foreseen by the Strategy for waste management in the Republic of Croatia. Given that "management of hazardous waste is considered to be of the interest for the Republic of Croatia" (Official Gazette No. 178/04) it is proposed that the storage space be the ownership of the State. Another option is to give it either to the companies that treat hazardous waste or to other interested companies;
- continue exporting PCB-waste for final treatment abroad, in the environmentally sound manner, taking into account all relevant international regulations, standards and directives for transfer of international borders (due to the economic situation and anticipated quantity of PCB-waste, construction of PCB treatment facility has not been a considered option).

**Available programmes or plans for development and dissemination of information about substitutes and equipment, and their production and use**

Croatia does not have its programme for development and dissemination of information about substitutes and equipment, and their production and use.

To enable fulfilment of the Stockholm Convention regarding development and dissemination of information about substitutes and equipment and their production and use the following is proposed:

- publish educational material/publications with directives regarding the use of PCB substitutes (possibly with the list of the substitutes, their physico-chemical characteristics and their manufacturers);
- make educational material/publications available to all owners the equipment with PCB e.g. though web page of the Ministry of Environmental Protection, Physical Planning and Construction.

### 3.3.4.3 Implementation of the Action Plan

Action Plan should be implemented through three areas:

- Coordination of Action Plan implementation;

- Updating of the legislation, development of directives and strategies, and
- Gradual elimination of PCBs use.

**FIRST YEAR**

- Define focal point to monitor and control implementation of the Action Plan and define scope of its activities which must include:

- monitoring and regular updating of database about owners of the equipment with PCB;
- monitoring of the status of the equipment with PCBs;
- monitoring of disposal of the equipment with PCBs;
- monitoring of the use of PCB substitutes, and
- reporting to the competent state bodies and Secretariat of the Stockholm Convention about the progress in PCB elimination;

- design operative plan and define necessary funds, identify and sensibilize the stakeholders (business entities, competent bodies of state administration) for fulfilment of the Stockholm Convention;
- update the existing legislation regarding production, use, import and export, identification and labelling of PCBs/equipment with PCBs (in closed and semi-closed systems) in order to fulfil the provisions of the Stockholm Convention either by promulgation of new laws/regulations/by-laws or by amending and supplementing the existing ones;
- prepare the directives for the use of the substitutes for PCBs;
- ensure space for temporary storage of PCBs till their final treatment;
- eliminate gradually the use of the equipment with PCBs according to its lifetime (optimal lifetime of capacitors is around 20 years, and of transformers about 40 years) and functionality, taking into account that the Stockholm Convention deadline is the year **2025**;
- ensure transport of the withdrawn equipment to temporary storage;
- export the equipment with PCB for final disposal, taking into account that the Stockholm Convention deadline for disposal of such equipment is the year 2028; (according to the EU legislation EU (Council Directive 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT)) deadline for disposal of all equipment with PCB is the year **2010**);
- offer to the companies signing of the agreement on elimination of PCBs in line with the Stockholm Convention, in order to obtain international financial support from international institutions, and
- develop the strategy for identification of the stockpiles, waste, products and articles with PCB in the open application.

**2. – 4. YEARS**

- Ensure regular implementation of regulatory provisions;
- prepare the directives regarding identification, decontamination, use, transport, storage and disposal of the equipment with PCBs and of PCB-waste, organize education about stated directives for their owners and make them public;
- disseminate the directives about the use of PCB substitutes;
- identify and label the equipment with PCBs, and
- make the most comprehensive possible inventory (database) of the equipment with PCBs and update the database so as to create the preconditions for reporting about the progress in PCB elimination.

**THROUGHOUT IMPLEMENTATION OF THE ACTION PLAN**

- It is proposed to regularly update database about the equipment with PCBs, in order to have the control over elimination of the equipment with PCBs;
- It is proposed to organize workshops on the progress of implementation, in order to monitor and control the ongoing activities;
- It is proposed to review the Action Plan every three years and to make necessary amendments and supplements;
- Every five years a Report on the progress in PCBs elimination to be submitted to the parties Conference.

Timelines for all activities is shown in Table 54.

Table 54. Timelines for implementation of the PCBs Action Plan

| | DURATION OF PROJECT | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Activities | IMPLEMENTATION YEARS | | | | | | | | | | | | | | | | | | | | | | | |
| | | Short-Term | | | | Mid-Term | | | | | | Long-term | | | | | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 1 | **Co-ordination Action Plan implementation** | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.1 | Identification of Implementing Agency and her responsibilites | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2 | Identification of Stakeholders | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.3 | Developing work plan and budget | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.4 | Re-evaluation of the action plan | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.5 | Evaluation workshops | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.6 | Reporting to CoP of SC | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | **Updating current legislation, development of guidelines and procedures** | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.1 | Updating of legislation (production and use of PCBs) | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2 | Updating of legislation (export and import of PCBs) | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.3 | Updating of legislation for identification and labelling PCB equipment (closed and semi closed applications) | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4 | Capacity building for legislation inforcement | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.5 | Developing of guidelines for identification, decontamination, usage, transport, storage and disposal of PCB equipment and PCb waste | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.6 | Education about developed guidelines | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.7 | Developing guidelines for PCB alternatives | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.8 | Dissemination of guidelines on PCB alternatives | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.9 | Development of strategy for identification of PCBs in open systems | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | **Phasing out of PCB equipment** | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.1 | Identification and quantification of PCB containing equipment (conc > 0.005) | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.2 | Labelling of PCB containing equipment | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.3 | Development of more accurate PCB inventory (PCB data base) | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.4 | Voluntary Agreements with companies to phase-out PCBs | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.5 | Construction of temporary storage facility | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.6 | Replacing equipment from use | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.7 | Transportation of equipment on temporary storage | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.8 | Export of PCB for treatment | | | | | | | | | | | | | | | | | | | | | | | | |

### 3.3.4.4 Requirements in capital investments

It is assumed that due to the economic situation in Croatia and the assessed volumes of PCB-waste there are no plans for the construction of PCBs treatment plants. Hence, capital investments in this area are not planned. We will continue exporting all waste.

The price for waste disposal abroad is about USD 3.75/kg, i.e. disposal of the registered PCB-waste from the whole country requires around 5.6 million USD

Out of capital investments, the most important is construction of temporary storages for PCB-waste within one or more Regional centre for waste treatment, foreseen by the draft Strategy for waste management in the Republic of Croatia. Cost approximation for construction is 500 000 USD.

### 3.3.4.5 Cost assessment for Action Plan implementation

Table 55 shows assessment of the overall costs of the Action Plan implementation

Table 55. Assessment of the overall costs of Action Plan implementation

| Activity | Unit | No. | Unit price (USD) | Total price (USD) |
|---|---|---|---|---|
| **1. Coordination of the Action Plan implementation** | | | | |
| Project coordinator | month | 48 | 2 000 | 96 000 |
| Travel expenses (local and foreign experts) | person | 30 | 40 | 1 200 |
| Equipment (computers, software) | | 1 | 5 000 | 5 000 |
| ***Total phase 1*** | | | | ***102 200*** |
| **2. Updating of current legislation, development of directives and strategy** | | | | |
| Local experts | month | 12 | 2 000 | 24 000 |
| Training of inspection to ensure implementation of law/two experts | month | 4 | 2 500 | 10 000 |
| Development of directives/expert | month | 2 | 2 500 | 5 000 |
| Informing and education of the stakeholders about developed directives/two experts | month | 6 | 2 000 | 12 000 |
| Development of directives about the use of alternatives/expert | month | 2 | 2 500 | 5 000 |
| Informing and education of the stakeholders about developed directives / two experts | month | 6 | 2 000 | 12 000 |

| Activity | Unit | No. | Unit price (USD) | Total price (USD) |
|---|---|---|---|---|
| Development of strategy for PCB identification in the open systems /two experts | month | 3 | 2 000 | 6 000 |
| ***Total phase 2*** | | | | ***74 000*** |
| **3. Gradual elimination of PCBs from use** | | | | |
| Identification and quantification of the transformers with PCBs | sample | 30 000 | 100 | 3 000 000 |
| Labelling of the equipment | 3000 labels | 3000 | 5 | 15 000 |
| Maintenance of database about the equipment with PCBs /detailed inventory | year | 10 | 3 000 | 30 000 |
| Voluntary agreement | month | 9 | 2 000 | 18 000 |
| Construction of temporary storage for the equipment with PCBs | | | | 500 000 |
| Disposal of the equipment with PCBs | | | | 5 600 000 |
| ***Total phase 3*** | | | | ***9 163 000*** |
| | | | | |
| **Total costs of the Action Plan** | | | | **9 339 200** |

### 3.3.5 Activity: Production, Import and Export, Use, Stockpiles and Waste of DDT (Annex B Chemicals)

Separate Action plan for DDT was not developed.

### 3.3.6 Activity: register for specific exemptions and the continuing need for exemptions

Croatia has not filed any specific exemptions to Annex A or Annex B chemicals. The country has decided that it will not file such exemptions in the future; therefore no activities are required to address the obligation of Article 4 of the Convention.

If an exemption is filed, the chapter will be elaborated.

### 3.3.7 Action Plan: measures to reduce releases from unintentional production

#### 3.3.7.1 Action Plan Objectives and Priorities

The purpose of this Action Plan is to define activities and measures that the Republic of Croatia should take to satisfy the requirements of the Stockholm Convention having for final objective the reduction/elimination of by-product releases to the environment. Annex C of the Stockholm Convention refers to the following by-products:

- Polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF)
- Hexachlorbenzene (HCB) and
- Polychlorinated biphenyls (PCB

The Action Plan determines and describes those steps and activities that the Republic of Croatia should take for the effective implementation of the Convention. The Action Plan priorities are:

- Improvement of legal, financial and institutional frameworks for reducing/eliminating by-product releases to the environment taking into consideration the process of approaching the EU;
- Establishment of a comprehensive monitoring:
- Strengthening of public awareness and their integration in the decision-making process and implementation of measures.

The Action Plan also determines short-term and long-term activities, commitments and procedures Croatia should undertake for reducing/eliminating by-product releases in question to the environment.

The Action Plan specifically refers to the obligations ensuing from the Stockholm Convention including:

- Assessment of existing and expected by-product releases to the environment;
- Evaluation of laws/regulations effectiveness:
- Development of a strategy for reducing/eliminating by-product releases to the environment;
- Education and training;
- Review every five years of the strategy for reduction/elimination of by-product releases to the environment;
- Planning of the Action Plan implementation;

- Promotion of accessible, cost-effective and practical measures for achieving an actual and significant release reduction or source elimination;
- Support to the replacement/substitution of raw materials, products, processes;
- Promotion of the BAT principles ("best available techniques):
- Promotion of BEP principles ("best environmental practices).

The Action Plan for reduction/elimination of by-product releases to the environment should be in line with the objectives for POPs compounds as determined in the National Environmental Protection Strategy (Official Gazette 46/02) and National Environmental Action Plan (Official Gazette 46/02). The above-mentioned strategic documents lay down the following framework objectives concerning persistent organic pollutants:

- Reducing POPs emissions (including hexachlorbenzene and dioxins/furans) by the year 2010 as compared to the 1990 emissions in accordance with requirements under international agreements;
- Reducing total emissions from existing stationary sources to the prescribed limit value level.
- Gradual phasing out of PCB use in the existing equipment by the year 2010;
- Harmonization of the existing legislation with European guidelines and international treaties.

The Action Plan priorities are as follows:

- Drafting of legal regulations, measures, guidelines and procedures in connection with POPs chemicals listed in Annex C;
- Taxes and fees for import, production and/or use of specific materials or substances that are a potential source of POPs chemicals listed in Annex C;
- Agreements on a voluntary basis with companies and industrial groups in connection with POPs chemicals listed in Annex C;
- Reporting and activities relating to public informing
- Gradual phasing out of substances and products contaminated with POPs chemicals or those which may generate POPs chemicals;
- Treatment and ultimate disposal of POPs contaminated waste;
- Recovery of locations contaminated with POPs chemicals listed in Annex C.

Activities and measures determined by the Action Plan are proposed pursuant to the Stockholm Convention requirements, and are in accordance with basic principles of the environmental protection policy under which the setting up of objectives and their achievement to reduce/eliminate by-product releases are possible only in mutual partnership of all participants (state administration, economy sector and the public) as well as by change of behaviour in production and consumption using numerous and various instruments (administrative restrictions, incentives on a voluntary-based principle).

