International POPs Elimination Project

Fostering Active and Efficient Civil Society Participation in Preparation for Implementation of the Stockholm Convention

Croatia - Country Situation Report on POPs

Green Action

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About the International POPs Elimination Project

On May 1, 2004, the International POPs Elimination Network (IPEN http://www.ipen.org) began a global NGO project called the International POPs Elimination Project (IPEP) in partnership with the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Program (UNEP). The Global Environment Facility (GEF) provided core funding for the project.

IPEP has three principal objectives:

- Encourage and enable NGOs in 40 developing and transitional countries to engage in activities that provide concrete and immediate contributions to country efforts in preparing for the implementation of the Stockholm Convention;

- Enhance the skills and knowledge of NGOs to help build their capacity as effective stakeholders in the Convention implementation process;

- Help establish regional and national NGO coordination and capacity in all regions of the world in support of longer term efforts to achieve chemical safety.

IPEP will support preparation of reports on country situation, hotspots, policy briefs, and regional activities. Three principal types of activities will be supported by IPEP: participation in the National Implementation Plan, training and awareness workshops, and public information and awareness campaigns.

For more information, please see http://www.ipen.org.

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The views expressed in this report are those of the authors and not necessarily the views of the institutions providing management and/or financial support.

This report is available in the following languages: English, Croatian.

Contents:

1. What are POPs?

Persistent Organic Pollutants, or POPs, are chemical compounds which persist in the environment. All of them are to some extent are resistant to photo-, chemical- and bio-degradation processes. They tend to be highly soluble in fat but not in water, and they therefore bio-accumulate in the fat of living organisms.

They pose a high risk to human health. Exposure to individual POPs has been associated with cancer, neurotoxic, behavioural, and reproductive effects. Due to their accumulation in fats they are likely to be passed to succeeding generations in utero and through breast milk.

They have also been found far away from places where they have been produced or used because they are able to evaporate in warm climates and to be absorbed and transported by atmospheric particles. Once they reach colder climates they cannot evaporate and have therefore been found in the polar regions despite the lack of sources there.

POPs have also been linked to population declines in fish and other wildlife, as well as being linked to specific disorders such as reproductive dysfunction, eggshell thinning, metabolic changes, deformities and birth defects, cancers, behavioural changes, hormone system dysfunction, immune suppression, feminization of males and masculinization of females.[1]

Twelve of these chemicals are covered by the Stockholm Convention, which aims at either restricting or eliminating their production and use, or their unintentional production. The chemicals are:

Table 1: POPs covered by the Stockholm Convention

Pesticides	**Industrial Chemicals**	**Unwanted Bi-Products**
Aldrin	Polychlorinated biphenyls (PCBs)	Polychlorinated dibenzo-p-dioxins (PCDDs)
Dieldrin	Hexachlorobenzene (HCB)	Polychlorinated dibenzofurans (PCDFs)
Endrin		Polychlorinated biphenyls (PCBs)
Hexachlorobenzene (HCB)		Hexachlorobenzene (HCB)
Chlordane		
DDT (1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane)		
Heptachlor		
Mirex		
Toxaphene		

2. Sources of POPs

The most up to date and comprehensive overview of POPs levels and POPs sources in Croatia is the 2004 National Implementation Plan (NIP), although it should be noted that several important changes have taken place since it was published, especially in the area of legislation, where laws and regulations continue to be changed at a rapid pace to meet the demands of EU accession. Therefore some of its recommendations have been implemented. The NIP contains a good overview of the work which has been done so far on POPs in Croatia, but shows that much of the data available is rather old or that sampling has often taken place on a one-off basis rather than consistently over time. The 2002 UNEP Regional-Based Assessment raises a number of the same issues as the NIP, for example on

[1] International Joint Commission (IJC) on the Great Lakes: "Seventh Biennial Report on Water Quality, Windsor/Detroit, 1994, http://www.ijc.org/php/publications/html/7bre.html, quoted in World Federation of Public Health Associations: "Persistent Organic Pollutants and Human Health", WFPHA, May 2000, http://www.wfpha.org/pg_projects_pops.htm, p.7

lacking data about POPs levels, and the need for more action on PCB stockpiles and contaminated areas. There is also a National Profile from 1997 but this is rather out of date by now.

POPs pesticides

There are currently no known sources of POPs pesticides in Croatia as all of them have been banned for production and usage for several years, except for mirex, which was never permitted. The NIP gives details about usage of POPs pesticides from 1962-1976 and about DDT usage in forestry until 1989.[2]

Table 2: POPs pesticides in Croatia and year banned

Pesticide	Year banned in agriculture
Chlordane	1971
DDT	1972
Aldrin	1972
Dieldrin	1972
HCB	1980
Toxaphene	1982
Endrin	1989
Mirex	Never permitted for commercial use

Source: National Implementation Plan, Executive Summary, p. I

Note that all production, circulation and usage of POPs pesticides, whether for agriculture or other purposes, is now banned in Croatia.[3] No stockpiles of POPs pesticides have been detected in Croatia.

PCBs (intentional production)

PCBs are on the list of banned toxins, with the exception of existing equipment containing PCBs in closed systems, which may continue to be used. An inventory of PCBs[4] in Croatia was undertaken in 2003 by APO d.o.o[5] together with the Ministry of Labour and Welfare. According to the inventory there are 22 859 capacitors and 304 transformers containing PCBs in Croatia, weighing a total of 1 384 383 kg.[6] Hrvatska Elektroprivreda is the biggest owner of capacitors containing PCBs, while most of the transformers are owned by the chemical and metal industries.[7]

In addition between 1996 and 2001, 167 tonnes of PCBs, PCT and PBB were imported[8], and there is still a stockpile of around 1 tonne of liquid PCB[9]. It is not clear what the purpose of the imports was and this has been identified as an area for further investigation in the NIP.

No usage of PCBs in open systems such as in adhesives, dyes or plastics, has been identified in Croatia.

