REPUBLIC OF CROATIA

MINISTRY OF THE ENVIRONMENTAL PROTECTION, PHYSICAL PLANNING AND CONSTRUCTION

NATIONAL IMPLEMENTATION PLAN

FOR THE IMPLEMENTATION OF

STOCKHOLM CONVENTION ON PERSISTANT ORGANIC POLLUTANTS

Zagreb, February 2009

1 INTRODUCTION

Countries of the world adopted the Stockholm Convention on Persistent Organic Pollutants on 23 May 2001 in Stockholm. The Convention is directed at reduction, and where appropriate – emission abatement of 12 organic compounds (POP) into the environment (aldrin, chlordane, DDT, dieldrin, eldrin, heptachlor, hexsachlorbenzene, mirex and toxaphene, PCBs, HCB, PCDD/PCDF). The Convention has entered into force on 17 February 2004. The Convention prescribes conditions each party should fulfil towards elimination of production, use, import and export of Persistent Organic Pollutants on global level. Fulfilling these conditions would result in significant reduction or total termination of POP emissions to the environment.

Republic of Croatia signed the Convention in May 2001. National Implementation Plan Proposal for implementation of the Stockholm Convention on Persistent Organic Pollutants in the Republic of Croatia was elaborated within the framework of the project "*Enabling activities to facilitate early action in the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) in the Republic of Croatia*" (UNIDO Project No: GEF/CRO/02/007). National Implementation Plan Proposal was accepted and approved by Expert Project Implementation Committee. In accordance with the Convention Republic of Croatia is obliged to deliver the Secretariat of the Convention National Implementation Plan within 2 years from the Convention's ratification in the Republic of Croatia.

Republic of Croatia ratified the Stockholm Convention in November 2006 and became a party to the Convention in April 2007.

During 2008 National Implementation Plan Proposal (NIP in the further text) was revised primarily in the part relating to legislation and institutional organisation.

1.1 Aims of the Stockholm Convention

The Stockholm Convention on persistent organic pollutants (the Convention in the further text) is focused on abatement and termination of releases of 12 Persistent Organic Pollutants (POPs in the further text).

Persistent Organic Pollutants are organic compounds resistant to photolytic, chemical or biological decomposition. POPs have low solubility in water and high solubility in fat. As a result of that it accumulates in tissue of living organisms. These compounds are present in the environment in small quantities, however they can travel long distances by air and water thus widely spread and present even in the areas where never been used.

The Persistent Organic Pollutants group encompasses organochlorine compounds. Organochlorine compounds are all organic compounds containing one of more chlorine atoms.

Organochlorine pesticides (OCP) like DDT, aldrine, dieldrine, hexachlorobenzene (HCB), hexachlorocyclohexane (CHC) and heptachlor as well as polychlorinated biphenyls (PCB) make two widely used groups of persistent organic pollutants.

The Convention relates to:

- products (PCB, pesticides, insecticides, rodenticides, fungicides) - (aldrin, chlordane, DDT, dieldrin, eldrin, heptachlor, hexsachlorbenzene, mirex and toxaphene);

- polychlorinated dibenzo-p-dioxin (PCDD) and polychlorinated dibenzofurans (PCDF), two groups of compounds known under the common name „dioxins" were never intended for use, nor they are naturally

present compounds. These two groups of compounds encompass 210 congeners in total and some highly toxic therefore the need for their monitoring and estimation/evaluation emerged. Dioxins (PCDD) and furans (PCDF) originate as undesirable by-products in thermal processes and chemical reactions mainly through two mechanisms: "*de novo*" synthesis of basic elements: carbon, hydrogen, oxygen and chlorine (usually with catalyst with temperatures between 250 and 500 ºC) or via precursors (chlorinated organic compounds used in various chemical processes) on 200 to 450 ºC. Emissions of PCDD/PCDF in the environment occur via emitting and /or transfer through water, air, soil, products and waste. These four groups include over four hundred compounds amongst which some proved cancerogenous. Due to their characteristics and effects in all parts of biosphere, including humans, organochlorine compounds are the most researched compounds;

- products used for disease control, e.g. (DDT for malaria).

Chemicals included in the Convention are listed in the Annexes A (I and II part), B (I and II part) and C. Annex D provides conditions and criteria for inclusion of new chemicals into the list.

Requirements of the Convention relating to chemicals are displayed in three articles:

- Article 3 relates to produced chemicals. This article prescribes measures for reduction or termination of emissions occurring in intended production and usage,
- Article 5 relates to products occurring as a consequence of unintended production as a result of human activities, and
- Article 6 prescribes measures for reduction and termination of emissions from storages materials and waste for all 12 chemicals or groups.

1.2 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 (aldrin, chlordane, DDT, dieldrin, eldrin, heptachlor, hexsachlorbenzene, mirex and toxaphene) 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 waste that contain POPs on the way to eliminate it as a waste. Their disposal should be made in an environmentally sound manner taking into account international regulations, standards and guidelines.

1.3 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.

1.4 The Stockholm Convention requirements relating to Polychlorinated Biphenyls

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, while 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).
All parties, signatories to the Stockholm Convention shall:

1. Eliminate the use of PCBs in equipment by 2025 (e.g. transformers, capacitors and other receptacles containing liquid stocks);
2. Identify, label and remove from use the equipment containing greater than 10% PCBs and volumes greater than 5 litres;
3. Identify, label and remove from use the equipment containing greater than 0.05% PCBs and volumes greater than 5 litres;
4. Identify, label and remove from use the equipment containing greater than 0.005% PCBs and volumes greater than 0.05 litres;
5. Prohibit the export and import of PCBs and equipment containing PCBs (except for the purpose of environmentally sound waste management);
6. 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;
7. Achieve the environmentally sound management of PCB waste as soon as possible, but not later than 2028;
8. Develop and implement strategies for identification of stockpiles, products and articles in use and waste containing PCBs;
9. Manage stockpiles in a safe, efficient and environmentally sound manner upon their becoming waste;
10. 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.
11. Prohibit the use, recycling, recovery and direct or alternative uses of polychlorinated biphenyls
12. Develop strategies for identifying contaminated sites and for their remediation in an environmentally sound manner.
13. 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.

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

Persistent organic pollutants formed and released unintentionally from anthropogenic sources are:

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

Polychlorinated dibenzo–*p*–dioxins and dibenzofurans, hexsachlorbenzene and polychlorinated biphenyl's occurred accidentally and are emitted from thermal processes, including organic substance and chlorine as a result of incomplete combustion or chemical reactions. Categories of industrial sources presenting potential sources of emission of above described chemicals into the environment are:

(a) Waste incinerator, including installations for co-incineration of municipal, hazardous, medical waste or sewage sludge;
(b) Cement kilns where hazardous waste is burned;
(c) Pulp production using elemental chlorine or chemicals that generate elemental chlorine for bleaching;
(d) Following metallurgical heated processes:
    - secondary copper production,
    - sintering installations in ferrous and steel industry,
    - secondary aluminium production,
    - secondary zinc production.

Polychlorinated dibenzo–*p*–dioxins and dibenzofurans, hexsachlorbenzene and polychlorinated biphenyls can also occur accidentally and be emitted from the following sources:

(a) Waste incineration in the open, including burning waste in the fields;
(b) Heating processes in metallurgy not listed in the II part;
(c) Wide use combustion sources;
(d) Fossil fuels in public and industrial furnace;
(e) Combustion installations for burning wood and other biogenic materials;
(f) Specific chemical processes in production that accidentally emits Persistent Organic Pollutants, production of chlorofenol and chloranil in particular;
(g) Crematories - incineration;
(h) Motor vehicles, especially ones using leaded fuels;
(i) Disintegrating of animal carcasses;
(j) Dying fabric and leather (chloranil) and final processing (using alkali extraction);
(k) Installations for processing outdated vehicles;
(l) Smoulder of copper cables;
(m) Oil refinery waste.

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.

2 NATIONAL CHARACTERISTICS

2.1 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 56.594 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 Peri-panonian area covers the lowlands and rolling hills of the eastern and north-western 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 (Istria 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:	87 661	km^2
Land area:	56 594	km^2
Territorial sea area:	31 067	km^2
Length of coast with islands:	5 835,3	km
Length of mainland coast:	1 777,0	km
Length of island coast:	4 058,0	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 78.4 inhabitants per square kilometre ranks Croatia among the medium populated countries of Europe.

2.2 Socio-political structure

Croatia has become an independent state in 1991 as a part of break-up of former Yugoslavia. It has been a UN member from May 22 1992. Diplomatic relations are developed and maintain with 167 countries of the world.

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 state authority constitutes of: legislative (Croatian Parliament), executable (the Government and the President) and judicial. Authority division principle includes mutual cooperation and reciprocal control of authority carrier prescribed by the Constitution and laws. In the Republic of Croatia laws have to comply with the Constitution, and other regulation to comply with the Constitution and laws as well. Everyone is obliged to oblige with the Constitution and laws as well as respect legal order of the Republic of Croatia.

The Croatian Parliament 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, adopt 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.

The President of the Republic of Croatia presents and represents the Republic of Croatia at home and abroad. The President of the Republic looks after 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.

The Government of the Republic of Croatia performs 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, adopts 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.

Courts conduct 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.

State authority encompasses 13 Ministries, 4 Central State Offices, 9 State Administrative Organisations and County Offices of State Administration. Local self-government units in Republic of Croatia are cities and municipalities that perform work of local significance, but were not assigned to the state bodies. Large cities present self-governing units with more than 35.000 people and are centres of larger area development. Units of regional self-government represent Counties that perform work of regional significance and interest.

There are 21 units of regional self-government: 20 counties and Town of Zagreb and 556 units of local self government: 127 towns and 429 municipalities.

Following the adoption of Resolution on EU Accession of Republic of Croatia by Croatian National Parliament on 18 December 2002, Croatia submitted an EU membership request on 21 February 2003 in Athens. Subsequently, on 18 June 2004 European Council granted Croatia a status of a candidate country. Accession related negotiations commenced 3 October 2005 in Luxemburg.

2.3 Economic characteristics

Croatian Economy in 2006 ascended with annual rate of 4, 5%, while GDP was 34, 2 billion USD or 7700 USD per capita. Inflation of 3,2% is amongst lowest in the region. Average exchange rate of Croatian monetary unit, Kuna, amounted 7, 40 HRK/EUR, or 5, 94 HRK/USD respectively in 2006.

European Union is the main Croatian foreign trade partner because it covers 68% of total foreign trade. Republic of Croatia is a member of World Trade Organisation (WTO) from 2000 and Central European Foreign Trade Agreement (CEFTA) from 2003.

Table 1 shows the economic indicators for 2006.

Table 1. Economic indicators*

	Year	
GDP, billion USD	2006	34.220
GDP per capita, 000 USD	2006	7.700
Population, million (listed)	2006	4.4
Industrial production (%)	2006	4.5
Inflation rate (%)	2006	3.2
Unemployment rate (%)	2006	11.2
Exports, bln USD	2006	10.3
Imports, bln USD	2006	21.4
Foreign Exchange reserves HNB, bln USD end of period	2006	5.9

* Source: Croatian Bureau of Statistics (DSZ/CBS), Croatian National Bank (HNB), Ministry of Finance (MF), Ministry of Economy, Labour and Entrepreneurship and Croatian Chamber of Commerce

2.4 Profiles of Economic Sectors

2.4.1 Agriculture, Fishery, Forestry and Food Industry

Croatia is 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 3,15 million hectares of arable land in total, 63,4% is being farmed while the rest is used as grazing land, swamps, reed and fish ponds. In private ownership is 81,6% of total arable land.

Livestock farming have always played an important role in this region. 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. Agricultural land occupies 3,137 million hectares or 55,6% out of which 34,4 % was seeded with one year crops while 4% was under the permanent crops. 37% of land total is forest area. According to latest data, 5,5% of population works in the primary sector. Agricultural census conducted in 2003 showed small farms are dominant agriculture practice. Average size of a farm in Croatia is 2,59 hectares.

2.4.2 Agricultural Biodiversity

Plant species: Production of arable crops, livestock feed, and industrial plants, is mostly based on plant species developed and produced in domestic institutes for plant selection. In fruit and vineyard farming foreign varieties are mostly used, though indigenous varieties of grape vine have an important role.

Wheat, as the most important cereal, has registered 276 varieties on the official list of plant species. 90% of those varieties were generated in Croatian institutions for plant breeding. Corn is the second most important arable crop and has registered 612 varieties on the official list of plant species. 57 % of those varieties were generated domestically. Barley is another important cereal with 143 (predominantly domestic) varieties. Most important industrial plants are sugar beet (100 varieties), tobacco (75), soy (74) and sunflower (43).

Cattle: Abundance in livestock biodiversity in Croatia is reflected in large number of authentic breeds and population of cattle adjusted to local environmental breeding conditions with their own genotype and phenotype characteristics.

Forest is spread on 2,1 million hectares of Croatia which equals 37% of total Croatian land. Forest management is based on sustainable development principles. Due to sustainable management the forest structure and composition is very similar to the natural composition. 81% of the woods are state owned.

Sea fishery encompasses work of 3.680 fishing units owned by professional fishermen or companies. Although the number of vessels increased 30% since 1999 the vessels are predominantly small sized. Total fish catch is limited to 145 tonnes while catch limitation within the breed does not exist.

2.4.3 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. Industry generates approximately 20% of Croatian GDP and employs approximately 267 000 workers, respectively 25 percent of the employed in Croatia.

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.

2.4.4 Tourism

As one of the most important tourist destinations in the Mediterranean, Croatia possesses a long tradition in tourism and favourable developmental opportunities. Revenues from tourism amounted to USD 10.5 billion in 2007.

Croatia offers 212.350 beds in hotels and in tourist facilities, 400 000 beds in private accommodation, and 217 000 places in camps. There are 50 marinas with 15 400 berths along the entire coast. The advantages of Croatian tourist products are primarily well-preserved natural resources, cultural and historical heritage, a mild Mediterranean climate, its vicinity to European markets and a possibility of active holidays at the ecologically protected destinations.

2.4.5 Construction Industry

In 2007 the Croatian building industry, an important sector of the national economy, had 96.000 employees in 23.500 companies. It counts for 6.0 % of Croatian GDP with positive growing from 2001. 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 entered 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 is conducted by Croatian Highways Ltd.

2.4.6 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. 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.

2.4.7 Infrastructure

Roads: Total 28.788 km out of which 7.869 state, 10.544 municipality and 10.375 local

Railways: 2 726 km of tracks

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

Share of transport in GDP is 9% and in total number of employees 6%.

2.4.8 Utility services

Utility services is and integral system, 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 private persons, on the basis of concession contracts or contracts for the delivery of utility services.

2.4.9 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 (10.8% in 2007). This sector employed 18% of the total number of employees in the economy of Republic of Croatia in 2007.

2.4.10 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.

2.5 Environmental overview

2.5.1 Air Protection

Croatia has a long tradition of monitoring air quality which commenced in the 1960's.

Emission reduction of pollutants was particularly noticeable in the beginning of 1990s as a result of industrial production decline and subsequently closure of large emission sources (Coke Production Bakar, Sisak Ironworks, and Aluminium Factory Šibenik).

In accordance to Ordinance on Air Quality Classification of areas and populated areas (Official Gazette 68/08) Republic of Croatia is divided into 6 inhabited areas that include urban and industrial areas (Zagreb, Sisak, Kutina, Rijeka, Osijek and Split) and 7 other areas. In the largest part air quality is of 1st category concerning content of sulphur dioxide (SO_2), carbon monoxide (CO) and benzene. Limit values for nitrogen oxides (NOx) and particles (PM10) are primarily due to intensive traffic in Zagreb, Osijek and Rijeka. Ozone concentration is increased in the coastal area. In industrial zones larger sources of air pollution referring to specific parameters H_2S and NH_3, are recognised in oil refinery Sisak and Rijeka as well as petrochemical installation „Petrokemija" in Kutina.

Air Protection Act (Official Gazette 178/04 and 60/08) prescribes that in the case of air-quality in some area reaches 2nd category air quality an Air Pollution Reduction Plan to reach limit values must be drawn.

In the area of 3rd air-quality category one must establish a Recovery Programme for stationary pollution source as well as a implementation deadline for this Programme. In the areas where 3rd air-quality category is a consequence of many small point sources (traffic, house heating, etc.) comprehensive Recovery

Programme must be made. Polluters are obliged to apply and financially support pollution prevention and abatement measures.

2.5.2 Inland waters

Croatia is relatively rich in water resources, and has relatively big rivers as well as the karst area that is especially important for the water regime. Volume of waters is estimated roughly at 7 000 m^3 annually per capita while taking into account the border and cross-border waters, not including the rivers of Danube and Neretva, it is approx. 17 000m^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. 43% 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 tank. The quality of most of the rivers is one level below desired. Croatia has a small number of water treatment plants. Only a few smaller towns (Daruvar, Đurđevac, Gospić, Virovitica) have mechanical and chemical-biological wastewater treatment plant, while from bigger towns only Zagreb has central facility for mechanical wastewater treatment. A level of settlements' connection to waste water treatment plants is following: there are 38 plants with pre-treatment, 24 with first degree of treatment, 46 with the second degree treatment and only one with third. Furthermore, out of 28% of waste water that is directed to waste water treatment plants 43% is pre-treated and treated in the first degree, and 57% on the second degree (source: Water Management Strategy).

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

The quality of surface and underground water did not significantly change in the past five years. Most of the surface waters belong to the quality category II and III. Due to increased population and industrial development pollution stress is more present in Black Sea river runoff than the Adriatic one.

Waste industrial waters are emitted into public sewage system or tank with or without treatment. 30% of the total industrial waste water is released to the sewage system with no treatment whatsoever. Chemical and petrochemical industries emit majority of the industrial waste waters while wood processing industry and food industry release waste water with the greatest level of pollution load. Agriculture and traffic are greatest dispersed pollution sources; however their systematic impact monitoring does not exist. Tran boundary pollution sources are not significant and have local character only. Transboundary pollution is addressed within bilateral agreements.

2.5.3 Waste Management

13.0 million tons of waste is generated annually in Croatia (3.0 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.

In accordance to Waste Management Plan for Republic of Croatia in the period of 2007 - 2015 (Official Gazette 85/07) organised municipal waste collection encompasses 92% of the population. 98% of collected waste is disposed on 160 official large landfills that are, with rare exceptions, built with no basic protection measures. 80 landfills also take hazardous waste and 40 of them damage to the environment has been established. Only seven landfills have working permits. Methane emissions from the landfills make 4,5% of total greenhouse emissions in Croatia. Though problems of industrial and hazardous waste no hazardous waste landfill has been built.