The Action Plan incorporates the proposed activities and measures grouped in 6 major activities and 29 separate measures totally. Tables show the time schedule of implementation for particular measures as well as implementation cost estimate.

### 3.3.7.2 Action Plan Activities and Measures

**Legal regulations/measures, instructions and procedures**

Eight measures have been proposed relating to making, reviewing and expanding a list of persistent organic pollutants in Annex C of the Stockholm Convention, adopting the Strategy, as well as introducing and expanding regulations for ultimate reduction and elimination of by-product releases to the environment.

**Adopt a new regulation on compulsory level monitoring and reporting of by-product releases listed in Annex C to the environment**

The purpose of this measure is to establish, within one-year period, a legal framework for systematic monitoring of by-product levels in the environment, as well as to introduce an obligation to report on by-product releases listed in Annex C to the environment.

**Prepare instructions and procedures for making an inventory of POPs listed in Annex C**

The necessity to reach an agreement on methodologies of making POPs inventory listed in Annex C of the Stockholm Convention and the reporting method arises from inventory overview of by-product releases to the environment.

The Republic of Croatia has obligation to estimate POPs emission into air (including PCDD/PCDF and HCB) in accordance with the international methodology EMEP/CORINAIR, officially accepted by the executive body of the Convention on a Long-range Transboundary Air Pollution (CLRTAP).

Annex C of the Stockholm Convention, in addition to PCDD/PCDF and HCP includes also PCB as a by-product, and introduces UNEP Toolkit (Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases, UNEP 2001). UNEP Toolkit elaborates a methodology for estimate of PCDD/PCDF releases and /or transfers to the environment through 5 media: air, water, soil, products and residue/waste.

Having in mind that methodologies EMEP/CORINAIR and UNEP Toolkit differ, it is necessary to adjust and to agree to the procedure for making POPs inventory as well as reporting procedure.

It is necessary to prepare instructions and procedures for making an inventory of POPs listed in Annex C of the Stockholm Convention. The estimated time for measure implementation is one year.

**Make a detailed inventory of POPs compounds listed in Annex C of the Stockholm Convention**

According to the guidelines and procedures for making POPs inventory listed in Annex C of the Stockholm Convention, it is necessary to review in detail and to expand the inventory of PCDD/PCDF releases to the environment, and make a detailed inventory of HCB and PCB releases as by-products.

When making an inventory, it is necessary to provide and enable a better insight in activity data under individual categories and subcategories, as well as data on specific technological processes. It is also necessary to analyze the state of equipment for release reduction and the plant filter capacity. The emission factors that are determined on the basis of the actual measurements of by-product emissions to the environment, measurement of emission levels of stationary and mobile sources, as well as contaminated locations, should be used in estimating by-product releases to the environment.

The identification of specific substances and products that are contaminated or are a potential source of POPs chemicals listed in Annex C should be also included in the inventory. In addition, it is necessary to identify all locations contaminated by POPs chemicals listed in Annex C of the Stockholm Convention. The time scheduled for measure implementation is 3 years.

**Draft a strategy for a gradual phasing out of substances and products contaminated by or which may generate POPs chemicals, treatment and ultimate disposal of POPs-contaminated waste and remediation of sites contaminated by POPs chemicals listed in Annex C**

The strategy must be in accordance with the Stockholm Convention requirements, requirements of other international conventions and undertaken commitments, it must take into consideration a process of approaching the EU, and it must meet requirements of national strategies and plans.

The strategy must be in conformity with waste treatment measures and plans under national strategies, including present-day and ecologically sound methods and technologies for waste disposal, as well as the remediation of sites contaminated by POPs chemicals listed in Annex C of the Stockholm Convention.

In drafting the strategy, all interest groups should be involved, short-term and long-term priorities should be set, and all interested parties should be enabled to participate in monitoring, reviewing and expanding the proposed objectives and measures.

The strategy should promote a principle of partnership and shared responsibility with a view to attain the ultimate objective of reducing/eliminating by-product releases to the environment. A period of two years is planned for drafting the strategy.

**Review the existing and adopt new regulations in connection with limit values of POPs as listed in Annex C in food and the environment.**

It is necessary to review the existing and adopt new regulations in connection with limit values of POPs as listed in Annex C in food and the environment, Croatian regulations should harmonize with the EU regulations and international treaties. Estimated time period for measure implementation is 2 years.

The following text gives a short overview of the existing Croatian legislation referring to POPs compounds in Annex C of the Stockholm Convention, proposals for reviews and amendments, as well as some examples from the European countries (restrictions and recommendations) concerning the maximum permitted concentrations of PCDD/PCDF in food and specific segments of the environment.

**Food**

Law regulates the HCB and PCB maximum permitted levels in the Republic of Croatia: *The Rules on Amounts of Pesticides, Toxins, Mycotoxins, Metals, Histamines and Similar Substances that May Occur in Food, and Other Requirements Concerning the Health-sound Food and Articles for General Use, National Gazette 46/94; Rules on Amendments to the The Rules on Amounts of Pesticides, Toxins, Mycotoxins, Metals, Histamines and Similar Substances that May Occur in Food, and Other Requirements Concerning the Health-sound Food and Articles for General Use, National Gazette 45/98 and 11/01,* but it does not regulate those for PCDD/PCDF.

The existing regulations concerning HCB and d PCB should be reviewed and adjusted with those of the European Union, and new regulations concerning the PCDD/PCDF maximum permitted levels in food should be adopted. Some countries have drafted regulations and recommendations concerning the PCDD/PCDF concentrations in milk. (Table 56)

Table 56. PCDD/PCDF in milk and products (concentration in pg I-TEQ $kg^{-1}$ of milk fat) – maximum values and recommendations

| Country | Concentration (pg I-TEQ/kg of milk fat) | Comments/ Recommendation |
|---|---|---|
| Germany | < 0.9<br>> 3.0<br>5.0 | - targeted concentration<br>- recommendation not to put on the market<br>- maximum concentration |
| Ireland | 5.0 | - maximum concentration |
| Netherlands | 6.0 | - maximum concentration |
| Great Britain | 0.7<br>16.6 | - milk and products with < 2% of milk fat<br>- maximum concentration |

## Water

The following regulations prescribe the PCDD/PCDF, HCB and PCB maximum permitted concentrations in Croatia:

- By-law on Water Classification (Official Gazette 77/98),
- By-law on Hazardous Substances in Water (Official Gazette 78/98),
- Rules on Sanitary Propriety of Drinking Water (Official Gazette 46/94)
- Rules on Indicator Limit Values of Hazardous and Other Substances in Waste Waters (Official Gazette 40/98)

The following should be done:

- Harmonize the limit values of PCB mass concentrations ($\mu g/L^{-1}$) in specific types of water (*By-law on Water Classification, Official Gazette 77/98*) with those defined in the EU regulations, and fix the concentration limit values ($\mu g/L^{-1}$) of PCDD/PCDF and HCB in specific types of water;
- Harmonize By-law on Water Classification and By-law on Hazardous Substances in Water, in a section relating to the PCB maximum mass concentration in the land water category type II-V;
- Harmonize the PCDD/PCDF, HCB and PCB maximum permitted mass concentrations ($\mu g/L^{-1}$) in land waters types I-V and in sea (*By-law on Hazardous Substances in Water, Official Gazette 78/98*) with values defined in the EU regulations.
- Harmonize the health indicators of water used for public water supply (*Rules on Sanitary Propriety of Drinking Water Official Gazette 46/94*) in a section relating to PCDD/PCDF, PCB and HCB, with indicators defined in the EU legislation.
- Harmonize permitted mass concentrations of total organochlorine pesticides in technological waters (*Rules on Indicator Limit Values of Hazardous and Other Substances in Waste Waters, Official Gazette 40/99*) with values determined in the EU legislation, as well as define the permitted mass concentrations for PCDD/PCDF and PCB in industrial waste waters, which are discharged to natural receptacle, or public drainage system.

## Soil

*The Rules on Protection of Agricultural Soil against Contamination by Harmful Substances, National Gazette 15/92,* determine the maximum permitted values, expressed in $mg/kg^{-1}$ of dry substance, for 2,3,7,8 - tetrachlorodibenzo-p-dioxin, HCB and PCB in soil. The values stated in the Rules should be harmonized with those defined in the European Union regulations. Germany and Netherlands have made detailed recommendations concerning PCDD/PCDF concentration in soil. They are shown in table 57 as an example for consideration.

Table 57. PCDD/PCDF in soil (concentration in ng I-TEQ kg-1 of dry substance) – maximum values and recommendations

| Country | Concentration /ng I-TEQ $kg^{-1}$ of dry substance | Comments/ Recommendation |
|---|---|---|
| Germany | < 5.0 | - targeted concentration |
| | 5 - 40 | - production control on agricultural land |
| | > 100 | - soil remediation on children playgrounds |
| | > 1 000 | - soil remediation in housing zones |
| | > 10 000 | - soil remediation regardless of location and purpose |
| Netherlands | 1.0 | - agricultural land |
| | 10 | - pasture land |

Air

Limit values of pollutant emissions from stationary sources into air are regulated by

- By-law on Limit Values of Pollutant Emissions from Stationary Sources into Air, Official Gazette 140/97 and
- By-law on Modifications and Amendments to By-law on Limit Values of Pollutant Emissions from Stationary Sources into Air, Official Gazette 105/02.

Emission limit value for dioxins and furans of the waste gas generated in waste incinerators and in cement kilns involving waste co-incineration is 0.1ng/m $^{-3}$. The determined limit value is in conformity with the EU guideline (2000/76/EC) that relates to all types of waste incinerators and co-incinerators.

In the Republic of Croatia, the emission limit values for dioxins and furans for other industrial processes should be prescribed in accordance with the EU regulations. Several countries, members of the European Union, have prescribed limit values, i.e. for iron industrial processes and for some other industrial and technological processes.

It is necessary to introduce systematically the most important instrument for dioxin and furan emission reduction, and this is the implementation of IPPC Directive – Integrated Pollution Prevention and Control, the purpose of which is to reduce the environmental impact of the biggest industrial installations by reducing air, water and soil pollution, minimizing the waste they generate, and rational use of natural resources and energy.

As the significant PCDD/PCDF sources in Croatia are uncontrolled processes of burning (uncontrolled fires, uncontrolled waste and biomass burning) it is necessary to restrict these uncontrolled burning processes by law and to appoint a competent institution for prevention and control of uncontrolled burning processes.

**Adopt new regulations for reducing/eliminating the production and use of substances and products containing POPs chemicals listed in Annex C of the Stockholm Convention**

For the purpose of reducing/eliminating by-product releases to the environment, new regulations should be adopted for reduction/elimination of production and use of substances and products containing POPs chemicals listed in Annex C of the Stockholm Convention, defined in detailed POPs inventory (chapter 2.3). The scheduled time for measure implementation is one year.

**Introduce a programme for IPPC Directive implementation and application of best available techniques, which do not involve excessive costs, and are in accordance with the EU regulations (BAT and BEP principles).**

In making out a programme for applying BAT and BEP principles, it is necessary to include also BAT and BEP rules that will be accepted after the ratification of the Stockholm Convention. At the moment the UNEP document *Best available techniques (BAT) and best environmental practices (BEP) for reducing and/or eliminating emission of POPs by products* is available.

The time scheduled for implementation of this measure is two years.

**Develop and apply a stricter surveillance system over implementation of regulations concerning POPs chemicals listed in Annex C**

Surveillance over implementation of regulations is possible only when an efficient inspection system is developed. For a more effective surveillance over implementation of regulations concerning POPs chemicals listed in Annex C, the inspection system should be improved. The time scheduled for the implementation of this measure is four years.

**Fees for import, production and/or use of specific materials or substances that are a potential source of POPs compounds listed in Annex C of the Stockholm Convention**

In introducing fees for import, production and/or use of specific materials and substances that are a potential source of POPs compounds listed in Annex C the following measures are proposed:

**Introduce fees for import, production and/or use of specific materials or substances representing a potential source of POPs compounds listed in Annex C of the Stockholm Convention**

Pursuant to the Stockholm Convention requirements and in accordance with the EU policy, which clearly defines the application of economical instruments as a best way for the integration of economic and ecological aspects in the economic development, the introduction of fee for import, production and/or use of specific materials and substances that are a potential source of POPs compounds listed in Annex C is required. They are defined in detailed POPs inventory as well as other specific substances and products polluted by or representing a potential source of POPs compounds listed in Annex C.

The competent body for collecting and managing these fees is the Fund for Environmental Protection and Energy Efficiency, established in 2003.

