Crucial Elements of the Pollutant Release and Transfer Register as related to the Stockholm Convention

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Crucial Elements of the Pollutant Release and Transfer Register and Their Relationship to the Stockholm Convention

Report based on experience of Czech NGOs 2004 – 2017

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1 Introduction

The process of the preparation of a Pollutant Release and Transfer Register (PRTR) in Thailand has been ongoing at least since 2011, when JICA started a pilot project in Rayong Province (Kondo and Limjirakan 2013, Pollution Control Department and Industrial Estate Authority of Thailand 2015). However, EARTH and its NGO forerunner, CAIN (Campaign for Alternative Industry Network), were deeply involved in the preparation of the PRTR in Thailand. CAIN advocated the introduction of a PRTR in Thailand as long ago as 2003 (Saetang 2013). The call for a Right to Know among Thai civil society has an even longer history, starting after the chemical explosion at the Bangkok Central Port (the Klong Toey Case) on March 2, 1991.

The perception of the evaluation of a PRTR in Thailand describes quite well all the concerns of Thai industry regarding the introduction of a PRTR (Kondo and Limjirakan 2013), and, according to our experience from the Czech Republic, they are very similar in each country where this unique system is introduced.

Our report is focused on demonstrating how a PRTR can be used not only for free access to information about pollution releases and transfers of different groups of chemicals but also to show that it can be useful for industry to address loopholes in its technology as well as to save money on leaching chemicals that are used in the production process. We tried also to address the relationship of the PRTR system to the Stockholm Convention and persistent organic pollutants (POPs) at the same time, as it is an issue that has been much discussed in recent years. The bulk of the report is based on the practical experience of the Arnika Association with the implementation of the Czech PRTR.[1]

2 Pollutant Release and Transfer Register (PRTR)

2.1 Definition of PRTR

There are many definitions of Pollutant Release and Transfer Registers (PRTRs) available in the literature. UNITAR recently provided this one: *"A Pollutant Release and Transfer Register (PRTR) is a catalogue or database of releases and transfers of potentially harmful chemicals including information on the nature and quantity of such releases and transfers. The data for PRTRs can be collected from point sources of pollution, such as factories, as well as from diffuse sources, such as agricultural operations or transportation activities. A typical PRTR covers releases to air, water and land as well as wastes transported to treatment and disposal sites.*

Key features of a PRTR include: periodic collection of information to allow tracking of trends over time; the use of common identifiers for chemicals, facilities and locations to facilitate comparison and aggregation of the data; computerisation of the information for ease of analysis; and dissemination of the information to government policy makers and the general public. Some potential applications of PRTR information include mapping the data to discern the proximity of pollution sources to population centres or to ecologically sensitive areas, as a way of highlighting potential health or environmental impacts and effectively targeting management efforts. Trends in the data can

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[1] The Czech PRTR system is called the Integrated Pollution Register, Integrovaný registr znečišťování in Czech, and so the abbreviation "IRZ" is often used for the Czech register.

reveal the progress being made by individual facilities or industrial sectors in reducing waste and minimising pollution, or for identifying opportunities for improvement.

To summarise, a PRTR is a mean for obtaining regular, periodic information about releases and/or transfers of chemical substances of interest and for making this information accessible to those who may be interested and/or affected by it. As such, a PRTR is a tool for promoting efficient and effective policies for environmental protection and sustainable development." (UNITAR 2018a).

PRTRs *"were established in several countries after the 1984 Bhopal Disaster, and the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, which affirmed the "right-to-know" of communities and workers about toxics chemicals and other substances."* (Wikipedia 2018)

2.2 Right to Know as an essential part of a PRTR

Wikipedia adds to the above definition of a PRTR: *"PRTRs provide users with free access to information on environmental emissions, enhancing [the] transparency and accountability of industry by providing geographic locations of facilities that release pollutants. PRTRs represent an incentive for finding innovative solutions that can reduce pollution and lead to sustainable increase in productivity, facilitate compliance with environmental standards and international agreements, and create a regular reporting of national data on emissions into the environment and transfers of hazardous waste."* (Wikipedia 2018)

Whether the proposed design of the PRTR for Thailand will allow full and open access to information about all releases and transfers of pollutants or not is still a question. Right to Know seems to us to be an essential part of a PRTR system. Some concerns of industry (Kondo and Limjirakan 2013) show that it will be necessarily be so in the case of the Thai PRTR. If it only provides the public with access to aggregated data based on PRTR reporting, it will not allow the public or local authorities to address specific sources of pollution.

2.3 UNITAR and OECD Clearinghouse Service

UNITAR and the OECD (Organization for Economic Cooperation and Development) also provide broad and systematic support to countries which want to introduce a PRTR and/or develop it further. Both these organizations also provide a comprehensive clearinghouse on their websites. Their publications can be downloaded from UNITAR's (UNITAR 2018b) or the OECD's (OECD 2018) websites.

3 Important elements of well-designed PRTRs

The basic elements of PRTRs are quite widely discussed in the two volumes of the Guidance Document published by the OECD (OECD 2014, OECD 2015). The following chapters are rather brief and based on practical experience with the Czech PRTR system in comparison with the European Pollutant Release and Transfer Register (E-PRTR). The recommendations that are included are mainly from the point of view of the use of a PRTR by public initiatives or local authorities.

3.1 Industrial sectors

There are different approaches to the definition of the industrial sectors obliged to report to PRTRs. For example, the US TRI system is based on the capacity of the factory in combination with the character of its industrial activity. The E-PRTR is based on a list of industrial activities defined in the E-PRTR Regulation, similarly to the Japanese or Australian PRTR systems (OECD 2014). We found the original Czech approach based purely on exceeding a reporting threshold applied to all industrial and agricultural sectors to be the most effective way to obtain the most relevant data about the chemicals listed in the PRTR.

The difference between the number of facilities with reporting obligations according to the E-PRTR and really reporting into the Czech PRTR was compared in a study from 2010 (Petrlík 2010) and can be found in Table 1.

3.2 Thresholds

The threshold is a definition of the volume of chemicals above which reporting to the PRTR becomes obligatory for legal entities, mostly industrial or agricultural facilities. When this amount of a chemical or chemicals is exceeded by an entity, it is necessary to report specific data about the releases and/or transfers of the chemical substance(s) into the PRTR. The approach to the definition of the threshold depends on the general construction of the PRTR and varies between different reporting systems. For some PRTRs it is a basic definition of the conditions under which a certain facility should report into the PRTR about that specific chemical and so it defines a basic duty for the facility to report, and it is based on the amount of output, the total chemical content (volume) in releases or transfers. In other PRTRs the definition of the threshold is based on the total chemical input into the production chain in the facility. The definition of the threshold is crucial for the amount of data collected into the PRTR database for either approach. We can demonstrate it through the example of the definition of the hexachlorobenzene threshold in the E-PRTR or the Czech IRZ (see Chapter 3.6.1).

Thresholds are discussed further in Chapter 5 in a more detailed way.

Table 1: Summary of the numbers of facilities reporting into the IRZ on the basis of obligations ensuing from the E-PRTR Regulation (thus, also subject to the Industrial Emissions Directive (IED) regime) and of facilities reporting on the basis of exceeding the reporting thresholds for some of the substances into the IRZ in individual regions. The data in the table is based on annual reports for 2007. If the reporting were performed solely according to Annex I to the E-PRTR Regulation, only 628 facilities would be covered, and, thus, the data in the IRZ would only be from 55% of the facilities, in comparison with the situation in 2008. Source: (Maršák, Hlavatý et al. 2009).

Region	Facilities with industrial activity listed in Annex I to the E-PRTR	Facilities in total	Facilities as a percentage of total amount (%)
Středočeský (Central Bohemia)	84	133	63
Jihomoravský (South Moravia)	79	145	54
Ústecký (Usti nad Labem)	67	92	73
Moravskoslezský (Moravia-Silesia)	65	99	66
Jihočeský (South Bohemia)	50	71	70
Pardubický (Pardubice)	47	102	46
Vysočina (Bohemian-Moravian Highlands)	44	101	44
Plzeňský (Pilsen)	41	75	55
Olomoucký (Olomouc)	36	81	44
Královéhradecký (Hradec Kralove)	36	75	48

Zlínský (Zlin)	23	73	32
Liberecký (Liberec)	22	47	47
Hlavní město Praha (Capital City, Prague)	18	22	82
Karlovarský (Karlovy Vary)	16	23	70
Total	628	1139	55

Note: Only data exceeding the limits is included. Source: Reports into the IRZ concerning 2007. Data valid as of April 30, 2009.

3.3 Chemically specific reporting

It is crucial that the PRTR contains a list of specific chemicals for which reporting is obligatory. Those should be very specific chemicals, mostly possessing a CAS number. In certain cases they could also be groups of chemicals when they are naturally measured together and it makes sense to report them as a group, such as, for example, polychlorinated dibenzo-p-dioxins and dibenzofurans, in short dioxins (PCDD/Fs). Groups of chemicals with very different effects and properties on the list, such as, for example, heavy metals or volatile organic compounds (VOCs), should not be accepted. Additionally, the total volume of chemicals or wastes released does not tell us much about the real potential impact on the environment. Such groupings should not be accepted in a well-designed PRTR.

3.4 Periodicity of reporting

Normally, annual reporting is a good practice for most PRTR systems as it is important to have an uninterrupted chain of reports about releases and transfers. EPER, the predecessor of the E-PRTR, had a three-year periodicity, which proved to be an obsolete practice and was changed to annual reporting into the E-PRTR.

Figure 1 defines the different flows that can be covered by a good PRTR. There should be at least releases into air, water, and soil, and transfers in wastes and waste waters, both off-site and on-site. A well-designed PRTR covers “normal operation” as well as accidental releases.

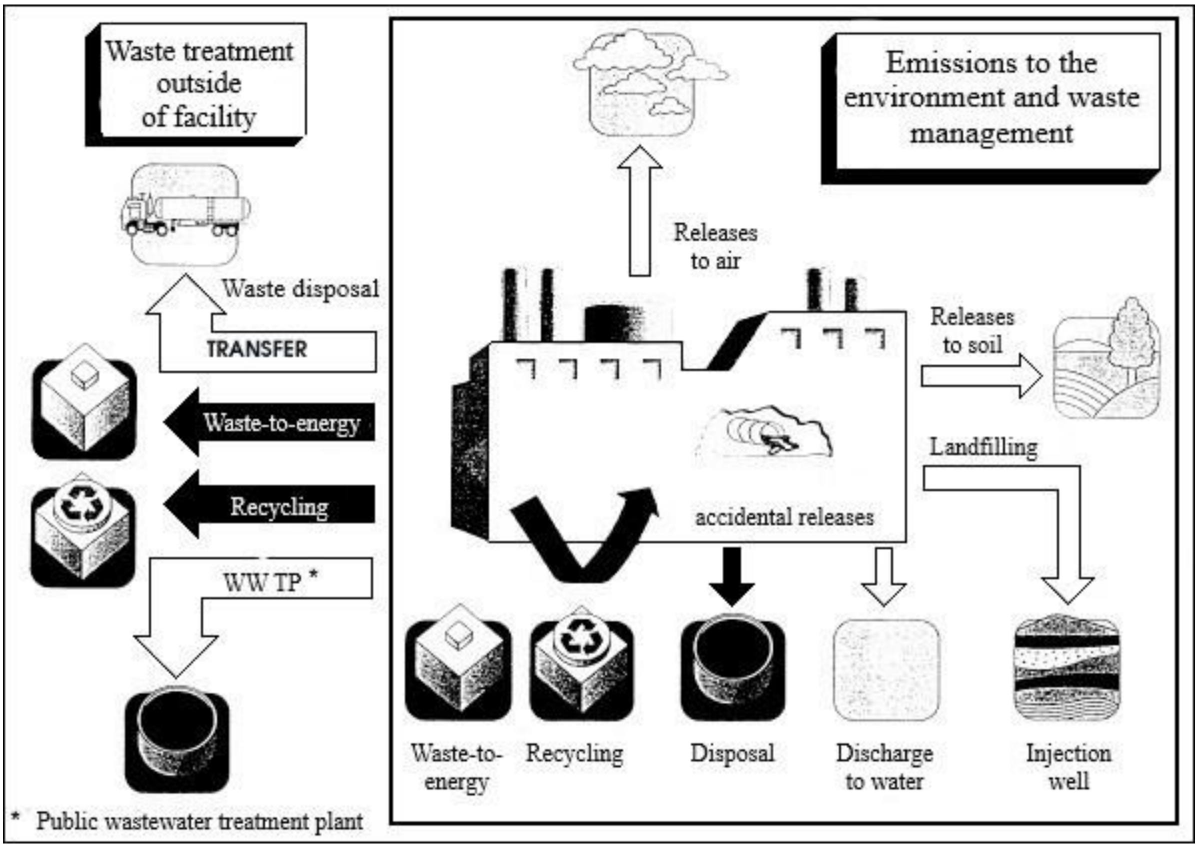

Figure 1: Model of PRTR and flows covered. Source: (Muir, Jurčíková et al. 1995)

4 PRTR and reduction of releases of harmful chemicals

Free access to information, as described briefly in Chapter 2, allows the public and public agencies to compare releases of certain chemicals by different facilities, which creates a kind of natural pressure on industrial companies to reduce these toxic releases. Governments and governmental agencies can support industrial companies or whole sectors in setting goals to reduce releases of certain chemicals or groups of them by establishing specific programmes for the reduction and/or prevention of toxic releases. A good example of such a programme was 33/50, introduced together with TRI in the USA (US EPA 1991). Different programmes for the reduction of releases of chemicals by industry are also run by the State Fund for the Environment in the Czech Republic (SFŽP) and helped to reduce the releases of volatile organic compounds (VOCs), for example, as described in the case studies below.