Introduced economic instruments include stress to environment fee introduced in 2004, packaging disposal fee introduced in December 2005, as well as fees that discourage single use package and encourage multi-use package. Amount of produced municipal waste on the territory of Croatia annually is assessed at 1,31 million tonnes. Waste produced in tourism is 44.362 t, waste collected separately sums to 26.937 t, and composed green waste produced amounts to 15.000 t. Waste disposed to landfills is assessed at 1,04 mil. t. Municipal waste collected separately (paper cardboard, glass, PET packages, soft drinks and other beverages tin cans, household appliances) is organised in all Counties counting approximately 50 cities and over hundred municipalities, but with various intensity. Waste collection is organised based on so called „hold system"

through out Croatia, meaning various waste components are disposed in various containers; to containers, recycling points, recycling yards, through systems for collection of biodegradable waste, etc. On the territory of Croatia there are seven recycling yards, approximately 4000 paper collecting containers, approximately 4000 glass packaging collecting containers, approximately 1.300 PET packaging and 600 containers for beverage tin cans.
In accordance to Waste Management Plan for Republic of Croatia in the period of 2007 - 2015 (Official Gazette 85/07) 74,5% of waste is composed of biodegradable waste. In other words, it was estimated that 756.175 t of biodegradable waste was produced in 1997.

2.5.4 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. 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.

2.5.5 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.

2.5.6 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 eutrophication. The “algae blooming” was also registered in some part of the Central Adriatic. In accordance to Data and Indicators on Marine Environment, Fishery and Mariculture Database (ran by Croatian Environmental Agency), data on algal blooming are available for years from 1998 till 2007. For the time being data is being collected within the Jadran Project.

The North Adriatic rivers have the greatest impact on the concentration of nutrients, the river Po contributing more than half of the total amount of phosphor and nitrogen, i.e. circa 75% of inorganic nutrients. 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 % goes to waste water treatement plants. The greatest threats to the coastal area are forest fires.

2.5.7 Chemicals management

Implementation of The Law on Chemicals started on December 21, 2005. It improved the existing legal basis and eliminates 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 are growing steadily, but still not quickly enough.

2.5.8 Transport

Most of the transport is conducted 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 carries 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.

2.5.9 Cleaner Production in Environmental Protection

No mechanisms for stimulating adjustments of the economy to a cleaner production have been developed. A relatively small number of companies have introduced the ISO 9000 quality system, while ISO 14000 even less so. 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.

2.5.10 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 genetically modified food in Croatia.

2.5.11 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.

2.5.12 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. In 2003 Croatian Parliament adopted a Law on Protection from Noise (Official Gazette 20/03) that established noise protection measures on land, sea and air, as well as monitoring of implementation measures for abatement or decreasing of noise.

2.6 Environment and public health

The air, water and soil pollution, inadequate waste treatment as well as excessive noise and exposure to ionising and non-ionising radiation may cause an increase of the sick, meaning a deterioration of the sick population condition. It is estimated that the harmful quality of drinking water affects the health of 10-15 % of the Croatian population. The recent war has left also a specific danger: minefields. It is estimated that more than 10% of the national territory is mined. Drinking water from public water suppliers is regularly controlled by public health services, disease prevention inspection and public health laboratories. The results show that less than 10% (7,2 – 9,5 %) of samples taken state-wide and continuously.

2.6.1 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. At this moment more than 230 landfills are in the process of recovery. There are also projects for packaging, tyres, oil and car wrack collection implemented. In 2007, along with adopting Ordinance on Medical Waste Management (Official Gazette 72/07), collection of medical waste commenced.

The air quality will be improved by using fuels with reduced content of lead and sulphur concentration, and by redirecting goods and travellers to ecological transportation.

In 2007 Croatian Government recognised renewable energy sources as one of priorities in environmental protection; the same year there was 500 kilometres of gas-pipeline built which made gas, as the most acceptable ecological fuel, accessible in most of the Country. Making gas available in Dalmatia is the next step. Wind turbine generators have been allocated mostly in the coastal area while two factories of bio fuels have been opened (In Ozalj and Virovitica) (source: www. vlada.hr)

3 INSTITUTIONAL 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.

3.1 Environmental and sustainable development policy in Croatia

The environmental protection policy is within the competence of the Ministry of Environmental Protection, Physical Planning and Construction while the Ministry for Regional Development, Forestry and Water Management is competent for protection and management of waters. Environmental protection legislation consists of laws, regulations and ordinance. 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: *Environmental Protection Act, Air Protection Act, Regulation on Limit Value Emission of Pollutants into Air from Stationary Sources, Waste Act, Ordinance on waste management, Water Act, Regulation on Water Classification, Regulation on Hazardous Substances in Water, Ordinance on Indicator Limit Values Indicators of Hazardous and Other Substances in Waste Waters, Law on Chemicals, Plant Protection Act.*

The most important laws concerning the environmental protection in Croatia are as follows: National Environmental Protection Strategy (Official Gazette hereinafter referred as to OG 46/02), Environmental Protection Act (OG 110/07), Air Protection Act (OG 178/04, 60/08), Air Quality Protection and Improvement Plan in the Republic of Croatia for 2008 – 2011 (OG No. 61/08), Waste Management Strategy (OG 130/05), Waste Act (OG 178/04, 11/06, 60/08), Water Management Strategy (OG 91/08) and Water Act (OG 107/95, 150/05).

3.1.1 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.

3.1.2 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.

3.1.3 Environmental Protection Act

Environmental Protection Act (Official Gazette 110/07) regulates environmental protection principles and sustainable development principles, environment components' protection and environmental stress protection. Furthermore it regulates environmental protection entities, sustainable development and environmental protection documents, environmental protection instruments, environmental monitoring, information system, access to information on the environment, access to justice in the environmental issues, public participation in the environmental issues, responsibility for environmental damage, funding and general policy instruments in environmental protection as well as administrative and inspection control.

General goal of the Act is ensuring comprehensive protection of environmental quality, safeguarding biodiversity and diversity of the landscape, rational use of natural resources and energy in the best environmental practice, providing basic condition for healthy living and sustainable development. Act defined Environment as general good of interest with special protection from Republic of Croatia. Act regulates that in environmental interventions should not be influence on living quality, healthy living, plant and animal life in accordance with sustainable development.

Apart form articles of this Act dealing with requirements of Aarhus Convention, one of the most important novelties is definition of integrated environmental protection conditions as a result of EU IPPC Directive requirements (Directive 2008/1/EC). In practice, it means that every company have to obtain integrated environmental protection conditions in accordance to the Environmental Protection Act before building and operation commencing, reconstruction or significant change in production that could cause emissions to air, soil and sea. Integrated environmental protection conditions are defined with a goal of comprehensive environmental protection using prevention, reduction and to greatest extent pollution elimination primarily on its source as well as ensuring carefully planned resources management and establishment of sustainable equilibrium between human act and socio-economical development on one side, and natural resources and regenerative abilities of the nature on the other. The Act also contains articles that regulate prevention of large scale accidents that would include hazardous substances and in which procedures and ordinances are in compliance with SEVESO II Directive (*96/82/EC*)

3.1.4 Air Protection Act

Air Protection Act (Official Gazette 178/04, 60/08) determines measures, organisation, implementation and monitoring and improvement of air quality. Air quality, being one of the environmental components of public value, has special protection of Republic of Croatia. Protection and improvement of air quality with the goal

of sustainable development, is based on basic environmental protection principles defined in Environmental Protection Act as well as requirements of the international law.

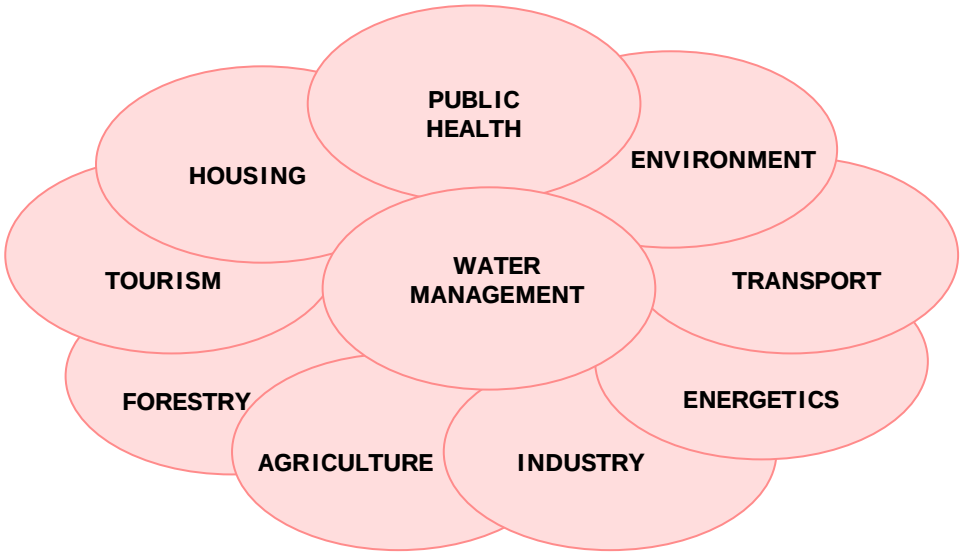
The Act regulates basic goals of air protection, plan documents and public participation in their making; monitoring and affirming air quality on state and local level, classification of areas in accordance to established air quality, registering and monitoring of point sources, conducting expert work on monitoring of air quality, abatement measures, economic instruments, control, incompliance and fines.

Air Quality Protection and Improvement Plan in the Republic of Croatia for 2008 - 2011 (OG 61/08) is the Air Protection Strategy implementing document as well as integrated part of the Environmental Protection Strategy. The Plan encompasses principles and criteria for defining goals and priorities, air quality improvement assessment, air quality protection and improvement aims and measures, including intersect oral measures, priority measures, activities and dynamics of measures implementation with cost and benefits analysis. Plan takes up all the existing measures and upgrades them with additional measures that analysis pointed out as indispensable for fulfilling the Plan's aims since they were not, in this point in time, based in any valid regulations, are being prepared of transposed form the EU *Acquis*.

3.1.5 Water Management Strategy

Primary aim of water management is drafting of plan documents for water management including those resulting from approximation to European Union. The drafting is taking into consideration positions and politics of Croatia on the development as well as Constitution and laws that determine place and role of water in the society which derive the following principles:

– Waters are general good with special protection from Republic of Croatia and cannot be owned;
– Waters are irreplaceable condition to life and work and should be used only in accordance to legally determined conditions;
– Total water wealth that and sin disposal to Republic of Croatia is valuable natural and development resource and it should be managed in rational and sustainable manner;
– Total need for water and managed water regime need to be equally and just fully fulfilled countrywide;
– criteria and priorities in water management need to be established on the state level, starting with obligations of integral environmental protection and reaching general, economic.



WATER MANAGEMENT COORELATION TO SOCIO-ECONOMIC ENVIRONMENT

3.1.6 Water Act

Water Act regulates legal status of water and water resources, modality and conditions of water governance (use of waters, water protection, management of rivers and other waters as well as protection form the

adverse water impacts), organisational and application modality of work and tasks of water management; basic requirements for conducting operations in water management; authority and obligations of state authority and other state bodies, municipalities and other legal entities as well as other issues related to water management.

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

3.2.1 Monitoring of individual compounds

3.2.1.1 POPs Pesticides

Ministry of Agriculture, Fishery and Rural Development (MAFRD) is the central body for management of POPs pesticides by issuing licences and use requirements.

Ministry of Health and Social Welfare (MHSW) is responsible for issuing of:

- import licence for active substances used for formulation of various pesticides if classified as dangerous chemicals,
- import licence for finished pesticides formulations in the public health field if classified as dangerous chemicals,
- decisions on releasing biocide preparations to the market

The same Ministry is also responsible for determining the maximum permitted values of pesticides that products may contain when is placed the market, and a licence for its household use.

Ministry of Agriculture, Fishery and Rural Development is competent for the registration, i.e. for issuing a trade permits for plant protection products, and trade permit for animal parasite control products 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.

"Hrvatske vode" issues permits for substances that could end up in waters.

3.2.1.2 PCBs

Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC) and State Inspectorate (SI) are responsible for the management of devices containing PCBs and liquids containing PCBs. Inspectors of occupational safety within the State Inspectorate 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.

Croatian Environmental Agency (CEA) is running a registry of delivered forms in accordance to Ordinance on Polychlorinated Biphenyl and Polychlorinated terphenyls (OG 105/08).

3.2.1.3 PCDD/PCDF, HCB and PCBs

Emission control of PCDD/PCDFs, HCBs and PCBs is in competence of the Ministry of Environmental Protection, Physical Planning and Construction as well as the Ministry of Economy, Labour and Entrepreneurship (MELE).

Republic of Croatia became a Party to the 1979 Convention on Long-Range Transboundary Air Pollution (The LRTAP Convention) as well the Convention Protocol on Monitoring and Evaluation of Long-Range Transmission of Air Pollutants in Europe (EMEP Protocol) in 1991. As a result of that the Republic of Croatia became obliged to establish its annual emissions of air pollutants in the territory.

Air Emission Inventories on the territory of Republic of Croatia is responsibility of Environmental Protection Agency.

Emissions calculations encompass eleven main sectors and polluting compounds (SO_2, NOx, CO, NMVOC, NH_3), particles (TSP, PM_{10}, $PM_{2,5}$), heavy metals (Cd, Pb, Hg, As, Cr, Cu, Ni, Se and Zn) and persistent organic pollutants (PAH, HCH and DIOX).

This report serves as a document for fulfilling obligations of Republic of Croatia towards international agreements and as a basic indicator of implemented measures aiming at reduction of air pollutants.

The Labour and market Department within the Ministry of Economy, Labour and Entrepreneurship is authorised for drafting regulations on working environmental parameters:

1. Safety at Work Act (OG, No. 59/96, 94/96, 114/03, 100/04, 86/08 and 116/08)
2. Safety at Work Working with Polychlorinated Biphenyls Polychlorinated Naphthalene and Polychlorinated Terphenyls Ordinance (OG, No. 7/89)
3. Ordinance on Atmospheric Pollutants Allowed Limits in Working Rooms and Spaces, and Biological Limit Values (OG, No. 92/93)
4. Ordinance on Safety at Work Business Conditions for Legal Entities (OG, No. 114/02 and 126/03)
5. Ordinance on Working Environment, Machinery and Hazardous Appliances Inspection (OG, No. 114/02 and 126/03)

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

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

- control of level assessment and comparison with levels prescribed by laws, ordinances 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 inspection of analytical procedures are performed from time to time.

Research institutes (Institute of Medical Research and Occupational Health, and Institute Ruđer 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.

However, considering the number of compounds, the unevenly results are probably due to the municipal laboratory equipment conducting analyses.

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.

For that slugs/matrix that legislation and ordinances request testing before use quality of analytical procedures is also examined. Analysis of PCBs content in waste oils and fuel oils is one of those cases. The analytical procedure has been examined by the Croatian State Office for Metrology (CSOM). In the scope for their work the Office is currently examining and adopting standards for sampling, processing and analysis of different types of samples which will unify analysis methodology of different kinds of samples, especially those with control quality purpose. In research work, as anywhere in the world, there is a freedom in choice of sampling and analysis methodology depending on the research goals. However, all methods have to be validated in accordance to accepted international criteria.

3.2.2.1 Water monitoring

Croatian Waters monitor concentration of organochlorine pesticide in waters (rivers and accumulation water). However, results are not equable with regard to number of tested compounds. That is probably caused by a difference in abilities of regional laboratories performing the analysis. Beside stated, Croatian Waters monitor quantities of PCBs in sediments and biota on measurements stations: in rivers Kupa and Sava as well as in sediments of rivers Mirna, Raša, Neretva, Cetina, Jadra, Krka and Zrmanja.

Ministry of Regional Development, Forestry and Water Management issues water permits for circulation of chemicals that may enter in water.

Although the systematic monitoring of pesticides concentration in sea sediment (as well as in organisms) has not been performed, according to new Marine Strategy Directive it will necessary to conduct continuous monitoring in sea as well.

3.2.2.2 Monitoring in samples of animal origin

A comprehensive monitoring of POP compounds in samples taken from the environment, food or people does not exist in Croatia. Partial monitoring programme for tracking levels of certain POPs compounds in animal origin samples was organized by the Ministry of Agriculture, Fishery and Rural Development on national level.

3.2.2.3 Food monitoring

Physical and chemical analysis of pesticides and their residuals in food conducts Croatian Institute of Public Health (CIPH), while the residual of pesticides in food is determined by County Institutes for Public Health. For systematic monitoring of all pesticides, including the pesticides belonging to a group of persistent organic pollutants there are no obligatory regulations, and therefore there is no institutional authority over the issue.

3.3 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 field of environmental protection, 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.

3.4 International conventions and agreements

The Republic of Croatia has signed some thirty international conventions and agreements having various implications.

International Treaties Ratified by the Republic of Croatia

A. General

- Convention of Environmental Impact Assessment in a Transboundary Context (ESPOO 1991)

  Published in the Official Gazette – International Treaties, hereinafter referred to as OG-IT No. 6/96 and entered into force as regards The Republic of Croatia – September 10, 1997
- Protocol on Strategic Environmental Assessment (Kiev 2003)

  The Republic of Croatia signed the protocol in 2003.
- Convention on Transboundary Effects of Industrial Accidents (Helsinki 1992)

  Published in the OG-IT No. 7/99 and entered into force as regards The Republic of Croatia – April 19, 2000 (OG-IT 10/01)
- Protocol on Pollutant Release and Transfer Register (Kiev 2003)

  The Republic of Croatia signed the protocol in 2003.
- Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus 1998), OG-IT 01/07
- Rotterdam Convention On the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticide in International Trade OG-IT No. 04/07

B. Climate change

- United nations Framework Convention on Climate Change

  Published in OG-IT No. 2/96, entered into force as regards The Republic of Croatia – July 7, 1996
- The Kyoto Protocol to the Framework Convention on Climate Change (Kyoto 1999)

  Published in OG-IT No.05/07, entered into force as regards The Republic of Croatia – August 27, 2007

C. Atmosphere

- Convention on Long-range Transboundary Air Pollution (Geneva 1979)

  Pursuant the notification on succession, the Republic of Croatia became a party to the Convention on 8 October 1991 (OG- IT 12/93).
- 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) (Geneva 1984)

  Pursuant the notification on succession, the Republic of Croatia became a party to the Convention on 8 October 1991 (OG- IT 12/93).

- Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Further Reduction of Sulphur Emissions (Oslo 1994)

  Published in OG–IT No. 17/98 corrigendum, 3/99 - came into force with respect to the Republic of Croatia on 27 April 1999.

- Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to the 1979 Convention on Long-range Transboundary Air Pollution (Goeteborg 1999); it was published in OG-IT No. 04/08 and came into force on 5 January 2009.

- Protocol on the 1979 Convention on Long-range Transboundary Air Pollution Concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes

  Published in OG–IT No. 10/07 came into force with respect to the Republic of Croatia on 1 June 2008

- Convention on Long-range Transboundary Air Pollution Concerning the Control of Emissions of Nitrogen Oxides or Their Transboundary Fluxes

  Published in OG–IT No. 10/07 came into force with respect to the Republic of Croatia on 1 June 2008

- Protocol to the 1979 Convention on Long-range Transboundary Air Pollution of Heavy Metals (Aarhus 1998)

  Published in OG_IT No.10/07, came into force with respect to Republic of Croatia on 1 June 2008 (OG_IT No. 2/08).

- Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Persistent Organic Pollutants (Aarhus 1998)

- Published in OG_IT No.05/07, came into force with respect to Republic of Croatia on 5 December 2007 (OG_IT 9/07)

- Stockholm Convention on Persistent Organic Pollutants (Stockholm 2001)

  Published in OG_IT No.11/06, came into force with respect to Republic of Croatia on 30 April 2007 (OG_IT 2/07)

- Vienna Convention for the Protection of the Ozone Layer (Vienna 1985)

  Pursuant the notification on succession, the Republic of Croatia became a party to the Convention on 8 October 1991 (OG- IT 12/93).

- Montreal Protocol on Substances that Deplete the Ozone Layer, (Montreal 1987)

  Pursuant the notification on succession, the Republic of Croatia became a party to the Convention on 8 October 1991 (OG- IT 12/93).

- Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (London 1990)

  Published in OG–IT, No. 11/93 came into force with respect to the Republic of Croatia on 13 January 1994.

- Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (Copenhagen 1992)

  Published in OG–IT, No. 8/96 came into force with respect to the Republic of Croatia on 12 May 1996.

- Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal 1997)

  Published in OG–IT, No. 10/00, came into force with respect to the Republic of Croatia on 7 December 2000, and the effective date was published in OG-IT 14/00.

- Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (Beijing 1999)

  Published in OG–IT, No. 12/01, came into force with respect to the Republic of Croatia on 24 July 2004.

D. Sea

- Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona 1976)

  Pursuant the notification on succession, the Republic of Croatia became a party to the Convention on 8 October 1991 (OG- IT 12/93).

- Protocol for the Prevention and Elimination of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft (Barcelona 1976)

  Pursuant the notification on succession, the Republic of Croatia became a party to the Convention on 8 October 1991 (OG- IT 12/93).

- Amendments to the Convention for the Protection of the Mediterranean Sea against Pollution

- (Barcelona, 1995), Published in OG–IT, No. 17/98, came into force with respect to the Republic of Croatia on 9 July 2004.

- Amendments to the Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft or Incineration at Sea (Barcelona 1995), Published in OG–IT, No. 17/98, came into force with respect to the Republic of Croatia on 9 July 2004.

- Protocol Concerning Cooperation on Preventing Pollution from Ships and, in Cases of Emergency, Combating Pollution of the Mediterranean Sea (Malta 2002), Published in OG–IT, No. 12/03, came into force with respect to the Republic of Croatia on 17 March 2004

- Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean. (Barcelona 1994 and Monaco 1995)

  Published in OG–IT, No. 11/01, came into force with respect to the Republic of Croatia on 12 May 2002

- Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources (Athens 1980)

  Pursuant the notification on succession, the Republic of Croatia became a party to the Convention on 8 October 1991 (OG- IT 12/93).

- Protocol for the Protection of the Mediterranean Sea against Pollution From Land-Based Sources and Activities (Syracuse 1996), OG 3/2006

- Protocol for the Protection of the Mediterranean Sea against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Sub-Soil (Madrid 1994)

- Protocol on the Protection of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal (Izmir 1996), Republic of Croatia has not signed the Protocol.

- Act on Ratification of Amendments to Protocol for the Protection of the Mediterranean Sea against Pollution From Land-Based Sources and Activities (Syracuse 1996) OG-IT No. 3/06

- Protocol on Integrated management of Mediterranean Coastal Area (Barcelona 2008)

  Republic of Croatia has signed the Protocol.

E. Soil

- United Nation Convention to Combat Desertification in Countries Experiencing Serious Draughts and/or Desertification , Particularly in Africa, (Paris 1994)

  Published in OG–IT No. 11/00 came into force with respect to the Republic of Croatia on 4 January 2001

F. Waste

- Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal (Basel 1992)

  Published in OG–IT No. 3/94 came into force with respect to the Republic of Croatia on 7 August 1994.

G. Water

- Convention on Protection and Sustainable Use of Danube River Cooperation (Sofia, 1994) OG 2/96
- Convention on Protection and Use of Transboundary Waterways and International Lakes (Helsinki 1994), published in OG-IA No. 4/96 and Protocol on Water and Health published in OG-IT No. 4/2006.

3.5 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 (OG-IT 2/96).

3.6 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.

3.7 Legislation and regulation addressing POPs (manufactured chemicals and unintentionally produced POPs)

Currently, there are no POP compounds productions in Croatia, nor they are 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. In the field of unintentional POPs formation and release there is legal obligation for industry and industrial processes (potential sources of chemicals in Annex C of the Stockholm Convention) to apply BAT - Best Available Techniques.

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

3.8 Management of POPs chemicals, implementation and management control

Law on Chemicals (OG 150/05 and 53/08) 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 persons producing, dealing with and using chemicals in Croatia have to fulfil. 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. This Law includes also POPs chemicals listed in the Convention.

4 CURRENT POPS AFFAIR ASSESSMENT IN THE REPUBLIC OF CROATIA

The present situation in Croatia concerning the POPs management is not satisfying and does not treat equally all 12 compounds/groups of compounds 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.

4.1 POPs pesticides - Annex A, Part I of the Stockholm Convention

In the case of chemicals listed in Annex A – Part I, the necessary institutional and legal frameworks for the implementation and application of the Convention exist, and currently there is no production of these chemicals or it is planned. The use, application and production of these chemicals in Croatia are prohibited by law.

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, hexsachlorbenzene, chlordane, heptachlor, aldrin, dieldrin, eldrin, 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 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 rodenticides)	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 Croatia.	

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

*In accordance to List of Poisons Whose Production, Trade and Use Is Prohibited (OG 29/05), lindane is banned not earlier than 2005. In 1972 ordinance lindane is prohibited only in some plant protection substances.

In adopting 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.

4.1.1 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 repel pest in wood and textile and
- as accessories for general use (sprays and other formulations for household usage with the minimum quantity of active substances in pesticide).

Pesticides are put into circulation in compliance with regulations of several various laws and ordinances 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
Ordinance On Mandatory Requirements For Legal Persons Performing Wholesale Or Retail Of Plant Protecting Agents, And Training Methods And Procedures For Employees Guarding And Issuing Plant Protecting Agents *OG 40/96, 96/98, 155/04, 08/06*
Ordinance On Integral Requirements For Evaluation And Registration Of Plant Protecting Agents *OG 116/06, 80/07*
Ordinance On Registration Procedures For Plant Protecting Agents *OG 57/07*
Ordinance on Plant Protecting Agents Labelling *OG 11/07*

Act on Plant Protecting Agents *OG 70/05*
Ordinance On Documentation For Evaluation Of Active Substance In Plant Protecting Agents *OG 53/06*
Ordinance On Documentation For Evaluation Of Plant Protecting Agents *OG 59/06*
Ordinance on Charges Level And Distribution of Funds Within the Registration of Plant Protecting Agents, evaluation of Active Substance and Plant Protecting Agents Permit Issue *OG 94/07*
Ordinance on Sampling Methods Regarding Application of Official Control of Pesticide Residues in And on Products *OG 77/08*
List of Active Substances Allowed to Use in Plant Protection Preparations in the Republic of Croatia *OG 80/08*
Register of Registered Plant Protecting Agents *OG 10/08*
Ordinance on Plant Protection Substances Assessment and Registration Documentation *OG 59/06*
Ordinance on Maximum Levels in Pesticides In Food For Humans and Animals *OG 119/07*
Ordinance On Mandatory Requirements For Legal Persons Performing Wholesale Or Retail Of Plant Protecting Agents, And Training Methods And Procedures For Employees Guarding And Issuing Plant Protecting Agents *OG 40/96, 96/98, 155/04, 08/06*
Ordinance On Registration Procedures For Plant Protecting Agents *OG 57/07*
Ordinance on Determination of Border Crossings for Plant Protecting Agents Transport *OG 21/08*
TOXINS/CHEMICALS
Biocide Preparations Act *OG 63/07, OG 38/08*
Ordinance on Documentation for Assessment of Active Substances in Biocide Preparations, Documentation for Assessment of Biocide Preparations, Procedures for Assessment of Biocide Preparations and their Use, and Types of Biocide Preparations Including Descriptions and integral principles for Biocide Preparation Assessment *OG 90/08*
Ordinance on the List of Active Substances in Biocide Preparations *OG 90/08*
Ordinance on the List of Existing Allowed Active Substances in Biocide Preparations *OG 90/08*
Ordinance on the List of Existing Prohibited Active Substances in Biocide Preparations *OG 90/08*
Ordinance on conditions concerning special measures of protection at work with toxins for legal persons using toxins in scientific research *OG No. 148/99*
List of toxins used for maintenance of communal hygiene, disinfecting, rodent control, removal of bad smell and decontamination *OG No. 151/02*
Ordinance on Minor Amounts of Poison Meant for Laboratory And Scientific Purposes *OG No. 39/03*
Act on Chemicals *OG 150/05, OG 53/08*
Ordinance on Procedures for Safety and Technical Sheet Fill-in *OG 111/06*
Ordinance on Hazardous Chemicals Registry Management and Registry Data Delivery Procedure *OG 113/06*
Ordinance on Special Conditions for Public Entities Involved in Production, Market and Use of Dangerous Chemicals and Conditions for Public and Private Entities Involved in Retail and Use of Dangerous Chemicals *OG 68/07*
Ordinance on New Substances *OG 61/07*
Ordinance on Classification, Labelling, Marking and Packaging of Chemicals *OG 23/08*
List of Hazardous Chemicals Whose Market is Prohibited or Limited *OG 17/06*
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade *OG – International Agreement No. 4/07*
Ordinance on Conditions, Knowledge Gain Modality and Examination on Poison Protection *OG 62/99*
Ordinance on Group I Poisons (Affecting Airborne) Storage Conditions and Modalities *OG 92/99*
WATERS
Water Act *OG No. 107/95*
Regulation on Hazardous Substances in Waters *OG No. 78/98*
National Plan for Water Protection *OG No. 8/99*
Regulation on Water Classification *OG No. 77/98*
Ordinance on Health Propriety of Potable Water *OG No. 47/08*
Water Act Amendments Law *OG 150/05*

VETERINARY MEDICINE
Law on Veterinary Medicines and Veterinary-medical Products *OG No. 79/98*
Ordinance on Quality Control Procedures for Veterinary Medicines, Curative Supplements and Veterinary-medical Products, Storage, and Quality Control Registry Keeping *OG No.* 148/99
List of Readymade Veterinary Medicines, Curative Supplements and Veterinary-medical Products Approved for Use *OG No. 73/00*
Law on Veterinary and Medical Products *OG 84/08*
Ordinance on Principles and Directives of Good Veterinary and Medical Products Producers' Practice *OG120/07*
Prohibiting Order on Use of Particular Veterinary Medicines on Animals in Human Food Chain *OG 120/07*
Annex to the List of Veterinary Medicines, Therapeutical Supplements and Veterinary and Medical Products Approved for Circulation *OG 119/07*
List of Veterinary Medicines, Therapeutical Supplements and Veterinary and Medical Products Removed form the List of Veterinary Medicines, Supplements and Veterinary and Medical Products Approved for Circulation *OG 119/07*
Veterinary Act *OG 41/07*
List of Veterinary Medicines, Therapeutical Supplements and Veterinary and Medical Products Removed form the List of Veterinary Medicines, Supplements and Veterinary and Medical Products Approved for Use *OG121/05*
Ordinance on Production, Circulation and Use Conditions for Therapeutical Animal Food *OG 101/05*
List of Veterinary Medicines, Therapeutical Supplements and Veterinary and Medical Products Removed form the List of Veterinary Medicines, Supplements and Veterinary and Medical Products Approved for Use *OG 159/04*
ENVIRONMENT
Environmental Protection Act *OG No. 110/07*
Waste Act *OG No. 178/04, 111/06, 60/08*
National Environmental Strategy *OG 46/02*
Environmental Protection Intervention Plan *OG 12/01*
Ordinance on Environmental Impact Assessment *OG 85/06*
AGRICULTURE
Agricultural Land Law *OG No. 66/01, 87/02, 90/05, 152/08*
Ordinance on Protection of Agricultural Soils From Harmful Substances *OG No.15/92*
Law on Plant Protection Agents *OG 70/05*
Law on Health of Plants OG *75/07*
List of Active Substances Allowed in Plant Protection Agents in Republic of Croatia *OG 8/08*
Registry of Registered Plant Protection Agents *OG 10/08*
Ordinance on Registry Procedure for Plant Protection Agents *OG 57/07*
Ordinance on Documentation for Evaluation and Registration of Plant Protection Agents *OG 59 /06*
Ordinance on Documentation for Evaluation of Plant Protection Agents *OG 53/06*

4.1.2 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 the market. It is necessary to emphasize that the amounts produced in Croatia during the 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 and up to the year 2000 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.

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 acceptable. 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 year^{-1}) in Croatia from 1962-1976**

Active substance	**Year**				
	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	**Year**				
	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	Year				
	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 (kg of active substance /year)**

	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

In the years 1945, 1946, 1953, 1967 and 1969 was not used

	Year										
	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 (active substance: kg/year) in Croatia in the period 1971-1975**

	Year				
	1971	1972	1973	1974	1975
Use of DDT	2 363	4 912	884	8 437	6907

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

	Year							
	1979	**1980**	**1981**	**1982**	**1984**	**1985**	**1986**	**1987**
Use of DDT	4	75	399	551	16 450	679	360	140

In the above mentioned period, the lands covered with 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 the POPs accumulation process in the environment. Due to the mentioned prohibitions and existing regulation currently POPs containing pesticides are not in use, furthermore their use is not feasible. In the process of use permit issuing for a particular pesticide the attention is paid towards avoidance oft he persistent ones.

POPs pesticides that contain active substance prohibited by the Convention are not used in the forestry. The practice of using plant protection agents containing POPs a component is prevented since those agents are not produced or in use in Republic of Croatia.

Ministry of Regional Development, Forestry and Water Management – Forestry Directorate runs the registry on plant protection agents, their quantities and active substances contained in every particular agent. Data are annually updated. In addition, the use permit compatibility with regulations of every age is regularly closely examined. Croatian Woods (Public Ltd.) and Forestry Institute in Jastrebarsko are the largest users of plant protection agents and they are exchanging data on their use with the Ministry in cooperative and ideal manner. DDT has been forbidden about forty years ago, however the use of DDT is registered, occasionally, in Forestry Institute, till 1986 though in symbolic quantities and for scientific purposes only.

4.1.3 Imports and exports of POPs pesticides

Given that Croatia does not produce POPs pesticides, there is no way of their export in any country of the world.

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 Social Welfare (MHSW) or Ministry of Agriculture, Fishery and Rural Development (MAFRD) and report to The Croatian Institute for Toxicology. The importer is obliged to announce the transfer of such a weight across the national border at least three days in advance. Importer is also obliged to maintain hazardous substances register and submit the register to Croatian Toxicology Institute. 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. 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 MHSW 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.

Republic of Croatia ratified the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade that came into power on 14 February 2008. The Convention promotes common responsibility and cooperation in international trade of certain hazardous chemicals and pesticides in concern for human health protection and environmental protection. The Convention ensures control and effective decision making on import and export of chemicals listed in the

Convention as well as efficient control of international trade on the mentioned. Amongst those chemicals are POPs pesticides and industrial chemicals.

4.1.4 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.

4.1.5 Current capacities/potentials for testing of POPs

It has to 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.

It is not needed to establish new laboratories but to strengthen existing ones.

4.1.6 Conclusion

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.

Analytical laboratories are not adequately except for analysis. It is necessary to provide funding for organisation of laboratories, equipment and adequately trained staff. 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.

4.2 PCBs - Annex A, Part II

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. Regarding PCB, changes in legislative and institutional regulations are recommended. 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.

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

4.2.1 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 preparation of 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 Health - Zagreb, Institute "Ruđer Bošković"- Zagreb, State Institute for Public Health and county Institutes for Public Health, etc.

Data of 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 were collected and compiled.

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

4.2.2 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:

- Ordinance on occupational safety regarding the substances containing polychlorinated biphenyls, polychlorinated naphthalene's and polychlorinated trephines (OG No. 7/89);
- Waste Act (OG No 178/04, 111/06, 60/08);

- Regulation on Categories, Types and Classification of Waste With a Waste Catalogue and List of Hazardous Waste (OG 50/05)
- Basel Convention on the Control of Transboundary Movements of Hazardous Waste and its Disposal (OG-IT No. 3/94);
- Law on Transportation of Hazardous Substances (OG No. 79/07);
- Ordinance on the Maximum Permitted Concentrations of Hazardous Matters in the Air of Working Premises and Areas and on Biological Limiting Values - (OG No. 92/93)
- Ordinance on Highest Levels of Pesticide Residues in Food and Animal Feed (OG 117/07)
- Ordinance on the Levels of Toxins, Metals, Metalloids and Other Hazardous Substances that can be Found in Food (OG No. 16/05)
- Ordinance on the Protection of Agricultural Land from Pollution with Harmful Substances (OG No. 15/92)
- Regulation on Hazardous Substances in Water (OG No. 78/98)
- Regulation on Water Classification (OG No. 77/98)
- Ordinance on Undesirable and Prohibited Substances in Animal Feed (OG 118/07)
- Law on Chemicals (OG 150/05, OG 53/08)
- List of Dangerous Chemicals Whose Transport Is Limited or Prohibited (OG 17/06)
- Ordinance on Waste Management (OG 23/07, OG 111/07)
- Ordinance on the Management of Polychlorinated Biphenyls and Polychlorinated Terphenyls (OG 105/08)
- Ordinance on Management of Waste Water Treatment Sludge Used in Agriculture (OG 38/08)

Until 2006 in Republic of Croatia there was no legal biding documents prohibiting import of PCBs or its use in closed systems. The new Law on Chemicals (OG 150/08 and 53/08) and List of Hazardous Chemicals with Prohibited or Limited Circulation (OG 17/06) prescribes that it is prohibited to circulate and use PCBs except in the cases of maintenance of existing installations until their end of use. In September 2008 the Ordinance on Polychlorinated Biphenyls and Polychlorinated Terphenyls Management was adopted (OG 105/08). The Ordinance envisaged final disposal of all PCB installation till 31 December 2010. In addition circulation of PCBs and PCB using equipment is also prohibited after 31 December 2010. The same Ordinance prescribes the obligation of all PCB equipment larger owners to submit the list of PCB equipment of volume larger than 5 dm^3 of volume to the authorised Ministry and the Croatian Environmental Agency

4.2.2.1 Legal framework for handling of the equipment with PCBs during their operation

«Ordinance on Occupational Safety Regarding the Substances Containing Polychlorinated Biphenyls, Polychlorinated Naphthalenes and Polychlorinated Terphenyls» (OG No. 7/89) is the only effective official act in the Republic of Croatia that regulates handling and labelling of the equipment with PCBs/PCTs and occupational safety measures in their respect. At special approval of the competent inspectorate this Ordinance also permits the use of PCBs in the closed systems in fire-protected areas.

Law on Chemicals (OG 150/05 and 53/08) and List of Hazardous Chemicals with Prohibited or Limited Circulation (OG 17/06) prescribes it is prohibited to put into circulation or/and use PCB except in the cases of already installed equipment till its end of use. In the same time, the prohibition on the import of PCB using equipment will be in power on 31 December 2010 (Ordinance on Polychlorinated Biphenyls and Polychlorinated Terphenyls Management OG 105/08).