[2] NIP, p.31-33

[3] Republic of Croatia: List of Toxins Whose Production, Circulation and Use is Forbidden, Official Gazette 29/05

[4] APO d.o.o: "Inventar polikloriranih bifenila (PCB-a) u Republici Hrvatskoj", September 2003, http://www.cro-cpc.hr/projekti/pops/PCB%20Izvjestaj.pdf

[5] APO is the waste management company which has coordinated the NIP process through its Cleaner Production Centre

[6] NIP, p.40

[7] NIP p.54

[8] These shared a common import tariff number and have therefore been registered together. NIP, p.47

[9] NIP p. 49

Waste management in Croatia has until now been very haphazard, and until recently none of the country's landfill sites met European standards. Therefore it is possible that any of these sites contain PCB-contaminated waste.

Importing hazardous waste is illegal in Croatia, as the country has no facilities for dealing with it. Since 1994 Croatia has exported 267.7 tonnes of waste containing PCBs[10] to be disposed of by incineration in France and Belgium or disposal in German salt mines.

PCBs and HCBs (unintentional production)

Research on releases from the unintended production of PCBs and HCBs has not been carried out in Croatia so far,[11] but the new Regulation on Monitoring Air Quality (Official Gazette 155/05) includes a requirement to monitor PCBs, HCB, chlordane and DDT in the air. They have not been included in any inventory, and no information about likely sources is included in the NIP.

PCDDs/PCDFs

PCDD and PCDF emissions from waste incinerators and cement kilns are monitored according to the Regulation on Pollutant Emission Limit Values from Stationary Sources, Official Gazette 140/97, amended by 105/02, 108/03 and 100/04. However other PCDD/PCDF sources do not appear to be monitored regularly. A dioxin and furan Inventory was been carried out in 2003[12] by Ekonerg d.o.o consultants, using the 2001 UNEP Toolkit for PCDD/PCDF emissions, which gives an idea of the sources of dioxins and furans but does not involve exact measurements of emissions, so can be used only for guidance.

Figure 1: Plomin coal power plant. Power generation and heating has been estimated as the largest source of dioxins and furans in Croatia

The more detailed assessments in the NIP[13] show that by far the most significant source of dioxin emissions is burning wood in households (90.741 $gTEQ^{-1}$ for 2000[14]), which is included in the "power generation and heating" category. This somewhat surprising assessment may be a result of the fact that Croatia is not a heavily industrialized country and that much of the highly polluting industry that existed has closed down within the last 15 years, leaving only a few main industrial sources. The NIP recommends that efforts should be made to switch from coal and wood burning to gas[15] in order to decrease dioxin emissions, however we would question this approach. While gas combustion produces less pollution than coal or wood during combustion, it is nevertheless a finite and increasingly expensive resource which is found only in certain areas and therefore has to be transported for long distances. When comparing the pollution caused by gas vs. wood it is therefore also necessary to take into account the pollution caused by extracting and

[10] For more details see NIP p.47-48
[11] NIP p.55
[12] Ekonerg d.o.o. "Dioxin and Furan Inventory in Republic of Croatia", 2003, English Summary on Croatian CPC website at: www.cro-cpc.hr/projekti/pops/PCDD_PCDF%20Sazetak_eng.pdf
[13] NIP p.63-77
[14] NIP, p.60
[15] NIP p.55

transporting gas, including the pollution caused by building pipelines, and the potential of energy efficiency measures and renewable energy should also be included in the calculations. As far as we are aware no such calculation has been made for Croatian conditions and it is therefore premature to make a wholesale recommendation to switch to gas.

In 2001 the major manufacturers of metal and metal products (by total revenue) were TLM Šibenik dd., Dalekovod dd. Zagreb, Željezara Sisak, Trgometal dd. Zagreb, Jedinstvo PMD Krapina, MIV Varaždin, and Limex Donji Miholjac.[16] Emissions from their facilities should be consistently monitored and strategies for reducing them should be drawn up.

Table 3: Assessment of overall environmental emissions of PCDD/PCDF in 2001

Main categories of PCDD/PCDF sources	**Annual emissions of PCDD/PCDF (g TEQ/year)**				
	Air	**Water**	**Soil**	**Product**	**Leftovers/Waste**
Waste Incineration Plants	1.4				3.6
Ferrous and non-ferrous metal production	3.1	?	?		22.3
Power generation and heating	105.7?				20.6
Mineral products production	2.3				0.01?
Transport	0.9				
Uncontrolled combustion processes	2.2?		1.7		?
Production of chemical and consumer goods	0.1?	0.002?		0.8	0.3?
Miscellaneous	0.001?			?	?
Waste treatment/disposal	?	?	?		2.7
TOTAL:	115.7?	0.002?	1.7?	0.8?	49.5?

Source: Ekonerg d.o.o. "Dioxin and Furan Inventory in Republic of Croatia", 2003/ NIP p. 80
Note: the figures shown are medians, and empty boxes denote an insignificant route.
? = the potential route is significant but either the emissions factor or activity is missing
? after the figure = the number is not representative because some subcategories have not been fully quantified.

It is noteworthy that Croatia's only hazardous waste incinerator, PUTO in Zagreb, was closed in 2002 after a fire in the storage area (see right). Its PCDD/PCDF emissions were measured twice in 2001 and were above the legal limit of 0.1 ng I-TEQ^{-1} both times.[17] There are now 11 medical waste incinerators left in Croatia[18] but no domestic or hazardous waste incinerators, which means that emissions should now be lower in this category. However, Zagreb City Council is planning to build a 385 000 t/y municipal waste incinerator in Zagreb, which would again change the situation.

PCDD/PCDF emissions from mineral product production are mainly from cement production in Croatia, but also from brick production.[19] At least three cement works also burn waste such as old tyres and waste oil, which is likely to affect their emissions.