Free access to information about releases of pollutants for the public and local authorities (Right to Know) is an essential part of public supervision of industrial development and helps to support release reduction programmes.

4.1 Case studies: Examples of positive impacts of the IRZ from the point of view of VOC releases from Czech industrial facilities after five years of operation of the Register

4.1.1 Dichloromethane

Dichloromethane ranks among the volatile organic compounds (VOCs) to which attention is paid in the European Union because of their hazardousness to human health. It is used as a solvent, in the production of pharmaceuticals, in adhesives, and in other fields of activity. In 2009, a stricter regulation concerning this substance was adopted in the EU (EP/EC 2009).

The development of dichloromethane releases may be used as an example of a major reduction of emissions of a volatile organic compound within five years of reporting into the IRZ. The MoE summary report on reported dichloromethane releases stated that *"In spite of the increasing number of reporting facilities, the total amount has been decreasing gradually, and it has decreased from the starting level of 233.9 tons (2004) to 5.5 tons (2008)."* (Maršák, Hlavatý et al. 2010). The total reduction of dichloromethane releases is depicted in Fig. 2. In practice, it was mostly changes in three facilities that contributed to it: the pharmaceutical company Ivax Pharmaceuticals (currently Teva) in Opava, Jitona Rousínov, manufacturing furniture, and Kurt O. John Březůvky, manufacturing shoes.

4.1.2 Examples of reductions of dichloromethane releases

4.1.2.1 Ivax Pharmaceuticals

Ivax Pharmaceuticals is a company focusing on the manufacture of pharmaceuticals, and its production facility is located in Opava.[2] The facility reduced its emissions of potentially carcinogenic substances from 173,773 kg in 2004 to 2400 kg in 2008. Dichloromethane, used by Ivax Pharmaceuticals in manufacturing pharmaceuticals, formed the absolute majority of the releases. The development of the releases in the individual reporting years may be found in Fig. 2.

Large amounts of dichloromethane were released from the Ivax Pharmaceuticals facility primarily in emissions into the air, and, to a lesser extent, also in wastewater directly discharged by the facility.

4.1.2.2 Jitona Rousínov

The big furniture-manufacturing company Jitona Rousínov (formerly Tusculum Rousínov) replaced dichloromethane, used in furniture manufacturing, in the autumn of 2007 (Jitona 2007). This measure resulted in such a reduction of dichloromethane releases that the substance was not reported any more by Jitona Rousínov in its reports for 2008. In contrast to Ivax Pharmaceuticals, only releases into the air occurred at Jitona Rousínov.

[2] Now the facility in Opava belongs to the Teva company, without its production focus having changed.

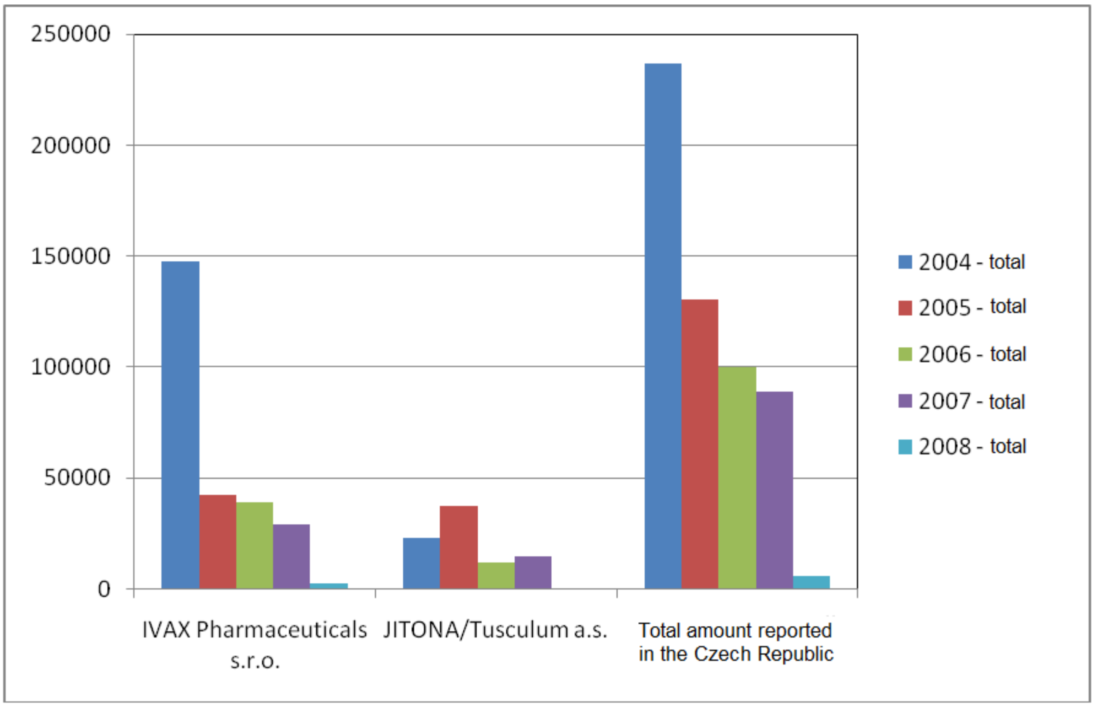

Figure 2: Graph depicting the development of dichloromethane releases reported into the IPR by two industrial facilities (in kg), in comparison with the total releases reported into the IRZ for the whole Czech Republic. From the graph, it is obvious that the selected facilities were the major industrial sources of the releases of this substance.

4.1.3 Tetrachloroethylene

Tetrachloroethylene ranks among the most problematic chemical substances released into the environment, in particular in the event of its release into water. In the Czech Republic, several places may be listed where local sources of drinking water could not be used as a consequence of tetrachloroethylene being released into water, e.g. in Kouřim and in Bor u Skutče (Petrlík 2003). Paradoxically, a reporting threshold for releases into soil has not been set for tetrachloroethylene in the E-PRTR.

Together with trichloroethylene, tetrachloroethylene is used as a solvent by dry cleaners and in mechanical engineering. It also serves as a raw material for the manufacturing of fluorinated hydrocarbons. Additionally, it is used for the production of other chemicals, and in trace amounts it may be found in some consumer goods, such as in inks for printers, adhesives, colour carriers, and silicon lubricants.

In view of the fact that it is a substance probably carcinogenic to humans, in group 2A according to the classification of the International Agency for Research on Cancer (IARC) (IARC 2017), its releases into the air are also important. The reporting threshold for them in the IRZ is set at the level of 2 tons/year.

According to the IRZ data, a significant reduction of emissions reported into the IRZ did not take place in the period 2004-2008 (see Fig. 3). In this case, the total amounts of emissions reflect the increasing or decreasing numbers of reporting entities. This is clearly obvious from Fig. 4. It rather seems that the reporting discipline of some of the tetrachloroethylene users improved, or this was an impact of the relatively high reporting threshold. The development of emissions reported into the IRZ by selected big polluters by this substance is shown in Fig. 5.

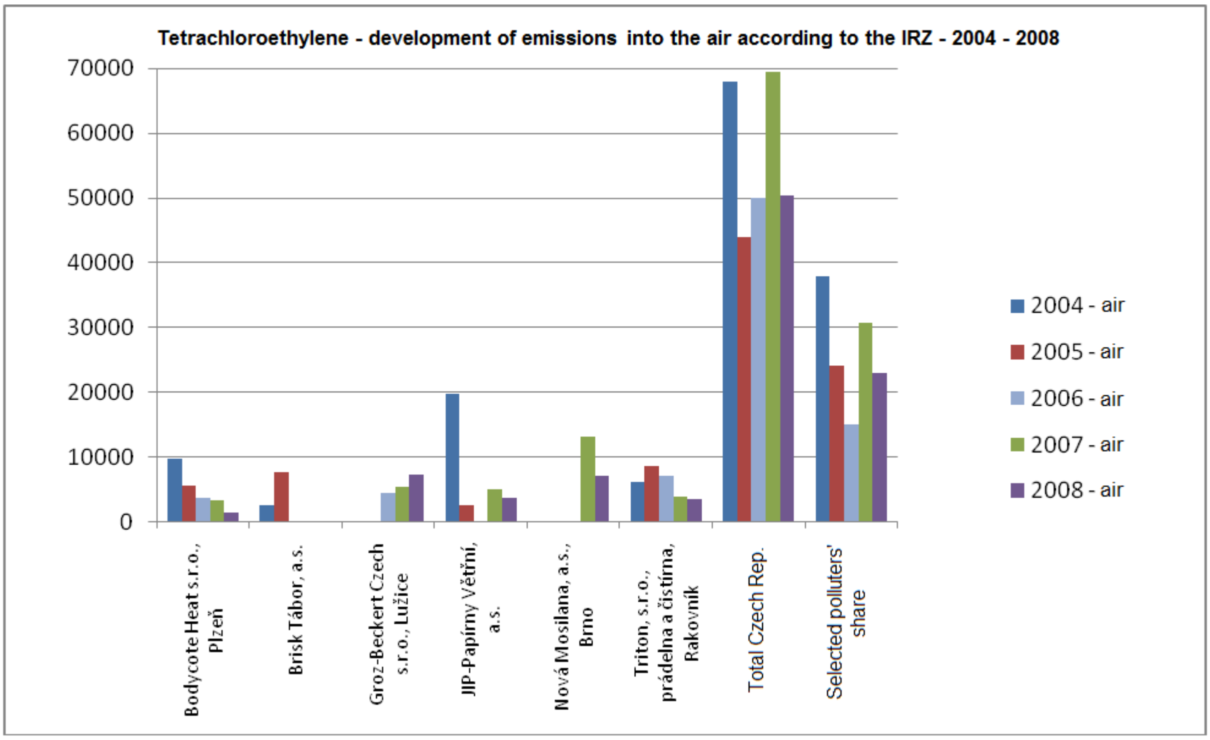

Figure 3: Comparison of tetrachloroethylene emissions reported into the IRZ by six big polluters with the sum of tetrachloroethylene emissions reported into the IRZ in the whole Czech Republic (including reports below the limit). In all the reporting years, the selected polluters contributed to the reported tetrachloroethylene emissions by a third to a half.