4.2.2.2 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 Waste Act (OG No. 60/08), and the Ordinance on Waste Management (OG 23/07, OG 111/07,) while waste classification and categorization is performed according to the Regulation on Categories, Types and Classification of Waste With a Waste Catalogue And List of Hazardous Waste (OG 50/05)

Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste (OG 50/05) i.e. their part Waste Catalogue "transformers and capacitors with PCBs or PCTs" states 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 Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste (OG 50/05), relevant to the content of PCBs and halogen.

In 2005 the Regulation on Waste Categories, Type and Classification with a Waste Catalogue (OG 50/05) has been adopted. Waste containing PCB was not, even in this Regulation, integrated into a separate category, but categorised in several sub-categories;

- Waste under the code Q12 „Contaminated substances (e.g. oils contaminated with PCB/polychlorinated biphenyl, etc.) ",
- In the category A-10 as waste displaying one of the characteristics of hazardous waste listed in the Annex II of the Ordinance and containing PCB and/or PCT (e.g. dielectrics, etc.)
- In the category C32 as elements of the 1.B waste that makes them hazardous and displaying one of the characteristics of hazardous waste listed in the Annex II and containing PCB and /or PCT In category H13 as substances and preparations which, after disposal, can create other compounds d.g. in the process of draining and displaying one of the characteristics of hazardous waste listed in the Annex II (explosive, carcinogenic, etc.) Containing values of PCB in that case has to be above 100mg/kg dry substance.
- A1. Metal waste and wastes containing metal; A1180 Electric and electronic hardware and waste that contain components like large batteries, and batteries included into the List A, mercury circuits, cathode pipes glass and other covered glass as well as condensers of polychlorinated biphenyl's or those contaminated with elements listed in the List A (cadmium, mercury, led, polychlorinated biphenyl's) to the extent they show characteristics of the Annex II.3 group;
- A3180 Waste, substances and objects that contain, are composed of , or contaminated with terphenyls, polychlorinated naphthalene or polybrominated Biphenyls or any other polybrominated analogues of the chemical compounds in the concentration larger than 50mg/kg or more;
- C49 – compounds similar to polychlorinated dibenzo-furan
- C50 - compounds similar to polychlorinated dibenzo-para-dioxin ;
- C51 – carbohydrates and their oxygen, nitrogen and/or sulphur compounds if not otherwise stated in the Ordinance;
- RA. – Waste that predominantly contains organic compounds, but can contain metal and other inorganic materials: RA 010 Waste and objects that contain, are composed of, or are contaminated with polychlorinated terphenyls, polychlorinated biphenyls or any other polybrominated analogous of the chemical compounds in the concentration larger than 50mb/kg or more;
- RC- Waste that can contain inorganic or organic compounds; RC010 – every element from the same group as polychlorinated dibenzofurans; RC 020 – every element from the same group as polychlorinated dibenzodioxin.

According to the Waste Act (OG No. 178/04, 111/06, 60/08) the import of hazardous waste and hazardous waste contaminated with PCBs is prohibited.

In 1994 the Republic of Croatia ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal (OG-IT No. 3/94). By this Convention "waste materials and objects

containing or contaminated with polychlorinated biphenyls (PCB) i.e. polychlorinated terphenyls (PCT) i.e. polybrominated biphenyls (PBB)“ (label 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.

4.2.2.3 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 (OG No. 79/07). 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.

4.2.2.4 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.

Ordinance on the Maximum Permitted Concentrations of Hazardous Substances in the Air of Working Premises and Areas and on Biological Limiting Values (OG No. 92/93) specify limit values of polychlorinated biphenyls in working premises and give 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.

Regulation on Hazardous Substances in Waters (OG 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 Regulation on Water Classification (OG No. 77/98). Relevant to the type of water it ranges from 0.01-0.2 $\mu g\ L^{-1}$. Namely, concentration limit value for PCBs in waters class I is <0.01 $\mu g\ L^{-1}$, in waters class II 0.01-0.02 $\mu g\ L^{-1}$, in waters class III 0.02-0.04 $\mu g\ L^{-1}$, in waters class IV 0.04-0.2 $\mu g\ L^{-1}$ and in waters class V >0.2 $\mu g\ L^{-1}$.

Ordinance on the Protection of Agricultural Land from Pollution with Harmful Substances (OG 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.

Ordinance on the Toxins, Metalloids and Other Substances in Food (OG No. 16/05) specify permitted levels of polychlorinated biphenyls in the following foodstuffs:

Table 8. **Highest allowed quantities of PCBs in food**

Food	Highest allowed quantities of PCBs ng/g fat
Eggs and egg products	200
Poultry meet and products	200
Milk	
- fresh milk	100
- thermally processed	100
- milk products	100

Table 9. **Highest allowed quantities of PCBs in food**

Food	Highest allowed quantities of PCBs mg/kg
Food for infants and kids	0,2
Fish and shelves	2,0 *
Red meet	3,0 **

* Per eatable part
** Per quantity of fat

4.2.3 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, 26 transformers type 2 TBN 1600-12/K was 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). The use of PCB containing equipment is allowed till December 31, 2010.

4.2.4 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.

Data on volumes of PCBs in the closed systems were collected during inventory. According to them Croatia has:

22 859 capacitors 655 705 kg
311 transformers 735 900 kg

Total volume of PCBs in the closed systems in Croatia is 1 391 605 kg.

Before the PCBs inventory project the database contained approximately 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.

4.2.5 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 10 shows the number and weight of capacitors in use, damaged and for reserve by each county.

Table 10. **Number and weight of the capacitors in use, damaged and for reserve by counties**

COUNTY	Number/pieces				Weight/kg			
	In use	Damaged	Backup	Total	In use	Damaged	Backup	Total
Zagrebačka	2411	205	129	2745	97.116,3	2.647,1	8.284,8	108.048,2
Krapinsko-zagorska	397	43	1	441	13.685,6	1.321,2	44,0	15.050,8
Sisačko-moslavačka	2406	274	8	2688	34.249,6	1.937,8	262,1	36.449,5
Karlovačka	811	67	24	902	28.044,3	11.607,8	1.868,0	41.520,1
Varaždinska	493	13	12	518	10.281,9	561,0	516,0	11.358,9
Koprivničko-	686	59	44	789	14.204,1	2.065,6	1.214,6	17.484,3
Bjelovarsko-	683	26	29	738	11.772,2	790,4	661,2	13.223,8
Primorsko-goranska	1804	338	196	2338	66.722,8	5.813,4	5.340,5	77.876,7
Ličko-senjska	60	2	0	62	0	0	0	0
Virovitičko-podravska	225	9	0	234	8.284,8	431,4	0,0	8.716,2
Požeško-slavonska	813	14	9	836	22.013,4	393,1	257,8	22.664,3
Brodsko-posavska	3262	165	17	3444	86.588,4	4.519,0	851,8	91.959,2
Zadarska	520	8	31	559	12.740,9	223,4	411,1	13.375,4
Osječko-baranjska	1368	21	203	1592	59.669,6	343,8	6.618,0	66.631,4
Šibensko-kninska	522	132	59	713	26.604,0	5.328,0	2.491,0	34.423,0
Vukovarsko-srijemska	147	12	2	161	3.155,6	358,8	57,0	3.571,4
Splitsko-dalmatinska	2032	546	147	2725	46.137,3	3.080,2	3.230,8	52.448,3
Istarska	445	28	27	500	10.416,2	531,6	1.078,8	12.026,6
Dubrovačko-	205	7	17	229	10.472,2	200,8	474,8	11.147,8
Međimurska	620	23	2	645	16.896,0	748,0	86,0	17.730,0
TOTAL	19910	1992	957	22.859	579.055,2	42.902,4	33.748,3	655.705,9

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. 579 055,2 kg. Damaged equipment accounts for 8.7 % i.e. 1992 pieces i.e. 42 902,4 kg and the stockpiles account for 4.2%, i.e. 957 pieces i.e. 33 748,3 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-Dalmatia, 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-Dalmatia.

The smallest number of capacitors can be found in Lika-Senj County (60 pieces in use, 2 pieces damaged), however their weight remains unknown; followed by Vukovar-Srijem county and Dubrovnik-Neretva County.

Table 11 shows the number and weight of transformers in use, damaged and for reserve by each county.

Table 11. **Number and weight of the transformers in use, damaged and for reserve by counties**

	Number/pieces				Weight/kg			
COUNTY	In use	Damaged	Backup	Total	In use	Damaged	Backup	Total
Zagrebačka	30	0	0	30	28.750,0	0	0	28.750,0
Krapinsko-zagorska	0	0	0	0	0	0	0	0
Sisačko-moslavačka	57	0	0	57	244.874,0	0	0	244.874,0
Karlovačka	108	0	12	120	261.889,0	0	57.680,0	319.569,0
Varaždinska	4	0	0	4	4.970,0	0	0	4.970,0
Koprivničko-križevačka	1	0	0	1	102,0	0	0	102,0
Bjelovarsko-bilogorska	0	0	0	0	0	0	0	0
Primorsko-goranska	12	0	0	12	27.110,0	0	0	27.110,0
Ličko-senjska	0	0	0	0	0	0	0	0
Virovitičko-podravska	3	0	0	3	4.070,8	0	0	4.070,8
Požeško-slavonska	0	0	0	0	0	0	0	0,0
Brodsko-posavska	19	0	1	20	41.460,0	0	0	41.460,0
Zadarska	1	0	0	1	950,0	0	0	950,0
Osječko-baranjska	23	0	1	24	29.690,0	0	0	29.690,0
Šibensko-kninska	2	0	0	2	3.990,0	0	0	3.990,0
Vukovarsko-srijemska	0	0	0	0	0	0	0	0
Splitsko-dalmatinska	4	0	0	4	2.302,0	0	0	2.302,0
Istarska	23	0	0	23	21.180,0	0	0	21.180,0
Dubrovačko-neretvanska	8	0	1	9	4.800,0	0	0	4.800,0
Međimurska	1	0	0	1	2.060,0	0	0	2.060,0
TOTAL	296	0	15	311	678.201,8	0	57.680,0	735.877,8

Status analysis of the transformers shows that the majority transformers are in use and account for 95.1 % i.e. 289 pieces i.e. 670 997,8 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 questionnaire, it does not mean that there is no transformer.

4.2.5.1 Equipment analysis by age

Tables 12 and 13 show the number, weight of capacitors and manufacturing years, which served as the basis for determining their replacement deadlines.

Table 12. **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
Zagrebačka	328	329	1.219	518	2	33	316	2.745
Krapinsko-zagorska	89	137	158	28	6	0	23	441
Sisačko-moslavačka	1.139	190	1.104	95	21	0	139	2.688
Karlovačka	65	217	486	18	0	0	116	902
Varaždinska	62	63	141	216	0	0	36	518
Koprivničko-križevačka	513	96	112	68	0	0	0	789
Bjelovarsko-bilogorska	182	62	276	198	0	0	20	738
Primorsko-goranska	325	503	746	248	47	0	469	2.338
Ličko-senjska	0	0	62	0	0	0	0	62
Virovitičko-podravska	19	55	114	36	10	0	0	234
Požeško-slavonska	25	38	640	106	11	0	16	836
Brodsko-posavska	2.430	22	749	210	15	0	18	3.444
Zadarska	88	422	13	34	0	0	2	559
Osječko-baranjska	676	156	418	132	91	3	116	1.592
Šibensko-kninska	0	695	18	0	0	0	0	713
Vukovarsko-srijemska	4	4	129	0	0	0	24	161
Splitsko-dalmatinska	932	317	950	359	30	0	137	2.725
Istarska	33	157	95	48	27	0	140	500
Dubrovačko-neretvanska	0	0	101	90	0	0	38	229
Međimurska	66	15	245	308	0	0	11	645
TOTAL	6976	3478	7776	2712	260	36	1621	22.859

Table 13. **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
Zagrebačka	10.696,1	6.508,2	77.302,8	9.567,8	30,0	16,5	3.926,8	108.048,2
Krapinsko-zagorska	2.597,2	5.315,6	5.478,8	567,8	360,0	0	731,4	15.050,8
Sisačko-moslavačka	3.880,8	3.559,4	26.243,0	112,5	323,4	0	2.330,4	36.449,5
Karlovačka	1.059,8	2.416,2	30.547,6	1.302,0	0	0	6.194,4	41.520,0
Varaždinska	63,0	426,8	5.610,6	4.610,5	0	0	648,0	11.358,9
Koprivničko-križev.	8.835,5	3.307,1	2.504,1	2.837,6	0	0	0	17.484,3
Bjelovarsko-bilogorska	2.426,6	2.905,2	5.437,8	2.454,2	0	0	0	13.223,8
Primorsko-goranska	4.497,9	18.440,8	30.886,5	5.814,6	2.163,0	0	16.073,9	77.876,7
Ličko-senjska	0	0	0	0	0	0	0	0
Virovitičko-podravska	583,8	1.563,6	5.263,2	825,6	480,0	0	0	8.716,2
Požeško-slavonska	670,0	984,0	18.427,3	1.502,6	610,0	0	470,4	22.664,3
Brodsko-posavska	65.682,0	572,0	18.892,2	5.454,8	855,0	0	503,2	91.959,2
Zadarska	3.366,0	9.407,4	332,0	210,0	0	0	60,0	13.375,4
Osječko-baranjska	39.408,4	7.739,4	11.001,8	5.109,6	2.138,0	27,0	1.207,0	66.631,2
Šibensko-kninska	0	33.883,0	540,0	0	0	0	0	34.423,0
Vukovarsko-srijemska	117,6	58,8	2.667,0	0	0	0	728,0	3.571,4
Splitsko-dalmatinska	7.934,7	8.953,6	27.108,4	7.043,4	0	0	1.408,0	52.448,1
Istarska	526,4	4.849,3	2.750,8	801,4	0	0	3.098,7	12.026,6
Dubrovačko-neretv.	0	0	4.505,0	3.472,8	0	0	3.170,0	11.147,8
Međimurska	2.987,0	537,0	10.398,0	3.533,0	0	0	275,0	17.730,0
UKUPNO	155.332,8	111.427,4	285.896,9	55.220,2	6.959,4	43,5	40.825,2	655.705,4

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 determine the year of manufacture for 1.1 % capacitors.

Tables 14 and 15 show the number and quantity of transformers by their age and counties

Table 14. **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
Zagrebačka	5	5	7	5	4	0	4	30
Krapinsko-zagorska	0	0	0	0	0	0	0	0
Sisačko-moslavačka	28	5	24	0	0	0	0	57
Karlovačka	36	13	10	41	10	0	10	120
Varaždinska	0	0	2	2	0	0	0	4
Koprivničko-križevačka	0	0	0	1	0	0	0	1
Bjelovarsko-bilogorska	0	0	0	0	0	0	0	0
Primorsko-goranska	4	2	6	0	0	0	0	12
Ličko-senjska	0	0	0	0	0	0	0	0
Virovitičko-podravska	0	2	0	1	0	0	0	3
Požeško-slavonska	0	0	0	0	0	0	0	0
Brodsko-posavska	5	2	9	2	2	0	0	20
Zadarska	0	0	1	0	0	0	0	1
Osječko-baranjska	4	6	4	2	4	0	4	24
Šibensko-kninska	0	0	0	0	0	2	0	2
Vukovarsko-srijemska	0	0	0	0	0	0	0	0
Splitsko-dalmatinska	0	0	1	2	0	0	1	4
Istarska	10	2	4	6	1	0	0	23
Dubrovačko-neretvanska	1	0	0	8	0	0	0	9
Međimurska	0	0	1	0	0	0	0	1
TOTAL	93	37	69	70	21	2	19	311

Table 15. **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
Zagrebačka	12.220,0	4.536,0	3.520,0	2.394,0	2.080,0	0	4.000,0	28.750,0
Krapinsko-	0	0	0	0	0	0	0	0
Sisačko-	128.352,0	16.960,0	99.562,0	0	0	0	0	244.874,0
Karlovačka	157.840,0	16.420,0	19.970,0	80.809,0	36.010,0	0	8.520,0	319.569,0
Varaždinska	0	0	1.890,0	3.080,0	0	0	0	4.970,0
Koprivničko-	0	0	0	102,0	0	0	0	102,0
Bjelovarsko-	0	0	0	0	0	0	0	0
Primorsko-	10.870,0	4.440,0	11.800,0	0	0	0	0	27.110,0
Ličko-senjska	0	0	0	0	0	0	0	0
Virovitičko-	0	0	2.970,8	0	1.100,0	0	0	4.070,8
Požeško-slavonska	0	0	0	0	0	0	0	0
Brodsko-posavska	11.200,0	3.600,0	17.910,0	3.560,0	5.190,0	0	0	41.460,0
Zadarska	0	0	950,0	0	0	0	0	950,0
Osječko-baranjska	6.590,0	6.590,0	5.340,0	4.710,0	6.460,0	0	0	29.690,0
Šibensko-kninska	0	0	0	0	0	3.990,0	0	3.990,0
Vukovarsko-	0	0	0	0	0	0	0	0
Splitsko-dalmat.	0	0	1.890,0	250,0	0	0	162,0	2.302,0
Istarska	11.440,0	0	0	7.040,0	2.700,0	0	0	21.180,0
Dubrovačko-	4.800,0	0	0	0	0	0	0	4.800,0
Međimurska	0	0	2.060,0	0	0	0	0	2.060,0
TOTAL	343.312	52.546	167.863	101.945	53.540	3.990	12.682	735.877,8

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 22.5%. They are followed by those manufactured in the periods 1971-1975 (11.9%) and 1986-1990. Those manufactured after 1990 represent the minority (0.7%). There are no manufacturing data for 6.1 % 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.

4.2.6 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.

4.2.7 Use of PCBs in the open systems

In the open systems polychlorinated biphenyls 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 Ordinance on Occupational Safety Regarding the Substances Containing Polychlorinated Biphenyls, Polychlorinated Naphthalenes and Polychlorinated Terphenyls (OG 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.

4.2.8 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.

4.2.9 Import and export of 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 Ministry of Economy, Labour and Entrepreneurship there has been no application for the permit to use PCBs in the closed systems, as per Article 2 of the Ordinance on Occupational Safety Regarding the Substances Containing Polychlorinated Biphenyls, Polychlorinated Naphthalenes and Polychlorinated Terphenyls (OG No. 7/89).

4.2.10 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 2007 and are referred to as the data about imported PCBs. Actually, polychlorinated biphenyls have their tariff number (along with polychlorinated terphenyls (PCT) and polybrominated biphenyls (PBB)) 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 16.

According the same data, in the period from 2002 till today amount of 2,09 kg liquids containing biphenyls and terphenyls was imported.

Table 16. **Volumes of the imported PCBs, PCT, PBB in the period 1996- 2001***

Year of import	Amount/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
TOTAL (1996-2001)	167164.35

**(Source: Ministry of Finance of the Republic of Croatia, Customs Administration of Republic of Croatia)*

4.2.11 Import of PCB waste

Waste Act (OG No. 178/04, Article 47) 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.