Figure 2: Fire in PUTO incinerator[1]

[16] NIP, p.64
[17] NIP p.63
[18] Republic of Croatia Waste Management Strategy, Official Gazette, 130/05
[19] NIP, p.68

3. Levels of POPs

POPs pesticides

Food: The NIP only presents data on POPs in food from 1986-1989 and 1992-1996, and we have not been able to access any more recent data. The NIP data showed that DDT and lindane levels in Croatian beef and pork significantly decreased during that period, and that other compounds were at about the same level. (DDT decreased from a median of 18 $\mu g/kg^{-1}$ to 1 $\mu g/kg^{-1}$).[20]

Soil: There is little data about POPs pesticides in soil as systematic monitoring is not carried out. The NIP presents data only from a few locations, where sampling was carried out in the mid-1990s, but which does not tell us much about the current situation.

River water: See Table 4.

Table 4. Levels of organochlorine pesticides and of polychlorinated biphenyls in river water samples (ng L-1) collected between 1.1.2000 and 31.12.2002

Site and year of sampling	PCBs	Total OC pesticides	Lindane	DDT
Rivers and reservoirs in 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 S	0 S
2000	NR	NR	0 S	0 S
Mura (Goričan):				
2000	NR	NR	100 S	2-3200
2002	NR	NR	100 S	5 S

** Sampling sites: Mirna, Raša-Most Potpican, Butoniga reservoir (surface), Sveti Anton, Mutvica, Balobani, Rakonek, Kokoti, Blaž, Tivoli, Gradole, Sveti Ivan, Bulaž, Mlini, Pazincica - Dubravica, Pazincica - Ponor, Boljuncica (mouth)*
S - the same level in all samples
NR = unavailable data

PCBs

There is no database of PCB-contaminated locations, and research and remediation in this area should be a high priority for the government. So far there have been two locations (both HEP[21] sites, at Komolac (Dubrovnik) and Plomin), which have been remediated after accidents with equipment containing POPs.

However, there are several more locations where PCBs have been detected but the extent of the contamination is not known and remediation has not been carried out. These are the electricity sub-stations in Delnice, Zadar, Šibenik – Bilice, Kaštel Sućurac and Dubrovnik (where contamination near to the site was still present after the remediation work) Of these, the sites which are the greatest cause for concern are Šibenik, where PCB contamination of 470.32 mg/kg^{-1} was measured in soil 2.5 metres

[20] NIP p.88
[21] Hrvatska Elektroprivreda d.o.o, the state-owned electricity company

from the capacitors; and Zadar, where PCB contamination of 172.909 mg/kg^{-1} was measured 1metre from the capacitors.[22] These sites are of particular concern because they are sited in karst areas which are highly permeable and facilitate pollution of underground waters.

In addition, PCB contamination is suspected in the areas most affected by the 1990s war, for example Sisak, Karlovac, Gospić, Osijek – Ernestinovo, Vukovar, Pakrac, Šibenik aluminium and ferrous-alloy factory, and Lipik. In these areas military vehicles and equipment containing PCBs were destroyed but research to determine the presence and extent of the pollution has not been done.

The NIP presents data on PCBs in food between 1984-1988 and 1992-1996, which shows that the mean level of PCBs in Croatian fish dropped significantly (from 59 or 287 µg/kg^{-1} (Arochlor 1254 and Aroclor 1260) to 46 µg/kg^{-1} (total PCBs), but that levels in imported fish were much lower (6 µg/kg^{-1} on average).23 In 1997 some research was carried out at various locations to assess the extent of PCB contamination as a result of electricity substations during the war. High levels of PCBs (as much as 4004 µg/kg^{-1} in one case, and with a median of 259 µg/kg^{-1}) were found in fish in the Zadar Marina, at the mouth of the Vruljica stream (Zadar), and in Dubrovnik.[24] Between 2002 and 2005 Zadar was one of the sites for the APOPSBAL project[25], co-ordinated by Recetox of Czech Republic, which gathered further data and will hopefully lead to the remediation of the site of the former electrical transformer station.

Figure 3: Map of Croatia[26]

[22] Picer et al. 1998, 2000, cited in NIP, p. 51
[23] NIP p. 89
[24] NIP p.92.
[25] Recetox: "Assessment Of The Selected Pops (PCBS, PCDDS/FS, OCPS) In The Atmosphere And Water Ecosystems From The Waste Materials Generated By Warfare In Former Yugoslavia", 2002-2005 http://www.recetox.muni.cz/projekty/apopsbal/index.php
[26] Source: www.map-of-Croatia.co.uk

PCDDs/PCDFs

Air: Levels of dioxins and furans in the air in Croatia were analyzed for the first time in 1993 with two samples, taken in Zagreb (Ksaver Street) and Jastrebarsko, a small town in Zagreb County. The sample from Zagreb showed a PCDD/PCDF level of 92.3 fg I-TEQ m-3, and the Jastrebarsko sample showed 105 fg I-TEQ m-3. Between 1997 and 2000, samples were taken in Zagreb around the now closed hazardous waste incineration plant (PUTO), in the centre of Zagreb (Đorđićeva street), in the industrial zone in the eastern part of the city (Žitnjak) and in northern peripheral parts of Zagreb (Ksaverska Street).[27] The levels of POPs compounds expressed as toxic equivalents, calculated with international factors of equivalent toxicity based on the toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin, are shown in Table 5.

Table 5. Levels of PCDD/PCDF in the air samples collected in Zagreb between May 1997 and March 2000.

Sampling Point	Sampling Time	Mean Temp. (^{o}C)	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

** The incinerator only began operating in 1998, whereas the samples were taken in 1997. In 2001, the LGA "Report on carrying out of emission measurements in the waste gas of the hazardous waste incineration plant"[28] showed that the twice-yearly samples taken during the operation of the incinerator were above the limit value of 0.1 ng I-TEQ m-3 as set out in the Regulation on the Emissions Limit Value for Air Pollutants from Stationary Sources (Official Gazette No. 140/97).*[29]

[27] B. Krauthacker, S. Herceg Romanic, M. Wilken and Z. Milanovic: "PCDD/Fs in ambient air collected in Zagreb, Croatia" Chemosphere, Volume 62, Issue 11, March 2006, pages 1829-1837

[28] Landesgewerbeanstalt Bayern: "Report on carrying out of emission measurements in the waste gas of the hazardous waste incineration plant, Zagreb", LGA, Nurnberg, 2001

[29] NIP p.63

In addition, one sample was taken from a garden fire of unknown content, and another sample was taken during an accidental fire on a landfill tip, where the PCDD/F level was 13 200 fg I-TEQm-^{3}. The PCDD/F level in the landfill fire was much higher than any of the other samples, including those from the industrial zone.