When introducing an economic instrument, it is essential to define clearly the targets, include all interest groups, and analyze the instrument effect and stimulus to the economy. The fixing of a fee amount is a very delicate question and it depends on the objective significance, set deadlines and the overall economic situation. The time scheduled for making out this measure is one year.

**Inform all interest groups on introduction of fees and their possible financing through the Fund**

It is essential that all interest groups are informed in due time about the fee introduction and of a financing possibility through the Fund. The time scheduled for measure implementation is one year.

**Agreements on a voluntary basis with companies and other industrial groups**

One of the basic principles of the environmental protection policy, in accordance with the environmental protection policy of the European Union and requirements ensuing from the Stockholm Convention, is the achievement of partnership between economic development and the environmental standards. However, partnership approach demands reaching mutual agreements with companies or industrial groups with the aim of reducing and/or eliminating by-product emissions to the environment.

It is necessary, through special agreements and incentives, to initiate investment in the environmental protection, the introduction of cleaner and sustainable technologies and application of BAT and BEP principles

In this connection a body competent for the Stockholm Convention implementation should initiate agreements with companies and industrial groups by way of the following measures:

- identify potential companies or industrial groups within a period of 3 years,
- make out a framework draft for agreements on a voluntary basis within a period of 1 year,
- initiate negotiations and agreeing to mutual commitments within a period of 3 years,
- monitor negotiations and agreement implementation.

The time scheduled for a measure implementation is 3 years.

**Reporting and informing the public**

For a successful implementation of the Action Plan, the education, reporting and informing the public and interest groups is of utmost importance. The objective is to enable a simple and timely access to information and to initiate and enable participation in decision-making process. The mechanisms for information exchange should be developed as well as prepare education and training programmes.

The activity programme should include:

- Development of education and training programmes for implementation of Action Plan (within 2 years);
- Drafting of guidelines and carrying out progress evaluation of the plan implementation, and reporting in accordance with the Stockholm Convention requirements (continuously);
- Provide information on the Action Plan implementation available to the public and all the interested parties (continuously).

**Gradual phasing out of POPs-contaminated substances and products or those which may generate POPs chemicals, treatment and ultimate disposal of POPs contaminated waste and recovery of locations contaminated with POPs chemicals listed in Annex C**

According to the Stockholm Convention requirements the following should be done:

- Elaborate in detail objectives, including implementation procedures provided in the Strategy, for gradual phasing out of substances and products contaminated with or those which may generate POPs compounds listed in Annex C;
- Elaborate implementation procedures for treatment and ultimate disposal of POPs-contaminated waste listed in Annex C of the Stockholm Convention;
- Elaborate in detail objectives and implementation procedures for recovery of locations contaminated with POPs compounds listed in Annex C of the Stockholm Convention.

The estimated time necessary for implementation of measures is 5 years.

Table 58. Time schedule of the Action Plan implementation

| | DURATION | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ACTIVITIES | IMPLEMENTATION TIME (YEARS) | | | | | | | | | | | | | | | | | | | | | | | |
| | | Short-term | | | | | Medium-term | | | | | | | | | | | | | | | | | | |
| | End of the main activities | 1. | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 1 | **Coordination of Action Plan implementation for POPs** | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.1 | Designate a body responsible for Action Plan implementation | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2 | Assess the needs and determine the conditions for operation of the body responsible for the Action Plan implementation | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.3 | Identify and prepare interest groups for the Action Plan implementation | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.4 | Determine and facilitate operation of the Committee for monitoring the Action Plan implementation | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.5 | Develop a work plan and a cost estimate for the Action Plan implementation | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.6 | Organize workshops for evaluation of Action Plan implementation | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.7 | Reporting and, where appropriate, updating the Action Plan | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | **Legal provisions/measures, instructions and procedures** | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.1 | Pass new regulation for compulsory monitoring of levels and reporting on releases of Annex C by-products to the environment | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2 | Develop instructions and procedures for compiling an inventory of POPs listed in Annex C | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.3 | Develop a detail inventory of POPs listed in Annex C to the Stockholm Convention | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4 | Develop a Strategy for phasing out the substances and products contaminated by POPs or being possible sources of POPs, handling and ultimate disposal of waste contaminated by POPs listed in Annex C, and remediation of sites contaminated by POPs listed in Annex C | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.5 | Revise current and pass new regulations for limit values of Annex C POPs in food and in the environment | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.6 | Pass new regulations for reduction and/or phasing out the production and use of substances and products containing POPs listed in Annex C to the Stockholm Convention | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.7 | Develop a program for implementation of IPPC Directive and application of the best available technologies not involving too high investment and in line with the EU regulations (BAT and BEP principles) | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.8 | Develop and apply a more stringent system of supervision of implementation of legal provisions for POPs listed in Annex C | | | | | | | | | | | | | | | | | | | | | | | | |

| | DURATION | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ACTIVITIES | IMPLEMENTATION TIME (YEARS) | | | | | | | | | | | | | | | | | | | | | | | |
| | | Short-term | | | | | Medium-term | | | | | Long-term | | | | | | | | | | | | | |
| | End of main activities | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 3 | **Fees on import, production and/or use of specific materials or substances being a potential source of POPs listed in Annex C** | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.1 | Introduce fees on import, production and/or use of specific materials or substances being potential source of POPs listed in Annex C to the Stockholm Convention | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.2 | Inform all interest groups about introduction of fees and financing possibilities by the Fund | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | **Voluntary agreements with companies or industrial groups** | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.1 | Identify potential companies or industrial groups | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.2 | Develop a form for voluntary agreements | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.3 | Start the negotiations and contracting of mutual obligations | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.4 | Monitor implementation of agreements | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | **Reporting and public information** | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.1 | Develop educational programs and organise training for implementation of the Action Plan | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.2 | Develop instructions and evaluate the implementation plan progress, and report in line with the Stockholm Convention | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.3 | Provide information to the public and to all interested parties about the Action Plan implementation | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | **Phasing out the substances and products contaminated by POPs or being possible source of POPs, and disposal of waste contaminated by POPs listed in Annex C** | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.1 | Detail the objectives, including implementation procedures set in the Strategy for phasing out the substances and products contaminated by POPs or being possible source of POPs listed in Annex C | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.2 | Elaborate implementation procedures for handling and ultimate disposal of waste contaminated by POPs listed in Annex C to the Stockholm Convention | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3 | Detail the objectives and implementation procedures for remediation of sites contaminated by POPs listed in Annex C to the Stockholm Convention | | | | | | | | | | | | | | | | | | | | | | | | |

### 3.3.7.3 *Cost estimate of the Action Plan implementation*

It is very difficult to evaluate the total financing cost of the Action Plan implementation, because of lack of exact data about costs, exact investment projects to be carried out are not determined, and the whole plan is an on-going process in which new projects will be included. This will definitely have effects to the total costs of the Action Plan implementation. In addition, there is no cost estimate available for harmonization of Croatia's and the EU legislation.

Table 59 shows approximate distribution costs pursuant to particular activities and roughly estimated total amount of financing costs concerning the Action Plan implementation.

Table 59. Approximate cost estimate of the Action Plan implementation

| Activities | Cost estimate (USD) |
|---|---|
| **1 Coordination of Action Plan implementation** | |
| *Total* | *667 000* |
| **2. *Legal requirements, instructions and procedures*** | |
| Adopt a new regulation on compulsory level monitoring & reporting on by-product emissions listed in Annex C to the environment | 16 700 |
| Prepare instructions and procedures for making inventory of POPs compounds listed in Annex C | 8 300 |
| Make a detailed inventory of POPs compounds listed in Annex C | 66 700 |
| Draft a strategy for gradual phasing out of POPs-contaminated substances and products or of those which may generate POPs chemicals, treatment and ultimate disposal of POPs contaminated waste and recovery of locations contaminated with POPs chemicals listed in Annex C | 33 300 |
| Review the existing and adopt new regulations concerning limit values of POPs compounds listed in Annex C in food and in the environment | 33 300 |
| Adopt new regulations for reducing/eliminating the production and use of substances and products containing POPs listed in Annex C of the Stockholm Convention | 33 300 |
| Introduce a programme for IPPC Directive implementation and application of best available techniques, which do not involve excessive costs in accordance with the EU regulations (BAT and BEP principles) | 167 000 |
| Develop and apply a stricter surveillance system over implementation of regulations concerning POPs chemicals listed in Annex C | 33 300 |
| *Total* | *391 900* |

| | |
|---|---|
| **3 Fees for import, production and/or use of specific materials and substances that are a potential source of POPs compounds listed in Annex C** | |
| Introduce fees for import, production and/or use of specific materials and substances that are a potential source of POPs compounds listed in Annex C | 33 300 |
| Inform all interest groups on fee introduction and its possible financing through the Fund | 16 700 |
| *Total* | *50 000* |
| **4 Agreements on a voluntary basis with companies and industrial groups** | |
| Identify potential companies and industrial groups | 25 000 |
| Make out a framework draft for agreements on a voluntary basis | 8 300 |
| Initiate negotiations and agreeing to mutual commitments | 50 000 |
| Monitor agreement implementation | 25 000 |
| *Total* | *108 300* |
| **5 Reporting and informing the public** | |
| Develop the education and training programmes for implementation of Action Plan | 66 700 |
| Draft guidelines and carry out progress evaluation of the plan implementation, and report in accordance with the Stockholm Convention requirements | 216 700 |
| Make information on the Action Plan implementation available to public and all interested parties | 83 300 |
| *Total* | *366 700* |
| **6 Gradual phasing out of POPs-contaminated substances and products or those which may generate POPs chemicals, treatment and ultimate disposal of POPs contaminated waste** | |
| Elaborate in detail objectives, including implementation procedures provided in the Strategy, for gradual phasing out of substances and products contaminated with or those which may generate POPs compounds listed in Annex C | 25 000 |
| Elaborate implementation procedures for treatment and ultimate disposal of POPs-contaminated waste listed in Annex C of the Stockholm Convention | 25 000 |
| Elaborate in detail objectives and implementation procedures for recovery of locations contaminated with POPs compounds listed in Annex C of the Stockholm Convention | 25 000 |
| *Total* | *75 000* |
| | |
| **Total cost of Action Plan** | **1 658 900** |

### 3.3.8 Activity: measures to reduce release from stockpiles and wastes

Inventory has determined only PCBs stockpiles and waste. Namely, some PCB equipment which is kept as back up, some stockpiles of liquid PCBs, PCB equipment which is out of function and some liquid and solid PCBs waste *(please refer to chapter 2.3.2.6 for exact data)*. This identified stockpiles and waste are within the owner's facilities and are controlled by the state authorities.

Needed activities to prevent and reduce releases from some in the future identified stockpiles and waste are elaborated in the following chapter.

### 3.3.9 Strategy: identification of stockpiles, articles in use and wastes

#### 3.3.9.1 Strategic goals and priorities

During inventory of POPs compounds the following has been established:

- there is no major stockpile of POPs pesticides, articles in use with POPs pesticides or POPs pesticides waste;
- there are stockpiles of PCB equipment, minor stockpiles of liquid and the equipment with PCBs that is not in use and represents waste;
- the inventory has not identified any use of PCBs in the open systems;
- the inventory has not identified the existence of the products, of the articles in use or waste that is contaminated or contains the compounds from Annex C.

During implementation of the proposed measures it should be taken into account that the inventory results of POPs pesticides do not show any existence of POPs pesticides, stockpile, objects or waste. This arises from the fact that in Croatia there has never been any synthesis of POPs pesticides. In addition, at the time of their use, due to scarcity of foreign currency it was possible to import only the quantities that covered annual needs, whereas the new ones were purchased only when the existing stockpiles were emptied.

#### 3.3.9.2 Proposed measures for identification of major stockpiles, article in use and waste

This section states legal and technical measures to be brought for identification of POPs stockpiles, articles in use and waste.

**Promulgation of new and adjustment of the existing legal regulations for identification of major stockpiles, articles in use and waste**

According to the Stockholm Convention, a decision must be made about designing of the national strategy for:

- identification of the stockpiles containing POPs compounds from Annex A and B, and
- identification of the products, articles in use and waste which comprise or contain POPs compounds, or which are contaminated with the chemicals from Annex A, B and C of the Convention.

The strategy should be used for identification of the stockpiles with the compounds from Annex A and B, and ensure safe, efficient and environmentally sound management of these stockpiles.

Keeping and management of stockpiles of the compounds from Annex A and B should be allowed only if they are exported for environmentally sound disposal.