4.2.12 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).

During the period from 1994-2007 Croatia has exported 406.2 t of waste with PCBs. Quantities of the exported transformers, capacitors, liquid PCBs and other waste contaminated with PCBs are given in Table 17.

Table 17. **Quantities of the exported waste with PCBs in the period 1994-2007***

Year of export	Quantity of exported transformers and capacitors with PCB/tons	Quantity of exported liquid with PCBs and other waste contaminated with PCBs/tons
1994.	23,2	0
1995.	36,2	4,3
1996.	59,6	0
1997.	15,2	1
1998.	38,1	4,0
1999.	15,8	0
2000.	43,9	0,5
2001.	12,8	0
2002.	13	0
2003.	n.a.	n.a.
2004.	23,8	10,5
2005.	45,40	0
2006.	38,45	0,65
2007.	19,78	0
TOTAL (1994.-2007.)	385,23	20,95
TOTAL	406,18	

* Waste Act (OG No. 178/04, 111/06, 60/08) was brought in 1994 and the Basel Convention was ratified. This was the onset of systemic monitoring of waste export.

4.2.13 Market situation and customs control

The Croatian Law 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 Regulation on customs tariff, published once yearly.

Regulation currently in force classify *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 under following heading numbers:

Heading No. 3824.7900 - - mixtures and preparations containing oksiran (ethylene oxide), polybrominated biphenyls (PBB), polychlorinated biphenyls (PCB), polychlorinated terpfeniles (PCT) or tris (2,3-dibromopropyl) phosphate

Heading No. 3824.8200 - - - ... containing polychlorinated biphenyls (PCB), polychlorinated terpfeniles (PCT) or polybrominated biphenyls (PBB)

From December 2001, polychlorinated biphenyls have heading no. *27109100* – waste oils that contain PCB, PCT and PBB as well as, *29029030* – other cyclic carbohydrates -biphenyls and terphenyls.

Transformers and capacitors with PCB do not have their special tariff number. They do not require any special customs control or monitoring.

4.2.13.1 Illegal trade

Since the import of PCBs is prohibited and export of equipment allowed until December 31, 2010, possible illegal trade is estimated to be very low.

4.2.14 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.

4.2.14.1 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 42.900 kg i.e. 1.992 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.

4.2.14.2 Disposal sites

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 *Ordinance on the Methods and Conditions for the Landfill of Waste, Categories and Operational Requirements for Waste Landfills (OG No. 117/07).*

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 (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.

4.2.15 National capacities for PCBs monitoring

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 Ordinance regarding approved laboratories (OG No. 78/97) the Directorate for Water Management within the Ministry of Regional Development, Forestry and Water Management 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.

4.2.16 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 Ordinance on Waste Management (OG No. 23/07, 111/07).

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.

4.2.17 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 - aluminium plant, 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);
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 on such locations are given in Table 18.

Table 18. **Mass fractions of PCBs in sampling (mg/kg)**

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 a level of 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 of the soil in Croatia it can be concluded that karst is particularly vulnerable to contamination with polychlorinated biphenyls due to the 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.

4.2.18 Up to date experience in remediation of PCBs contaminated facilities in Croatia

Up to date in Croatia there has been only two remediation facilities contaminated with PCBs:

- 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 facility in Komolac was the first remediate facility that was damaged in the war and contaminated with PCBs.

- Thermal Power Plant PLOMIN (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.

4.2.19 Conclusion

Based on collected information the following conclusions can be drawn:

There are regulations in Croatia that prohibit import of PCB equipment from December 31, 2010.

Timetable for treatment are determined by the *Ordinance on management of polychlorinated biphenyls and polychlorinated terphenyls* and are due to December 31, 2010.

Same Regulation obliges the PCB owners to submit to the competent authority the list of equipment with the volume greater than 5 dm^3 until March 2009 the latest.

- there is no manufacture of liquid PCBs in the Republic of Croatia;

There has been some import of PCB containing liquids registered till 2002, however in the very small quantities (about 2 kg).

- 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;

Total amount of PCBs in closed systems in Croatia is 1.391.593 kg, 22 859 capacitors with total mass of 655.705,9 kg and 311 transformers with total mass of 735.887,8 kg

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 locations 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;

4.3 DDT - Annex B of the Stockholm Convention

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.

4.4 Assessment of unintentional production and releases of PCDD/PCDF, HCB and PCBs Annex C of the Stockholm Convention

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.

4.4.1 Legal regulations in the field of PCDD/PCDF

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

- Air Protection Act (OG No. 178/04 and 60/08)
- Regulation on limit values for pollutant emissions from stationary sources into the air (OG No. 21/07, 15/08).
- Ordinance on monitoring air quality (OG No. 155/05)
- Water Act (OG No. 150/05)
- Regulation on Hazardous Substances in Waters (OG No. 78/98)
- Law on Agricultural Land (OG No. 66/01, 87/02, 90/05)
- Ordinance on the Protection of Agricultural Land from Pollution with Harmful Substances (OG No. 15/92)
- Law on Adoption of Protocol on Persistent Organic Pollutants with Convention on Long-distance Transboundary Air Pollution from the Year 1979 (OG – IA 11/2006)

Inventory of PCDD/PCDFs emission reports are the integral part of annual reports on the pollutant emissions into air on the territory of Croatia. Emissions inventory 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 Air Protection Act (OG 178/04, 60/08) 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

4.4.2 PCDD/PCDFs inventory

UNEP Chemicals methodology, «*Standardized toolkit for Identification and Quantification of Dioxin and Furan Releases*» (UNEP 2001) was applied for the Croatian Inventory of PCDD/PCDF making. This methodology ensured 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 19 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 19. **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)			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

No.		Main categories and sub-categories of PCDD/PCDF sources	Potential routes of PCDD/PCDF expansion in environment				
			air	water	ground	products	waste
	b	Biomass power plants	X				X
	c	Landfill, biogas combustion	X				X
	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

No.		Main categories and sub-categories of PCDD/PCDF sources	Potential routes of PCDD/PCDF expansion in environment				
			air	water	ground	products	waste
	c	Smoke houses	x			x	X
	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)

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

An 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 $year^{-1}$).

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

1. 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).
2. Emission factors: determined from the UNEP 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.

4.4.3 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 20.

Table 20. **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

fuel	E.F. ng t^{-1}	consumption t $year^{-1}$	emission gTEQ $year^{-1}$	total g I-TEQ/year
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	
natural gas	0.00102*	519 200 000	0.00053	
refinery gas	1.0	262 400	0.00026	**0.13**

*E.F. ng m^{-3}

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

fuel	E.F. ng t^{-1}	consumption t $year^{-1}$	emission gTEQ $year^{-1}$	total g I-TEQ/year
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	
extra light heating oil #	1 000.0	402 700	0.40270	
extra light heating oil ▲	21.4	4 400	0.00009	
heating oils#	1 000.0	25 400	0.02540	
heating oils ▲	100.5	37 000	0.00372	
natural gas / m^3 #	0.00102*	609 300 000	0.00062	
natural gas / m^3 ▲	0.00102*	53 000 000	0.00005	
LPG #	1.0	69 000	0.00007	
LPG ▲	1.0	0	0.00000	**93.06**

*E.F. ng m^{-3} #- global consumption ▲- boiler houses and steam production

3. Combustion in industry

fuel	E.F. ng t^{-1}	consumption t $year^{-1}$	emission gTEQ $year^{-1}$	total g I-TEQ/year
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	0.00102*	844 500 000	0.00086	
LPG	1.0	23 600	0.00002	**10.47**

* E.F. ng m^{-3}

4. Production processes without fuel combustion

process	E.F. ng t^{-1}	consumption t $year^{-1}$	emission gTEQ $year^{-1}$	total g I-TEQ/year
Steel production (EL)	70 000.0	71 021	4.97147	4.97

5. Road transport

fuel	E.F. ng t^{-1}	consumption t $year^{-1}$	emission g I-TEQ $year^{-1}$	total g I-TEQ/year
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 mobile machines and sources

E.F. ng t^{-1}	consumption t $year^{-1}$	emission g I-TEQ $year^{-1}$	total g I-TEQ/year
N/A	53 200		
N/A	72 300		
100.5	1 400	0.00014	0.0001

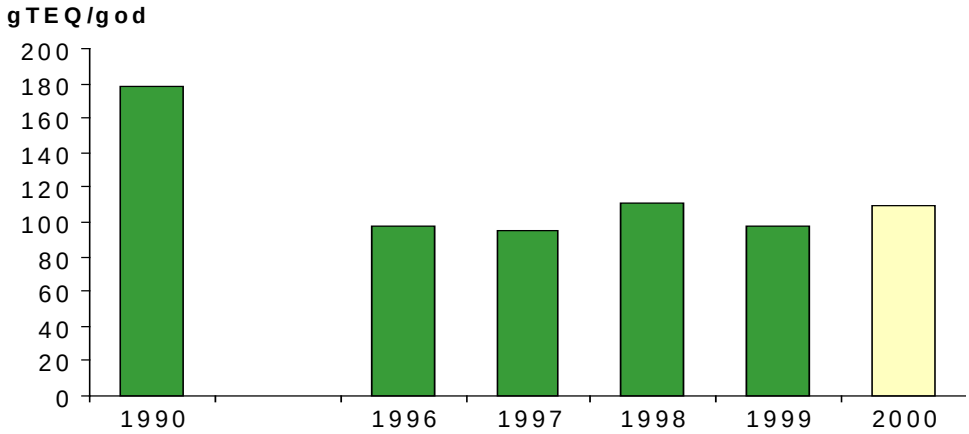
7. Waste treatment and disposal

E.F. ng t^{-1}	consumption t /year	emission g I-TEQ $year^{-1}$	total g I-TEQ/year
89 000.0	3 152	0.28053	0.28

TOTAL **109.05**

In comparison to 1999 the emissions of dioxin and furan to the year 2000 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



4.4.3.1 Assessment of environmental emissions of dioxin 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, Croatian Chamber of Economy and EKONERG, reports of PUTO (hazardous waste incineration plant),. Methodology used for assessment of dioxin and furane releases in 2001 is UNEP Toolkit ("Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases" –UNEP 2001).

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, 2002 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 emissions limit value (ELV) was above 0.1 ng I-TEQ m^{-3} as set by the Regulation on limit values for pollutant emissions from stationary sources into the air (OG 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 µg I-TEQ t^{-1}, for the state-of-the-arts technologies, to 35 000 µg I-TEQt^{-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 µg I-TEQt^{-1} and EF for leftover/waste i.e. 900 µg I-TEQ t^{-1}.

Assessment of environmental emissions of PCDD/PCDF from the main category 1 – waste incineration plant is shown in Table 21.

Table 21. **Assessment of environmental emissions of PCDD/PCDF from the main category 1- waste incineration plant**

		EF (µg I-TEQ t^{-1})			Annual emissions (g I-TEQ/year)		
		Air	Residue/waste				
Class	Source category		Flying ash	Bottom ash	Amount (t)	Air	Residue/waste
2	Hazardous waste incineration plant Controlled combustion, minimal control system for air pollution	350	900	ND	3.967	1,4	3,6

* ND – not determined;

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 µg I-TEQ t^{-1} for air and between 0.2 and 15 µg I-TEQ 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 22.

Table 22. **Assessment of environmental emissions of PCDD/PCDF from the main category 2 – ferrous and non-ferrous metals production**

Subcat.	Class	Source category	Amount (t)	Emission factor (µg I-TEQ t^{-1})		Release (g I-TEQ $year^{-1}$)	
				Air	Waste	Air	Residue/ waste
		Ferrous and non-ferrous metals production - TOTAL	263.839			3,11	22,33
c		Iron and steel production – utilities a foundries - TOTAL	208.229			1,2	0,13
	1	Iron and steel plants	57.993	10	15	0,6	0,1
	2	Foundries	150.236	4,3	0,2	0,6	0,03
d	2	Secondary copper production	2.060	50	630	0,1	1,3
e	2	Secondary aluminium production	52.385	35	400	1,8	20,9
f	2	Secondary aluminium production	1.165	35	ND	0,01	0

* ND – not determined. Water, soil and products are not important route of PCDD/PCDF release

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:

- a/b. –fossil and biomass fuel-fired utilities;
- 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 23.

Table 23. **Assessment of environmental emissions of PCDD/PCDF from the main category 3 – power and heat production**

Subcat.	Class	Source category	Emission factor (µg I-TEQ t^{-1})		Amount (t)	Release (g I-TEQ $year^{-1}$)	
			Air	Residue/ waste		Air	Residue/ waste
		Power and heat production – - TOTAL			1.286.822	105,68	20,6
a		Fossil fuel-fired utilities			176.645	0,4	0,3
	2	Coal fuel-fired power boilers	10	14	19.645	0,2	0,3
	3	Heavy fuel- fired power boilers	2,5	NO	45.100	0,1	0
	4	Light fuel oil/natural gas fired power boilers	0,5	ND	111.900	0,1	0
b	2	Biomass fuel-fired installations	50	15	12.200	0,6	0,2

d	2	Home furnace - biomass	100	20	1.043.000	104,3	20,1
e		–Small businesses, institutions, fossil fuels - total			54.977	0,38	?
	1	Coal furnace	70	5	543	0,04	?
	2	Heating oil furnace	10	NA	30.019	0,3	0
	3	Gas furnace	1,5	NA	24.415	0,04	0

* ND – not determined, NA – not applicable, not important route of PCDD/PCDF release

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 24.

Table 24. **Assessment of environmental emissions of PCDD/PCDF from the main category 4 – mineral products production**

Subcat.	Class	Source category	Emission factor (µg I-TEQ t^{-1})		Amount (t)	Release (g I-TEQ $year^{-1}$)	
			Air	Residue/ waste		Air	Residue/ waste
		Mineral products production TOTAL			5.919.917	2,333	0,01
a	3	Cement kilns	0,05	0,003	3.246.120	0,2	0,01
b	1	Limestone	10	ND	171.229	1,7	0
c	1	Brick	0,2	ND	1.862.506	0,4	0
d	2	Glass	0,015	ND	142.201	0,002	0
e	2	Ceramics	0,02	ND	56.530	0,001	0
f	1	Asphalt (preparation)	0,07	ND	441.331	0,03	0

* ND – not determined

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 µg I-TEQ t^{-1} according to UNEP Toolkit.

Assessment of environmental emissions of PCDD/PCDF is shown in Table 25.

Table 25. **Assessment of environmental emissions of PCDD/PCDF from the main category 5 – transport**

Subcat.	Class	Source category	Emission factor (µg I-TEQ t^{-1}) Air	Amount (t)	Release (g I-TEQ $year^{-1}$) Air
		Transport-TOTAL		1.323.402	0,945
a		Four-stroke engines -Total		661.572	0,505
	1	Leaded fuel	2,2	209.680	0,5
	2	Unleaded fuel without catalyst	0,1	45.189	0,005
	3	Unleaded fuel with catalyst	0,00	406.703	0
b		Two-stroke engines - Total		102.630	0,33
	1	Leaded fuel	3,5	52.420	0,2
	2	Unleaded fuel without catalyst	2,5	50.210	0,13
c	1	Diesel engines	0,1	557.800	0,1
d	1	Heating oils fuelled utilities	4	1.400	0,01

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 µg I-TEQ t^{-1} , and for soil it is 4 µg I-TEQ t^{-1} while other emission routes are not important.

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 6 – uncontrolled combustion processes**

Subcat.	Class	Source category	Emission factor (µg I-TEQ t^{-1}) Air	Soil	Amount (t)	Release (g I-TEQ $year^{-1}$) Air	Soil
6		Uncontrolled combustio products - TOTAL			433.918	2,2	1,7
a		Fires/burning of biomas					
	1	Forest fires	5	4	433.918	2,2	1,7

Forestry Management Directorate established, on 1 January 2009 Forest Fires Registry – digital database of forest fires presenting base for quantification of biomass per unit land size, thus presenting input data for quantification of burned biomass and released dioxins and furans.

Keeping unpredictability of forest fires keeping permanent bases for emissions monitoring and sampling for forests and parks might not be the best solution.

Damage on woodland caused by atmospheric pollutants is continuously monitored by the Institute in Jasterbarsko therefore it is possible to read the relevant data in the above mentioned reports

"Hrvatske šume" state owned company, owns 3 bio energy installations that use wood biomass from the surrounding forests (Gospić, Ogulin, Delnice) for fuel. The Installations are still in a test phase making data for calculations of dioxins and furans easily accessible.

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 27.

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 µg-I-TEQ t^{-1} (according to UNEP Toolkit).

Approximate assessment of environmental emissions of PCDD/PCDF is shown in Table 28.

Table 27. **Assessment of environmental emissions of PCDD/PCDF from the main category 7 – Production of chemicals and consumer goods**

Subcat.	Class	Source category	Emission factor (µg I-TEQ t^{-1})				Amount (t)	Release (g I-TEQ $year^{-1}$)			
			Air	Water	Product.	Residue/ waste		Air	Water	Product.	Residue/ waste
		Production of chemicals and consumer goods - TOTAL					726.747	0,14	0,002	0,804	0,3
a		Pulp and paper - total					578.835			0,8	
	3	Technical paper – no bleaching			0,5		533.835			0,3	
	5	Recycled paper			10		45.000			0,5	
b	2	Chemical industry - Total					147.912	0,14	0,002	0,004	0,3
		EDC/VCM, EDC/VCM/PVC	0,95	0,015	0,03	2	147.912	0,14	0,002	0,004	0,3

Table 28. **Assessment of environmental emissions of PCDD/PCDF from the main category 8 – Miscellaneous**

Subcat.	Class	Source category	Emission factor (µg I-TEQ t^{-1})	Amount (t)	Release (g I-TEQ $year^{-1}$)
			Air		Air
		Miscellaneous		14.567	0,001
e		Cigarette smoking			
	2	Cigarettes	0,1	14.567	0,001

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 15µg I-TEQ t^{-1}, and it was applied only for products. Other expansion routes are not applicable. Total emission amounts to 2.7 g I-TEQ $year^{-1}$. Assessment of total releases of PCDD/PCDF is shown in Table 29.

Table 29. **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 I-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.