Seasonal variation of PCDD/F levels was evident with higher levels in winter than in summer, and the PCDD/F levels in ambient air collected in Zagreb were found to be at the lower end of the published data range.

4. Damage caused by POPs

Pesticides: The study of POPs in humans in Croatia began in 1969 with analyses of fat tissue, and more extensive monitoring of POPs in human serum and breast milk began in 1975. These analyses included pesticides and later also PCBs. The NIP shows results from these analyses from 1975 until 1997, but the results come from different locations in different years,[30] and it is therefore not possible to discern any trends from these results. Neither are the results recent enough to give us a picture of the current situation.

PCBs: PCBs were measured in the breast milk of nursing mothers in Zagreb between 1981 and 1995 showed a decline in the level of PCBs.[31] However, measurements of PCBs taken from 30 serum samples in 1995 and 1997 showed a rise in the levels of some PCB congeners in humans, however we have been unable to access any more recent data to see if this trend has continued.

Table 6: Levels (median; ranges are in the brackets; μg L-1) of PCB congeners in blood serum of general population

PCB congener	General Population	
	1995 (N=14)	1997 (N=16)
PCB-28	0.1 (0 - 0.3)	0.2 (0 – 0.5)
PCB-52	0.7 (0.3 – 1.5)	2.5 (0.5 – 9.1)
PCB-101	0.4 (0 – 3.4)	0.5 (0 - 2.4)
PCB-138	0.5 (0.2 – 1.2)	0.5 (0.2 – 4.6)
PCB-153	0.5 (0.3 – 1.6)	0.5 (0.1 – 2.4)
PCB-180	0.3 (0.2 – 2.7)	0.3 (0 – 0.9)
Sum of six PCBs	2.4 (1.5 – 6.4)	4.4 (1.9 – 11.4)

PCDDs/PCDFs: Little analysis has been done on dioxins and furans in humans due to the lack of appropriate equipment, however samples taken in Zagreb between 1981 and 2000 showed a decrease from 24.2 pg TEQ g^{-1} of fat to 5.9 pg TEQ g^{-1} of fat, and on the island of Krk there was a decrease from 12.0 pg TEQ g^{-1} of fat in 1986/7 to 5.2 pg TEQ g^{-1} of fat in 2000.

Other than the above, it is not known what harm has been done by POPs in Croatia, as there has not been sufficient research in this area, either in determining effects on human health or effects on eco-systems.

5. Laws currently regulating POPS

International treaties ratified or signed by Croatia concerning POPs

In Table 7 are listed all international conventions signed by Croatia that are related to POPs.

[30] NIP p. 105-6
[31] NIP, p.31

Table 7: International Treaties concerning POPs signed or ratified by Croatia.

Treaty:	Signed:	Entered into force for Croatia:
Stockholm Convention on Persistent Organic Pollutants	2001	Not ratified
Geneva Convention on Long-Range Trans-boundary Air Pollution	Party by succession notification	8th October 1991
Protocol to the 1979 Convention on LRTAP on Long Term Financing of the Cooperative Programme for Monitoring and Evaluation of the LRTAP in Europe	Party by succession notification	8th October 1991
Protocol to the Aarhus Convention on Pollutant Release and Transfer Registers	1998	Not ratified
Basel Convention on the Control of Trans-boundary Movements of Hazardous Waste and their Disposal	Acceded 9th May 1994	7th August 1994

Croatia has not signed the 1998 Rotterdam Convention on Prior Informed Consent (PIC).

Laws regulating POPs in Croatia

Table 8 gives overview about laws regulating POPs in Croatia.

Table 8: Laws regulating POPs in Croatia

Law	Official Gazette Reference:
Law on Environmental Protection	NN 82/94 amended by NN 128/99
Law on Air Protection	NN 178/04
Regulation on Monitoring Air Quality	NN 155/05
Regulation on Pollutant Emission Limit Values from Stationary Sources	NN 140/97, amended by NN 105/02 108/03 and 100/04
Regulation on Monitoring Pollutant Emissions from Stationary Sources	NN 01/06
Regulation on Maximum Allowed Concentration of Noxious Substances in the Air of Working Premises and on their Biological Limit Values	NN 92/93
Law on Waste	NN 178/04
Regulation on Categories, Types and Classification of Waste with Waste Inventory and Hazardous Waste List.	NN 178/04

Table 8 continued:

Law on Water	NN 107/95, amended by NN 150/05
Regulation on the sanitary propriety of drinking water	NN 182/04
Regulation on Water Classification	77/98
Regulation on Hazardous Substances in Water	78/98
Regulation on Indicator Limit Values of Hazardous and Other Substances in Waste Waters	NN 40/99, amended by 6/01 and 14/01
Law on Chemicals	NN 150/05
Law on Plant Protection	NN 10/94 amended by NN 117/03, to be

	replaced by NN 70/05 from the beginning of 2007
List of Toxins Whose Production, Circulation and Use is Forbidden	NN 29/05
Regulation on Safety at Work with Substances Containing Polychlorinated Biphenyls, Polychlorinated Naphthalene and Polychlorinated Terphenyls	NN 7/89
Regulation on the quantity of pesticides, toxins, mycotoxins, metals and histamines and similar substances which may occur in food, and on other conditions regarding sanitary propriety of food and items of general use	NN 46/94
Regulation on carrying out monitoring of food and establishment of levels of nutrients, contaminants, additives and other ingredients and substances	NN 135/04
Regulation on toxins, metals, metalloids, and other harmful substances which may occur in food	NN 16/05
Regulation on the Protection of Agricultural Land from Pollution with Harmful Substances	NN 15/92
Law on transportation of dangerous substances	NN 97/93

The limit values set out for POPs levels in food and environmental media are set out in Appendix 1 of this report.