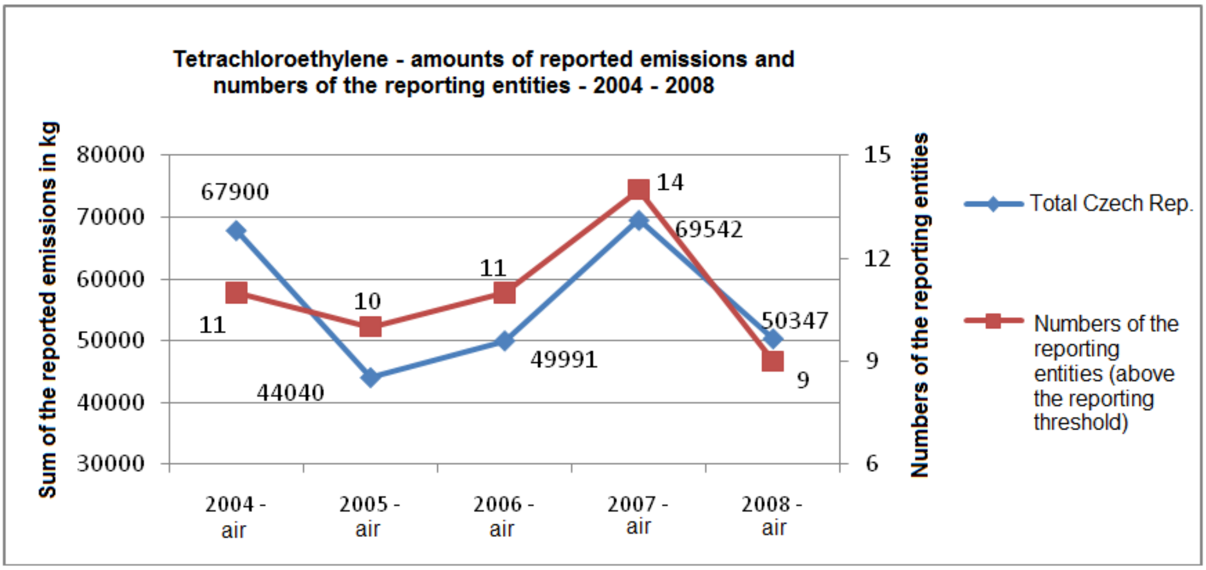

Figure 4: Comparison of curves showing the numbers of facilities reporting tetrachloroethylene emissions into air into the IRZ, and the total amounts of reported emissions of this substance.

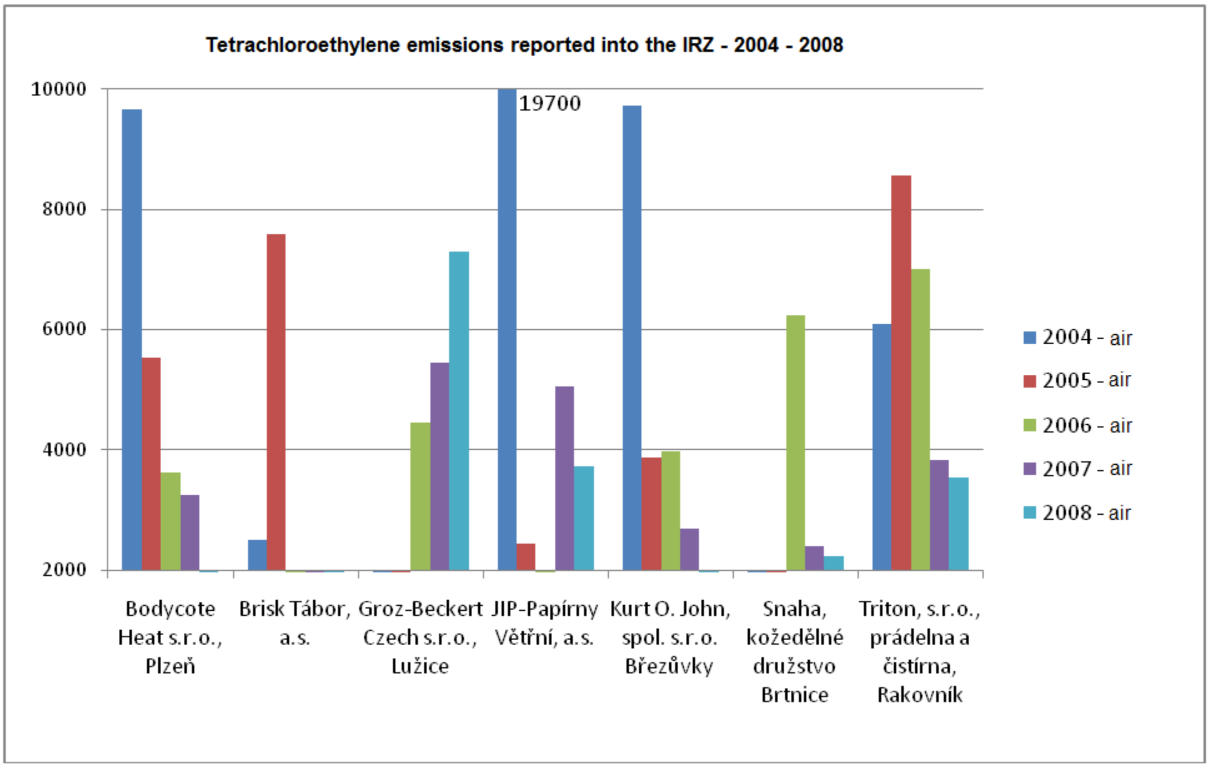

Figure 5: Development of the tetrachloroethylene emissions reported into the IRZ in the period 2004-2008 by the selected facilities releasing this substance in the Czech Republic. The data is in kg. In view of the fact that the reporting threshold for tetrachloroethylene releases is at the level of 2000 kg, the starting value of the y-axis is also set at this level in the graph. Bodycote Heat reported an amount below the reporting threshold in releases concerning 2008 (1420 kg).

It is obvious from Fig. 5 that, with one exception, all the selected facilities reduced their tetrachloroethylene releases, but, in spite of this, no considerable decrease in the reported emissions of this substance took place, as shown in Fig. 4. When analysing the data in the IRZ more deeply, we find that the number of reporting facilities with annual emissions on the level of 5 to 8 tons, which did not originally report into the IRZ in 2004, increased. It may only be guessed whether this happened because of the fact that they did not exceed the reporting threshold, or for other reasons. In the course of 2004-2008, it turned out that an important group of the reporting facilities was formed of big dry cleaners, represented by the facility Triton, s.r.o. in Rakovník in Fig. 5, i.e. the kind of facilities that would not have to submit reports if the IRZ were reduced to the E-PRTR level.

4.1.4 Examples of reductions of tetrachloroethylene emissions

Within five years of reporting into the IRZ commencing, several positive changes took place in the facilities showing the highest contributions to the tetrachloroethylene emissions reported into the IRZ in 2004. Specifically, the technological procedure for degreasing metal parts was changed in the facility manufacturing automobile spark plugs Brisk Tábor, a.s. (see Fig. 6). The operation of the new equipment is based on the use of water comprising a cleaning agent in the concentration of 3-5% for the removal of greasy deposits and scale (Arnika 2007). The Jihočeské papírny paper mill in Větřní reduced its tetrachloroethylene consumption in paper production. On the other hand, significant new sources of releases of this substance appeared among the reporting facilities, for example, the facilities Groz-Beckert Czech, s.r.o., and the Nová Mosilana, a.s. textile factory in Brno, as is also obvious from Fig. 3.

Figure 6: New Midi 400 degreasing equipment in the Brisk Tábor facility. Thanks to its installation, the spark plug manufacturer was able to replace tetrachloroethylene, used in the manufacturing process before. The equipment was installed within the framework of the environmental project “Degreasing of metal parts” supported by the State Environmental Fund. Photo: Brisk Tábor, a.s.

4.1.5 Trichloroethylene

Trichloroethylene is used, together with tetrachloroethylene, as a solvent by dry cleaners and in mechanical engineering. More than 80% of trichloroethylene is used for steam degreasing and for cleaning metal parts. It is also found in certain preparations for households and for general use, e.g., it may be present in correction fluids for typewriters and in preparations for removing paints, adhesives, and stains. Additionally, it is used as a raw material for syntheses in the chemical industry, and as a raw material for CFC, HCFC, and HFC substitutes. In the past, it was used as a fumigant for grain, and it also found a limited use as an anaesthetic in medicine and dentistry.

From the point of view of its impact on human health, trichloroethylene is ranked among those substances carcinogenic to humans, in group 1 according to the IARC classification (IARC 2017), and it has mutagenic effects as well. Similarly to tetrachlorethylene, trichloroethylene was also a frequent cause of surface water contamination in the Czech Republic (Broulík 2009); (Tůmová 2007), and, because of that, it is surprising that no reporting threshold was set for releases of this substance into soil in the E-PRTR, and, thus, not in the Czech IRZ either.

The development of the reported emissions into the air was similar as in the case of dichloromethane, i.e., they decreased considerably after the start of reporting into the IRZ, in the period 2004-2008. This is clear from Fig. 8.

4.1.6 Examples of reductions of trichloroethylene emissions

The greatest reductions of trichloroethylene emissions were ensured by the facilities Federal-Mogul Friction Products, a.s. in Kostelec nad Orlicí, Amati-Denak, a.s. in Kraslice and in Hradec Králové, and Galvamet, s.r.o. (see Fig. 7). In the case of the facility of the musical instrument manufacturer Amati-Denak, a.s. in Kraslice, a certain role was surely played by pressure from the local government authorities, specifically the mayor of Kraslice, who reacted to the lists of biggest polluters by mutagenic substances, created on the basis of the IRZ data. In the case of the facility in Kraslice, the musical instrument manufacturer installed new technology, as follows from a public statement by the company, issued in 2007 *"… the company will bring new technology to Kraslice. Subsequently, releases of the substance will be zero. By the end of the year, the case should be solved …"* (Zeman 2007).

Concerning 2008, in addition to Spolana, trichloroethylene emissions were reported by Amati-Denak in Hradec Králové only, and, moreover, in an amount below the reporting threshold (1180 kg).

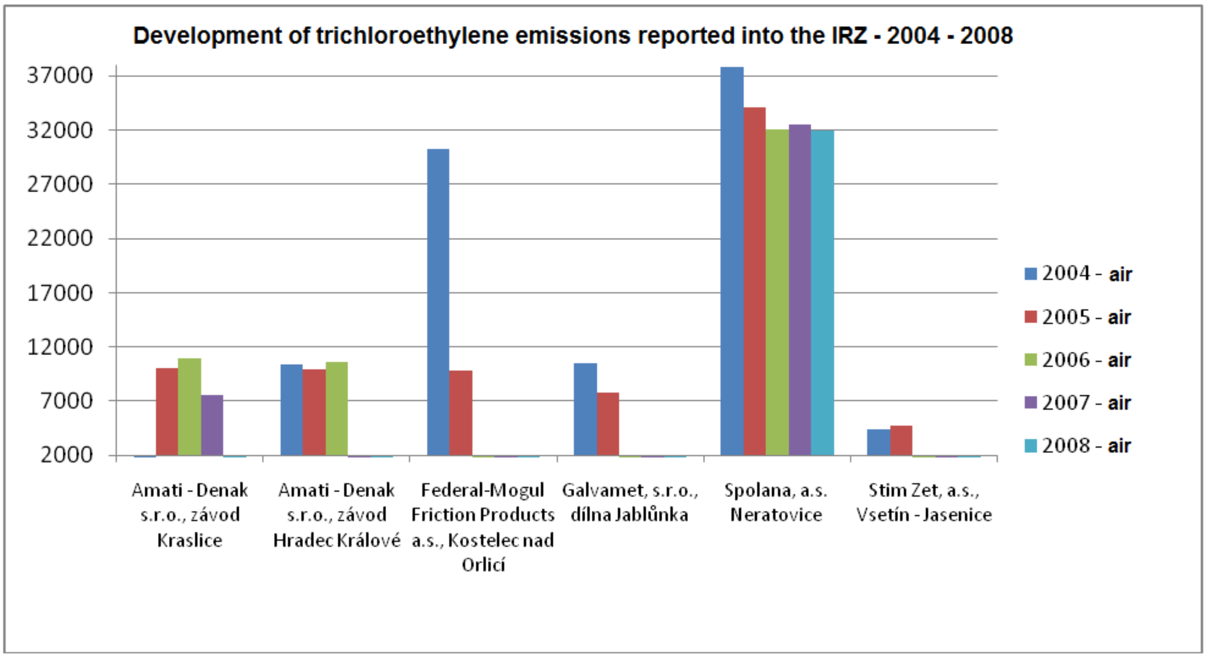

Figure 7: Trichloroethylene emissions, as reported into the IRZ by big air polluters with this substance in the Czech Republic in the period 2004-2008. With the exception of Spolana Neratovice, all the big polluters were already below the reporting threshold in 2008 (Amati-Denak reported 1180 kg in its facility in Hradec Králové in 2008). In view of the fact that the reporting threshold for trichloroethylene releases is at the level of 2000 kg, the starting value of the y-axis is also set at this level in the graph.