When promulgating the regulations regarding strategy it is necessary to:

- prepare the instructions and directives for identification of the stockpiles containing or contaminated with the compounds from Annex A and B, and
- prepare the instructions and directives for identification of waste, articles in use and products containing or contaminated with the compounds from Annex A, B and C.

**Technical measures for implementation of the strategy**

Technical and implementation measures that would ensure application and implementation of the instructions and directives must have reference to the following activities:

1) Measures for identification of the stockpiles containing or contaminated with the compounds from Annex A and B:

- identification and quantification of the stockpiles
- labelling of the stockpiles
- development of more comprehensive inventory
- protection of identified stockpiles to prevent releases
- construction of temporary storage
- collection and transport of the stockpiles to the constructed temporary storage, and
- export of the stockpiles for treatment and final disposal.

2) Measures for identification and proper handling and disposal of waste, articles in use and products containing or contaminated with the compounds from Annex A, B and C:

- preparation of questionnaires for collecting information
- identification of waste, articles in use and products
- protection of identified waste to prevent releases
- development of more comprehensive inventory
- substitute the identified products and articles in use and
- final disposal of articles in use.

### 3.3.9.3 Implementation of the Strategy

Strategy would be implemented in three phases:

- Coordination of the Action Plan implementation;
- Harmonization of legal regulations and development of technical instructions/procedures and
- Identification of the major stockpiles, articles in use and their proper management

For the successful implementation of the Strategy nominated implementation body should ensure cooperation on country level between local authorities. Some multi stakeholder body will also be

founded. Multi stakeholder body would hold meeting once per year to evaluate progress and success of the action plan implementation. Based on the performance action plan would be amended (if necessary) every two years.

Second phase (development of legislation, procedures and guidelines for identification of major stockpiles, article in use and waste) would last one year.

These guidelines would also include the part about how to manage stockpiles and how to handle and dispose articles in use.

Final phase (seven years) would include building of the temporary storage for collection of the identified stockpiles, waste and articles in use which would be replaced. (For this purpose temporary PCBs storage can be also used as predicted in the chapter 3.3.4). And the last activity within this phase would be the identification of stockpiles and articles in use. After stockpiles and articles in use would be identified, they should be managed in the safe way to protect the environment and humans.

Table 60 shows timetable for the implementation of the Strategy.

Table 60. Timetable for the implementation of the Strategy

| | Activities | Years of implementation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Main activities | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | **Coordination and organization of the Strategy implementation** | | | | | | | | | |
| 1.1 | Appointment of the implementation body | ■ | | | | | | | | |
| 1.2 | Assessment of the needs of the implementation body | ■ | | | | | | | | |
| 1.3 | Identification of stakeholders | ■ | | | | | | | | |
| 1.4 | Appointment of the Multi stakeholder body | ■ | | | | | | | | |
| 1.5 | Evaluation of the Strategy | | | | ■ | | ■ | | ■ | |
| 1.6 | Workshops for evaluation of implementation | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 2 | **Harmonization of legal procedures, development of technical instruction** | | | | | | | | | |
| 2.1 | New regulations regarding identification of the stockpiles, waste and articles in use | | ■ | | | | | | | |
| 2.2 | New regulations regarding managing stockpiles and handling and disposal of articles in use | | ■ | | | | | | | |
| 2.3 | Development of technical instructions and guidelines | | ■ | | | | | | | |
| 3 | **Identification of the stockpiles, articles in use and their proper management** | | | | | | | | | |
| 3.1 | Building the temporary storage | | | ■ | ■ | ■ | | | | |
| 3.2 | Identification of the stockpiles, articles in use | | | | ■ | ■ | ■ | ■ | ■ | ■ |
| 3.3 | Replacing and disposal of articles in use | | | | ■ | ■ | ■ | ■ | ■ | ■ |

### 3.3.9.4 Cost assessment for strategy implementation

Table 61 shows the assessment of financial costs for strategy implementation.

Table 61. Assessment of financial cost for strategy implementation

| Activity | Unit | Number | Unit price (USD) | Total (USD) |
|---|---|---|---|---|
| **1. Coordination of the implementation** | | | | |
| Project coordinator | years | 9 | 24 000 | 216 000 |
| Travelling (local and foreign experts) | person | 30 | 40 | 1 200 |
| Workshops | | 3 | 2500 | 7 500 |
| Equipment (computers and software) | | 1 | 5 000 | 5 000 |
| ***Total phase 1*** | | | | ***229 700*** |
| **2. Harmonization of legal procedures and development of technical instruction** | | | | |
| New regulations regarding identification of the stockpiles, waste and articles in use | month | 3 | 2 000 | 6 000 |
| New regulations regarding managing stockpiles and handling and disposal of articles in use | month | 3 | 2 000 | 6 000 |
| Development of technical instructions and guidelines | month | 6 | 2 000 | 12 000 |
| ***Total phase 2*** | | | | ***24 000*** |
| **3. Identification of the stockpiles, articles in use and their proper management** | | | | |
| Identification of the stockpiles, articles in use | years | 6 | 10 000 | 60 000 |
| Replacing and disposal of articles in use | years | 6 | 10 000 | 60 000 |
| ***Total phase 3*** | | | | ***120 000*** |
| | | | | |
| **Total cost of the Action Plan** | | | | ***373 700*** |

### 3.3.10 Activity: manage stockpiles and appropriate measures for handling and disposal of articles in use

All activities needed for managing of identified stockpiles of POPs and for proper handling and disposal of articles in use are presented in previous chapter. Cost estimation for this activity is also included in the previous chapter.

### 3.3.11 Strategy: Identification of contaminated sites (Annex A,B and C Chemicals) and remediation in an environmentally sound manner

#### 3.3.11.1 Action Plan objectives and priorities

Given the fact that the inventory has not unambiguously identified the sites contaminated with POPs compounds, but has rather preliminary identified potentially contaminated ones, this Action Plan will state the activities and measures necessary for development of the national strategy for unambiguous identification of POPs-contaminated sites, contamination scope and potential environmentally sound remediation. It will, further, indicate which part of legislation needs reconciliation or where new regulations are necessary, so as to ensure promulgation and implementation of the national strategy and technical measures for timely implementation, as well as costs assessment for implementation of this Action Plan.

#### 3.3.11.2 Preliminary identification of the sites contaminated with POPs compounds

**Sites contaminated with POPs pesticides**

The inventory of POPs compounds, based on the available data, has not identified any site contaminated with POPs pesticides. However, given the fact that POPs pesticides were used in mixtures, imported and exported, further systematic investigations are required of the country areas where they had been used intensively, so as to unambiguously identify their possible contamination. These studies should be carried out in Osijek-Baranja, Vukovar-Srijem and Bjelovar-Bilogora counties.

**Sites contaminated with PCBs**

With regard to former and current equipment with PCBs in Croatia (transformers and capacitors) and recent war (1991-1995) that caused considerable destructions and shelling of power plants, there was a post-war preliminary identification of the sites potentially contaminated with PCBs. Inspection of these sites revealed presence of PCB compounds in the soil and air. These studies and inventory of POPs compounds identified three sites at the coastal part **(Zadar, Rijeka Dubrovačka and Bilice nearby Šibenik)** which require further investigations, so as to unambiguously determine their real status and a degree of potential contamination.

**Sites contaminated with PCDD/PCDF**

Additional investigations are required to determine potentially contaminated sites with PCDD/PCDF because such data are lacking. Attention must be paid to the sites nearby potential sources of PCDD/PCDF environmental emissions and of those where preliminary studies revealed presence of PCBs in soil, because there might be some quantities of PCDF.

### 3.3.11.3 Proposed measures for identification of contaminated sites and their possible remediation

These section states legal and technical measures to be brought for a definite identification of the sites contaminated with POPs compounds, and their possible remediation.

**Promulgation of new and harmonization of the existing legal regulations for identification and remediation of the sites contaminated with POPs compounds**

According to the Stockholm Convention the government must decide on adopting of the national strategy for identification and remediation of the sites contaminated with POPs compounds.

When developing the strategy the laws and by-laws (regulations and instructions) have to be promulgated or adjusted to define all steps and procedures for a successful harmonization of the strategy.

Given compulsory maintenance of register of environmental emissions (Law on Environmental Protection, Official Gazette No. 82/94 and 128/99) either the Law on Environmental Protection or a new act (e.g. Law on the Protection of Soil from Pollution) should explicitly set the obligation to keep register of the sites contaminated with POPs compounds. As regards identification of responsibilities for environmental pollution, existing Law on Environmental Protection ensures exercising of the "polluter pays" principle.

Setting up of the institution responsible for management and surveillance of the register as well as for financial sources should be integrated within the regulation setting obligation to make environmental pollution register. This register could serve as a model for management of the overall national register of polluted sites.

Also, limit values of the pollutants in soil for various purposes should be set. A new regulation is required to impose compulsory application of environmentally sound remediation practices in the contaminated sites.

**Technical measures for the establishment and management of the register and for remediation of contaminated sites**

Once the establishment of the register of soil contamination is defined as legal obligation, the next is to specify technical measures and procedures for its design and maintenance with regard to the sites contamination with POPs compounds.

In addition, the procedures or instructions for identification of such sites and for the assessment of their contamination level have to be developed on the technical level (remediation priority list and timelines). These procedures and instruction must contain the assessment of contaminated sites with regard to their human and environmental impact, as well as the assessment of their remediation costs.

Besides, the ways of proper treatment of contaminated but not remediated sites must be specified so as to prevent their potential environmental impact.

When priority list of the sites to be remediated is made, the instructions and procedures have to be developed for their environmentally sound remediation.

Remediation surveillance/monitoring of contaminated sites must be scheduled, relevant to every individual case.

### 3.3.11.4 Implementation of the Action Plan

Action Plan would be implemented in three phases:

- Coordination of the Action Plan implementation;
- Harmonization of legal regulations, and
- Identification of the sites contaminated with POPs.

Successful implementation of the Action Plan requires implementation body that should ensure cooperation between local and self-government administration (counties, cities and municipalities). It is also preferable to have a supervising body (Commission) comprising the representatives of all stakeholders. This body would ensure participation of all stakeholders, because the success of the Action Plan depends on joint coordination and implementation of the Action Plan on the national, administrative and social levels. This supervising body would assemble once yearly to evaluate progress of the Plan. Based on its performance the plan would be amended every three years, if necessary.

At the initial stage, implementation timelines and performance procedures with their frequency monitoring would be identified and approved. The first, organizational phase would take 1 year.

Harmonization of all legal regulations and development of all aforementioned regulations and instructions should take 1 year. After that, field identification of the sites contaminated with POPs compounds would start, relevant to the results of these activities, priorities and remediation. These actions should take 5 years. The register of contaminated sites would be established and updated together with the above-mentioned activities.

Table 62 shows timelines for implementation of the Action Plan.

### 3.3.11.5 Requirements in capital investments

Major investments would go for upgrading laboratories' technical capacities (equipment and professional staff), to ensure the most efficient and rapid identification of the potentially contaminated sites, and for remediation of the contaminated sites.

Table 62. Timelines for implementation of the Action Plan

| | Activities | YEARS OF IMPLEMENTATION | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Short-term | | | | Mid-term | | | | | | Long-term | | | | | | | | | | | | | |
| | Main activities | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 1 | **Coordination and organization of the Action Plan implementation** | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.1 | Appointment of the implementation body | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2 | Assessment of the needs of the implementation body | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.3 | Identification of stakeholders | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.4 | Appointment of the Commission | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.5 | Identification of the Action Plan and budget | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.6 | Evaluation of the Action Plan | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.7 | Workshops for evaluation of implementation | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | **Harmonization of legal procedures** | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.1 | New regulations regarding establishment of the cadastre of contaminated sites | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2 | New regulations regarding environmentally sound remediation of contaminated sites | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.3 | Identification of the institution to manage the cadastre and to be responsible for implementation | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4 | Building up of institutional capacities | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | **Identification of the sites contaminated with POPs** | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.1 | Development of the directives and instructions for identification and assessment of contaminated sites | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.2 | Identification and assessment of contaminated sites | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.3 | Management of the cadastre of contaminated sites | | | | | | | | | | | | | | | | | | | | | | | | |

### 3.3.11.6 Cost assessment for Action Plan implementation

Table 63 shows the assessment of financial costs for strategy implementation.