6. NGOs and POPs

NGO and public awareness about POPs

Awareness of POPs appears to be low in Croatia, both among NGOs and society in general. Knowledge about individual chemicals is somewhat higher, but is still at a low level. Although the Stockholm Convention pesticides containing POPs have all been banned in Croatia, they are perhaps more well-known than substances such as PCBs and dioxins and furans which currently pose a greater threat. The general public lacks self-confidence to get involved in debates about issues which are seen as 'scientific', even when their health is concerned, whilst government officials and scientists are all too often reluctant to involve non-'experts' in policy debates, and do not appear to have attempted to educate the public about POPs through the media or other means. The large gaps in knowledge about the situation concerning POPs in Croatia makes systematic public education difficult, but there should at least be an attempt to convey the issues through the media and to show what is being done, how the public can participate, and where they can learn more. At the moment the main public document about POPs is the NIP, which is 177 pages long, and there has been extremely little or no media coverage of the issue.

NGO capacity on POPs

NGOs have hardly carried out any work on POPs as a whole, although some have been campaigning on POPs-related issues, particularly against waste incineration and co-incineration in cement kilns. Some of these are carried out by local citizens' groups, which have good local knowledge but little experience in campaign methods or scientific work. For details of each group known to us, see Table 2 below.

The Franjo Koščec NGO from Varaždin in the north of Croatia has carried out a project entitled "What do you need to know about nutrients and toxins in the Danube environment?" which included 10 workshops and roundtables in northern Croatia and a booklet explaining the current situation. They

have also carried out another project entitled "Heavy metals and other toxic substances in the Ormož reservoir". Both of these projects have covered some POPs.

Current level of NGO communication and coordination on POPs

22 Croatian environmental NGOs are linked together in the Green Forum network, which addresses a wide range of issues. However we are not aware of any projects or campaigns directly on POPs by environmental NGOs. We are not aware of any information focused on POPs distributed by NGOs in Croatia so far.

Figure 4: Members of Green Action informing the public about the likely dangers of Zagreb's planned municipal waste incinerator.

Involvement of NGOS in the NIP process

It is important to note that the NIP process is being coordinated by the Croatian Cleaner Production Centre, which may sound like an NGO but is part of APO d.o.o, the 'environmental services' and waste management company owned by Hrvatska Elektroprivreda d.o.o. (HEP), the state-owned electricity company.

The NIP lists two NGOs as being involved in the NIP's development: Knowledge for Environment (Dr. Velimir Pravdić), and the Croatian Air Pollution Prevention Association (Dr. Blanka Krauthacker).

The Croatian Air Pollution Prevention Association is linked with the Institute for Medical Research and Occupational Health at the University of Zagreb, and has a high level of expertise in the issue. Although technically an NGO it does not orient itself towards public information or participation, and its involvement in the NIP process is more in an academic expert capacity than in an NGO one.

Dr. Pravdić has pointed out that he was appointed to the group as a member of the Croatian Society for Natural Sciences, not Knowledge for Environment, and that this was on the basis of his long career as an Environmental Chemist.[32]

It is therefore rather misleading to state that NGOs have been involved in the process, as those organizations identified as NGOs were rather academic experts. There has been no participation by groups which would seek to inform and involve the public in this issue, though the Croatian Cleaner Production Centre maintains that NGOs were invited to take part in workshops on the NIP process but did not respond.[33]

[32] E-mail from Dr. Velimir Pravdić, NIP development participant, to Pippa Gallop, 9th March 2006

[33] Goran Romac, Croatian Cleaner Production Centre, Telephone Conversation with Bernard Ivčić, Green Action, 15.03.2006

NGOs currently active on POPs

According to the Ministry of the Environment, Spatial Planning and Construction, in 2004 there were 268 non-governmental organizations dealing with environmental issues in Croatia.[34] In addition there are a number of informal citizens' initiatives.

None of the NGOs are systematically dealing with POPs as a group of chemicals. The two people who took part in the development of the National Implementation Plan and are listed as belonging to NGOs were appointed primarily as scientists.[35] Although technically their organizations qualify as non-governmental, these are academic organizations rather than public interest organizations.

Most of the activities connected with POPs carried out by NGOs have been on a local level in connection with emissions from specific facilities.

Local groups

Table 9: NGOs and citizens' initiatives connected with POPs

Organization	Focus of POPs-related work	Website
Franjo Koščec	Danube, Ormož reservoir	www.franjo-koscec.hr
Eko-2000	CIOS metal reprocessing factory, Zagreb	www.eko-2000.hr
GrIn	Koromačno cement works, Istria	None
Sunce	Dalmacijacement, Split	http://www.sunce-st.org/
Jakuševec Association for the Protection of the Environment (UZOJ)	Former PUTO hazardous waste incinerator, Zagreb	http://www.jakusevec.4t.com/
Green Action	Planned municipal waste incinerator, Zagreb	www.zelena-akcija.hr

7. Efforts to deal with POPs

Political/corporate efforts

The Croatian government has signed but not ratified the Stockholm Convention, and a National Implementation Plan was completed in November 2004. The co-ordination of the NIP has been delegated to APO d.o.o., a subsidiary of the state electricity company HEP, so can only indirectly said to be carried out by the government.

Apart from the bans on POPs pesticides introduced several years ago, the government has been making an accelerated effort to update legislation relating to POPs during the last two years. The new laws and regulations introduced can be seen in Table 8 above. PCBs have also been included in the 2005 Waste Management Strategy: usage must be stopped in Croatia by 2025 and they must be safely disposed of by 2028. Legislative efforts are the strong point of activities dealing with POPs in Croatia, and are making rapid progress.

The most urgent area still requiring attention is the research and remediation of PCB-contaminated areas, which requires action by the government and by HEP. In Zadar this is being undertaken within the framework of the APOPSBAL project co-ordinated by Recetox of Czech Republic,[36] but in other areas, particularly Slavonia, more work is needed.