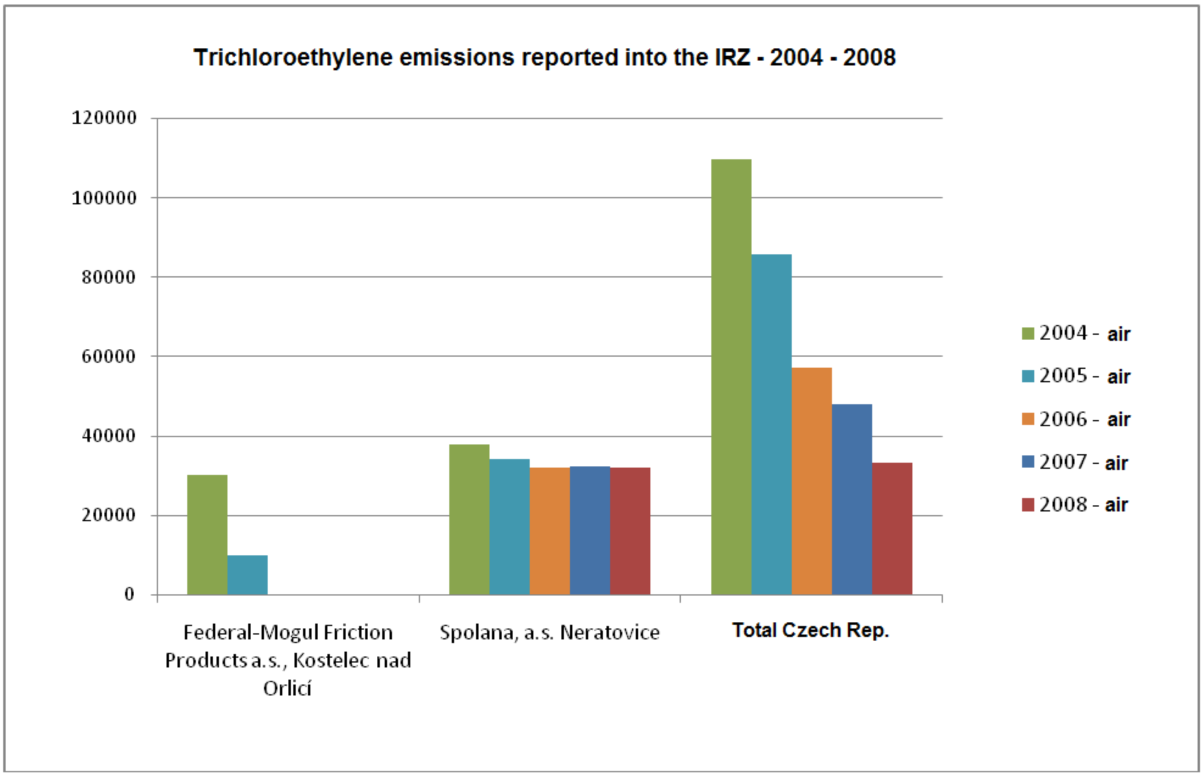

Figure 8: Graph showing the development of the total amounts of trichloroethylene emissions into the air in the whole Czech Republic in comparison with the amounts reported, in the individual years, by the two biggest polluters in 2004 – Federal-Mogul Friction Products, a.s. in Kostelec nad Orlicí and Spolana Neratovice.

5 Thresholds

Various pollution registers (PRTRs) define the duty to report the relevant chemical substances very differently. The US and Canadian systems differ substantially from the European ones in that they use a combination of limits for the individual substances (however, usually in view of the amounts used in the manufacturing) and limits for, e.g., hours of work done. The comparison of the various limits for reporting emissions of selected substances into the air is obvious from Table 2.

The Czech IRZ differs from the European PRTR by a simple rule stipulating that the duty to report a relevant substance into the IRZ arises as a result of the reporting threshold being exceeded. In those cases where a reporting threshold has not been set for releases and/or transfers of substances, releases and/or transfers of the substances should not be reported. In the E-PRTR, reporting thresholds were combined with specified areas of industrial activity, identical to the list of installations to which Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control[3] applied. The difference between the numbers of facilities that should report according to the E-PRTR rules and according to the simple rule of the reporting thresholds being exceeded may be found in Table 1. It is obvious from Table 2 that certain more progressive registers distinguish polychlorinated biphenyls (PCBs), measured as indicator congeners in absolute weight, from the values stated for dioxin-like congeners and converted to the toxic equivalent (here, WHO-TEQ). In spite of the fact that according to the practice of the Czech IRZ, and, probably, also of some of the reports into the E-PRTR, this is distinguished too, it was not reflected in setting specific

[3] This EU directive was the predecessor of the Industrial Emissions Directive (IED).

reporting thresholds corresponding, in this case, to the ones set for dioxins. POPs in general and in relation to PRTRs are also discussed further in different parts of Chapters 6 and 7 of this report.

Table 2: Comparison of reporting thresholds for releases (emissions) of selected substances into the air in various PRTR systems.

Substance	Czech Republic	E-PRTR	Canada	USA	Scotland	Switzerland
Hexachlorobenzene	10	10	0	4.5 (10 pounds)	1	10
PCDDs/PCDFs	0.0001	0.0001	0	0.0001****	0.00001	0.001
PCBs	0.1	0.1	-	4.5 (10 pounds)	0.1	0.1
PCBs in WHO-TEQ	-	-	-	0.0001****	0.00001	-
PAHs	50	50	50*	45.4 (100 pounds)	1*****	50
Mercury	10	10	**	4.5 (10 pounds)	1	10
Cadmium	10	10	**	0.1%******	1	10
Dichloromethane	1000	1000	***	0.1%******	1000	1000
Tetrachloroethylene	2000	2000	***	0.1%******	100	2000
Vinyl chloride	1000	1000	***	0.1%******	1000	1000
PM_{10}	50000	50000	500	-	1000	50000
$PM_{2.5}$	-	-	300	-	1000	-

*Summary reporting threshold for total releases and transfers from the facility

** The duty to report applies to facilities using mercury or cadmium in the process in the amounts of 5 kg or more annually, and, simultaneously, 20,000 man-hours or more are worked in them annually.

*** A facility has a duty to report the substances in the relevant "section" if they were, in 2009, manufactured, produced in the course of the manufacturing, or otherwise used, in the weight concentration ≥ 1% (with the exception of unintentional by-products and waste rock in mines), and in total amounts exceeding 10 tons and more, and the workers (including contracted manpower) worked 20,000 hours in the relevant facility.

**** Common limit for dioxins and dioxin-like compounds, also including PCBs belonging to the category of "dioxin-like" compounds

***** Four indicator PAHs according to LRTAP

****** For cadmium, dichloromethane, tetrachloroethylene, and vinyl chloride (similarly as for a number of other substances), what is called the deminimis limit (exception) in % content is set in the USA.

5.1 Hexachlorobenzene – an example of a weak threshold in the E-PRTR

In the European register, and, thus, also in the IRZ, the reporting thresholds for hexachlorobenzene releases into the air are either set at such a high level that they are only exceeded by a few facilities, or the total emissions of this substance both into the air and into water are severely underestimated in the individual EU states. Hexachlorobenzene emissions into the air were reported into the E-PRTR by no more than four facilities from the whole EU for 2007, and by no more than five facilities for 2008. (For the reporting year 2007, these were a chemical plant in Finland and three Belgian cement works co-combusting waste. For 2008, the reporting was performed by a Belgian metallurgical plant, a cement works, one Finnish and one German chemical plant, and a Spanish facility for metal surface treatment.) Releases into water were reported by 11 European facilities for 2007, and by six facilities for 2008 (mostly municipal wastewater treatment plants). In the USA, the reporting threshold is 10 pounds = 4.5 kg (USEPA 2010). The reporting threshold in Scotland is even stricter, at the level of 1 kg.

Hexachlorobenzene, as an important POPs contaminant in waste in particular, is also discussed in subchapter 7.5 of this report.

6 Chemically specific reporting about waste transfers

In the Czech Republic, data on the amounts of chemical substances in wastes is not centrally summarized in any other database than in the IRZ. Information on the chemical composition of wastes is present in documents for waste transport, and/or may be stated in records documenting the operation of facilities for waste management; however, this information is neither recorded nor processed centrally, and, moreover, its processing would not result in such a comprehensive system as the IRZ. It is a pity that the duty to report the presence of chemical substances in wastes has not been introduced generally in the EU.

Usually, the reporting of transfers of chemical substances does not give rise to a duty to perform new measurements. From the very nature of the problem, the chemical composition of wastes leaving the premises of industrial facilities has to be found, in view of the limitations valid for the individual facilities for waste disposal or utilization. Until 2012 the IRZ required substances in wastes to be reported in 72 cases on a list with a total of 93 items. However, the number of substances really reported was even much lower, a little more than half, as shown in Table 3. From 2012 (so already for the year 2011), the duty to report waste transfers was reduced to only 26 substances (MV ČR 2011).

Table 3: Numbers of substances according to the release/transfer type. Source: http://www.irz.cz

Release/transfer type	2004	2005	2006	2007	2008
Releases into the air	36	36	39	36	36
Releases into water	24	24	25	31	30
Releases into soil	10	10	0	0	0
Transfers in wastewater	32	22	25	28	30
Transfers in waste	34	38	40	39	41

The main argument against the publication of data on chemical substances in wastes was, and still is, the statement that it is a duplication. However, the proponents of this opinion have not yet proved that similar data could be found in any other central database. In the CEHO (Centre for Waste Management) system, which is mentioned by those arguing that there is duplication, the amounts of waste a facility produces in the individual waste categories may be found; however, the system does not contain any data on the content of specific substances.

The state administration does not have any other available database where information on, for example, the amounts of mercury or hexachlorobenzene in wastes may be found easily. In fact, both these substances belong among the priority ones from the point of view of international conventions and European strategies. Because of that, it is a pity that the duty to report the presence of these substances in wastes has not been set at the EU level. From the point of view of the usability of such data it is a pity that the reporting threshold has been set at the level of 5 kg in the Czech Register, which is a relatively large amount of mercury.

The importance of monitoring waste in the IRZ may be well documented by the case of mercury and other heavy metals, and/or POPs, as is obvious from the corresponding chapters of this study. Both cases well illustrate the importance of reporting chemical substances in wastes from the standpoint of monitoring compliance with international conventions and strategies at the EU level. From this point of view, the data in the IRZ is still an undervalued source of information.

The reduction to the duty to report only 26 substances in waste transfers seems to be a radical reduction, but the majority of information for the public and authorities was saved in the IRZ, although data about some POPs, such as, for example, hexachlorobutadiene or pentachlorobenzene, is missing. The reporting of heavy metals and some POPs continues (MV ČR 2011).

6.1 Case study: Arsenic in waste transfers

6.1.1 Arsenic

Arsenic already had the reputation of a poison a long time ago. It is ranked among the critical substances from the point of view of water pollution, especially pollution of drinking water sources. It shows a significant ability to accumulate in river sediments. In certain cases, the adsorption and release of arsenic back from the sediments into the liquid phase may be the most important factor in its concentrations in this phase. However, it shows much greater mobility than mercury. It does not accumulate in fish much, and, because of that, the danger of high exposure through the consumption of fish has not been recorded.

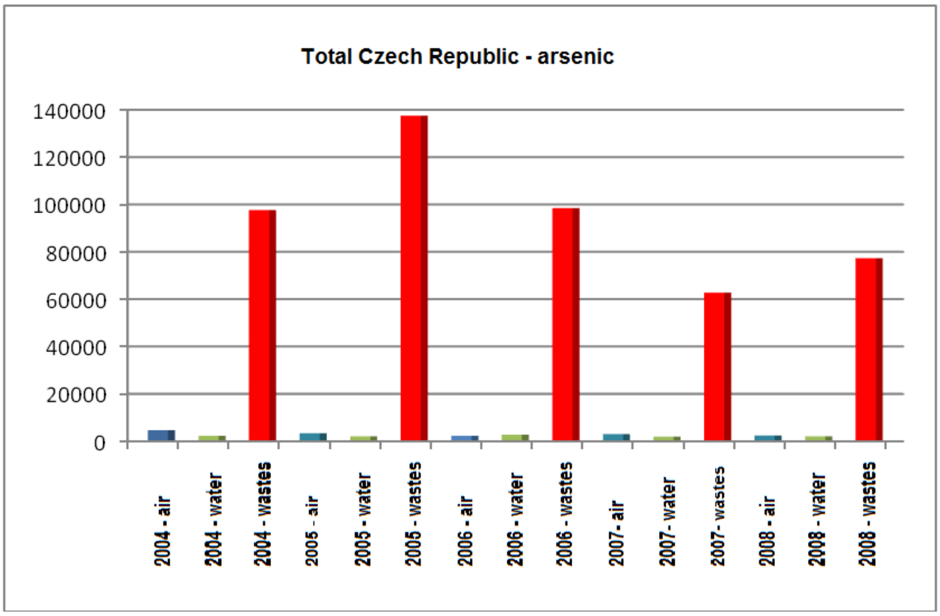

Figure 9: Total amounts of arsenic and its compounds reported into the IRZ concerning the individual years, according to the type of releases and transfers in the period 2004-2008.