Table 63. Cost assessment for Action Plan implementation

| Activity | Unit | Number | Unit price (USD) | Total (USD) |
|---|---|---|---|---|
| **1. Coordination of the Action Plan implementation** | | | | |
| Project coordinator | month | 60 | 2 000 | 120 000 |
| Travelling (local and foreign experts) | person | 30 | 40 | 1 200 |
| workshops (materials, organization and premises) | | 5 | 2500 | 12 500 |
| Equipment (computers and software) | | 1 | 5 000 | 5 000 |
| ***Total phase 1*** | | | | ***138 700*** |
| **2. Updating of effective legislation** | | | | |
| Development of regulations regarding setting up of the register of contaminated locations | month | 2 | 2 000 | 4 000 |
| Development of regulations regarding environmentally sound remediation of contaminated locations | month | 2 | 2 000 | 4 000 |
| ***Total phase 2*** | | | | ***8 000*** |
| **3. Development of directives and identification of contaminated sites** | | | | |
| Development of directives for identification and assessment of contaminated location/two experts | month | 12 | 2 500 | 30 000 |
| Identification and assessment of contaminated location/two experts | month | 36 | 2 000 | 72 000 |
| Maintenance of the register of contaminated location/one expert | year | 10 | 2 000 | 20 000 |
| ***Total phase 3*** | | | | ***122 000*** |
| | | | | |
| **Total cost of the Action Plan** | | | | ***268 700*** |

### 3.3.12 Activity: facilitating or undertaking information exchange and stakeholder involvement

#### 3.3.12.1 Strategic goals and priorities

The main strategic goal of information exchange is to enable exchange of information about production, use and release of POPs compounds and their alternatives, including information about their harmful properties and financial and social costs that they might generate. The Convention parties can exchange this information in direct contact or through the Convention Secretariat.

To achieve this goal, a national focal point must be appointed to act as the liaison between the Convention and all local stakeholders i.e. that will take part in the information exchange on the international and local levels.

It is important to point out that the exchanged information about human health and safety and about environmental impact will not be treated as confidential for Convention purposes. As for other information, the parties shall agree about their confidentiality.

#### 3.3.12.2 Guidelines of the information exchange policy

Strategy of information exchange will be based on:

- international information exchange, and
- national information exchange.

International information exchange comprises information exchange between the Convention parties and international organizations and forums. Information exchange on the national level is timely and accurate exchange of information between all stakeholders in POPs issues (ministries, agencies, NGOs, professional associations, etc.).

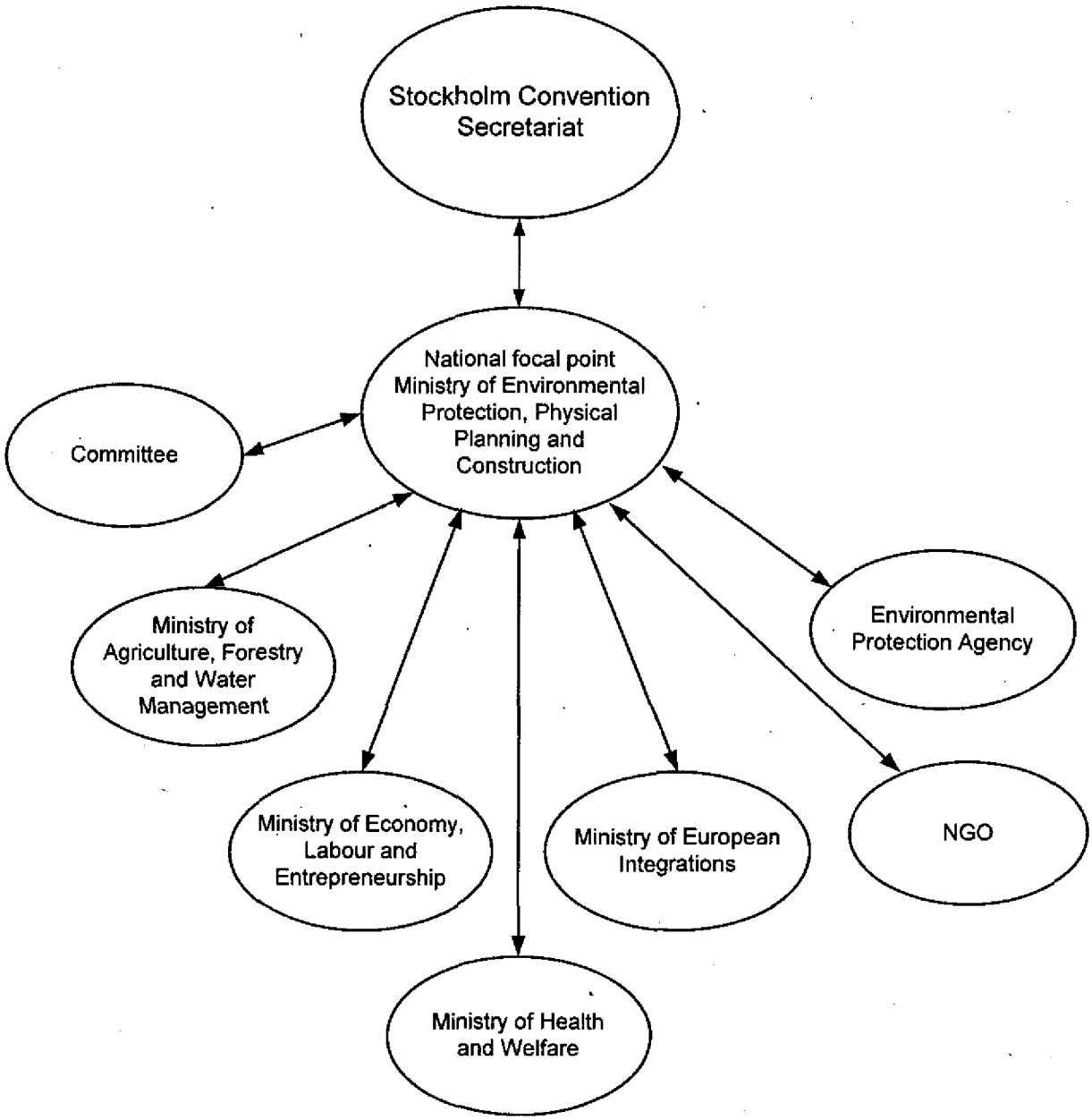
#### 3.3.12.3 Organization of the national focal point for information exchange

Focal point of the Stockholm convention is the competent ministry in charge for environmental protection. It would play the role of the focal point for information exchange and would be responsible for implementing this programme, for administrative affairs and technical support.

Also, it is a central body through which all stakeholders are provided with information. In addition to providing the information from the competent Croatian institutions, processing them and passing over to the Conference Secretariat, it would circulate them there from to all competent Croatian institutions (see the communication scheme in Figure 6).

Given very many stakeholders *(Ministry of Agriculture, Forestry and Water Management, Ministry of the Economy, Labour and Entrepreneurship, Ministry of Health and Welfare, Ministry for European Integrations, Environmental Protection Agency, etc.)* the plan is to set up a Commission of the representatives of the competent Ministries and other organizations and institutions. Its function would be consultancy and surveillance, support in information exchange and interconnection of institutions and stakeholders. Every competent institution would appoint a person responsible for communication with the focal point.

Figure 6. Communication scheme



### 3.3.13 Activity: public awareness, information and education

#### 3.3.13.1 Goals and priorities in education, awareness rising and public information

Action Plan for education, awareness rising and public information is aimed to describe and define the information programme and public education about persistent organic pollutants in compliance with the Stockholm Convention, in order to increase public awareness. All programmes must be oriented towards the selected target groups so that they become competent for proper handling of persistent organic pollutants and thus increasing public awareness about them. Final goal is to include the public into decision-making about the issues related to the use and gradual elimination of production and use of persistent organic pollutants, prevention of their environmental release and ensurance of disposal and treatment of POPs waste in environmentally sound manner.

Priority proposals of the Action Plan are to:

- propose optimal, feasible and predictable programmes for education and public information;
- define the body that shall coordinate and implement the adopted programmes;
- identify target groups for which educational and information programmes are intended, and
- channelling the information.

Before the programmes are defined their respective target groups must be identified. If the public is viewed as a group of people with different interests and level of knowledge about POPs compounds, the same educational programmes cannot be equally applied to everyone. Therefore, specific target groups must be selected, namely:

- representatives of the competent institutions;
- professional public;
- technical and managing staff of the companies using POPs compounds;
- workers;
- women and children;
- teaching staff and pupils;
- media representatives, and
- representatives of non-governmental organizations (civil sector).

Table 64. shows the respective programmes and target groups.

Shortcomings and possible restrictions in implementation of the Action Plan can be in the first place low level of knowledge about persistent organic pollutants, absence of awareness about the threats to human health and human and environmental safety, diversities between the target groups and limited funds.

Table 64. Programmes and target groups:

| | Representatives of competent institutions | Expert public | Technical and managing staff | Workers | Women and children | Teachers and pupils | Media representatives | NGO representatives |
|---|---|---|---|---|---|---|---|---|
| Publications | √ | √ | | | | √ | √ | √ |
| Instructions and guidelines | | | √ | √ | | | | |
| Posters and prospectuses | | | | | √ | √ | √ | √ |
| Seminars, professional lectures | | √ | √ | | √ | | √ | √ |
| Courses | | | | √ | | | | |
| Quizzes and contests | | | | | | √ | | |
| Informative centre | √ | √ | | | √ | √ | √ | √ |
| Exhibitions | √ | √ | | | √ | √ | √ | √ |

### 3.3.13.2 Basic guidelines for education, information and increase of public awareness

Strategy for public information, education and increasing of its awareness is based on the following:

- Access to information

  *According to the Stockholm Convention all signatory parties, in particular the groups at risk, have free access to all data and information regarding persistent organic pollutants. All information must be accurate, timely and updated.*

- Determine an institution responsible for implementation of the programmes for education and increase of public awareness

  *Success of the programmes for education and increase of public awareness requires identification of responsibility for their implementation. A decision as to whether it is the National focal point or the National centre for information exchange is the concern of the signatory party. Without that the Programmes can be neither implemented not carried out.*

- Development and implementation of the programmes for education and increase of the awareness in all target groups

  *Individual programmes for education and increase of public awareness must be designed for every identified target group.*

Possible difficulties and restrictions in implementation of the strategy for informing and increase of public awareness might appear primarily during selection of the programme for every target group. Absence of technical equipping, availability of necessary funds and absence of the management support in business entities may be the limiting factor in implementation of the Action Plan.

### 3.3.13.3 Planned programmes for informing, increase of public awareness and education

Below are some examples of the programmes for informing, education and increase of public awareness about POPs compounds.

**Printed materials**

- Publications

  Publications should contain basic data about POPs compounds, their negative impact on human health and environment and prevention measures.

  To be comprehensible to as many readers as possible the publications must be designed by the experts in relevant fields as well as the sociologists and communication experts.

  Every edition will be published in 1 000 copies.

- Manuals for handling of persistent organic pollutants, equipment and waste containing the pollutants (identification, labelling, handling, transport and storage).

- Posters and prospectuses with simple colourful presentation of basic data about the types of persistent organic pollutants and safety measures.

**Seminars, expert lectures, round tables and courses**

For the exchange of knowledge and education it is proposed to organize regular seminars, expert lectures and round table discussions. These would create the opportunity for eminent experts to deliver to target groups, and in acceptable way, their knowledge about the use and handling of persistent organic pollutants and about the use of their substitutes. Courses at business entities for workers professionally exposed to the equipment with PCBs would be of particular importance. They will be organized in cooperation with and support of the managing and technical staff.

**Secondary schools contests and quizzes**

Organization, with teaching staff, of the Croatian secondary schools contests and quizzes about persistent organic pollutants are entertaining and popular ways of learning how to handle these substances. Awarding best pupils' works and pupils as well as encouraging pupils to stay in this area after graduating from the secondary school. They could also teach their parents and other family members about these issues.

**Exhibitions and setting up of an information centre**

As another possibility of public information are exhibitions and Information centres. According to the available information, except for the Ministry of Environmental Protection, Physical Planning and Construction there is no such centre. The purpose of such centre is to provide as much

information as possible under professional and expert support of its staff. The Centre requires only 1-2 rooms with 1-2 persons and an easily accessible site. It will hold the exhibition hall and a classroom style conference room (if possible).

***Exhibition hall***

The exhibits are changeable, comprising of:

- objects of original purpose (e.g. a part of the packaging material for pesticides, transformers, etc.);
- scale models of objects (power sub-stations, incinerators )
- photographs, paintings or other static visual presentation of the objects.