[34] Ministry of the Environment list of registered environmental NGOs in Croatia http://www.mzopu.hr/doc/Popis_nevladinih_udruga_2004.pdf

[35] E-mail from Dr. Velimir Pravdić, NIP development participant, to Pippa Gallop, 9th March 2006

[36] Recetox: "Assessment Of The Selected Pops (PCBS, PCDDS/FS, OCPS) In The Atmosphere And Water Ecosystems From The Waste Materials Generated By Warfare In Former Yugoslavia", 2002-2005 http://www.recetox.muni.cz/projekty/apopsbal/index.php

Monitoring:

Monitoring has been the weak side of Croatia's efforts to address POPs. Comprehensive monitoring of POPs in the environment, food and humans is not carried out in Croatia, and most monitoring is done occasionally as part of specific projects, rather than systematically. The NIP states that the country lacks sophisticated enough equipment for analyzing PCDDs and PCDFs, and that several new laboratories will need to be set up according to EU standards.[37] Monitoring is carried out in the following media as outlined below:

Air:
The Regulation on Monitoring Pollutant Emissions from Stationary Sources (Official Gazette 01/06) stipulates the methods of measuring air emissions of PCDD/PCDF, but not HCB and PCBs. The monitoring of HCBs and PCBs in air is included in the new Regulation on Monitoring Air Quantity (Official Gazette 155/05). Until now there has been no regular monitoring of HCBs and PCBs in air and they were not included in the Dioxin and Furan Inventory due to lack of time and budget.

Water:
Croatian Waters, the state water company, monitors organochlorine pesticide and PCB levels in rivers and reservoirs, but apart from the list of approved laboratories for measuring PCBs in water, there is no official list of approved laboratories for measuring PCBs in other media.

Food:
The Croatian Institute for Public Health carries out physical-chemical analyses for pesticides and residue analyses in food (mainly meat and dairy products) and municipal institutes for public health monitor pesticide residues in food.

Humans/Animals:
The Ministry of Agriculture, Forestry and Water Management has organised a partial monitoring programme of POPs compounds in samples of animal origin on the state level.

Health Registry

There is no health registry in Croatia connected with POPs, and monitoring of POPs levels in humans would need to be improved before such a registry could be effective.

8. State of Stockholm Convention Ratification and the National Implementation Plan

Croatia has signed but not ratified the Stockholm Convention. It is likely that ratification will take place before the end of 2006.[38] A National Implementation Plan was produced in November 2004, and as part of this process some NGOs were invited to take part in preparatory workshops. Thus the process has not been completely closed, but the general public would have been unaware that it was taking place as there do not appear to have been any publicly advertised consultations and the process has not been covered in the media. This is particularly of concern since the process is coordinated by APO d.o.o, a subsidiary of HEP. HEP should certainly have an interest in addressing POPs issues, since it is one of the major owners of equipment containing PCBs, and the PCB-contaminated sites are mostly its own sites, but at some points there may be conflicts of interest between the public interest and the company's profits. For example HEP is involved in plans for a Waste-to-Energy incinerator in Zagreb – can we therefore trust its subsidiary to provide unbiased recommendations and analysis concerning POPs emissions from waste incineration? There is no evidence of any irregularities in the NIP process, nor any suggestion that the process has been carried out in an unprofessional manner, but in such situations it is especially vital for NGOs and the public to closely monitor the process and raise any concerns they may have.

[37] NIP, p.23, 34

[38] Goran Romac, Croatian Cleaner Production Centre, Telephone Conversation with Bernard Ivčić, Green Action, 15.03.2006

9. Public awareness activities

As we have seen, so far there have been almost no activities aimed at bringing the POPs issue to the general public, and the NIP states that this must be carried out in the future. There are several reasons why activities have not been carried out so far, and these need to be addressed as soon as possible.

Firstly there appears to be a general feeling within official circles and academia in Croatia that discussion on environmental and scientific issues should be left to 'experts' (ie. specialised academics and politicians), and that public participation is more of a nuisance than something to be freely encouraged. This attitude is a leftover from former regimes in which free sharing of information was not the norm, but cannot be the basis for a functioning democracy, and public information activities should already have begun at a much earlier stage of the NIP process. Furthermore, Article 10 of the Convention plainly states the importance of public participation and awareness-raising.

It is true that there are certain obstacles to overcome, but these must be dealt with rather than allowed to lead to inaction on public participation issues:

- The media often fails to take an interest in political and scientific processes, preferring more sensational stories. This means that attention would have to be paid to getting the attention of the media and educating journalists about POPs-related issues.
- Most people in Croatia are not used to actively participating in political or scientific affairs and are not assertive about exercising their rights to participate and to be informed. There are also few NGOs with enough scientific expertise to meaningfully engage with POPs issues. Therefore extra effort needs to be put into informing the public not only about the scientific aspect of POPs but also about exactly what they can do themselves.
- Much of the data needed to give people an overview of the situation in Croatia is either missing or so old that it is of little use. Effort needs to be put both into gathering the missing data and into publishing it, preferably on the Internet as well as in the media. It is also important that data is presented in a way that it is comprehensible to an averagely intelligent person, with supplementary information to make it more meaningful. For example, instead of just publishing tables of data about POPs levels in water, it is necessary to add explanatory notes stating whether these levels are acceptable in Croatian and EU law, and whether they are a cause for concern for any other reasons. This is of course difficult as officials do not want to give citizens any cause for concern, and may err on the side of reassurance, and the need for checks and balances makes it particularly important that NGOs take an interest in these issues.
- One reason that POPs have not been a big issue in Croatia is because with a few exceptions, levels of POPs in Croatia are lower than in most industrialized countries. This makes the issue on one hand less interesting to the media, and can also be used by anyone reluctant to deal with the issue as a way to reassure people that everything is under control. Whilst it is indeed understandable that POPs does not seem to be Croatia's most urgent problem, it is also necessary to promptly address problems which do occur, such as PCB pollution as a result of the war, and also to take POPs emissions into account during the assessment of future plans and policies, for example energy policy and waste policy, to avoid creating larger problems in the future.