Long-term utilization of water with low As concentrations causes chronic disease. In the 1930s and 1940s, poisoning by arsenic was reported, caused by using unsuitable drinking water, showing arsenic concentrations up to several mg/l. The toxicity of arsenic depends on its state of oxidation. The compounds of As^{III} are approximately five to 20 times more toxic than those of As^{V}.

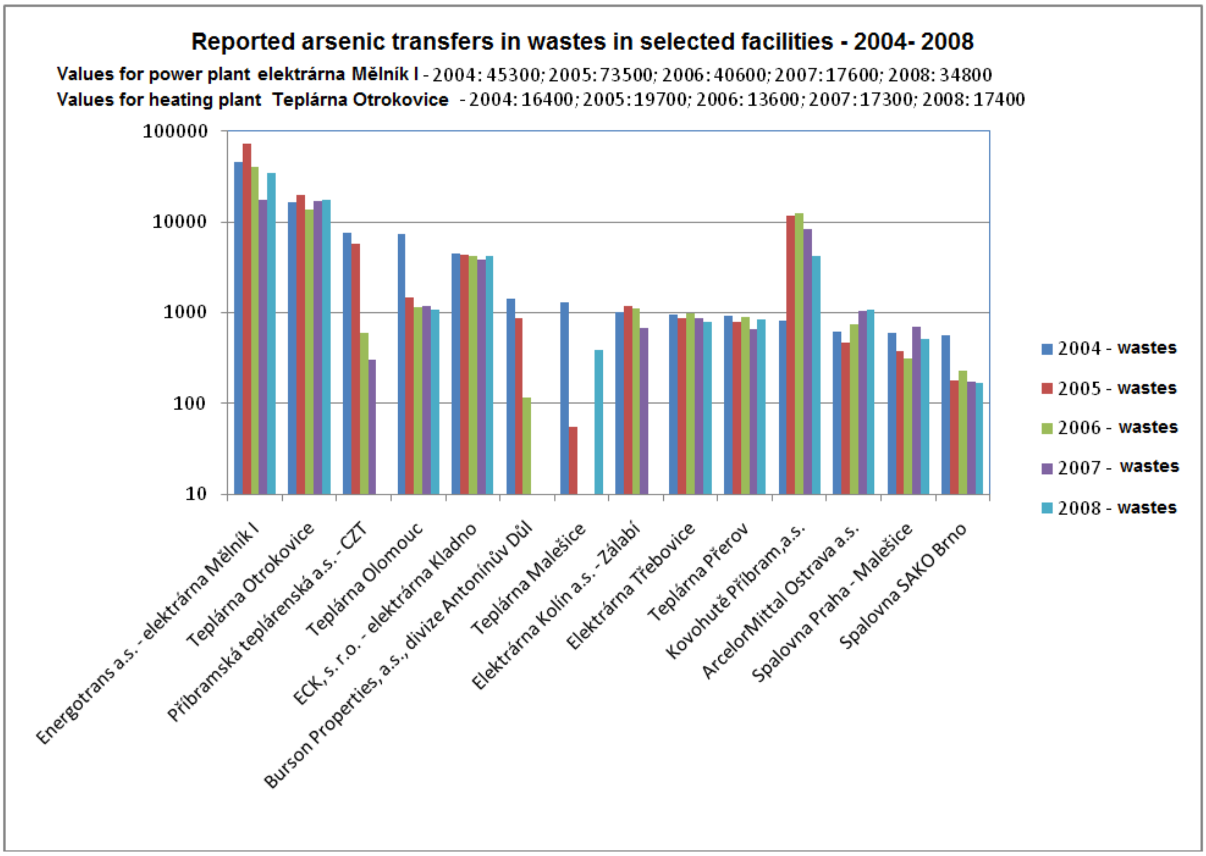

Figure 10: Development of amounts of arsenic and its compounds in transfers in wastes reported by selected facilities into the IRZ for the period 2004-2008 (expressed on a logarithmic scale). The values for the two biggest sources of arsenic in wastes in the individual years are given in the graph heading.

The anthropogenic sources of arsenic are fossil fuel combustion, metallurgical and ore-processing industries, the manufacturing of dyes, tanneries, the application of certain insecticides and herbicides, and the textile and glass industries. Considerable amounts of arsenic are present in the leachate from power plant fly ash (drainage water from sludge-drying beds may contain arsenic in amounts up to several mg/l) and in certain mine waters. An older research study showed the impact of lignite combustion on soil contamination by arsenic. In the Czech Republic, the highest values were found in the surroundings of the towns of Chomutov and Most (Ustjak 1995). Czech lignite contains higher concentrations of this substance.

Lignite is also combusted by the biggest sources of arsenic in transfers in wastes, as reported into the IRZ in the course of 2004-2008, namely the Elektrárna Mělník I power plant belonging to the company Energotrans, a.s., and, ranked second for all these years, the heating plant belonging to Teplárna Otrokovice, a.s., belonging to the E.on group. The third biggest source of arsenic and its compounds in wastes, as a sum of the amounts for all the five years of reporting into the IRZ, is the facility Kovohutě Příbram, a.s. This is shown in Fig. 10.

Fig. 9 shows that arsenic transfers in waste exceed the amounts of this heavy metal and its compounds reported in releases into the air and/or water much more significantly than in the case of mercury and cadmium, even in spite of the fact that the reporting threshold for transfers in wastes is higher than that for the thresholds for releases. If the duty to report chemical substances in wastes were cancelled, information on an important flow of arsenic and its compounds into the environment in the Czech Republic would be lost.

6.1.2 Arsenic in wastes produced by the Teplárna Otrokovice heating plant

As is obvious from Fig. 10, the heating plant owned by Teplárna Otrokovice, a.s., is, in the long term, the second biggest source of arsenic and its compounds in wastes reported into the IRZ. The importance of this information increases in particular in connection with the waste management method used by the energy plant. The waste is used as a certified material for landscape reclamation, for example in the Bělov sludge-drying bed for fly ash. In 2010, it was planned to use residues from lignite combustion in Otrokovice for back-filling a clay pit near Vážany, a part of Kroměříž. In its surroundings, pools and wetlands with protected and endangered species, especially amphibians, are found (Bílý 2010). Simultaneously, the deposited waste could come into contact with subsurface water. In view of the amounts of waste deposited by Teplárna Otrokovice, up to 7.5 tons of arsenic and its compounds per year could be deposited in the area, together with the waste. Without the data from the IRZ, this important information would not be available, and the information on the total amounts of arsenic in the potentially deposited wastes would be missing from the documents on the environmental impact assessment (Bílý 2010).

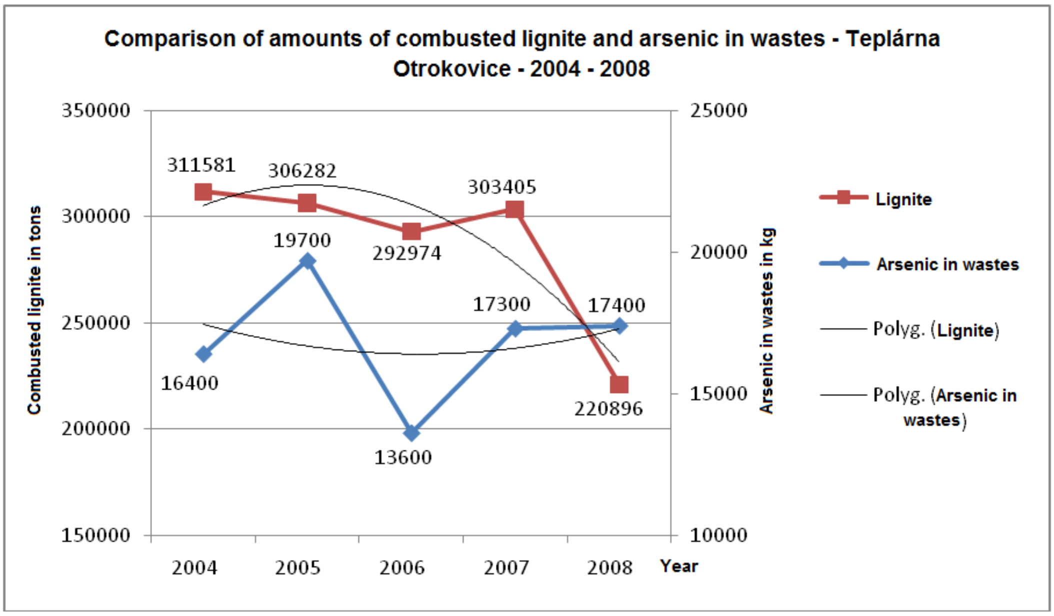

Figure 11: Graph showing the correlation between amounts of arsenic reported in wastes from Teplárna Otrokovice, and amounts of combusted lignite for the period 2004-2008, including the trend curves.

Table 4: Summary of fuel consumption in Teplárna Otrokovice (in tons per year). Source: (Anonymus 2009).

Fuel/year	2002	2003	2004	2005	2006	2007	2008
Lignite	291,407	311,700	311,581	306,282	292,974	303,405	220,896
Light heating oil	146	101	85	167	157	103	123
Biofuel					2061	4965	5741

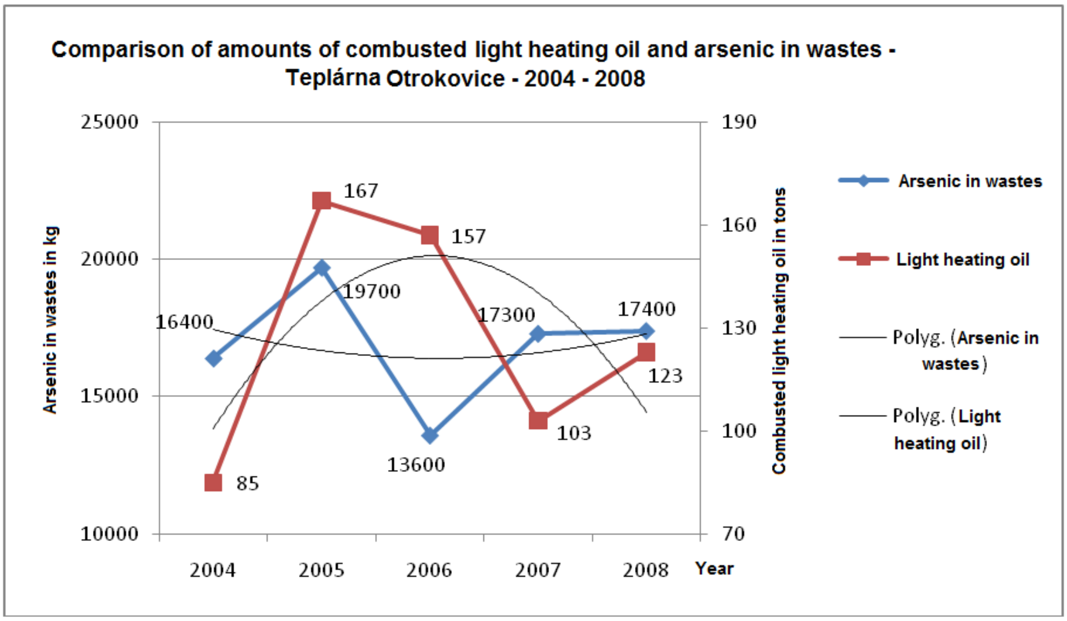

Figure 12: Graph showing the correlation between amounts of arsenic reported in wastes from Teplárna Otrokovice into the IRZ and amounts of light heating oil combusted in the period 2004-2008, including the trend curves.