***Classroom style conference room***

This room can be in the same place with the exhibition, but preferably separated, so that it can be suitable for:

- lectures;
- meetings (round tables, debates, etc.), and
- workshops.

The capacity should be suited according to possibilities.

The seats should enable different seating arrangements, relevant to purpose (straight rows, rows arranged around a centre or workshop groups of 3-5 participants).

There should be audio visual equipment: projection screen, monitor, overhead projector, projector stand, flipchart, whiteboard, display board, video and monitor, seating furniture and a cabinet. Exhibition stands should be movable for the exhibitions to be held in other places too. People's universities with a long-standing tradition in informing and educating the public are suitable for this purpose.

### 3.3.13.4 Implementation costs and financing of the programme for education, increasing of awareness and public information

Cost estimate is given in the below Table 65.

Table 65. Cost estimate of programme implementation

| | Description of the programme | Cost (USD) |
|---|---|---|
| 1 | Publishing of 3 publications of 1000 copies each (text, printing and distribution) | 25 000 |
| 2 | Publishing of manuals (text, printing and distribution) | 16 700 |
| 3 | Design of posters and prospectuses | 16 700 |

| | | |
|---|---|---|
| 4 | Seminars, technical lectures, round tables, courses (lecturers, space, equipment, materials, min. 6 lectures per year) | 33 300 |
| 5 | Organization of quizzes and secondary schools contests (awards and materials) | 33 300 |
| 6 | Information centre (space, 2 employees, exhibits and equipment) | 93 300 |
| 7 | Movable exhibitions (space, transport, daily allowances) | 8 300 |
| **10** | **TOTAL** | **226 600** |

Note: expenditures under 4 and 7 are yearly, while the others are single in the whole implementation period of the Action Plan.

### 3.3.14 Activity: effectiveness evaluation

COP will at its first meeting decide about the mechanism of periodical effectiveness evaluation of the implementation of the Convention. After the COP determines the system of effectiveness evaluation this action plan will be elaborated.

In order to provide Conference of Parties with monitoring data of the presence of the chemicals listed in ANNEX A,B and C, and about their regional and global environmental transport, Ministry of the Environmental Protection, Physical Planning and Construction will serve as a contact body on national level between the country and the COP. These foreseen activities are in line with the strategy for information exchange.

### 3.3.15 Activity: reporting

The reporting system should be developed after the 1st Conference of the Parties identifies reporting modes and procedures to the Conference Secretariat. The system would comprise performance assessment mechanisms with regard to Convention provisions and the ways the reports should be written.

### 3.3.16 Activity: research, development and monitoring

#### 3.3.16.1 Objectives and priorities of the Action Plan for R&D and establishment of systematic monitoring of POPs compounds and for its implementation

This Action Plan is aimed at establishing systematic monitoring of POPs compounds, so as to determine environmental levels of POPs compounds and, among others, to prove the assumptions of the Action Plan with regard to POPs pesticides, contaminated locations, stockpiles and objects in use, in that they do not represent actual problem in Croatia and that more information are required about environmental PCDD/PCDF levels.

Since according to the Convention R&D activities should be undertaken according to country capability and available resources, only areas with identified additional R&D project were listed.

For monitoring activities detail plan was developed, together with an implementation plan and the budget.

Priorities of the Action Plan are:

- to amend and develop legal regulations and by-laws for establishment of POPs compounds monitoring;
- to propose the structure of institutions responsible for establishment and implementation of POPs compounds monitoring;
- to propose timelines for establishment and implementation of POPs compounds monitoring;
- to propose the mode and scope of reporting and informing of public;
- to propose financing scope and schedule, and
- to ensure the funds through competent authority.

Limitations of the Action Plan arise mostly from the scarcity of available information, mostly due to unorganized system and insufficient funds. Unorganized monitoring of the emissions of POPs compounds, of their disposal, transport and transit, import and export, production, use, levels in the environment, food and humans limit the scope of actions from the Action Plan. Limitations of the Plan refer to impossibility to influence implementation of POPs compounds monitoring, because:

- draft regulations and by-laws are submitted by competent ministries to the Parliament and Government of the republic of Croatia and dynamics of their promulgation cannot be anticipated by the Action Plan;
- competences of the respective state institutions cannot be defined by the Action Plan but can be proposed and they are now still uncertain, and
- financing dynamics depends on the state budget, financial position of local self-government and on priorities given during their allocation;
- financing of the Action Plan depends on the goodwill of international community to give financial support for monitoring of POPs compounds, and
- participation of some institutions in monitoring of POPs compounds is not certain because they are parts of various state bodies, in respect to the body that will be responsible for monitoring of POPs compounds.

### 3.3.16.2 Current monitoring of POPs compounds

Analyses of the residual organochlorine pesticides and PCBs have been carried out in Croatia by the adequately equipped laboratory staff trained in trace analysis of the samples from environment. PCDD/PCDF has not been analyzed in our laboratories yet, but these preparations are underway. Currently the analyses of common concentrations of specific PCDD/PCDF congeners in various (uncontaminated) environmental samples are performed by the internationally approved laboratories abroad. The samples with moderately increased and higher levels of PCDD/PCDF can be analyzed at the Institute for Public Health of the city of Zagreb. Environmental PCBs are analyzed mostly by county institutes for public health, scientific institutions –Institute for Medical Research and Professional Medicine in Zagreb and Institute "Ruder Bošković", Zagreb. Croatia has not established systematic and permanent monitoring of PCBs in all environmental elements. The

only one of this sort is performed for some rivers and foodstuffs of animal origin. POPs compounds (mostly pesticides) in food, foodstuffs and objects for general use are monitored at some institutes for public health, primarily at those within bigger centres i.e. regions. Results of to date studies have shown that the levels in all analyzed samples are within lower ranges established in other European countries. Croatia has sources of POPs compounds which primarily comprise the systems still using PCBs and waste with PCBs, and PCDD/PCDF emissions from industries and improper waste disposal (municipal, hospital and technological) and its incineration (often uncontrolled). Information about contaminated sites is scarce and incomplete. This requires urgent further investigation, especially of the war-affected areas where the equipment with PCBs was destroyed. Information about possible presence of PCBs in converters as fluids for heat exchange is also incomplete and requires further investigation.

### 3.3.16.3 Measures for quality improvement and establishment of comprehensive monitoring of the levels of POPs compounds (environmental levels and monitoring of their elimination)

**Legal framework for creation of the conditions for levels monitoring**

It has been recorded that there is no systematic monitoring of the residual POPs compounds in all environmental elements. Current laws and by-laws regulate relatively well the ranges of tolerance and highest permitted levels of some compounds in environmental elements (air, soil, drinking and other waters and food). They partially determine testing methods for food and water.

Major problem is related to insufficiently clear definition and overlapping of the ministerial responsibilities (environmental protection, health, agriculture, forestry and waters) and to ensuring and channelling of the funds for implementation of environmental levels control and accidents.

Data collection about the use of POPs compounds is not easy because former laws and majority of current ones lack the provisions regarding data collection in the central registry and/or interpretation of available data. All collected information is the result of POPs insufficiently inter-connected expert controls and expert or scientific research. They have been published in various magazines or collections of works from professional and scientific events.

Monitoring of organochlorine compounds, including PCBs, is covered by the Rules on Monitoring of the Residues of Specific Substances in live Animals and Products of Animal Origin (Official Gazette No. 106/99). Completion of the rules (must include groups of PCDD/PCDF compounds and define highest permitted levels in food as per EU recommendations, define all compounds covered by the term "organochlorine compounds" and "PCB-total PCB", by which mixture or individual PCBs) would create a common monitoring principle for live animals, semi-finished products and products of animal origin. Promulgation (development) of similar rules to regulate the highest permitted levels of POPs compounds in the unstudied elements of the environment (soil, water, air and vegetation) and in the samples of human biological material (milk and blood), sampling frequency, number of samples and sampling protocol will present a legal basis for monitoring. Monitoring will be aimed at creating databases organized by geographic distribution and the basis for monitoring changes in the levels, as well as at getting the view of trends of individual pollutants under normal conditions i.e. in accidents.

Similar is with waste. There are no accurate data about the equipment with PCBs (transformers, capacitors and heat exchangers with PCBs) with insufficiently precise legal provisions.

Consequently, legal regulations must determine monitoring of air, water, soil and, particularly, all foodstuffs manufactured locally and abroad (cooperation with Environmental Protection Agency), monitoring in forests and parks, and testing of POPs compounds in the samples of human biological material. The criteria must be identified for the selection of sampling sites and sampling time

(frequency), profile and qualification of the sampling staff and profile, qualification and training of the staff that will analyze the samples. Only standardized analytical methods through which analytical equipment has been identified and through which staff competence has been proven can be applied.

**National capacities and resources for monitoring**

For successful study of majority of compounds from the POPs group (organochlorine pesticides and polychlorinated biphenyls) in environmental samples, the following must be ensured:

- corresponding highly qualified staff and technical personnel trained in the analysis environmental samples for compound traces;
- appropriate space and analytical equipment for detecting traces of POPs compounds. Basic equipment includes high-resolution gas chromatograph with electron capture detector (HRGC-ECD) or high-resolution gas chromatograph with mass spectrometer (HRGC-MS), and
- interconnected and testing system harmonized with good laboratory practice (GLP) and international standards.

The complete equipment for testing and control of the compounds from the group of organochlorine pesticides and polychlorinated biphenyls (HRGC-ECD) is available in Zagreb (Institute for Medical Research and Professional Medicine, Institute «Ruđer Bošković», Institute for Public Health, Veterinary Institute, Faculty of Food and Biotechnology and Faculty of Agronomy). Elsewhere in Croatia this work is performed mostly by ecological services of public health institutes (in Rijeka, Split, Osijek, Sisak, Pula, Zadar, Koprivnica and Karlovac). There are also qualified people who need additional training in trace analyses of organochlorine pesticides and polychlorinated biphenyls from the group of POPs compounds; therefore it is necessary to adjust the usage of existing capacities.

Reliable analysis of individual PCDD/PCDF congeners in uncontaminated environmental samples and human biological material requires a high-resolution gas chromatograph – high resolution mass spectrometer (HRGC-HRMS) and appropriately trained staff. This equipment and such staff are currently unavailable but the activities are underway to provide them.

For preliminary studies of relatively high amounts of all 17 relevant congeners from PCDD/PCDF group in environmental samples, Zagreb Institute for Public Health has necessary space, staff and equipment (Soxhterm extractor for processing of solid samples and FMS). This Institute meets special requirements for emission control of PCDD/PCDF compounds in combustion gases from stationary furnaces which refer to standardized isokinetic sampling equipment. It also meets minimal conditions for detection of higher PCDD/PCDF levels in that it has HRGC-MS-SIM.