10. Recommendations on eliminating POPs

The NIP makes highly detailed recommendations, most of which we would agree with. However, these need to be supplemented with attention to some more horizontal issues and preventative action concerning law enforcement in Croatia and the need not only to apply BAT/BEP (Best Available Techniques/Best Environmental Practices) principles but also to minimize the need for energy generation and waste incineration facilities through energy efficiency and waste prevention and re-use programmes.

Our recommendations, incorporating some of the most urgent recommendations from the NIP, are as follows:

- To open at least one laboratory in Croatia which is fully equipped for accurately monitoring PCDDs and PCDFs in human and environmental media.

- To systematically monitor levels of all POPs in humans and the environment, particularly PCDD and PCDFs in urban areas, areas near cement kilns, existing and former waste incinerators and other industrial facilities, and PCBs in areas known to be contaminated due to the destruction of electricity substations.
- To identify and monitor the main sources of unintentional PCB and HCB emissions.
- To systematically monitor POPs levels in workers who may be at particular risk of exposure
- To establish an organised network for data collection related to POPs exposure and its effects on human health
- To gather further data about locations which may be contaminated with PCBs (former war areas, waste dumps etc).
- To assess the need for remedial work in locations contaminated by PCBs and ensure that work is carried out as soon as possible
- To make satisfactory arrangements for the safe disposal of the remaining transformers and capacitors containing PCBs and to construct temporary storage facilities for the equipment which is to be exported.
- To allocate sufficient human and financial resources to undertake monitoring and enforcement of the relevant laws.
- To publish all results of emissions monitoring on the Internet in a manner which is understandable to non-scientists, for example quoting the data and comparing it to the Croatian or EU legal limits.
- To identify means to reduce unintentional POPs formation in major sources. This would include energy efficiency; analysis and introduction of renewable energy resources; waste re-use and prevention, and alternative means for treating infectious medical waste.
- Substances which are likely to generate POPs need to be identified and a strategy and timetable made for phasing out their use. Meanwhile fees need to be introduced for their import, production or usage.
- To define more clearly the institutional responsibilities of different Ministries concerning POPs.
- To implement a public awareness programme on POPs in Croatia, including information on what citizens can do themselves to address this issue.
- Ministries need to be more open to addressing concerns by the general public on emissions levels from industrial facilities and waste-burning facilities.

11. Recommendations on inventories

- The inventory on PCDD/PCDFs needs to be reviewed and expanded with additional information from systematic monitoring and information on hotspots. There are several areas (eg. the site of the former PUTO hazardous waste incinerator, the CIOS metal re-processing factory in Podsused, Zagreb, and the Koromačno cement kiln) where local residents are concerned about emissions levels but have not had their concerns addressed to their satisfaction.
- A comprehensive inventory on unintentional releases of PCBs and HCB needs to be compiled, as there is currently insufficient information to develop a strategy for reducing these releases.

12. Alternatives to POPs

Intentional production of POPs is no longer a big issue in Croatia as alternative pesticides have been in use for many years. Likewise it is no longer necessary to use PCBs in new transformers and capacitors and alternatives are now in mainstream use. The most problematic area is in the unintentional production of POPs, particularly PCDDs and PCDFs. Since the majority of these come from power generation in Croatia, it is necessary to find less polluting methods of generating heat and electricity, which not only minimize production of PCDDs and PCDFs but which also minimize other sources of pollution and do not contribute significantly to climate change. An in-depth analysis of alternative fuel sources is beyond the scope of this report, but should be undertaken by the government as part of its

energy strategy. It is clear that much could be achieved by increasing energy efficiency in Croatia, which would reduce the need to burn fossil fuels.

Although waste incineration is not a major source of dioxins and furans in Croatia at the present time, this is mainly because there are only a few medical waste incinerators operating, and in addition waste tires and waste oil is being burnt in some cement plants. Croatia now has a tire-recycling facility but for the moment it is running at full capacity. In the future we would recommend that the government and local authorities should choose waste prevention, re-use, and recycling strategies rather than incinerating waste, which would save both energy and resources, and reduce PCDD and PCDF emissions.

13. New POPs

Lindane was banned in Croatia in 2001, but it is likely that it continued to be used until the existing stocks were finished. There is little information on other POPs substances and their effects in Croatia as priority is being given to improving data on the Stockholm Convention POPs.

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Resources on POPs

Websites

www.cro-cpc.hr - Croatian Cleaner Production Centre

http://www.recetox.muni.cz/projekty/apopsbal/index.php - Recetox Project: "Assessment Of The Selected Pops (PCBs, PCDDs/Fs, OCPs) In The Atmosphere And Water Ecosystems From The Waste Materials Generated By Warfare In Former Yugoslavia", 2002-2005.

Databases

From 1993 to 1997 APO Ltd. created a PCB database in collaboration with the Ministry of Labour and Social Welfare and labour inspectors. This includes information on the age of equipment containing PCBs and its status - in service, out of order, in reserve. However, it is not clear how the public can easily access this database.

Reports

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APPENDIX 1: Croatian legal regulations on POPs levels.

Regulations stipulating limit values for POPs contamination

Croatian legal limits for PCBs and DDTs in water.[39]

	Water Class 1	Class 2	Class 3	Class 4	Class 5
PCBs	<0.01 μg L^{-1}	0.01-0.02 μg L^{-1}	0.02-0.04 μg L^{-1}	0.04-0.2 μg L^{-1}	>0.2 μg L^{-1}
DDT	<0.001	0.001-0.005	0.005-0.01	0.01-0.05	>0.05

Croatian legal limits for POPs contamination of drinking water:[40]
Pesticides 0.10 mg/l
Pesticides – total 0.50 mg/l
The limit value parameter is valid for each single pesticide. For Aldrin, Dieldrin, Heptachlor and Heptachlor Epoxide the limit value is 0.030 mg/l.