In spite of the fact that arsenic is an impurity present in all the lignite originating from the Podkrušnohorská pánev coalfield, certain big combustion sources report, in comparison with others, significantly higher amounts of this substance and its compounds in wastes. Teplárna Otrokovice is one of them. Thus, it is surely interesting to study the possible correlation between the amounts of fuels combusted and the amounts of arsenic and its compounds in transfers in wastes reported into the IRZ. As may be found on the website of the Teplárna Otrokovice operator itself, the facility has also been combusting, in addition to lignite, light heating oil, and, since 2006, also biofuel. A summary of the amounts of fuel combusted is given in Table 4.

Figs. 20 and 21 show the possible correlation between the amounts of lignite and light heating oil combusted and the sum of the reported arsenic in wastes. Any relationship with biofuel may practically be excluded in view of the zero amounts of this combusted in 2004 and 2005. A correlation with the amounts of lignite and heating oil combusted could not be proved, either. Thus, the arsenic amounts in wastes correlate, most probably, with fluctuations in the amounts of arsenic in the fuels that were combusted. Fluctuations in the presence of arsenic in the fuels, and whether it was monitored at all, cannot be deduced from the available sources. Neither can it be ascertained whether the fuel source was changed (for example, different lignite mines). The correlation would be interesting, for sure. However, carrying out the analysis in the future could be complicated by the limitations on the availability of information on arsenic transfers in wastes.

6.2 POPs wastes and PRTR

Wastes containing POPs are specific in many ways and require specific treatment and management as well. They are governed by two international conventions: the Stockholm Convention on POPs and the Basel Convention, which was established to control the transboundary movement of hazardous wastes. POPs represent a special group of chemicals that are already harmful to health and environment when present in small concentrations in the environment. More information about these chemicals and the Stockholm Convention can be found in Chapter 7. The issue of POPs wastes in relation to PRTR is also discussed there, in subchapters 7.4.1 and 7.5.1 in particular.

The synergies between the PRTR and the Stockholm Convention are broadly discussed in the following chapter, Chapter 7.

6.3 Recommendations concerning the reporting of wastes

If the E-PRTR imposed the duty to report heavy metals and persistent organic pollutants in wastes, the European Commission could monitor the flows of these substances in wastes much more easily, and use the data in the E-PRTR for reporting concerning international conventions. Simultaneously, it would be obvious, at first sight, which facilities are potentially problematic, and the flows of these hazardous substances in wastes could be mapped more easily. It is also valuable information for the operators themselves, who may use it to verify the efficiency of their technologies.

The minimum solution of reporting thresholds for reporting substances in wastes is presented in Table 5. This is a rather general suggestion that is also applicable for establishing a new PRTR system, including the one in Thailand. It is based on the case studies presented here in Chapters 6 and 7 of this report.

Table 5: A proposal for the minimum extent of chemically specific reporting on transfers of chemical substances in wastes into the PRTR, and reporting thresholds for them.

Substance	Reporting threshold proposal in kg/year	Substantiation
Hydrochlorofluorocarbons (HCFCs)	1	Protection of the Earth's ozone layer
Chlorofluorocarbons (CFCs)	1	Protection of the Earth's ozone layer
Halons	1	Protection of the Earth's ozone layer
Mercury and its compounds	1	Priority heavy metals
Cadmium and its compounds	5	Priority heavy metals
Arsenic and its compounds	10	Counted into the group of heavy metals, proved human carcinogen (IARC group 1)
DDT	1	POPs, Stockholm Convention
Hexachlorobenzene	1	POPs, Stockholm Convention
Pentachlorobenzene	1	POPs, Stockholm Convention
1,2,3,4,5,6-hexachlorocyclohexane (HCH)	1	POPs, Stockholm Convention
Lindane	1	POPs, Stockholm Convention
PCDDs/PCDFs and dioxin-like PCBs (in WHO-TEQ)	0.0001	POPs, Stockholm Convention, some of them proved human carcinogens (IARC group 1)
PCBs	1	POPs, Stockholm Convention, proved human carcinogens (IARC group 1)
Brominated diphenylethers (PBDEs)	1	POPs, Stockholm Convention
Polycyclic aromatic hydrocarbons (PAHs)	10	POPs Protocol to UN ECE Convention on Long Range Transboundarry Air Pollution
Asbestos	10	Human carcinogen (IARC group 1)

7 The Stockholm Convention on Persistent Organic Pollutants

The Stockholm Convention on Persistent Organic Pollutants (POPs) is a global treaty to protect human health and the environment from chemicals that remain unchanged in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the environment.

Exposure to POPs can lead to serious health effects, including cancer, birth defects, dysfunctional immune and reproductive systems, greater susceptibility to disease, and damage to the central and peripheral nervous systems (Secretariat of the Stockholm Convention 2008).

Given their long-range transport, no one government acting alone can protect its citizens or its environment from POPs. In response to this global problem, the Stockholm Convention, which was adopted in 2001 and came into force in 2004, requires its parties to take measures to eliminate or reduce the release of POPs into the environment.

7.1 Main provisions of the Stockholm Convention

The main provisions of the Stockholm Convention are listed on its website as follows (Secretariat of the Stockholm Convention 2008): *"Among others, the provisions of the Convention require each party to:*

Prohibit and/or eliminate the production and use, as well as the import and export, of the intentionally produced POPs that are listed in Annex A to the Convention (Article 3)

Annex A allows for the registration of specific exemptions for the production or use of listed POPs, in accordance with that Annex and Article 4, bearing in mind that special rules apply to PCBs. The import and export of chemicals listed in Annex A can take place under specific restrictive conditions, as set out in paragraph 2 of Article 3.

- *Restrict the production and use, as well as the import and export, of the intentionally produced POPs that are listed in Annex B to the Convention (Article 3)*

Annex B allows for the registration of acceptable purposes for the production and use of the listed POPs, in accordance with that Annex, and for the registration of specific exemptions for the production and use of the listed POPs, in accordance with that Annex and Article 4. The import and export of chemicals listed in Annex B can take place under specific restrictive conditions, as set out in paragraph 2 of Article 3.

- *Reduce or eliminate releases from unintentionally produced POPs that are listed in Annex C to the Convention (Article 5)*

The Convention promotes the use of best available techniques and best environmental practices for preventing releases of POPs into the environment.

- *Ensure that stockpiles and wastes consisting of, containing or contaminated with POPs are managed safely and in an environmentally sound manner (Article 6)*

The Convention requires that such stockpiles and wastes be identified and managed to reduce or eliminate POPs releases from these sources. The Convention also requires that wastes containing POPs are transported across international boundaries taking into account relevant international rules, standards and guidelines." (Secretariat of the Stockholm Convention 2008)

Other provisions of the Convention relate to the development of implementation plans (Article 7), procedures for the listing of new POPs in Annexes A, B, and/or C, information exchange (Article 9), public information, awareness and education (Article 10), research, development, and monitoring (Article 11), technical assistance (Article 12), financial resources and mechanisms (Article 13), reporting (Article 15), evaluation of effectiveness (Article 16), and non-compliance (Article 17).

7.2 PRTRs and the Stockholm Convention

A PRTR can be an important tool to follow the releases and transfers of POPs listed under the Stockholm Convention if designed properly for such a need. It can help to verify the release inventories of dioxins and other unintentionally produced POPs (U-POPs), including their transfers in wastes. So it supports efforts to minimize U-POPs releases according to Article 5 of the Convention. PRTR data can serve as a control measure for the performance of BAT/BEP technologies; they are defined in Annex C to the Convention.

A PRTR also helps to fulfil the obligations laid down in Article 6 of the Convention regarding POPs wastes. A PRTR can help by setting chemically specific reporting on wastes and collection of additional information about the disposal of POPs in wastes or their further transfers through the PRTR. The same tool can be useful for tracking potential traffic in prohibited POPs according to Article 3 of the Convention which were previously intentionally produced or used, such as e.g. PCBs or PBDEs.

The Stockholm Convention specifically mentions the use of a PRTR in Article 10: Public information, awareness and education, where in para 5 it is written: *"Each Party shall give sympathetic consideration to developing mechanisms, such as pollutant release and transfer registers, for the collection and dissemination of information on estimates of the annual quantities of the chemicals listed in Annex A, B or C that are released or disposed of"* (Stockholm Convention 2010).

The incorporation of the reporting on chemicals listed under the Stockholm Convention into a PRTR system can become one of the tasks established in the National Implementation Plan of the respective country(-ies) as defined in Article 7 of the Convention. POPs listed under the Convention can even become the initial chemicals for the establishment of the PRTR in the country as there are guidance documents available for their inventories (UNEP and Stockholm Convention 2013, UNEP 2017, UNEP 2017 a, UNEP 2017 b) which may help to calculate their emissions and transfers from certain sources within the country.

We try to document the use of a PRTR for these purposes through an example by using data from the Czech PRTR in particular.

7.3 Persistent Organic Pollutants

There are a number of persistent organic pollutants (POPs), and their lists differ depending on e.g. the legal regulation and/or rule. Some substances were included into the list of the global Stockholm Convention, while the list of POPs included into the POPs Protocol to the Convention on Long Range Transboundary Air Pollution (CLRTAP) is somewhat different. Below, hexachlorobenzene (HCB) and dioxins (an abbreviated name used for two groups that include, in total, 210 substances – polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans – PCDD/Fs) in particular will be discussed. Marginally, data on hexachlorobutadiene (HCBD) and pentachlorobenzene (PeCB) will also be mentioned in connection with HCB transfers in wastes.

7.4 Dioxins

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) form a group of 210 substances included both into the list of unintentional by-products according to the Stockholm Convention (Annex C) and among substances monitored by the POPs Protocol to the CLRTAP. From the whole group of these substances, called, in short, dioxins, usually the 17 most toxic congeners are monitored, of which only one, 2,3,7,8-TCDD, was classified as a human carcinogen (group 1) by the IARC. Their hazardousness for human health relates rather to their impacts on the hormonal system, or the development of the nervous system in children, and other impacts. For these substances, the maximum recommended daily intake has been set at the level of 1-4 pg WHO-TEQ/kg body weight per day by the WHO. However, the European Food Safety Agency reassessed TWI for dioxins recently and established a new recommended tolerable daily intake, derived from the tolerable weekly intake newly established by EFSA CONTAM, of 0.25 pg WHO-TEQ/kg bw/day. The new TWI is 2 pg WHO-TEQ/kg bw/week (EFSA CONTAM 2018), while the previous level of TWI was 14 pg WHO-TEQ/kg bw/week (SCF 2001).

Because the 17 most toxic congeners show different toxicities, toxic equivalents were introduced for the purpose of their comparison. Conversion to I-TEQ is used for reporting values into the IRZ. Conversion to WHO-TEQ is used for assessing the burden on the human population.

At the European level, reporting data on dioxin flows into wastes may be even more important than in the case of hexachlorobenzene. The first ever Community Implementation Plan of the Stockholm Convention (CIP) stated that the whole EU emitted (including emissions into wastes) about 20 g I-TEQ of these substances annually. From this amount, 20% was supposed to have been in releases into the air and 80% in wastes. Emissions into water could not be estimated at all, because of the lack of data. Further, this EU document stated that approximately 2 kg of dioxins (in I-TEQ) were deposited into landfills or were present in wastes used as secondary construction material annually (CEC 2007). In fact, a number of uncertainties exist concerning dioxin flows in wastes.

Figure 13 shows that, in the case of certain kinds of waste, it is sufficient that a facility only produces 100 tons of them, and already reaches the limit for reporting dioxins in transfers in wastes. The graph clearly demonstrates how the numbers of reports on dioxins in wastes into the IRZ are below the real situation. In order for the Register to reflect the reality, the checking in selected fields of industry, especially in the field of waste management and the metallurgical industry, would have to be improved. The frequency of reporting dioxins in wastes is also negatively influenced by the certification of wastes as products/construction material.

Reporting into the IRZ does not apply to substances contained in wastes that become parts of certified products, usually construction materials, and are already in the form of the certified products when they leave the premises of industrial facilities. However, toxic or hazardous substances remain in them. This category also includes, for example, dioxins in the SPRUK mixture produced by the incinerator of Termizo, a.s., in Liberec (Petrlík, Havel et al. 2008), and, because of that, the third municipal waste incinerator in the Czech Republic is missing among the facilities reporting dioxins into the IRZ in the majority of years.[4] This example illustrates the situation described in the EU Implementation Plan of the Stockholm Convention (see the previous paragraph).