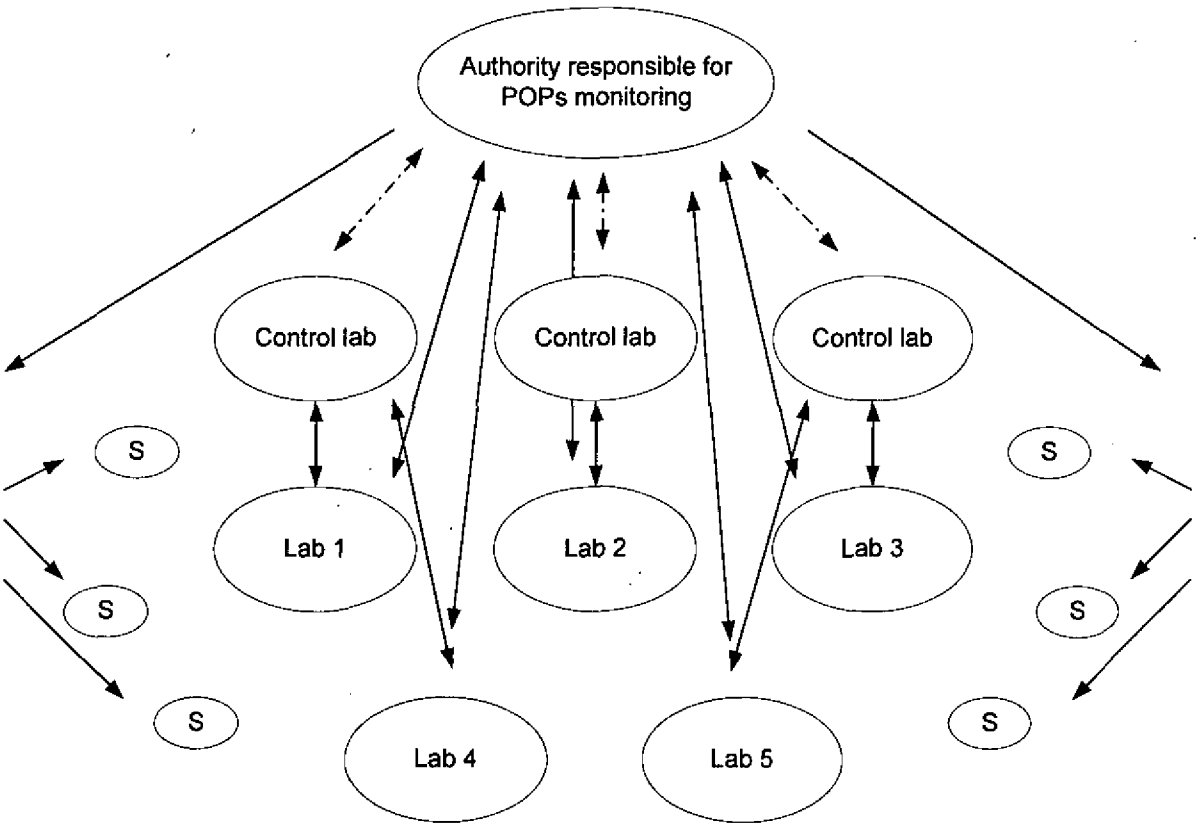
**Development of national, regional and local institutions responsible for POPs monitoring and providing relevant information (location, media, sampling frequency)**

Monitoring of POPs compounds should be added to the existing similar programmes for water which are coordinated by «Hrvatske vode», and to monitoring of meet and products of animal origin organized by the Ministry of Agriculture, Forestry and Water Management. The existing networked air sampling sites do not collect samples for measuring of POPs compounds. This should be introduced by the additional sites where POPs compounds pollution is expected either due to traffic, or industry or their transboundary transport.

Ministry of Environmental Protection, Physical Planning and Construction will identify a foreign institution, so far insufficiently engaged in monitoring of various environmental elements, that will monitor POPs compounds in humans and environment.

Laboratory equipment of scientific-research institutions and the institutes for public health (state, regional and county) is insufficient for determination of low levels of POPs compounds in various media. Precondition for good monitoring requires its provision, education of analysts as well as improved work control of these laboratories (measuring accuracy, results interpretation, methods selection, etc.).

**Monitoring flow chart**




***S - sample***

Competent institution will undertake complete organization of the labs network and of monitoring. Surveillance of monitoring implementation will be the responsibility of a supervisory body from the scope of environmental protection, comprising the experts (rather than politicians) from the respective fields. This institution should organize testing of all labs analyses either alone or appoint an approved institution to do that. The criteria to be met by all labs must be defined before testing of the analyses of each compound and medium, and must include method description, identification of compounds, return of the method, results repetition and reproduction, method precision, type of standard compounds and characteristic experimental conditions (HRGC-ECD and/or HRGC-MS-SIM; capillary columns with the specified selective liquid, length, diameter, etc.). Based on the testing of laboratory results, the responsible institution will approve that laboratory for such further analyses. In other words, the approval should define the compounds analyzed and media in which they are analyzed. Such an approval will not be issued for indefinite period but would be subject to renewal, while analytical quality tests would be performed at least every two years.

Due to scarce laboratory equipment for measuring of low POPs compounds and PCDD/PCDF, the funds must be ensured for their purchase and staff training. Despite falling trend of residual OC pesticides in vegetable and animal bio-samples, water, soil and human bio-samples, data about them are necessary for monitoring of their status. This is the obligation which arises from many international agreements and regulations, and will be indispensable for their reporting once Croatia becomes a Convention party.

The tasks of the approved institution shall also include organization of sample collection, because this must not be the task of analytical labs too. The existing network of county public health institutes and of their affiliates is not professionally equipped and is scarce in the equipment for trace analysis of persistent organic pollutants. These institutes have the staff that with the additional training, with a good sampling protocol and equipment will collect the samples and have them analyzed by the approved analytical labs. Prior to sample collection, the approved institution and the experts should agree on detailed sample collection protocols and data presentation, taking into consideration the methods applied, detection limits and analytical accuracy.

The control laboratories (also, however more stringently, tested for analytical quality) would be responsible for assisting the analytical laboratories in methods introduction, in removal of operating deficiencies and for occasional parallel analyses (especially of the samples with detected increased levels of pollutants). It will be more of surveillance, consultancy and assistance than analyses of the monitoring samples.

### 3.3.16.4 Monitoring organization and scope

Monitoring of POPs compounds in **humans should include blood i.e. serum/plasma samples.** Given the results of to date research, we think that this monitoring must be single and cover four wider areas (rural and municipal population, 50 samples from each): eastern Slavonia, NW and central Croatia (counties of Zagreb, Karlovac, Krapina-Zagorje and Sisak-Moslavina), Istria, Kvarner and south Dalmatia. Further monitoring should be expanded if in some areas the levels are far in excess to those in others. For trend analysis, the procedure should be repeated in the same areas every five years. Blood samples must be taken in all regions from equal number of general male and female population of similar age.

**Monitoring of POPs pesticides and PCBs in soil samples** would be performed in 3-year cycles, on 500 samples of agricultural soil taken annually (in biannual intervals). PCDD/PCDF should be tested on 100 soil samples in total (taken throughout 2 years). The collection will be proportional to the cultivated land in all counties and also cover the land polluted by military activities. Soil from the islands should be restricted to big and small ones with developed agriculture and sheep breeding. The samples should number 3-7, depending on the size of islands and agricultural/pasture surface. In the third year the samples would be taken only from the areas that show higher levels of pollution.

**Monitoring of food of animal origin** is already underway, within monitoring of the Ministry of Agriculture, Forestry and Water Management. It should continue within the initial scope and be referenced to the studies of hygienic correctness of food performed by public health institutes. This should be subject to harmonization of analytical methodology, reporting and testing of analytical quality. Monitoring must be expanded by PCDD/PCDF analyses, and during 2-year period 100 samples of different foodstuffs (of animal origin) should be analyzed.

Food monitoring must comprise local and imported products, and be performed in biannual cycles. In the first year 10 different products must be selected and analyzed by their 10 major local manufacturers. In the following year 20% of these products will be substituted for other products of the same manufacturers and 20% for the products of the manufacturers not controlled in the first

year. The samples will be taken monthly, paying attention that none is manufactured on the same date as the previous one. Imported food will be sampled according to its position in the food chain, but should preferably include one less important product (coffee, tea or spices). Sampling practice will be similar to that for local products, but should always include the manufacturers from different countries. In addition to current controls and monitoring of foodstuffs of animal origin, additional 500 samples should be taken from the products uncovered by the aforementioned programmes.

**Air monitoring** should be performed in biannual periods with one 7-day sample taken twice yearly (about. 1000 $m^3$ of air) at the sites currently used for the studies of other air pollutants. Sampling stations network has been developed or is currently being developed (relevant to the county). The estimated number of air samples is 500 for POPs pesticides and PCBs and 50 for PCDD/PCDF. Where POPs compounds are in significant excess, sampling and monitoring should continue over next two years.

**Water monitoring** is performed by «Hrvatske vode» but only of some rivers and artificial water impoundments. The study should be expanded to other recipients and water wells i.e. include all drinking water sources and sediments. Methodology and results reporting of current monitoring must be harmonized, and the quality of laboratory analyses tested. Besides the samples analyzed under the programme of «Hrvatske vode», 1000 samples from the sites uncovered by this programme should be analyzed too. Wherever applicable, water analyses comprise the waters and sediments. Sampling is performed during one year, which represents one cycle.

### 3.3.16.5 Implementation of the monitoring Action Plan

Implementation of the Action Plan depends upon the engagement of the competent state administrative bodies or on the bodies approved by them. It is based on the results of inventory, monitoring, education of the population and engagement of necessary funds.

First year: Identify a monitoring organizer and promulgate monitoring rules, design monitoring programme, identify monitoring responsibilities and analytical laboratories, develop information system for monitoring and results processing, purchase sampling and analytical equipment and perform training of the people responsible for monitoring and of the analysts, ensure funds for the above activities.

Second year: proceed with activities, start monitoring, and develop the information for public media to educate the public.

Third year: continue monitoring and education of the public, ensure funds for these activities.

Fourth year: proceed with previous year activities, process monitoring results and report about them.

Fifth year: proceed with previous year activities, prepare relevant legal regulations.

Sixth year: proceed with previous year activities, prepare relevant legal regulations.

Seventh year: proceed with previous year activities, prepare relevant legal regulations.

Priorities should be channelled towards: improvement of inspection controls, reduction of the sources of POPs compounds, development of the competent analytical laboratories network, organization of monitoring with financial support and organization of database aimed at informing the public about processed results and their interpretation.

Table 66. shows relevant timelines.

### 3.3.16.6 Requirements in capital investments

Most important is to establish and one equip analytical laboratory for testing the levels of PCDD/PCDF in environment and human biomaterial. There is no such laboratory in Croatia and this requires purchase of HRGC-ECD, additional equipment (e.g. centrifuge, extractor, vaporizer, etc.), space and competent staff (2 university-level analysts trained in mass spectra and trace analyses in various media – minimum 1 year of training in the qualified laboratory; 1-2 chemists with secondary-school also trained in trace analyses in various media).

To upgrade monitoring of POPs pesticides it is necessary, in the first place, to connect and coordinate the work of all qualified laboratories, to purchase necessary and accurate equipment for determination of trace POPs compounds and to train the experts in its use in the areas not covered so far.

### 3.3.8.1.Financing of the Action Plan

Financing of the monitoring Action Plan (over minimum 7 years) covers development of legal regulations and by-laws, of the information system, monitoring organization and concomitant quality testing of laboratories, purchase of laboratory equipment, staff training, collection of data about monitoring results and their processing, reporting about the results and organization of systematic notification of the public. Such activities will be covered by: responsible ministries, counties, local self-administration and international organizations (e.g. GEF and UNIDO). Equipping of analytical laboratories for PCDD/PCDF described in the previous section requires about USD 6 250 000. Implementation of monitoring (sampling and analyses) should require about (USD 2 500 000). Development of legal regulations and by-laws would be the responsibility of the corresponding ministries, as a part of their operations.

Anticipated funds for implementation of the proposed Action Plan are given in Table 67.

Table 66. Timelines of the Action Plan

| | PROJECT DURATION | MONTHS OF IMPLEMENTATION | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ACTIVITIES | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 | 63 | 66 | 69 | 72 | 75 | 78 | 81 | 84 |
| 1 | **Coordination of plan implementation** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.1 | Identification of the focal point | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2 | Assessed needs of the focal point | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.3 | Inclusion of stakeholders | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.4 | Setting up of the Commission | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.5 | Adoption of the Action Plan and identification of budget | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.6 | Revision of the Action Plan | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.7 | Workshops for implementation control | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | **Development of new and adjustment of current legal regulations** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.1 | Promulgation of new regulations | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2 | Adjustment of current regulations | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | **Strengthening of the capacities for monitoring of POPs compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.1 | Organization of monitoring network | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.2 | Methodology development | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.2 | QA and identification of qualified labs | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.3 | Upgrading of laboratory practices in the analysis of residual POPs compounds | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.4 | Identification of the sites and their sampling frequency, development of sampling procedures and identification of the sampling body | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.5 | Development of reporting modes | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.6 | Sampling, analyses and reporting about results | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.7 | Results assessment and interpretation | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | **Informing and increasing of public awareness** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.1 | Results interpretation and notification in the form suited to the public | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.2 | Organization of the web site for monitoring activities | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 67. Anticipated costs of monitoring

| | Costs by years (USD) | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| *Organization of monitoring* | 625 000 | 625 000 | | | | | |
| *Monitoring* | 83 330 | 666 700 | 166 670 | 166 670 | 166 670 | 166 670 | 166 670 |
| *Quality testing of laboratories* | 125 000 | 125 000 | | | | | |
| *Subsequent controls* | 12 500 | 12 500 | 25 000 | 25 000 | 25 000 | 25 000 | 25 000 |
| *Development of information system* | 41 670 | 41 670 | | | | | |
| *Results processing and maintenance of information system* | | | 16 670 | 16 670 | 16 670 | 16 670 | 16 670 |
| *Designing of web site* | 16 670 | 16 670 | | | | | |
| *Updating of web site* | | | 16 670 | 16 670 | 16 670 | 16 670 | 16 670 |
| *Purchase of sampling equipment* | | 16 670 | 16 670 | | | | |
| *Purchase of main equipment* | | 6 667 000 | | | | | |
| *Training of experts* | | 66 670 | 66 670 | | | | |
| *Informing of the public (media/ads/leaflets)* | | 16 670 | 16 670 | 16 670 | 16 670 | 16 670 | 16 670 |
| *Development of legal regulations – contribution of the state through the work of state administration* | 33 330 | 33 330 | 33 330 | | | 66 670 | |
| *Inspection controls - contribution of the state through the work of state administration* | | 100 000 | 100 000 | 100 000 | 100 000 | 100 000 | 100 000 |
| ***Total contribution of state administration*** | 33 330 | 133 330 | 133 330 | 100 000 | 100 000 | 133 330 | 133 330 |
| ***Total by years*** | **937 500** | **8 387 870** | **458 350** | **341 680** | **341 680** | **374 015** | **375 015** |
| ***Grand total costs in 7 years*** | | | | | | | **USD 11 217 120** |