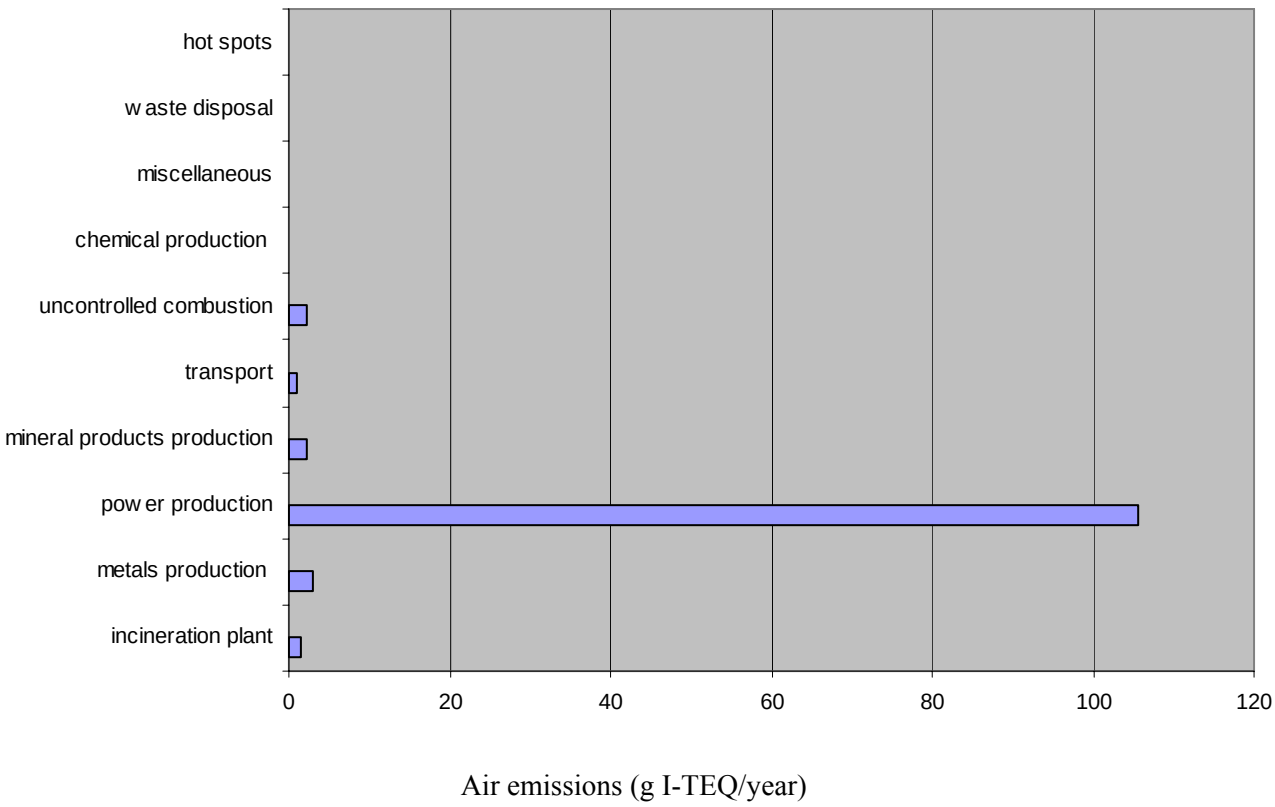
? after the number means that the number (information) is not representative because some sub-categories have not been fully processed.

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 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.

4.4.4 PCDD/PCDF Emission 2002-2006

In accordance to SNAP 97 application EMEP/CORINAIR methodology the calculation of dioxins and furans for the period of 2002 – 2006 have been made.

In the table 30 the results of the calculation have been displayed:

Table 30. **Results of PCDD/PCDF Calculation for the Period of 2002 – 2006**

Sector	Emission PCDD/PCDF g I-TEQ/a				
	2002	2003	2004	2005	2006
01 – Public thermal power station heating power stations and energy transforming stations	0,19	0,25	0,20	0,21	0,21
02 – Combustion in the non industrial furnaces	71,74	93,06	90,05	85,99	86,39
03 – Combustion in the industry	0,20	0,21	0,25	0,17	0,19
04 – Production processes	2,37	3,04	2,13	4,82	5,64
07 – Road transport met	0,22	0,19	0,17	0,15	0,15
09 – Waste disposal and processir	0,20	0,03	0,03	0,03	0,04
TOTAL	74,9	96,8	92,8	91,4	92,6

4.4.5 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 environment (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 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 31. Results of PCDD/PCDF inventory (2001)

Annual emissions of PCDD/PCDF (g I-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.

In the period from 2002 onwards inventory of PCDD/PCDF was implemented in accordance to EMEP/CORINAIR methodology and not in accordance to UNEP *Toolkit.* Data collected show increase of emissions in 2003 in comparison to the year 2002. In total, one can make conclusion that in 2006 emissions of dioxins and furans were 41,9% lower than in the year 1990.

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.

4.5 Information on the state of knowledge on stockpiles, contaminated sites and wastes

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 2.3.3.8 and 2.3.7.2 In addition to these information, during the inventory, carried out with the Croatian Army and the Ministry of Defence, preliminary laboratory tests of soil from eastern Slavonija (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 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.

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

Current and assessed production, use and release of POPs are indicated in the Table 32.

Table 32. **Current and assessed production, use and release of POPs.**

Year	2002/03 (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	1 391	1 391			
Closed and semi-closed applications	1 391	1 391	**	**	**
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	5.0	**	**	**	**
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	**	**	**	**

Year	2002/03 (Inventory)	2005	2010	2020	2030
Miscellaneous	0.001	**	**	**	**
HCB	*	**	**	**	**
PCBs	*	**	**	**	**

* - 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.

4.6 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.

4.6.1 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.

4.6.2 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.

4.6.3 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 in uncontrolled condition, 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, crematoria and transport.

4.7 Presence of POPs compounds in foodstuffs, environment and humans

4.7.1 POPs in Food

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 33 summarizes the data published in the period 1992-1996.

Table 33. **Mass fractions of pesticides (median ranges of HCB, α-HCH, γ-HCH, total DDT) and of total PCBs in food 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 34 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 34. **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 are shown in Table 35. 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.

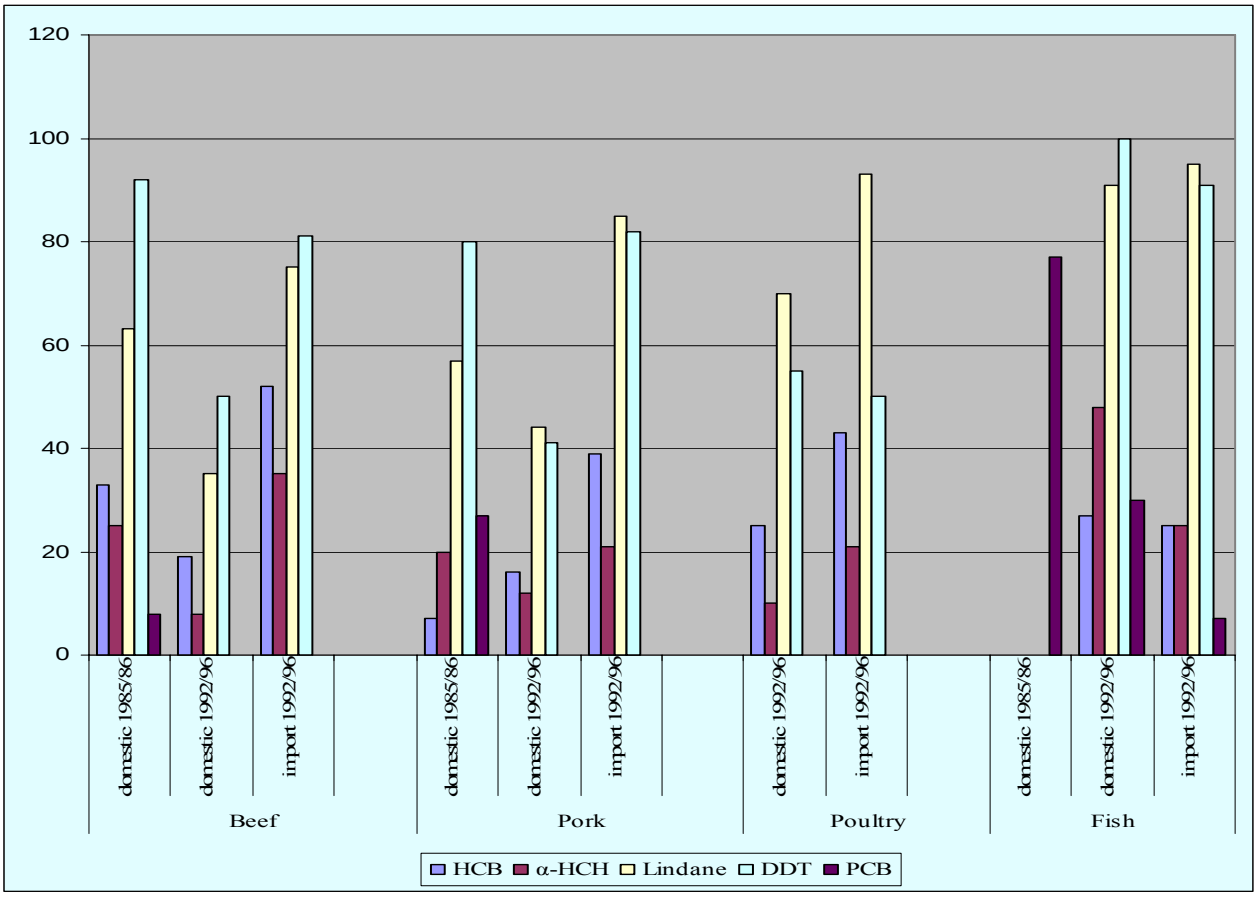
According to the findings of the Croatian Institute for Public Health the levels of organochlorine pesticides in eggs (poultry farms and individual households) analyzed in 2000 were within the range of 0-30.4 µg kg^{-1} of wet b.w. For total DDT determined were the highest levels. With respect to the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

Table 35. **Mass fractions of organochlorine compounds and PCBs (µg kg^{-1} fat, µg kg^{-1} of fish edible part) in food 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	-	
-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 food samples



4.7.2 Levels of POPs in the environment

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.

4.7.2.1 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 36. **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 birds.

- *Adriatic dolphin*

Fat tissue was 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 metabolites (α-HCH,β-HCH, γ-HCH, 4,4'-DDE, 4,4'-DDD and 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 and 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 37). 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 37. **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 38. 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 38. **Mass fractions 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

4.7.2.2 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 39.

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 was performed in the period from 1997 to 2000. Compounds' levels, expressed as toxic equivalent calculated with international factors of equivalent toxicity based on the toxicity of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin, are shown in Table 40.

Table 39. **Mass 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 40. **Mass concentration 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 low 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 41.

Table 41. **Mass concentrations (pg m^{-3}) of the compounds in the airborne particles PM_{10} and $PM_{2,5}$ 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 hovering particles was continued at the same location as in 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 43), 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 hovering particles performed in 2002 did not show any significant seasonal variations. Mass concentrations of the compounds absorbed 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 42. **Mass concentrations (pg m^{-3}) of organochlorine pesticides in fifty two 7-day samples of hovering particles PM_{10} collected in Zagreb from January till December 2002.**

COMPOUND	MASS 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 43. **Mass concentrations (pg m^{-3}) of PCB congeners in fifty two 7-day samples of hovering particles PM_{10} collected in Zagreb from January till December 2002**

COMPOUND	MASS CONC./pg m^{-3}			COMPOUND	MASS 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

4.7.2.3 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 Table 44. 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 44. **OC pesticides and PCBs in rain and snow: concentration range (ng L^{-3}) in aqueous phase and mass fraction (ng g^{-1} of dry sample) in the particles**

Sample	Site (sampling time)	OC pesticides	Total PCBs
rain - aqueous phase	Rijeka (1979/80)*	<1 - 2	1 - 12
rain - aqueous phase - particles	Zagreb (1990/92)*	<1 - 38 1 - 512	2 - 205 40 - 4155
snow - aqueous phase - particles	Zagreb (1990/92)**	<1 - 4 1 - 242	4 - 50 306 - 4082

* Analyzed OC pesticides: Dieldrin, 4,4'-DDT, 4,4'- DDE, 4,4'-DDD

** Analyzed OC pesticides: α-, β- and 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. As conifer carries several generations of needles, it is possible to determine pollution of a wider region and/or of a specific location in one or more years. Samples of larch, pine, lime, spruce, *Thuja* and fir tree (22 samples in total) collected at several locations 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 location), 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 Aroclor 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 locations in Zagreb as well as at 15 other sites all over Croatia. The results are shown in Table 45.

Table 45. **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 locations (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 46.

Table 46. **Mass fractions 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, PCDD and PCDF were also detected in traces in the rain and snow samples collected in Zagreb in the period 1990-1992. Out of individual congeners detected in rain and snow 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.

4.7.2.4 OC compounds in soil

There is an insufficiency in data on levels of persistent OC compounds in soil in Croatia due to the fact their systematic research has not been carried out. Total PCB levels 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. Table 47 gives the summary of these studies. In majority of samples from municipal and rural areas mass fraction of PCBs was characteristic for 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 47. **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 mass fractions of PCBs in soil within airports were found in the samples collected in the vicinity of the 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 mass fraction was exceeding 5000 μg kg^{-1}, and from the soil in vicinity to former chloroalkaline electrolysis facility. Total PCDD and PCDF found 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 mass fraction of total PCDD and PCDF exceeded 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.

4.7.2.5 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 highest levels are 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 decreased 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 L^{-1}). 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 bio-concentrate 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 48 compares the levels of these compounds found during past twenty years in some rivers, drinking water and in river sediments.

Table 48. T**PCBs levels in rivers and drinking water (ng l^{-1}) and in river sediment (μg kg^{-1} of a dry sample)**

Sample (N)	Sampling time	Concentration range/ mass fraction
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 49 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 49. **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**

Location 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):				
2000	NR	NR	1-30	1-50
2001	NR	NR	0■	0■
2002	NR	NR	0■	0■
Mura (Goričan):				
2000	NR	NR	100■	2-3200
2002	NR	NR	100■	5■

** Sampling locations: 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

4.7.2.6 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 perennial research 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 research of OC compounds in the samples of the surface micro layer and sea water taken at 1 m depth at several stations in the Rijeka Bay were carried out from 1977 till 1987. The results are shown in Table 50.

Mass fractions 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 50. 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 50. **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	Sample	DDT + metabolites		PCBs	
(Period)		Range	Median (N)	Range	Median (N)
Rijeka Bay (1977-1987)	coastal sea - water - surface micro layer	0.07 – 104.9 3 – 25.3	0.98 (24) 4.8 (7)	0.2-17.0 28-597	3.6 (23) 112 (7)
	open sea - water - surface micro layer	<0.06 – 0.99 0.75 – 4.2	0.21 (10) 1.3 (10)	<0.2-1.7 1-52	0.6 (10) 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

Levels of PCB s were examined 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. In addition to PCB, levels of DDT were determined. 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. Mas fractions of PCBs in the analysed sediments were within the range of 5.7-2203 µg kg^{-1} of dry weight (median 45 µg kg^{-1}), and of DDT 0.2-35 µg kg^{-1} of dry weight (median 1.5 µg 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 power sub-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.

4.7.2.7 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 perennial monitoring of organochlorine compounds blood and milk levels are given in Tables 52 and 53. At the beginning the studies had been focused on organochlorine pesticides, but were subsequently expanded to total polychlorinated biphenyls.

Table 51. **Mass concentration (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
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•)

* work-related exposure to organochlorine pesticides
♦ work-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 52. **Mass concentration (μg kg^{-1} of milk fat) of pesticides (median ranges of mass fractions 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, Dieldrin, Endrin, heptachlor, heptachlorepoxide and δ-HCH were also analysed but not detected

[A] range of arithmetic means of mass fraction 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, Dieldrin, Endrin and heptachlorepoxide were also analyzed (median range 0-0.7μg kg^{-1} of milk fat)

♦range of mass fraction 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 serum of professionally exposed workers. The total PCBs after Aroclor 1260 was also measured. All samples contained PCB-138 and PCB-153, while other congeners appeared in 80-98 % of cases. The results are shown in Table 53.

Table 53. **Mass concentration (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

Workers with work-related exposure to organochlorine pesticides or PCBs concentration determined in the serum were higher than the average levels in the general population, but still too low to produce any 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 tested subjects from Zagreb (μg L^{-1} of serum)

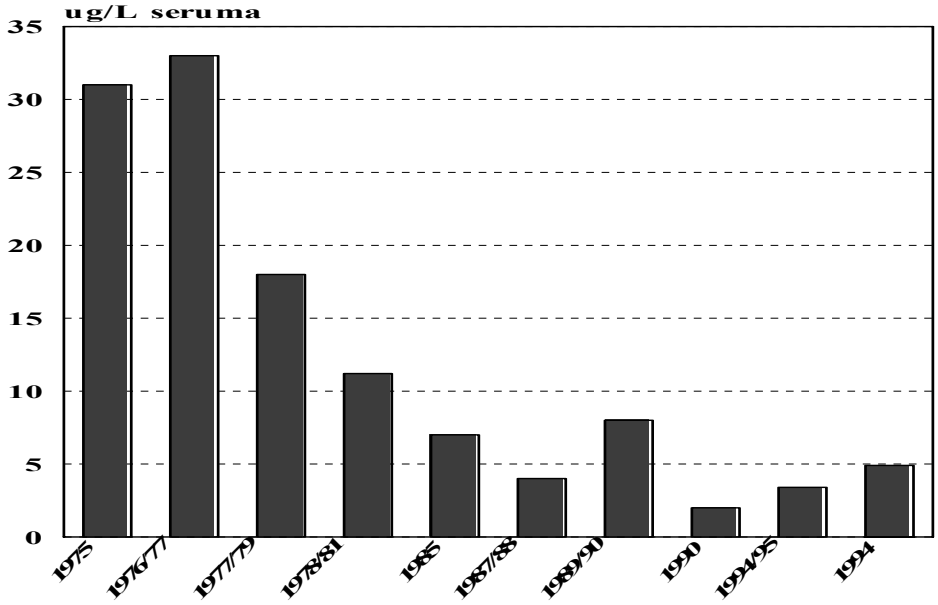
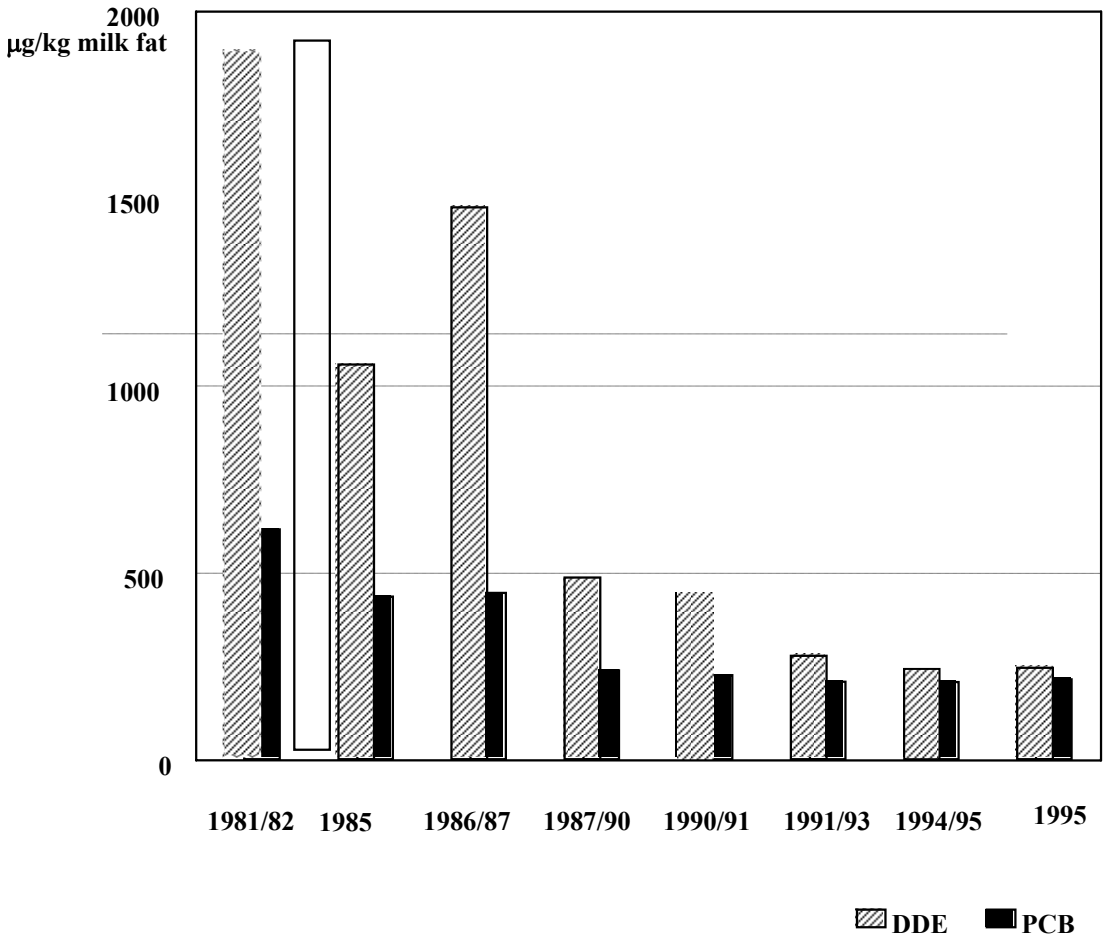


Figure 5 DDE and total PCBs in human milk of the nursing mothers from Zagreb (μg kg^{-1} of milk fat)



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 also for PCDD and PCDF.