Levels of POPs pesticides contamination permitted in food in Croatia[41] (in mg/kg)

Aldrin	
Meat and meat products (alone or together with Dieldrin, expressed as Dieldrin)	0.2
Milk	0.006
Eggs	0.02
Cereals and cereal products	0.01
DDT and derivatives	
Meat and meat products	1
Eggs, fruit, vegetables, vegetable oil	0.1
Cereals and cereal products	0.05
Milk	0.04
Endrin	
Fruit, vegetables, cereals	0.01
Meat and meat products, eggs	0.05
Milk	0.001
HCB[42]	
Cereals	0.01
Meat and meat products	0.2
Milk	0.01
Eggs	0.02
Fruit, vegetables, vegetable oil	0.05
Dried plants, tea	0.1
Heptachlor	
Cereals, fruit and vegetables	0.01
Heptachlor Epoxide	
Meat and meat products	0.2

[39] Regulation on Water Classification (Official Gazette 77/98). None of the other Stockholm Convention POPs are mentioned in this Regulation.
[40] Regulation on the sanitary propriety of drinking water, Official Gazette 182/04
[41] Regulation on the quantity of pesticides, toxins, mycotoxins, metals and histamines and similar substances which may occur in food, and on other conditions regarding sanitary propriety of food and items of general use, Official Gazette 46/94
[42] The Regulation in fact mentions HCR not HCB, but this is presumably a mistake.

Milk	0.004
Eggs	0.02
Chlordane	
Cereals, vegetable oil, fruit and vegetables	0.02
Meat and meat products	0.05
Milk	0.002
Eggs	0.005
Toxaphene	
Fruit and vegetables	0.4

Levels of PCBs, dioxins and furans permitted in foodstuffs in Croatia[43]:
Food may be put into circulation if the amount of Polychlorinated Biphenyls does not exceed the quantity set out in the table below, expressed as the sum of the seven congeners 28, 52,101,118,138,153, and 180.

Type of food	**Highest permitted level of PCBs (ng/g)**
Eggs	200
Meat and poultry	200
Milk	100
Type of food	**Highest permitted level of PCBs (mg/kg)**
Food for infants and small children	0.2
Fish and seafood (edible parts)	2.0
Red meat (fat)	3.0

Highest permitted quantities of PCDD and PCDF in food
Food may be put into circulation if the amount of Polychlorinated Dibenzodioxins (PCDD) and Polychlorinated Dibenzofurans (PCDF) do not exceed the levels shown in the table below.

The highest permitted quantities are expressed for 2,3,7,8-TCDD (2,3,7,8-tetrachlorodibenzodioxin) as toxic equivalent (TEQ), calculated by the individual amounts of dioxins with the corresponding toxic equivalent factors (TEFs). The result is expressed for 17 single congeners of dioxin and 12 single congeners of PCB, according to the formula: I-TEQ = amount of congener x toxic equivalent factor.

Food Type	**Highest permitted quantity (PCDD+PCDF) pg -PCDD/F-TEQ/g fat or product**
Meat and meat products:	
- ruminant meat (beef, lamb)	2 pg PCDD/F-TEQ/g fat*
- poultry and reared game	1.5 pg PCDD/F-TEQ/g fat*
- pork	0.6 pg PCDD/F-TEQ/g fat*
- liver and liver products	4 pg PCDD/F-TEQ/g fat*
Fish muscle tissue and fish products:	3 pg PCDD/F-TEQ/g of original product
Milk and milk products including butter	2 pg PCDD/F-TEQ/g fat*
Chicken eggs and egg products	2 pg PCDD/F-TEQ/g fat*
Animal fats:	
- bovine	3 pg PCDD/F-TEQ/g fat
- poultry and reared game	1.5 pg PCDD/F-TEQ/g fat
- pig	0.6 pg PCDD/F-TEQ/g fat
- mixed animal fats	1.5 pg PCDD/F-TEQ/g fat
Oil and fats:	
- vegetable oil	0.5 pg PCDD/F-TEQ/g fat
- fish oil intended for human consumption	1.5 pg PCDD/F-TEQ/g fat

*** Highest permitted quantities do not apply to products with less than 1% fat**

[43] Regulation on toxins, metals, metalloids, and other harmful substances which may occur in food, Official Gazette 16/05

Croatian legal limits for POPs in municipal sludge and compost from municipal sludge and waste[44]:

The maximum permitted level of PCBs in municipal sludge and compost from municipal sludge and waste should not exceed 0.5mg/kg of dry matter. The highest permitted amount of harmful organic substances in municipal sludge and compost from municipal sludge and waste, shown in mg/kg of dry matter are:

2. 3. 7. 8 - TCDD 0.002
3, 4, 3', 4' - TCAB 0.01
PCB, PCP, HCH (total, without Lindane),
Triazine herbicides (total) HCB, Heptachlor, Endrin, Aldrin and Dieldrin 0.05
Lindane 0.1
Total of the isomers DDT + DDD + DDE 0.5

Permitted levels of dioxin and furan emissions from waste incineration facilities[45]:

The emissions limit value, expressed as the sum of all compounds, for the concentration of dioxins and furans in exhaust gases of waste incinerators with the corresponding TEFs for the average values in a period of not less than 6 hours and not longer than 8 hours, is 0.1 ng/m^3.[46]

The mean daily emissions limit value of dioxins and furans in exhaust gases from the technological process of obtaining cement with co-incineration of waste is 0.1 ng/m^3.[47]

[44] Regulation on the Protection of Agricultural Land from Pollution with Harmful Substances, Official Gazette 15/92

[45] Regulation on Pollutant Emission Limit Values from Stationary Sources, Official Gazette 140/97, amended by 105/02, 108/03 and 100/04

[46] Amendment to Regulation on Pollutant Emission Limit Values from Stationary Sources, Official Gazette 140/97

[47] Amendment to Regulation on Pollutant Emission Limit Values from Stationary Sources, Official Gazette 108/03