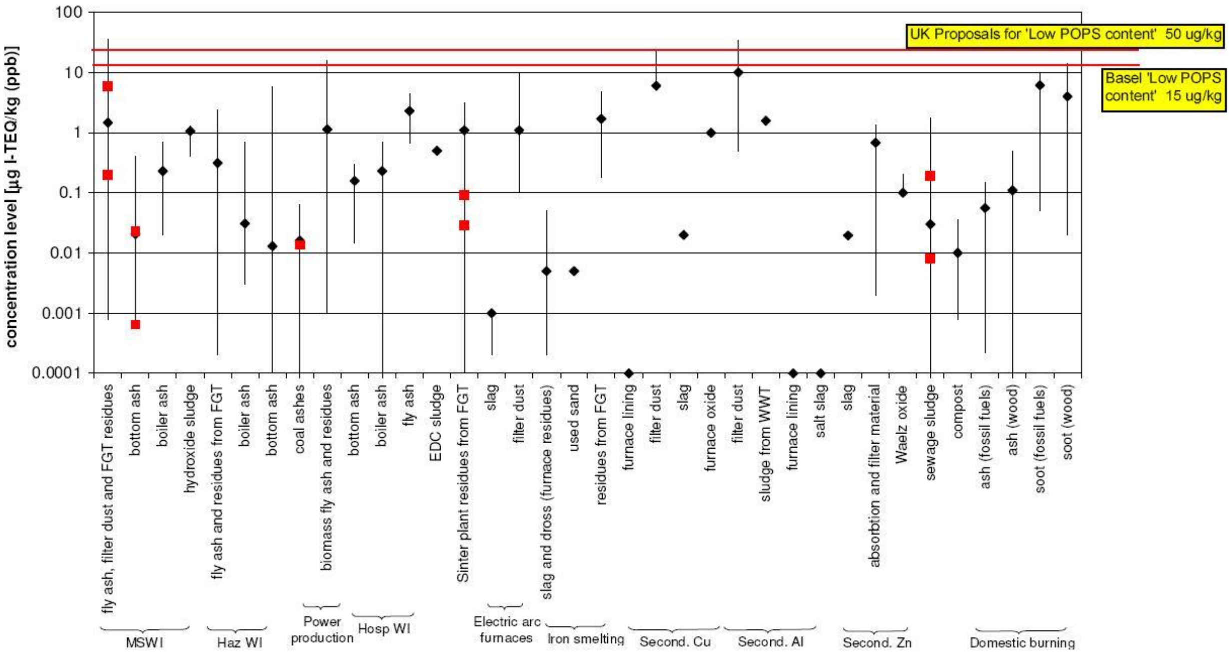

Figure 13: Dioxin concentrations in wastes from various industrial processes, including the limit for what is termed the "low POPs content" (see the Stockholm Convention). The graph was created on the basis of data presented in the BiPRO study concerning wastes with POPs contents (BiPRO 2005).

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[4] An exception was the year 2011, when the incinerator in Liberec needed to report SPRUK in wastes, because of the reclassification of the construction material. Thus, it reported 8 g TEQ PCDD/Fs in wastes into the IRZ in 2011.

7.4.1 Case study: Dioxins in Waste Incineration Residues

7.4.1.1 Introduction

"*Today solid residues from modern Waste-to-Energy facilities constitute the primary emission route to the surrounding environment. Although bottom ashes are generated in larger quantities, the main pollution potential is found in the air-pollution control (APC) residues originating from cleaning the flue gases before emission to air. While a range of different types of APC residues exists, the overall properties and environmental concerns are the same, regardless of the incinerator and country of origin*." (Astrup 2008) The incineration of solid waste results in a certain amount of residues in different forms. In total the residues are estimated to be between 25% and 35% (in some cases up to 40%) of the original weight of waste input (EA 2002, Petrlik and Ryder 2005). The larger volume is bottom ash, which can reach 20-30%[5] by mass of the original waste on a wet basis. The fly ash component of APC residues is in the order of 1-3% and total APC residues account for 2-5% of the waste input mass on a wet basis (Sabbas, Polettini et al. 2003). Fly ash and APC residues contain, in general, higher concentrations of toxic chemicals, including PCDD/Fs, than bottom ash. IPEN, Arnika, and NTN tried to estimate the total PCDD/Fs in WI residues generated each year globally in a study focused on ashes produced by incineration (Petrlik and Bell 2017).

PCDD/Fs in residues from Municipal Solid Waste Incineration (MSWI)

The total volume of fly ash[6] produced by waste incinerators globally is not easy to calculate as basic data is unavailable. In 2013, there were more than 1600 Waste-to-Energy (W-t-E) plants (as modern waste incinerators producing energy are called) globally. Their total capacity was more than 228.24 million tonnes per year (Coenrady 2013). If we calculate that 3% of fly ash is created from the total weight of burnt waste, the result is the production of 6.85 million tonnes of fly ash per year; however, the capacity of municipal solid waste incinerators (MSWI) is not always fully utilized, so fly ash production is most probably less than this estimate. On the other hand, some MSWIs are operated without energy outputs and are therefore not included in this capacity estimate. In addition, there are many hazardous waste (HazWI) and medical waste incinerators (MedWI) that are not included in this capacity estimate. Large hazardous waste incinerators are mostly operated only in developed countries, while in developing countries medical waste incinerators with a small annual capacity up to a few thousand tonnes are quite often used. When talking about the management of fly ash from waste incineration, we are probably talking about several million tonnes of residues that must be disposed of every year.

There are estimates of the total content of dioxins in waste incineration residues (mainly fly ash) derived from country reports and in National Implementation Plans (NIPs) for the Stockholm Convention, both of which are submitted to the Secretariat of the Stockholm Convention by 86 countries.[7] On the basis of this information, PCDD/Fs releases in waste incineration residues are almost 800 g I-TEQ per annum (EEC of SC 2016); however, when we look more closely we can see that the countries with the highest waste incineration capacity (e.g. Germany, China, and Japan) did not report any dioxins in their waste incineration residues and some others were not included.

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[5] For some waste incinerators in the UK this amount was up to 39%, according to data collected by the Environment Agency. Source: EA (2002). Solid Residues from Municipal Waste Incinerators in England and Wales A report on an investigation by the Environment Agency, Environment Agency: 72.

[6] We will use this term in order to simplify the text but the meaning is APC residues, including fly ash.

[7] NIPs can be found at http://chm.pops.int/Implementation/NationalImplementationPlans/NIPTransmission/tabid/253/Default.aspx and country reports at http://chm.pops.int/Countries/Reporting/NationalReports/tabid/3668/Default.aspx

7.4.1.2 PRTR and PCDD/Fs estimates

For the total capacity of W-t-E plants we can also calculate the total releases of PCDD/Fs in fly ash using the emission factors for waste incineration residues in the Dioxin Toolkit, which was updated in 2013 (UNEP and Stockholm Convention 2013). This calculation leads us to estimates of 3.4 kg I-TEQ and 45.6 kg I-TEQ dioxin releases per year (in fly ash wastes) for class 3 and class 4 municipal waste incinerators[8] respectively. This estimate assumes that W-t-E plants use 100% of their installed capacity, which is mostly not the case, but there is no data about the actual capacity used every year by W-t-E plants. Let us assume that between 85 and 90% of their capacity is used per annum. The total amount of dioxins released in WI residues should be adjusted from the previously quoted estimates using this percentage.

We are not able to perform the same calculation for hazardous and medical waste incinerators as information on their global capacity is not available. There are some indications of the scale of dioxin releases in fly ash from these waste incinerators in the NIPs from a few countries, and there is additional data from other information sources. They are either summarized in Table 6 or explained further in this study .

Table 6: PCDD/F releases in g TEQ/annum.

Country	Haz. waste incin.	Med. waste incin.	Year	Sources	Notes
Albania	0	0.07	2004	(MEFWA 2006)	
Argentina	27	-	2006	(República Argentina 2007)	
Brazil	20.72	-	2014	(Federative Republic of Brazil 2015)	
China	186	748.9	2004	(The People´s Republic of China 2007)	
Czech Republic	17.8	9	2015	(Mach 2017, MŽP 2018)	
EU	61.8	29.1	2005	(BiPRO 2005)	MedWI calculated for 10 EU member states only
EU Switzerland Norway	25	100	1999	(Wenborn, King et al. 1999)	Industrial waste and sewage sludge incineration
Hungary	11.53	-	2006	(Ministry of Environment and Water 2009)	Calculated from data in Annex 6
India	3,965.8	-	2010	(Government of India 2011)	This figure is for all waste incineration plants in India

[8] We can look at the situation in the Czech Republic in order to get a better idea of which of these two figures may be closer to reality: there are three MSWIs in this EU country. All three should be designated as class 4 waste incinerators according to the Dioxin Toolkit classification. Their capacity was 680,000 tonnes of waste per year in 2017 and by using the emission factors from the Toolkit we calculate 10.2 g I-TEQ as an estimate of the total dioxin releases in wastes from these three facilities. Comparing with the real figures from the Czech Pollution Release and Transfer Register (PRTR) system, we note that 26 g I-TEQ PCDD/F was reported for the year 2011, the only year when all three MSWIs had to report their PCDD/Fs transfers in waste.

					(including MedWI); however, there was only one W-t-E plant in operation in India with a capacity of 54,000 tonnes/annum, according to the database of more than 1600 facilities. Nearly 4.4 million tons of hazardous waste are generated every year in India.
Indonesia	58	-	2001	(The Republic of Indonesia 2008)	Not very clear whether all comes from hazardous waste incinerators
Kenya	10.15	-	2006	(MENR 2006, EEC of SC 2016)	Calculation for both hazardous and medical waste incinerators together (HazWI 18%; MedWI 82%)
Lithuania	0.64	0.5	2004	(MoE Republic of Lithuania 2006)	
Macedonia	0	0.11	2003	(MEPP 2004)	
Nigeria	0	15.851	2004	(Federal Ministry of Environment 2009)	
Turkey	0.9	0.352	2006	(MEF 2010)	

A collective inventory for 13 EU candidate countries[9] calculated total releases in waste incineration residues[10] from hazardous and medical waste incineration to be 5 g I-TEQ and 28 g I-TEQ respectively per year (Pulles, Quass et al. 2004). These figures seem to significantly underestimate the real situation as the three medical waste incinerators in the Czech Republic (with a total capacity of 8400 tonnes per annum) released more than 9 g I-TEQ dioxins into fly ash in 2015 (Mach 2017, MŽP 2018) and two hazardous waste incinerators with a capacity of 37,200 tonnes per year released 17.8 g I-TEQ PCDD/Fs, according to their reports into the Czech PRTR system for the year 2015 (Mach 2017, MŽP 2018). Summarized data about dioxin transfers in waste generated by hazardous waste incinerators in the Czech Republic as they were reported into the Czech PRTR (MŽP 2018) is shown in Table 7.

Table 7: Summary of the data about PCDD/Fs transfers in wastes as they were reported by the Czech HazWI into the Czech PRTR in the years 2012 to 2017. Source: (MŽP 2018).

Waste incinerator	2012	2013	2014	2015	2016	2017
AVE – HazWI – Kralupy n. Vlt.	0	0	0.015	0	0	0
Rumpold – HazWI Strakonice	0	0	0	0	0	1.019
SITA – HazWI Ostrava	0	0	0	1.9	1.6	1.9

[9] The inventory was taken before ten of the thirteen candidate countries became member states of the EU in June 2004.

[10] The dioxin inventory for new EU candidate countries used the term “releases to land” to mean releases in wastes, according to UNEP’s Dioxin Toolkit.

SITA – EMSEKO, HazWI Zlín	1.19	1.206	1.23	5.9	5.6	4.7
SITA – HazWI Trmice	4.16	17.16	9.42	15.9	10.2	11.36
Total	5.35	18.366	10.665	23.7	17.4	18.979

It is clear that total dioxin transfers in wastes from the five Czech HazWI reached levels between 5 and 24 g TEQ/year. This finding supports underestimation in the inventory made for EU candidate countries and also shows the usefulness of reporting about POPs in waste into a PRTR. HazWI of SITA company in Trmice reported the extremely large amount of 236 g TEQ of PCDD/Fs in transferred wastes in the year 2010, according to the data in the Czech PRTR (MŽP 2018).