Human milk samples had been collected in Zagreb, Jastrebarsko, Osijek, and Labin and on the island of Krk during 1981-1997. The results summary is given in Table 54. 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 54. **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 I-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

4.7.3 Identification of population group with established negative impact caused by POPs

This chapter gives a short survey of those populations, which are at potential risk of POPs exposure.

4.7.3.1 Population at potential risk

Analysis of the available study results in Croatia shows absence of indications about a group at marked risk of population professionally 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. During the potential accident involving transformers and condensators filed with PCBs some local contamination is expected 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.

4.8 Overview of technical infrastructure in the scope of measuring, analyses, development and research of POPs compounds

4.8.1 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 is 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.

4.8.2 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.

4.8.3 Proposal to improve the existing practices

Irrespective of the fact that the information about human levels of these compounds is 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.

5 INFORMATION, AWARENESS AND EDUCATION

Average Croatian population is not sufficiently well informed about POPs compounds and their negative 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 needs to be developed.

The issue of POPs is not enough covered in primary and secondary schools curricula. 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.

5.1 Overview of public information policy/practice related to environment

One of the basic principles of the new Environmental Protection Act (OG 110/07) is the *Principle of Public Participation and Access to Information*. In addition to the "Right of the public to access the information available to public authority and persons monitored by public authority..." public authority is obliged to assure environmental information access in its ownership or/and monitored in accordance to this Act and other acts that regulate public participation and information access right.

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. The Convention was ratified on 13 December, 2007 (OG 01/07).

Although the new Law has in increased the level of access to information, full access to information is reserved for „interested public", without precise criteria to define who represents „interested public". Because of the difference between „interested public" and „not interested public" as well as the vagueness of the term, there is the space left for discrimination and possible denying of relevant information to public.

5.2 Public information tools and mechanism

Environmental Protection Agency's project "Cooperation with the Public" operates in accordance with Environmental Protection Act and the Aarhus Convention. "Cooperation with the Public" is a permanent project of the Agency. In addition to covering needs of state legislative bodies, state authority or governmental organisations, the Agency is also trying to provide updated and reliable information to other entities of the public – economic entities, scientific community, nongovernmental organisations, environmental associations and organisations, especially the media. The Agency is especially focusing on the press and other public media providing additional information on actual events in the area of environmental protection

5.3 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.

5.4 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.

5.5 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 is not developed, that can cause the splits of 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)*.

6 EXISTING SYSTEM OF EVALUATION OF CHEMICALS IN THE PROCEDURES OF OPERATIONAL PERMITTING

There are various regulations that regulate, export issues, application, production and circulation of substances as:

- Medicaments/medicines for humans and animals,
- Goods and objects of general use and substances in the direct contact with food,
- Cosmetics,
- Opiates and other substances that can cause addiction,
- Animal feed,
- Explosives,
- Plant protection agents,
- Mineral fertilizers,
- Dangerous chemicals during the road, railway, sea or air transport,
- Chemicals needing special supervision during transport,
- Agents used for pest control in public health services.

Pesticides registered as plant protection agents, for use in public health services or veterinary services, are registered based on research and evaluation of particular commissions of the authorised Ministry.

Marketing and use of biocide preparations as well as their active substances are regulated in Law on Biocide Preparations (OG 63/07, OG 35/08). Legal sub-regulations prescribing active substances allowed in biocide preparations have been adopted. Only these substances and those revised by the EU can be contained in biocide preparations on the market (Ordinance on Active Substances List in Biocide Preparations and Ordinance on List of Existing Active Substances Allowed in Biocide Preparations OG 90/08). Establishment of the committee whose task would be to provide expert opinion on releasing biocide preparations to the market is in the process.

7 NIP IMPLEMENTATION

7.1 Governmental Policy in Croatia

In order to create preconditions for fulfilling party's obligations deriving form the Stockholm Convention there is a defined Focal Point authorised for the Stockholm Convention implementation including organisation and supervision of implementation of measures and activities deriving from the National Implementation Plan.

Government of the Republic of Croatia undertakes measures 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.

Informing the 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.

7.2 Implementation strategy

7.2.1 Overview

The Stockholm Convention was ratified on April 30, 2007. The ratification confirmed 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.

7.2.2 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:

- Elimination of all potential PCBs sources;
- 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 abatement 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 gave the mandate for NIP implementation to Ministry of Environmental Protection, Physical Planning and Construction. Due to the multidisciplinary nature of the problem, the authority for surveillance of NIP implementation should comprise representatives of other state bodies responsible for surveillance of the use of POPs compounds (Ministry of Agriculture, Fishery and Rural Development, Ministry of Regional Development, Forestry and Water Management; Ministry of Health and Social Welfare; Ministry of Economy, Labour and Entrepreneurship…).

7.2.3 NIP 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 effects 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 Croatian Environmental Agency (CEA) (web pages, publications, reports to the Government i.e. technical reports of the relevant ministries) according to Regulation on information and participation of the public concerned in environmental matters (OG No. 64/08) and Regulation on the Environmental Information System (OG No. 68/08).

7.2.4 Priorities and conditions for their accomplishment

1. National legislation needs to be harmonized with EU legislation.
2. Additional 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.
3. Capacity building in the country to continue inventories and monitoring programs for reporting to the Secretariat of the Stockholm Convention
   - more efficient inventory procedures was needed, especially regarding landfills, dumps, possible hot spots and contaminated sites
4. Improvement of public awareness and need for improvement in level of education.
   - level of public awareness about POPs effect on humans and environment is very low, which can result as inappropriate management of chemicals and waste
5. New financial sources and mechanism for implementation of SC should be found

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

7.2.5 Major milestones in the coordination of the NIP implementation

With regards to preparations for EU accession Croatia is currently in the process of approximation of Croatian legislation to the EU *Acquis*.

In accordance to Ordinance on management Polichlorinated Biphenyls and Polichlorinated Terfenils (OG 105/08) the final deadline for exclusion of PCBs from use is the year 2010.

7.2.6 Institutional arrangement and assignment of responsibility

In accordance to Article 7 of the Convention after delivered to the Convention NIP will be periodically examined and updated when appropriate. In accordance to Article 5 Parties to the Convention have an obligation to periodically report on NIP and Convention compliance progress. Therefore a committee constituted from implementing authorities' representatives will be established.

7.2.7 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.

7.2.8 Implementation control mechanisms

During the implementation of the NIP, each institution/agency will periodically report on implementation progress. All these activities will be presented to a Working Group with an aim to review and approve ongoing process of NIP implementation.

7.3 Measures, Programmes and Activities

7.3.1 Measure: Institutional and regulatory adjustment of POPs Management

Objectives and priorities

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.).

This part will state only the areas requiring the above mentioned adjustments. Further measures will propose activities, related timeframes and required funds to ensure implementation of necessary changes in the national legal and institutional framework from the scope of POPs compounds.

Identified areas requiring adjustments

ANNEX A – Part I, ANNEX B
Stockpiles with or contaminated by the substances from Annex A and B
Locations contaminated with the substances from Annex A and B
Products and objects in use and waste comprising or containing the substances from Annex A and B
Systemic monitoring of POPs pesticides in humans and environment
ANNEX A – Part II
Inventory of PCBs in the open and closed systems
Location contaminated with the substances from Annex A – Part II
Systemic monitoring of PCBs in the environment
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

7.3.2 Measure: Reduction or elimination releases of POPs from their production and use

Objectives and priorities

During the development of the 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. Usage of PCBs in open system was not determined during the inventory. Legal regulation in this field prohibits the usage of PCBs in open system.

Summary of current measures to reduce or eliminate releases of POPs from their production and use

Legal framework from the field of POPs pesticides prohibits their usage and production, and is in line with the provisions of the Convention.

Implementation

Given the fact that all the measures for successful elimination and reduce of POPs chemicals releases from their production and use, are oriented to the field of PCBs, the *chapter 3.3.4* includes implementation of this measure.

7.3.2.1 Envisaged activities form the field of Production, Import and Export, Use, Stockpiles and Waste POPs Pesticides (ANNEX A, Part I)

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 POPs pesticides in the environment 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 55 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 55. **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)	Facilities for the adequate treatment of POP pesticides ads hazardous waste are missing
d) i	The requirements for the collection and handling of hazardous waste and existing stockpiles of POPs pesticides – hazardous waste are defined. There are also regulations regarding transport of hazardous waste and its storage.
d) ii	Facilities for the adequate management of POP pesticides ads hazardous waste are missing
d) iii	Re-use of waste containing POP pesticides is not permitted in Croatia
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.

7.3.2.2 Envisaged activities from the field of Production, Use, Identification, Labelling, Removal, Storage and Disposal of PCBs and Equipment Containing PCBs

Objectives and priorities

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 is prohibited and will be applied from December 31, 2010.

The goal of activities related to 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 are education and public informing.

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 has not adopted the following legal acts related to PCBs to:

- 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 hydrocarbon-biphenyls, terphenyls"– tariff No. 29029030

To facilitate fulfilment of the Stockholm Convention it is proposed to amend and supplement the existing legislation/promulgation of new legislation regarding PCBs:

- amendments of and supplements to the Regulation 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 hydrocarbon-biphenyls, terphenyls"– tariff No. 29029030);
- 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 naphthalene or polychlorinated terphenyls (OG 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 accidents with the equipment with PCBs that involve environmental leakage of PCBs with the competent bodies – environmental protection inspection;
- amend Article 5 of the Ordinance 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 not be labelled in line with the Ordinance on Labelling of Toxins released on Domestic Market (OG of the No. 32/86).

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 health and safety;
- 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 the Waste Act (OG No. 178/04, 111/06,60/08))
- 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 health and safety 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 Ordinance on Occupational Safety Regarding the Substances Containing Polychlorinated Biphenyls, Polychlorinated Naphthalenes and Polychlorinated Terphenyls (OG No. 7/89). However, according to the obtained information, such application has never been submitted to the State Inspectorate.

In cooperation with the Ministry of Economy, Labour and Entrepreneurship and occupational health and safety 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.

In accordance to Stockholm Convention requirements and Ordinance on Polychlorinated Biphenyls and Polychlorinated Terphenyls (OG 105/08), and related to supervision of PBC equipment removal progress, the Croatian Environmental Agency will run and regularly update database on PCB equipment owners. The registry will be based on equipment reports to work safety inspection and suggested report of PCB contaminated waste to the environmental inspection. The registry will be established with the goal of gaining realistic picture on PCB equipment removal progress.

Plans for final treatment and disposal of PCB waste including identification of necessary spatial capacities

Storages for the staging waste are the areas within production sites, all over Croatia, where the equipment with PCBs is temporarily kept. In accordance with Ordinance on management of polychlorinated biphenyls and polychlorinated terphenyls (Article 7) the time period for temporary storage of PCBs, waste PCBs or equipment containing PCBs has been limited to 2 years prior to decontamination or recycling and/or final disposal.

PCB-waste is mostly exported in line with the Basel Convention.

Current 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 physicochemical characteristics and their manufacturers);
- make educational material/publications available to all owners the equipment with PCB e.g. through web page of the Ministry of Environmental Protection, Physical Planning and Construction.

Implementation of the envisaged measures

There are three areas of implementation:

- Coordination of implementation;
- Updating of the legislation, development of directives and strategies, and
- Gradual elimination of PCBs use.

It is necessary to:

- Determine quantity and type of equipment containing PCBs
- Monitor and control implementation measures through:

- 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 increase sensibility of the stakeholders (business entities, competent bodies of state administration) for fulfilment of the Stockholm Convention;
- Ensure transport of the withdrawn equipment to temporary storage;
- Export the equipment with PCB for final disposal, taking into account that the deadline for disposal of such equipment is the year 2010;
- Ensure regular implementation of regulatory provisions;
- Prepare the Guidelines for identification, decontamination, use, transport, storage and disposal of the equipment with PCBs and of PCB-waste, organize education about stated Guidlines for their owners and make them publicly available;
- It is proposed to occasionally review measures and to make necessary amendments;

Timelines for all activities is shown in Table 56.

Table 56. **Timetable for implementation of the planned activities**

Activity / measure	Authority	Implementation Period
Monitoring and regular updating PCB equipment owners database; - Monitoring status of PCB equipment; - Monitoring of PCB equipment disposal; - Monitoring of PCB substitutes;	MEPPPC/CEA	2009-2010
Drafting Guidelines for identification, decontamination, use, transport, storage and disposal of PCB equipment and PCB waste as well as organising education on these directives for the equipment owners. The Guidelines have to be publicly available;	MEPPPC	2010
PCB equipment withdrawal from use.	Equipment owners	2009 - 2010

7.3.3 Activities for Production, Import and Export, Use, Stockpiles and Waste of DDT (Annex B)

Additional activities are not envisaged.

7.3.4 Measure: Register of 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.

7.3.4.1 Planned activities for reduction and elimination of releases of PCDD/PCDF, HCB and PCB as by-products

Objectives and Priorities

Annex C of the Stockholm Convention refers to the by-products that occurred unintentionally and are discharged form the anthropogenic sources: Polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF), Hexachlorbenzene (HCB) and Polychlorinated biphenyls (PCB).

Activities determine and describe those steps and activities that the Republic of Croatia should take for the effective implementation of the Convention. Priorities are:

- Establishment of a comprehensive monitoring:
- Strengthening of public awareness and their integration in the decision-making process and implementation of measures.

Activities also determine short-term and long-term activities, commitments and procedures Croatia should undertake for reducing/eliminating by-product releases in question to the environment.

They specifically refer to the obligations ensuing from the Stockholm Convention including:

- Assessment of existing and expected releases to the environment;
- Evaluation of laws/regulations effectiveness:
- Development of a strategy for reducing/eliminating releases to the environment;
- Education and training;
- Review of the strategy for reduction/elimination of releases to the environment every five years;
- Planning the implementation of activities;
- Promotion of accessible, cost-effective and practical measures for achieving an actual and significant release reduction or source elimination (promotion of BAT principles);
- Support to the replacement/substitution of raw materials, products, processes;
- Gradual phasing out of PCB use in the existing equipment by the year 2010;
- Agreements on a voluntary basis with companies and industrial groups in connection with POPs;
- Reporting and activities relating to public informing
- Treatment and ultimate disposal of POPs contaminated waste;
- Handling and final disposal of waste as well as, recovery of locations contaminated with POPs chemicals listed in Annex C.

Activities 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).

7.3.4.2 Planned Activities and Measures

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).

UNEP Toolkit (*Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases, UNEP 2001*) is applied. 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.

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.

Draft a Programme 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

Programme 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.

Programme 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 programme, 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.

Programme 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.

Revise 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 harmonize the national legislation with the EU regulations related to limit values of POP compounds in food and environment listed in the Annex C.

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

In the Republic of Croatia legislation regulates the HCB, PCB and PCDD/PCDF maximum permitted levels through the Ordinance on Toxins, Metals, Metalloids and Other Harmful Substances that May Occur in Food (OG No. 16/05).

Some countries have drafted regulations and recommendations concerning the PCDD/PCDF concentrations in milk. (Table 57)

Table 57. **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 > 3.0 5.0	- targeted concentration - recommendation not to put on the market - maximum concentration
Ireland	5.0	- maximum concentration
Netherlands	6.0	- maximum concentration
Great Britain	0.7 16.6	- milk and products with < 2% of milk fat - maximum concentration

Water

The following Croatian regulations prescribe the PCDD/PCDF, HCB and PCB maximum permitted concentrations in water:

- Regulation on Water Classification (OG 77/98),
- Regulation on Hazardous Substances in Water (OG 78/98),
- Ordinance on Sanitary Propriety of Drinking Water (OG 47/08)

The following should be done:

- Harmonize the limit values of PCB mass concentrations ($\mu g/L^{-1}$) in specific types of water (*Regulation on Water Classification, OG 77/98*) with those defined in the EU regulations, and fix the concentration limit values (µg/L) of PCDD/PCDF and HCB in specific types of water;
- Harmonize Regulation on Water Classification (OG 77/98) and Regulation on Hazardous Substances in Water (OG 78/98), 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 (µg/L) in land waters types I-V and in sea (*Regulation on Hazardous Substances in Water, OG 78/98*) with values defined in the EU regulations.
- Harmonize the health indicators of water used for public water supply (*Ordinance on Sanitary Propriety of Drinking Water OG 47/08*) in a section relating to PCDD/PCDF, PCB and HCB, with indicators defined in the EU legislation.

Harmonization of National legislation is in process.

Soil

Ordinance on Protection of Agricultural Soil against Contamination by Harmful Substances (OG 15/92), determine the maximum permitted values, expressed in mg/kg of dry substance, for 2,3,7,8 - tetrachlorodibenzo-p-dioxin, HCB and PCB in soil. The values stated in the Ordinance 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 58 as an example for consideration.

Table 58. **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 5 - 40 > 100 > 1 000 > 10 000	- targeted concentration - production control on agricultural land - soil remediation on children playgrounds - soil remediation in housing zones - soil remediation regardless of location and purpose
Netherlands	1.0 10	- agricultural land - pasture land

Air

Limit values of pollutant emissions from stationary sources into air are regulated by:

- Regulation on Limit Values of Pollutant Emissions from Stationary Sources into Air, OG 21/07, 150/08,
- Emission Limit Values for dioxins and furans in the waste incinerator gasses and waste gasses occurring in the technological process obtaining cement using waste as fuel is 0,1 ng m^{-3}. Limit value is determined in accordance to EU Directive (2000/76/EC) relating to all types of waste incinerators including co-incineration of waste.