**Strategy for Research and Development on POPs**

Due to the current unsatisfactory status of research and development projects related to POPs compounds, the following fields are proposed in which present activities are already undertaken but require more attention:

- development of the procedures for biodegradation of persistent chemical compounds in environment (biological and microbiological degradation);
- study of the levels of harmful pollutants, PCDD, PCDF, PCBs and HCB in air and soil/sediment of the urban, rural and industrial areas;
- assessment of the intake of POPs compounds by food;
- study of distribution and levels of PAH compounds, PBDE, short-chained chlorinated paraffin and other POPs compounds in environmental elements;
- development of the methods to determine the levels of POPs compounds in (diffuse) mobile sources;
- epidemiological studies of the risk to health of various population groups;
- studies of environmental transfer and distribution of POPs compounds (atmospheric processes: division gas/solid phase; water/suspended particles; exchange water/soil/vegetation);
- inventory of global levels and of the models of global distribution of POPs compounds;
- study of occurrence, availability and flow of POPs compounds in soil, sediment and ground waters;
- study of the effects of POPs compounds on humans and animals, including molecular mechanisms of biodegradation, biotransformation and toxicity;
- study of environmental effect of POPs compounds; mixtures;
- study of deposition/emission processes, transformation processes and bioavailability of POPs compounds in terrestrial and marine eco-systems;
- development of analytical methods for determination of new types of POPs compounds, of their metabolites, stereoisomer and polar POPs compounds.

This listed priority areas will be elaborated in more detail during the NIP implementation process.

### 3.3.17 Activity: technical and financial assistance

Since Croatia is a country with economy in the transition, technical and financial assistance is crucial for the successful implementation of the Convention.

It is predicted that Croatia will apply for the funds available from the developed countries based on the arrangements established by the COP.

## 3.4 Development and capacity building proposals and priorities

The most important areas in which current capacities and capability need to be strengthened to achieve the objectives of the NIP are as follows:

- development of interim/temporary storage facility for collection of PCBs waste and PCB-containing equipment
- set up a new laboratory/ies for analysing PCDD/PCDF in environment (purchasing equipment and training of the laboratory staff)
- development of comprehensive monitoring system for POPs compound in environment

Financial needs for above mentioned areas are estimated in action plans and are as follows:

- temporary storage (500 000 USD)
- one laboratory for PCDD/PCDF (6 250 000 USD)
- monitoring system (2 500 000 USD)

## 3.5 Timetable for NIP implementation

Timetable for implementation of the whole NIP is based on the implementation plan of each action plan and strategy. Their overlapping shows that the implementation is based on:

- organisation and co-ordination of NIP activities
- adjustment of the existing or development of new legal regulations;
- development of technical instructions, directives and procedures that ensure implementation of legal regulations, and
- implementation of the action plans and strategies.

*Government will nominate an institution, which will be responsible for the implementation of the whole NIP. This institution will coordinate and oversee the implementation of each individual action plan and strategy, for which different institutions/bodies will be responsible.*

A short-term and the most important goal in 1-5-year period is identification of the focal points for the respective action plans and strategies, development of new or adjustment of current legal regulations, development of technical instructions and the onset of specific activities (e.g. construction of temporary storage for the equipment with PCBs, elimination of such equipment from use, education and notification of the public and organization and beginning of POPs compounds monitoring). This phase is very important as its properly organized activities and initiation of some can ensure their continued implementation in the future.

*This can be organized either through only one focal point responsible for all action plans and strategies, or through several bodies responsible for individual action plans and strategies. In that case it is necessary to identify the mechanisms for their coordination, so as to ensure coordinated implementation of NIP. It is particularly important to identify NIP implementation from the side of corresponding state bodies, as well as the assessment mechanisms of implementation and necessary adjustments of action plans and strategies).*

A medium-term goal is to carry on the measures for 5 - 10 year period.

In the long run (from 10 years on) it is necessary to permanently carry out the activities arising from individual action plans and strategies. Duration of these activities depends on their completion in the mid-term.

Table 68 shows the timetable of the NIP implementation.

Table 68. NIP implementation timetable

| | Activities | YEARS OF IMPLEMENTATION | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Short-term | | | | | Mid-term | | | | | Long-term | | | | | | | | | | | | | |
| | Main activities | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 1 | **Coordination and organization of the NIP implementation** | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.1 | Appointment of the NIP implementation body/bodies | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2 | Coordination of NIP implementation activities | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.3 | Official evaluation of the NIP implementation | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.4 | Workshops for evaluation of implementation | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | **Adjustment of the existing or development of new legal regulations** | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.1 | Adjustment / new regulations in the field of ANNEX A Chemicals | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2 | Adjustment / new regulation in the field of ANNEX C Chemicals | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | **Development of technical instructions, directives and procedures** | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.1 | Development of the technical instructions, directives and procedures from the field of ANNEX A Chemicals | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.2 | Development of the technical instructions, directives and procedures from the field of ANNEX C Chemicals | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | **Implementation** | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.1 | Implementation of the specific Action Plans and Strategies | | | | | | | | | | | | | | | | | | | | | | | | |

## 3.6 Resource requirements

Assessment of the funds is based on cost assessment of individual action plans and strategies. Action plans and strategies do not contain assessed costs of substitution of industrial equipment with PCBs which are considerable and will arise after their elimination from use.

Taking into consideration the abovementioned, total implementation costs of NIP's key segments is estimated to amount of 23 million USD

Total costs which relates to the changes/developing of the national legislation and which predicts the involvement of official authorities will be covered by the domestic sources are estimated to amount of 4.8 million of USD

Since the calculation of the incremental cost is not currently elaborated by the Stockholm Convention, NIP will be amended with this part once proper instructions will be provided.

As a conclusion it can be stated that, Croatia does not have sufficient money for implementation of the foreseen activities. Financial support of international organizations and of the bodies of the Stockholm Convention is expected, but it is subject to Croatia's becoming the Convention party. Only after that international financial support can be anticipated

# ANNEX I: UPDATED PCBs INVENTORY DATA

Table I: Number of the transformers by the year of their manufacture by counties

| COUNTY | Number of transformers (pieces) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | By 1970 | 1971 -75 | 1976 -80 | 1981 -85 | 1986 -90 | After 1990 | Unknown | Total |
| Zagreb | 5 | 5 | 7 | 5 | 4 | 0 | 4 | 30 |
| Krapina-Zagorje | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sisak-Moslavina | 28 | 5 | 24 | 0 | 0 | 0 | 0 | 57 |
| Karlovac | 36 | 13 | 10 | 41 | 10 | 0 | 10 | 120 |
| Varaždin | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 4 |
| Koprivnica-Križevci | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Bjelovar-Bilogora | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Primorje-Gorski | 4 | 2 | 6 | 0 | 0 | 0 | 0 | 12 |
| Lika-Senj | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Virovitica-Podravina | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 3 |
| Požega-Slavonija | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Brod-Posavina | 5 | 2 | 9 | 2 | 2 | 0 | 0 | 20 |
| Zadar | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Osijek-Baranja | 4 | 6 | 4 | 2 | 4 | 0 | 4 | 24 |
| Šibenik-Knin | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| Vukovar-Srijem | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Split-Dalmacija | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 4 |
| Istra | 10 | 2 | 4 | 6 | 1 | 0 | 0 | 23 |
| Dubrovnik-Neretva | 1 | 0 | 0 | 8 | 0 | 0 | 0 | 9 |
| Međimurje | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| TOTAL | 93 | 37 | 69 | 70 | 21 | 2 | 19 | 311 |

Table II: Weight of transformers by the year of their manufacture by counties

| COUNTY | Weight of transformers/kg | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | By 1970 | 1971 -75 | 1976 -80 | 1981 -85 | 1986 -90 | After 1990 | Unknown | Total |
| **Zagreb** | 12220 | 4536 | 3520 | 2394 | 2080 | 0 | 4000 | **28750** |
| **Krapina-Zagorje** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Sisak-Moslavina** | 128352 | 16960 | 99562 | 0 | 0 | 0 | 0 | **244874** |
| **Karlovac** | 157840 | 16420 | 19970 | 80809 | 36010 | 0 | 8520 | **319569** |
| **Varaždin** | 0 | 0 | 1890 | 3080 | 0 | 0 | 0 | **4970** |
| **Koprivnica-Križevci** | 0 | 0 | 0 | 102 | 0 | 0 | 0 | **102** |
| **Bjelovar-Bilogora** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Primorje-Gorski** | 10870 | 4440 | 11800 | 0 | 0 | 0 | 0 | **27110** |
| **Lika-Senj** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Virovitica-Podravina** | 0 | 0 | 2971 | 0 | 1100 | 0 | 0 | **4071** |
| **Požega-Slavonija** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Brod-Posavina** | 11200 | 3600 | 17910 | 3560 | 5190 | 0 | 0 | **41460** |
| **Zadar** | 0 | 0 | 950 | 0 | 0 | 0 | 0 | **950** |
| **Osijek-Baranja** | 6590 | 6590 | 5340 | 4710 | 6460 | 0 | 0 | **29690** |
| **Šibenik-Knin** | 0 | 0 | 0 | 0 | 0 | 3990 | 0 | **3990** |
| **Vukovar-Srijem** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Split-Dalmacija** | 0 | 0 | 1890 | 250 | 0 | 0 | 162 | **2302** |
| **Istra** | 11440 | 0 | 0 | 7040 | 2700 | 0 | 0 | **21180** |
| **Dubrovnik-Neretva** | 4800 | 0 | 0 | 0 | 0 | 0 | 0 | **4800** |
| **Međimurje** | 0 | 0 | 2060 | 0 | 0 | 0 | 0 | **2060** |
| **TOTAL** | **343 312** | **52546** | **167863** | **101945** | **53540** | **3990** | **12682** | **735878** |

## ANNEX II: ABBREVIATIONS

ADI – Available Daily Intake

BAT – Best Available Techniques

BEP – Best Environmental Practices

CBS – Croatian Bureau of Statistics

CLRTAP– Convention on Long Range Transboundary Air Pollution

DSZ – Croatian bureau of statistics

LVE – Limited Value of Emissions

HAC – Croatian Highways Ltd.

HC – Croatian Roads Ltd.

HEP – Croatian Power Supply Company

HRGC - ECD – High resolution gas chromatograph with electron capture detector

HRGC - MS – High resolution gas chromatograph with mass spectrometer

HRK – Croatian Kuna

HSE – Health, Safety and Environment

IAEA – International Atomic Energy Agency

IPPC – Integrated Pollution Prevention and Control

MF – Ministry of Finance

MAFWM – Ministry of agriculture, forestry and water management

MH – Ministry of Health and Social Welfare

MPC – Maximum Permitted Concentration

MZOPUG – Ministry of Environmental Protection, Physical Planning and Construction

N/A – Not Applicable

HNB – Croatian National Bank

ND – Not determined

NE – North East

NGO– Non Governmental Organisation

NPK – Nytrogen Phosphorus Potassium

OC – Organochlorine

PM – Particulate matter

PVC – Polyvinyl Chloride

R&D – RESEARCH AND DEVELOPMENT

SNAP - Selected activities for air pollution

UNEP – United Nations Environmental Programme

UNESCO – United Nations Educational, Scientific and Cultural Organisation

UNIDO – United Nations Industrial Development Organisation

UN – United Nations

USEPA – United States Environmental Protection Agency

VCM – Vinyl Chloride Monomer

WHO – World Health Organisation