In 2006 the Hungarian hazardous waste incinerators released PCDD/Fs into waste residues coming to more than 11.5 g I-TEQ per annum (Ministry of Environment and Water 2009). So just two out of 13 former EU candidate states account for total releases of at least 9 g I-TEQ and 29.3 g I-TEQ in WI residues per annum from medical and hazardous waste incinerators respectively. It is clear that the introduction of a duty to report dioxins in waste transfers into the E-PRTR would help the EU to improve its estimates of their flow in waste incineration residues.

The BiPRO study for the European Commission (BiPRO 2006) estimated 1900 g TEQ/year of PCDD/Fs in waste incineration residues for EU countries; however, this report did not include solid residues from hazardous waste incineration into the PCDD/Fs inventory for wastes. This figure for all residues is more closely specified in a previous BiPRO report (BiPRO 2005), where fly ash and APC residues from MSWI account for 1530 g TEQ/year, HazWI counts for 61.8 g TEQ/year in fly ash and APC residues, and MedWI for 29.1 g TEQ/year in fly ash and other APC residues. The estimates for the share of hazardous and medical waste incineration seem to be underestimated in the light of data from two countries with rather small HazWI and MedWI capacity, namely the Czech Republic and Hungary, as shown above (Ministry of Environment and Water 2009, Mach 2017, MŽP 2018).

On the basis of available data, the overall calculation for PCDD/Fs in fly ash and other APC residues produced by HazWI and MedWI globally might be within a similar scope as they are for MSWI when calculated according to the Dioxin Toolkit emission factors.

"It means that in total the releases could amount to approximately 7 kg I-TEQ of dioxins released into waste incineration residues annually (at a minimum), although the final figure is more likely closer to or over 10 kg TEQ/year of PCDD/Fs, "[11] Arnika and IPEN concluded in their global study about dioxins in waste incineration residues (Petrlik and Bell 2017).

The PRTR data reported into the Czech system was very helpful for the estimation of the total dioxin flow in the WI ash in the study.

Dioxins are not present only in HazWI residues but were also reported in MSWI residues and air pollution control (APC) residues, including fly ash in particular. The amounts of dioxins reported by MSWI into the Czech PRTR between 2012 and 2017 can be found in Table 8.

Table 8: Summary of the data about PCDD/Fs transfers in wastes as reported by the Czech MSWI into the Czech PRTR in the years 2012 to 2017. The last row is the total amount reported for HazWI, for comparison. Source: (MŽP 2018).

[11] Just to indicate the scope: the total amount of PCDD/Fs released was calculated at the level of almost 71 kg TEQ/year on the basis of data for 86 countries. Fiedler, H. (2016). Release Inventories of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans. Dioxin and Related Compounds: Special Volume in Honor of Otto Hutzinger. M. Alaee. Cham, Springer International Publishing: 1-27.

Provozovna	2012	2013	2014	2015	2016	2017
Plzeňská teplárenská, a.s., ZEVO Plzeň	0	0	0	0	0.455	0.001
Pražské služby, a.s. MSWI Malešice	13	8	11	4.56	5.7	26.75
MSWI SAKO Brno	2.543	2.25	3.773	2.857	2.236	2.238
Termizo, a.s. Liberec	2.1	0	0	0	0	0
Total	17.64	10.25	14.77	7.42	8.39	28.99
Totals for HazWI	5.35	18.366	10.665	23.7	17.4	18.979

The volume of dioxins respectively reported into the Czech PRTR in ashes from HazWI and MSWI for the last six years is very similar, 94 and 87 g TEQ/year respectively.

PCDD/Fs have also been reported in wastes produced by metallurgical plants throughout the whole period of operation of the Czech PRTR. The total amount reported for the metallurgical industry was substantially higher than that reported by waste incinerators in total during the last six years. The only additional industry which reported dioxins in wastes was the remediation facilities which cleaned up dioxin ecological burdens in the Spolana Neratovice chemical plant. They should report less by using technologies to destroy highly complex POPs such as PCDD/Fs and dioxins should be destroyed rather than disposed of in landfills.

7.5 Hexachlorobenzene

Hexachlorobenzene belongs among the substances included into all three Annexes (A, B, and C) to the Stockholm Convention on Persistent Organic Pollutants, because it has been used as a pesticide and as a technical substance, and, simultaneously, it is produced as an unintentional by-product in a number of industrial activities. In the Czech Republic, the main problem it currently poses is as an unintentional by-product', and, thus, it is important to monitor both its releases into the air and water and the amounts transferred in wastes.

7.5.1 Case study: Hexachlorobenzene and similar POPs in waste transfers

Because of the facts that the reporting thresholds are set at a high level and that hexachlorobenzene is detected in wastes inconsistently, this substance belongs among the ones on which only limited data is present in the Czech IRZ: data on HCB transfers in wastes from the Spolek pro chemickou a hutní výrobu (Spolchemie) facility in Ústí nad Labem, concerning all the reporting years, accompanied by another report submitted by BCD CZ, remediating contaminated sites in Spolana Neratovice, concerning 2008. And, with the exception of 2006, there is always one report on HCB releases into water, again from Spolchemie in Ústí nad Labem. In view of the fact that HCB is regarded as one of the main POPs that has contaminated, and still continues to contaminate, the environment in the Czech Republic and Slovakia, it should be considered whether the reporting threshold for this substance in the E-PRTR should be reduced, and, simultaneously, whether a duty to report this substance should be introduced, similarly to other important POPs (for example, dioxins), in wastes.

In the European Community Implementation Plan of the Stockholm Convention, the total HCB emissions in the EU (25 states were evaluated), including its transfers in wastes, are estimated to be 4000 kg (CEC 2007), and of this amount, 3500 kg into the air and 500 kg into wastes. However, this is in complete contradiction of the fact that Spolchemie has already been reporting HCB transfers in wastes in the order of hundreds of tons into the IRZ for five years; in the period from 2005 to 2008 this was approximately 500 tons, and even 42 tons more for 2006 (see Table 9). This means that the authors of the estimate for the Community Plan made a mistake of at least one order of magnitude. If a general duty to report POPs in wastes into the E-PRTR existed in the European Union, experts and officials, as well as politicians, would have more objective data at their disposal at the EU level. Naturally, all this is provided that the Czech company has not been making a repeated error in its calculations.

Other POPs find their way into wastes as unintentional by-products at Spolchemie in Ústí nad Labem, too. Hexachlorobutadiene (HCBD), and pentachlorobenzene (PeCB) are produced in the same process as HCB. The development of the reported amounts of these three substances in transfers in wastes for the whole period of the existence of the IRZ is shown in Fig. 14. In the case of both HCB and the other two substances, a decreasing trend for their total amounts may be seen. In spite of that, their sum reported in 2008 represents one of the most serious problems in connection with POPs in the Czech Republic. If the legislators cancel the duty of the facilities to submit chemically specific reports on transfers in wastes, the state administration will lose what is essentially the sole easily available source of information on the amounts of these substances in the wastes produced by Spolchemie.

Table 9: POPs in transfers in wastes reported by Spolek pro chemickou a hutní výrobu (Spolchemie) in Ústí nad Labem into the IRZ concerning the period 2004-2008.

Substance	2004 - wastes	2005 - wastes	2006 - wastes	2007 – wastes	2008 - wastes
Hexachlorobenzene (HCB)	423,000	497,000	542,000	489,000	391,000
Hexachlorobutadiene (HCBD)	161,000	178,000	194,000	175,000	140,000
Naphthalene	1130	720	720	<100	<100
Pentachlorobenzene	26,900	19,100	20,800	18,700	15,000
Sum of HCB, HCBD, and PeCB	610,900	694,100	756,800	682,700	546,000

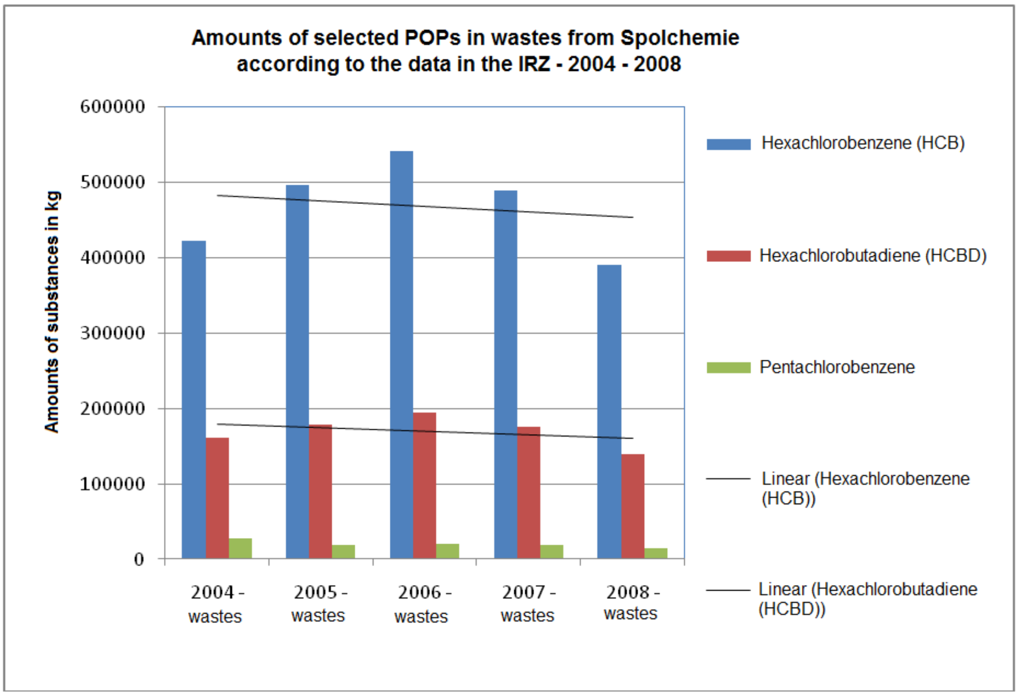

Figure 14: Graph depicting the development of the amounts of hexachlorobenzene (HCB), hexachlorobutadiene (HCBD), and pentachlorobenzene (PeCB), in wastes, according to the reports of Spolek pro chemickou a hutní výrobu (Spolchemie) in Ústí nad Labem into the IRZ.

8 Suggestions and conclusions

Different aspects of PRTRs were discussed in this report on the basis of Arnika's experience with the implementation of the Czech PRTR system, called IRZ, and its use for practical tasks such as the control of the flows of different toxic chemicals and/or the use of data for specific cases.

The main parts of the report were focused on:

1) Free access to information for which the term "Right to Know" is broadly used

Active publication of specific data freely accessible to the public on the internet was suggested to be an essential part of the PRTR system when established.

2) Industrial sectors covered by a PRTR

The original Czech approach of not excluding any industrial sector and defining the duty to report on the basis of the total amount of a chemical released or transferred was suggested as being the simplest and most useful one.

3) Thresholds for reporting into a PRTR as they are set for specific chemicals

Thresholds for chemicals must be established in such a way that the PRTR will cover all the major sources of chemicals. The thresholds for some chemicals in the E-PRTR are set far too high as they are way too high when one looks at the total releases of certain chemicals within a country like the Czech Republic. This applies to hexachlorobenzene, for example. There are suggestions as to how to establish thresholds for waste transfers in subchapter 6.3.

4) Use of a PRTR as a tool for reduction of VOCs releases

Several case studies demonstrating how the PRTR worked as an effective tool pushing the reduction of VOCs emissions by different industrial sources in the Czech Republic were described.

5) Chemically specific reporting about waste for heavy metals and POPs in particular

The PRTR was found to be the only information source about heavy metals or POPs in wastes for local and state authorities, as well as for the public. There is no other database collecting this specific information needed for the implementation of international conventions. This data is also useful for setting appropriate goals for addressing e.g. POPs in wastes.

6) Relationship of the PRTR and Stockholm Convention

The Stockholm Convention encourages the parties to the convention to use PRTRs in its article 10: "Each Party shall give sympathetic consideration to developing mechanisms, such as pollutant release and transfer registers, for the collection and dissemination of information on estimates of the annual quantities of the chemicals listed in Annex A, B or C that are released or disposed of." (Secretariat of the Stockholm Convention 2008)

A PRTR seems to be a very useful tool for the estimation of POPs releases and their transfers in wastes in particular.

All the above suggestions are also recommended for the establishment of a Thai PRTR system as there is good experience with all those elements in the Czech PRTR system, as well as in other PRTR systems.

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EUROPEAN UNION

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