Anticipated activities for reduction/removal of by-products released into the environment should be in accordance to goals defined for POPs compounds in the National Strategy for Environmental Protection (OG 46/02) and National Plan for Environmental Protection (OG 46/02). In these two strategic documents framework aims regarding POP compounds were given. In accordance to the Air Quality Protection and Improvement Plan in the Republic of Croatia for the Period of 2008 – 2011 a list of measures aiming at POPs reduction were given:

- Introduce a programme for IPPC Directive implementation and application of best available techniques, for reduction of POPs

In the Republic of Croatia it is necessary to systematically introduce IPPC Directive which presents the most important instrument for dioxines and furans emissions reduction instrument. The objective of IPPC Directive – directive on integrated pollution prevention and control, is to reduce environmental impact of the biggest industrial installations through reduction of air-pollution, water and soil pollution, waste minimisation and rational use of natural resources and energy.

In relation to POPs emissions reduction, the UNEP document *Best available techniques (BAT) and best environmental practices (BEP) for reducing and/or eliminating emission of POPs by products* is available.

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.

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 best available techniques 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,
- make out a framework draft for agreements on a voluntary basis,
- initiate negotiations and agreeing to mutual commitments,
- monitor negotiations and agreement implementation.

Reporting and informing the public

For a successful implementation of the planned activities, 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.

Programme should include:

- Development of education and training programmes for implementation of Programme;
- Drafting of guidelines and carrying out progress evaluation of the plan implementation, and reporting in accordance with the Stockholm Convention requirements;
- Provide information on the Programme implementation available to the public and all the interested parties.

The Regulation on Information Dissemination, Public Participation and Interested Public Participation in Environmental Matters (OG 64/08) is regulating information dissemination procedures as well as public participation and interested public participation procedures. The Regulation on Environmental Informational System (OG 68/08) writes that the aim of Informational System is interconnecting of all existing data and informational streams using modern tools such as internet and satellite technology. In addition the System aims at swapping paper-form reporting with a system which would allow users an access to information in their very source in an open and transparent way.

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.

Implementation sequence, subjects of implementing measures/activities and deadlines are shown in Table 59.

Table 59. Timetable of the Action Plan implementation

Activity/measures	Authority	Implementation Period
Establish a detailed Inventory of POP compounds listed in the Annex C	MEPPPC	2009-2010
Draw up a Programme for gradual removal of substances and products contaminated with POPs or that are able to derive POP compounds, proceedings for, and final disposal of, waste contaminated with POP compounds listed in the Annex C as well as recovery of locations polluted with POP compounds listed in the Annex C	MEPPPC	2009-2010
Revision of existing and adaptation of new regulation related to limit values of POP compounds listed in the Annex C in food and the environment.	MHSW	2009
Determine implementation procedure in Programme for gradual removal of substances and products contaminated with POPs or that are able to derive POP compounds listed in the Annex C	MEPPPC	2010 – 2013
Establish detailed goals and procedures for recovery of sites contaminated with PCB compounds listed in the Annex C of the Stockholm Convention.	MEPPPC	2010 – 2013

7.3.5 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.

Needed activities to prevent and reduce releases from some in the future identified stockpiles and waste are elaborated in the following chapter.

7.3.5.1 Programme for identification of major stockpiles, articles in use and wastes that contain POPs

Programme goals and priorities

During inventory of POPs compounds the following has been found out:

- 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.

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 the Programme 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.

Programme 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.

<u>Technical measures for implementation of the strategy</u>

Technical and implementation measures for the implementation of the Programme:

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:

- 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.

Programme implementation

For the successful implementation of the Programme cooperation between stakeholders is needed. Working groups will also be founded that would hold meeting once per year to evaluate progress and success of the programme implementation. Based on the performance action plan would be amended (if necessary) every two years.

Table 60 shows timetable for the implementation of Programme.

Table 60. Timetable for the implementation of the Strategy

Activity/Measures	Authority	Implementation Period
Study on establishing stored equipment, waste and equipment still in use	MEPPPC	2009
Development of technical procedures and instructions for stored equipment and equipment still in use identification including instructions for correct management of equipment.	MEPPPC/ Owners	2010

7.3.6 Measure: Managing stockpiles and appropriate measures for handling and disposal of equipment 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.

7.3.6.1 Programme for identification and remediation of POPs contaminated sites

Goals 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 Programme 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 of this Programme.

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.

Proposed measures for identification of contaminated sites and their possible remediation

Adoption of new adjustment of existing legal regulations directed towards identification and possible remediation of locations contaminated with POPs compounds.

According to the Stockholm Convention the government must decide on adopting of the programme for identification and remediation of the sites contaminated with POPs compounds. When developing the programme 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.

Within the Environmental Protection Act (OG No. 110/07) there is the obligation for the managing the Environmental Emission Register, the database on sources, types, amounts, points of release, transfer and disposal of pollutants and waste into environment. The basis of the Law is the determination of the responsibility in case of pollution, “polluter pays” principle.

The database on POPs contaminated sites is planned within the Environmental Information System.

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, is necessary 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.

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.

Table 61. **Timetable for the Implementation of the Programme**

Activity/Measures	Authority	Implementation Period
Identification of the POP compounds contaminated sites	MEPPPC	2010
Establishing directives and instructions for identification and evaluation of contaminated sites.	MEPPPC	2010
Identification and evaluation of contaminated sites.	MEPPPC	2010
Remediation of contaminated sites.	Owners/ FEPEE	2015
Running cadastre with information on contaminated sites.	CEA	2010

7.3.7 Information Exchange Programme

7.3.7.1 Guidelines of the information exchange policy

Programme for information exchange will be based on:

- international information exchange, and
- national information exchange.

7.3.7.2 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.

Given very many stakeholders the plan is to set up a Working Group consisting of the representatives of the competent Ministries and other organizations and institutions. Every competent institution would appoint a person responsible for communication with the focal point.

7.3.8 Programme for public awareness raising, informing and education

7.3.8.1 Goals and priorities in the field of education, awareness rising and public informing

Programme for education, awareness rising and public informing 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 assurance of disposal and treatment of POPs waste in environmentally sound manner.

Table 62 shows the respective programmes and target groups.

Table 62. **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	√	√			√	√	√	√

7.3.8.2 Basic guidelines for education, information and increase of public awareness

Programme 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. Media presentation for adverse features of compounds encompassed by the Stockholm Convention can be enhanced by supplementation of the Ministry of Regional Development, Forestry and Water Management Programme designed in cooperation with FAO with a goal of increasing awareness of forest fires threat (2006).

7.3.9 Measure: effectiveness evaluation and reporting

Conference of Parties (COP) has decided on the mechanism of periodical effectiveness evaluation of the implementation of the Convention.

In order to provide COP with monitoring data of the presence of the chemicals listed in ANNEX A,B and C, and about their regional and global distribution, 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 Programme for information exchange (chapter 4.3.12.).

The Ministry will also report to the Convention Secretariat for the purpose of evaluating degree of successful requirements completion.

7.3.10 Measure: Research, development and monitoring

7.3.10.1 Goals and priorities of the planned measures for R&D and establishment of systematic monitoring of POPs compounds in to the air, soil, water and its implementation

The goal is to establish systematic monitoring of POPs compounds, so as to determine environmental levels of POPs compounds and, among others, to prove the assumptions of the measures 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 are:

- to amend and develop legal framework for establishment of POPs compounds monitoring;
- to propose the structure of institutions responsible for establishment and implementation of POPs compounds monitoring;

- to propose timetable 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

Continuous 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 does not exist.

8 MEASURES FOR QUALITY IMPROVEMENT AND ESTABLISHMENT OF COMPREHENSIVE MONITORING OF THE LEVELS OF POPS COMPOUNDS

8.1 Legal framework for creation of the conditions for monitoring

It has been recorded that there is no systematic monitoring of the residual POPs compounds in all environmental elements. Current laws and regulations relatively well regulate tolerant 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.

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 Ordinance on Monitoring of the Residues of Specific Substances in live Animals and Products of Animal Origin (OG No.106/99). This Ordinance must be revising. It have to 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. By this it would create a common monitoring principle for live animals, semi-finished products and products of animal origin.

Such monitoring would be aimed at creating databases organized by geographic distribution (Geographic information system-GIS). It will be basis for monitoring of 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).

8.2 National capacities and resources for monitoring

For successful study of majority of POPs compounds (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 the organochlorine pesticides and polychlorinated biphenyls (HRGC-ECD) is available in Zagreb (Institute for Medical Research and Occupational Health, 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; 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.

The main laboratory within "Hrvatske vode"possesses equipment and staff for water monitoring.

8.3 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 programmes for water monitoring which are coordinated by "Hrvatske vode", and to monitoring of meet and products of animal origin organized by the Ministry of Agriculture, Fishery and Rural Development.

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.).

„Hrvatske vode" is an institution responsible for organisation, funding and implementation of monitoring of waters. There is a network of laboratories dealing with sample collection and analysis that exceed international intercalibration and, in accordance to intercalibration results, obtain authorisation from the Ministry Regional Development, Forestry and Water Management for research of indicators in particular medias. In the case a laboratory is not able to test a particular indicator it delivers its samples to the authorised laboratory enabled for testing. The legislation defines a referent laboratory responsible for control of other authorised laboratories. Ongoing introduction of HRN EN ISO/IEC 17025 norms will contribute to entire system becoming more equable and quality.

8.3.1 Monitoring organization and scope

8.3.1.1 Monitoring in blood samples

Monitoring of POPs compounds in humans should include blood i.e. serum/plasma samples**.** Given the results of up-to-date research, we think that this monitoring must be performed on one-time basis 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.

8.3.1.2 Monitoring of POPs pesticides and PCBs in soil samples

Project „Development of the Croatian Soil Monitoring Programme with Pilot Project LIFE05 TCY/CRO/000105", co-financed by the European Commission (Life Third Countries) with Croatian Environmental Agency as a leading institution and Faculty for Agronomy as a partner.

„Handbook for Permanent Monitoring of Soil in Croatia – first edition/draft version“ was drafted based on results of pilot projects conducted on agriculture, forest and contaminated soil in 2006 and 2007. The final aim of the project commenced in 2006 is defining a programme of permanent soil monitoring (forest, agriculture, contaminated) as a tool for collecting geo-referential soil data and in an adjusted format. One of the basic tasks is to determine the contamination degree as well as monitoring of agriculture soil which implies determination of POPs (PAH, PCB, triazin herbicides, organochlorine pesticides) content in soil.

The Croatian Soil Monitoring Programme was based on pilot projects and it will be presented to Government of Croatia and responsible Ministries in the beginning of 2009. This dataflow is needed equally for the soil monitoring process and mandatory environment reporting as well as international obligations of Croatia. In accordance to the Agricultural Soil Act (OG 66/01, 87/02, 90/05) and Ordinance on Foundation of the Soil Institute (OG 100/01) permanent monitoring of agricultural soil in Croatia is one of the basic tasks.

Data obtained by soil monitoring will be incorporated in Croatian Information System for Soil (HIST) which is an integral part of Environmental Protection Information System (ISZO). Environmental Protection Information System is a key governmental instrument for implementation of system for sustainable environmental governance, directing and monitoring of legislation implementation as well as environmental strategy and policy development on the national level.

System of permanent monitoring of soil must ensure comparability of data on the national and EU level. The comparability implies harmonised methods and standards for sampling, analysis, display and dissemination as well as choice of area for monitoring (setting geographical and other boundaries).

The new Law on agricultural land is in its final drafting phase and new Ordinance on Agricultural Land (OG 15/92) is just being adopted. The programme is leaning on numerous soil research completed to this day in Croatia as well as on the Croatian legislation.

8.3.1.3 Monitoring of food

Monitoring of food of animal origin is already underway, within monitoring of the Ministry of Agriculture, Fishery and Rural Development. It should continue within the initial scope and be referenced to the studies of hygienic correctness of food performed by public health institutes. The Ministry of Agriculture, Fishery and Rural Development is monitoring traces of organochlorine pesticide in animal food products (eggs, honey, milk, meat – muscle, animal fat) using State Programme for Residue Monitoring. These analyses are conducted by Croatian Veterinary Institute.

Also, Plan for Monitoring Sea Quality and Shellfish in Areas of Cultivation, Fishing and Re-cultivation includes monitoring of organochlorine pesticides content. There is a need for harmonisation of analytical methodology and reporting as well as verification of the analysis quality. Monitoring should be broadening to include PCDD/PCDF analysis.

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.

8.3.1.4 Air monitoring

Within the scope of National Network for Air Quality Monitoring which will be established by the end of 2010 through PHARE 2006 Project "*Establishment of Monitoring System and Air Quality Management*" the POPs content in the air will be monitored on four stations: Bilogora, Delta Neretve, Karojba and Plitvice Lakes. The National network is composed of air quality stations measuring air quality in background pollution, transboundary long-range transfer measuring stations, monitoring related to international obligations (Bilogora and Karojba) of the Republic of Croatia, stations located in national parks, parks, parks of nature, protected areas, sensitive natural systems and cultural and natural heritage (Plitvice Lakes, Neretva Estuary) and in accordance with Air Quality Measuring in State Network for permanent Air Quality Measurement Programme (OG 43/02).

Representatives of „Ruđer Bošković" Institute, Institute for Medical Research and Hydro-meteorological Institute took part in the „*Determination of trend in the ambient air POPs concentration in the Central and Eastern Region using the polyurethane foam-based passive air samplers (PAS_CEECs) – 2nd phase_2007"* project funded by the Czech Republic The project was consisted of air and soil sample collection on 5 different locations in Zagreb during 5 months and it was focused on examining correlation of persistent organic pollutants in the environment and their biological impact. The samples were analysed in the Czech Republic.

8.3.1.5 Water monitoring

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. Monitoring conducted by Croatian Waters encompasses approximately 330 measuring stations on lentic and stream water and many of them monitor organochlorine pesticides and PCBs content. "Hrvatske vode" are not authorised to monitor chemical content in wells used in water used in water supply. Control of these is the responsibility of the Ministry of Health and Social Welfare. Moreover, in order to determine monitoring scope for POPs it is necessary to conduct thorough analysis of possible presence of POPs in water.

8.3.2 Implementation of planned measures

Implementation 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.

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.

If the monitoring results during one or two years of monitoring do not show there is a presence of targeted compounds in, for example, water monitoring should be stopped or reduced in frequency and scope. Table 63 shows implementation sequence, implementation institutions and timelines.

8.3.3 Requirements in capital investments

The most important capital investment would be improving the capacity of existing laboratories for testing the levels of PCDD/PCDF in environment (soil, air, water, and sea) and human biomaterial. To upgrade monitoring of POPs pesticides it is necessary, in the first place, to connect and coordinate the work of all existing qualified laboratories.

8.3.4 Financing the implementation

Financing of the monitoring (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).

Table 63. **Implementation timetable**

Activity/Measure	Authority	Implementation Period
Defining monitoring system, adopting legislation	MEPPPC/Croatian Waters/MHSW/ MAFRD	2009
Implementing monitoring procedures	MEPPPC/Croatian Waters/MHSW/ MAFRD	2010 - 2015
Spreading information and increasing public awareness	MEPPPC/CEA	2010 -cont.

8.4 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 have already been undertaken but require more attention according to the recommendations of Stockholm Convention:

- 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.

Stated fields will be elaborated in more details during NIP implementation.

8.4.1 Measure: 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.

8.4.2 Areas Needing Strengthening Current Capacities

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
- Development of comprehensive monitoring system for POPs compound in environment

II Decision of adoption of National Implementation Plan for Stockholm Convention on POPs

8.5 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 phase
- Adjustment of the existing or development of new legislation;
- Development of technical instructions, directives and procedures that ensure implementation of legal regulations, and
- Implementation of the action plans and strategies.

Ministry of Environmental Protection, Physical Planning and Construction is institution responsible for the implementation of the whole NIP. It will coordinate and oversee the implementation of measures, activities and programmes.

A short-term and the most important goal in 1-5-year period is development of new or adjustment of current legislation, 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.

A medium-term goal is to carry on the measures for 5 - 10 year period.

Table 64 shows the timetable of the NIP implementation.

Table 64. **NIP implementation timetable**

In the long-term period (10 years onwards) it is necessary to continuously carry on with activities resulting form certain measures and activities. The length of the period depends on how quickly the requirements from the midterm period would be carried out **Activity/Measure**	**Authority**	**Implementation Period**
Adjustment of old or creation of new legislation	MEPPPC/MELE/ MHSW/ MAFRD/ MRDFWM	2009-2010
Establishing programmes, directives, technical instructions, procedures and proceedings	MEPPPC	2009-2010
Implementations of programmes and activities	MEPPPC	2010 onwards

8.6 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.

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.

Since 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. Now with Croatia being the Convention party, international financial support can be realised.

9 ANNEX I: ABBREVIATIONS

ADI – Available Daily Intake

BAT – Best Available Techniques

BEP – Best Environmental Practices

CBS/DSZ – Croatian Bureau of Statistics

CEA – Croatian Enviromental Agency

CLRTAP– Convention on Long Range Transboundary Air Pollution

ELV – Emission Limit Values

FEPEE – Fond for Environmental Protection and Energy Efficiency

HAC – Croatian Highways Ltd.

HC – Croatian Roads Ltd.

HCB – Hexachlorbenzene

HCH - Hexachlorcyclohexane

HEP – Croatian Power Supply Company

HRGC - ECD – High resolution gas chromatograph with electron capture detector

HRGC - MS – High resolution gas chromatograph with mass spectrometer

“Hrvatske vode”-Croatian Waters

“Hrvatske šume”- Croatian forests

HSE – Health, Safety and Environment

IAEA – International Atomic Energy Agency

IPPC – Integrated Pollution Prevention and Control

MF – Ministry of Finance

MAFRD – Ministry of Agriculture, Fishery and Rural Development

MELE – Ministry of Economy, Labour and Entrepreneurship

MEPPPC – Ministry of Environmental Protection, Physical Planning and Construction

MRDFWM – Ministry of Regional Development, Forestry and Water Management

MHSW – Ministry of Health and Social Welfare

MPC – Maximum Permitted Concentration

N/A – Not Applicable

HNB – Croatian National Bank

ND – Not determined

NE – North East

NGO– Non Governmental Organisation

NPK – Nitrogen Phosphorus Potassium

OCP – Organochlorine Pesticide

PCB – Polychlorinated Bipheniyes

PCDD – Polychlorinated dibenzo-p-dioxin

PCDF – Polychlorinated dibenzophurane

PM – Particulate matter

POP – Persistent Organic Pollutant

PVC – Polyvinyl Chloride

R&D – Research and Development

SI- State Inspectorate

SNAP - Selected activities for air pollution

TEQ – toxic equivalent

UNEP – United Nations Environmental Programme

UNESCO – United Nations Educational, Scientific and Cultural Organisation

UNIDO – United Nations Industrial Development Organisation

UN – United Nations

VCM – Vinyl Chloride Monomer

WHO – World Health Organisation